Emotion

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The Role of Uncertainty, Worry, and Control in Well-Being: Evidence From the COVID-19 Outbreak and Pandemic in U.S. and China

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Uncertainty about the future often leads to worries about what the future will bring, which can have negative consequences for health and well-being. However, if worry can act as a motivator to promote efforts to prevent undesirable future outcomes, those negative consequences of worry may be mitigated. In this article, we apply a novel model of uncertainty, worry, and perceived control to predict psychological and physical well-being among four samples collected in China (Study 1; during the early COVID-19 outbreak in China) and the United States (Studies 2–4, during 4 weeks in May 2020, 4 weeks in November 2020, and cross-sectionally between April and November 2020). Grounded in the feeling-is-for-doing approach to emotions, we hypothesized (and found) that uncertainty about one's COVID-19 risk would predict greater worry about the virus and one's risk of contracting it, and that greater worry would in turn predict poorer well-being. We also hypothesized, and found somewhat mixed evidence, that perceptions of control over 1's COVID-19 risk moderated the relationship between worry and well-being such that worry was related to diminished well-being when people felt they lacked control over their risk for contracting the virus. This study is one of the first to demonstrate an indirect path from uncertainty to well-being via worry and to demonstrate the role of control in moderating whether uncertainty and worry manifest in poor well-being.

Keywords: uncertainty, well-being, COVID-19, worry, perceived control

Supplemental materials: https://doi.org/10.1037/emo0001163.supp

The global pandemic caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2; colloquially COVID-19 or coronavirus) was the third leading cause of death for Americans in 2020 (Koh et al., 2021) and continued to claim lives globally,

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OSF Links: Study 1 (Sweeny, 2022a) – https://osf.io/vuwg3/; Study 2 (Werntz, 2022) – https://osf.io/z9y6u/; Study 3 (Hua, 2022) – https://osf.io/c2bxw/; Study 4 (Sweeny, 2022b) – https://osf.io/7xaq3/.

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Jennifer L. Howell and Kate Sweeny jointly formulated the theoretical underpinnings of the article, selected measures, and led data collection. Jennifer L. Howell conducted the initial analyses and wrote up the original draft of the article. Kate Sweeny provided the first major round of edits. Alexandra Werntz and Jacqueline Hua provided the second major round of edits. Jennifer L. Howell, Kate Sweeny, Jacqueline Hua, and Maryam Hussain all contributed to materials development and study programming. Jennifer L. Howell, Kate Sweeny, Jacqueline Hua, Alexandra Werntz, and Brian A. O'Shea all contributed to data cleaning and curation. All authors were involved in methodological development and data collection and all authors reviewed and edited the article.

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reaching nearly 4.5 million worldwide as of August 2021 (World Health Organization, 2021b). The virus originated in Wuhan, Hubei Province, China, and quickly spread throughout the globe (Centers for Disease Control and Prevention, 2020). Initial reactions around the world were varied, with some governments doing little and other governments closing public spaces, restricting travel, and imposing quarantines (The New York Times, 2020). The situation is unprecedented and stressful (Rehman et al., 2021; Salari et al., 2020). Perhaps one of the most challenging features of the pandemic is its myriad uncertainties: uncertainty about how many people will get sick and die, when people can go back to their normal activities, what one will do if forced into quarantine, what the long-term effects on the global economy will be, and perhaps most proximally, whether one will contract the virus. In the present investigation, we examined relationships among uncertainty, worry, and well-being and the moderating role of perceived control (i.e., over whether one will be infected by COVID-19) among groups of Chinese and U.S. residents during periods ranging from February to November 2020.

Worry in the Face of Uncertainty

Research on the feeling-is-for-doing approach to emotions (Zeelenberg et al., 2008) suggests that specific emotions motivate specific behaviors. For example, anger motivates people to seek retribution, whereas fear motivates people to escape or withdraw. When people are faced with uncertainty, as in the case of COVID-19, they typically experience worry (Lee & Hawkins, 2016; Rosen & Knäuper, 2009; Tiedens & Linton, 2001). Although researchers debate the precise definition of worry, we conceptualize worry as the aversive emotional experience of anxiety paired with the tendency toward perseverative, unpleasant thoughts about the future (following McCaul et al., 2020).

Even though worry is a typical experience in the face of uncertainty, unresolved and excessive worry is related to a host of negative physical and psychological outcomes (Behar et al., 2005; McLaughlin et al., 2007; for a review, see Watkins, 2008). However, worry can also serve an important motivational purpose: It motivates people to prevent specific undesirable future outcomes. Substantial evidence from health psychology supports worry's motivational effects, suggesting that people who worry more about a given health outcome are more likely to engage in preventive health behavior to avoid that outcome (e.g., vaccination, Brewer et al., 2004; cancer screening, Hay et al., 2006; and seatbelt use, Sutton & Eiser, 1990). Particularly relevant to the present work, recent research implicates worry as a primary factor driving COVID-19-protective behaviors (Erceg et al., 2022). Thus, consistent with the feeling-is-for-doing approach, worry plays an important role in survival by motivating prevention efforts.

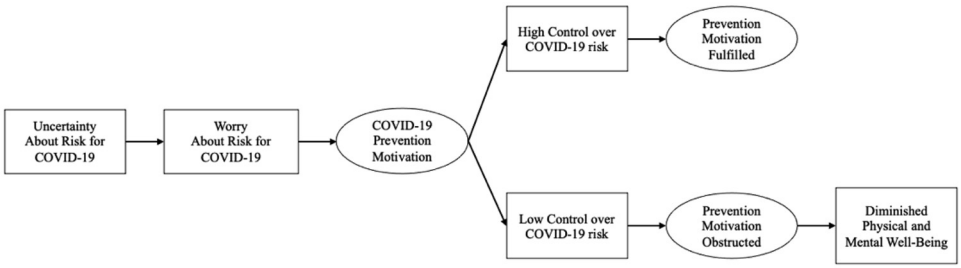
Of note, the theory we discuss here is meant to apply primarily to subclinical levels of worry and on situational rather than dispositional uncertainty—that is, the typical experience of worrying about an outcome when a situation is uncertain. Although the principles we discuss here are informed by research on both clinical and nonclinical worry and uncertainty, we do not intend to predict or provide a model for worry-related pathology, and we distinguish our approach from the sizable clinical literature focusing on intolerance of uncertainty and excessive worry as predictors and/or components of generalized anxiety disorder (e.g., Andrews et al., 2010; Buhr & Dugas, 2006; Dugas et al., 1997; Ladouceur et al., 2000).

The Role of Control

Unfortunately, worry cannot always serve its full motivational function. In some contexts, the motivational process of worry is at least partially thwarted—namely when people perceive they lack control over an outcome they wish to prevent. Using COVID-19 as an example, uncertainty about one's likelihood of contracting the virus prompts rising worry, which in turn prompts the motivation to avoid infection. For some, however, this motivation is obstructed because they believe they lack the ability to prevent infection. Put another way, a lack of perceived personal control (here, control over preventing infection) obstructs the action that worry motivates.

Figure 1 presents a conceptual model of the proposed process from uncertainty to well-being via worry and control. We propose that perceived control over one's risk of contracting COVID-19 moderates the process by which uncertainty about risk of contracting the virus can lead to poor physical health and psychological well-being (e.g., greater depression, more sleep disruption) via worry about the virus or one's risk. Specifically, we hypothesize that perceived control over COVID-19 risk allows uncertainty-induced worry about COVID-19 risk to fulfill its motivational goal of prevention, and thereby mitigates its negative effects on well-being. However, when control is low or perceived to be low, worry

Figure 1
Conceptual Theoretical Model



Note. The constructs in rectangles are those we measured in the present research, whereas those in ovals are theoretically proposed to be part of the process, but were not measured in the present work.

cannot fulfill its prevention goal, leading to negative consequences for health and well-being.

Prior research has pointed to the importance of perceived control in the link between uncertainty, worry, and health/well-being (Howell & Sweeny, 2019, 2020; Sweeny, 2018; Sweeny et al., 2020), but we know of no research specifically testing control as a moderator of the indirect relationship between uncertainty and health/well-being via worry. The most relevant study to date revealed that neuroticism, which typically moderates responses to stressful uncertainty (Bolger & Schilling, 1991; Schneider et al., 2012), has less of an effect on well-being in situations that provide more control over one's outcomes (Sweeny et al., 2020). Similarly, we suspect that the effect of uncertainty on well-being is most potent when people believe they lack primary control (i.e., control over one's objective outcome) because it inhibits the motivational function of worry. We tested this hypothesis in four studies completed at various points during the COVID-19 pandemic prior to the release of a vaccine.

Specifically, Studies 1 and 2 offer initial tests of our hypotheses using large samples from China during the initial period of the pandemic outbreak (Study 1; February 2020) and the United States as the pandemic initially evolved (Study 2; April-November 2020). Studies 3 and 4 conceptually replicate the first two studies but add a longitudinal component, examining the process over 4 weeks during May 2020 (Study 3) and two weeks during November 2020 (Study 4). Across all studies, we measure a host of physical and psychological well-being outcomes and use slightly different measures of our primary constructs. We believe doing so can help establish the robustness of our conceptual model, despite using short measures of our constructs throughout. We are careful to note the changes in these measures between studies.

Study 1

Method

Transparency and Openness

In all studies, we report how we arrived at our sample size, all data exclusions (if any), and all measures in the study. There are no manipulations in the studies. We did not preregister any of our hypotheses or analyses, but the conceptual approach and general hypotheses appear in a recently funded grant proposal, developed well before the current article (see https://www.nsf.gov/awardsearch/showAward?AWD_ID=1941579). All data were analyzed using SPSS Version 27 and the primary hypothesis tests are conducted using Hayes (2018) PROCESS macro 3.4, model 14.

Participants and Procedure

Participants were 6,304 residents of Wuhan and other areas of China affected by COVID-19 (65.5% women, 34.5% men; M_{age} = 23.03 years, SD_{age} = 7.11). The data were collected via two recruitment methods during the very beginning of the onset of the COVID-19 pandemic in China. The largest subsample (n = 5,561) was collected between February 12 and 26, 2020, via an online survey hosted on IQEQ (IQ and Emotional Quotient), a research-specific platform developed by one of the coinvestigators involved in a larger data-collection effort. Recruitment of this subsample was targeted toward college students on the WeChat social media platform, and participation was voluntary. The other subsample (n = 748) was collected between February 23 and 26, 2020 via WenJuanXing, a popular survey platform in China.

For context, China was the epicenter of the COVID-19 outbreak at the time. Deaths from COVID-19 exceeded that of the SARS epidemic (from the early 2000s) on February 10, and average reported cases each day ranged from 5,223 on February 12 to 499 on February 26 (World Health Organization, 2021a). In our sample, 70.3% reported that they were not "in quarantine" when they participated. They could have, though, still been in lockdown. Additionally, there were a variety of local and regional circumstances caused by the pandemic about which we have no data—for example, the city of Wuhan was blockaded & locked down for 76 days, from January 23 to April 8, 2020, suggesting all participants from that city were in lockdown during the study.

Recruitment occurred via social media (e.g., Weibo) aimed at the general public, and participation was again voluntary. The sample size was determined by the number of volunteers who agreed to participate. We did not exclude any data. Our final sample provided us with power at $1 - \beta > .80$ to detect any bivariate effect of r = .032 or greater. The study was approved by the Institutional Review Board for research involving human subjects at Nanjing University, China.

Measures

All measures were originally constructed in English and translated into Mandarin Chinese by Mandarin-speaking coinvestigators on the broader project. We report all measures relevant to the present analyses. Full study measures and anonymized data are available at: https://osf.io/vuwg3/.

Predictors

Uncertainty Regarding COVID-19 Risk. Participants responded to the question, "Do you think that you will contract coronavirus?" using the scale 1 = *definitely not*, 2 = *probably not*, 3 = *maybe*, 4 = *probably*, 5 = *definitely* (M = 1.75, SD = .83). To create a measure of uncertainty, we recoded 1 and 5 as low uncertainty (1), 2 and 4 as moderate uncertainty (2), and 3 as high uncertainty (3; M = 1.68, SD = .71). Of note, we recognize that this operationalization of uncertainty regarding risk captures uncertainty about the outcome (of contracting COVID-19) but does not necessarily reflect a lack of confidence tied to one's risk assessment (e.g., one could be very certain that they *may* get the virus). We assess different aspects of uncertainty regarding risk across studies with the understanding that, together, these different measurement approaches can provide a convergent picture of the role of uncertainty regarding risk.

Worry About COVID-19. We measured worry using a three-item scale adapted from the McCaul Brief Worry Scale (McCaul & Goetz, n.d.). Specifically, participants indicated "how often in the past week" they had "worried about the coronavirus" (1 = *never*, 2 = *rarely*, 3 = *sometimes*, 4 = *all of the time*), how "bothered" they were "by thinking about the coronavirus" and how "worried" they were "about the coronavirus" (1 = *not at all*, 2 = *somewhat*, 3 = *moderately*, 4 = *a great deal*, 5 = *extremely*). We z-scored these items and combined them to create an index of worry (M = .00, SD = .86, α = .83).

Moderator: Control Over COVID-19 Risk

Participants responded to the item, "I can control whether I contract coronavirus" using a scale ranging from 1 = *strongly disagree* to 7 = *strongly agree* ($M = 4.91$, $SD = 1.58$).

Criterion Variables: Psychological Well-Being

Anxiety and Depression. Participants completed the anxiety and depression subscales of the Brief Symptom Inventory (Derogatis & Fitzpatrick, 2004). They indicated the extent to which they experienced six symptoms of general anxiety (nervousness, spells of panic, feeling tense, feeling fearful, feeling suddenly scared, and feeling restless) and six symptoms of depression (feeling blue, feelings of worthlessness, feeling no interest in things, feeling lonely, feeling hopeless about the future, suicidal thoughts) "in the past week" on a scale ranging from 0 = *not at all* to 4 = *very much*. We summed these symptoms and divided by the total number of symptoms to create indices of general anxiety ($M = 4.32$, $SD = 4.81$) and depression ($M = 4.08$, $SD = 4.39$).

Positive and Negative Emotions. Participants completed the Scale of Positive and Negative Experience (Diener et al., 2009), indicating the extent to which they felt six positive (good, happy, positive, pleasant, joyful, contented) and six negative (bad, sad, negative, unpleasant, afraid, angry) emotions in the past week on a scale ranging from 1 = *very rarely or never* to 5= *very often or always* (positive: $M = 3.60$, $SD = .82$; negative: $M = 2.03$, $SD = .70$).

Life Satisfaction. Participants completed the Satisfaction with Life Scale (Diener et al., 1985); they indicated agreement with five items such as, "In most ways my life is close to ideal" and "I am satisfied with my life," on a scale ranging from 1 = *strongly disagree* to 5 = *strongly agree.* Items were averaged to create a single index of satisfaction with life ($M = 3.93$, $SD = 1.16$).

Criterion Variables: Physical Well-Being- Sleep Quality

Participants responded to a single item indicating their sleep quality over the past two weeks on the following scale: 1 = *frequent insomnia*, 2 = *normal*, 3 = *good*, 4 = *perfect* ($M = 2.84$, $SD = .76$).

Criterion Variables: Social Well-Being- Loneliness

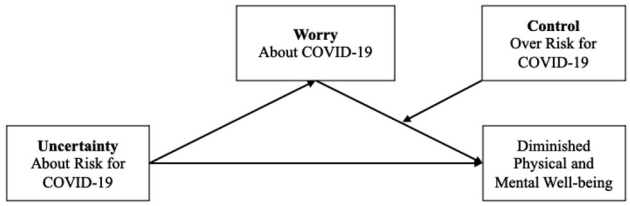
Participants completed the three-item Brief Loneliness Measure (Hughes et al., 2004) in which they indicated how frequently in the past week they felt that they "lacked companionship," were "left out," and were "isolated from others" (1 = *hardly ever*, 2 = *some of the time*, 3 = *often*; $M = 1.40$, $SD = .53$, $\alpha = .79$).[1]

Results

To test our hypotheses, we examined: (a) the direct effects of uncertainty, worry, and perceived control on well-being; (b) the indirect effect of uncertainty on well-being via worry; and (c) the moderating role of perceived control on the direct effect of worry on well-being and the indirect effect of uncertainty on health and well-being via worry. Figure 2 presents the conceptual model for our analyses.

Table 1 presents the results for all analyses predicting well-being from uncertainty regarding COVID-19 risk, worry about COVID-19, and perceived control over COVID-19 risk.

Figure 2
Analysis Model



Direct Effects of Worry and Control on Well-Being

As Table 1 reveals, there were main effects of worry about COVID-19 and perceived control over COVID-19 risk on all outcomes: People who worried more about and perceived they had less control over their risk for COVID-19 experienced more anxiety, more depression, more negative emotion, less positive emotion, more loneliness, and worse sleep.

Indirect Effect of Uncertainty on Well-Being

There were significant negative indirect effects of uncertainty regarding COVID-19 risk on well-being via worry about COVID-19 for all indicators of well-being. That is, uncertainty regarding COVID-19 was related to greater worry about COVID-19, and this worry in turn predicted poorer well-being.

Moderating Role of Control

Both the main effect of worry on well-being as well as the indirect effect of uncertainty on well-being via worry were moderated by perceived control for all indicators of well-being except sleep disruption. As the bottom four rows in Table 1 show, to the extent that perceived control over their COVID-19 risk was low, increases in COVID-19 worry and increases in uncertainty regarding COVID-19 risk (via worry) related more strongly to diminished well-being.

Two surprising findings emerged: Greater worry about COVID-19 and uncertainty regarding COVID-19 risk (via worry) related to lower positive emotion and satisfaction with life among people who reported high perceived control over their COVID-19 risk, but not among people who reported low perceived control.

Study 2

Study 2 aimed to conceptually replicate the effects observed in Study 1 in residents of the United States from a different period in the pandemic (i.e., April to November 2020). Additionally, we updated our measure of uncertainty by replacing "maybe" with "unsure" to represent a sense of uncertainty regarding risk more directly (more direct measures are used in Studies 3 and 4). We also focused our measure of worry specifically on COVID-19 risk rather than COVID-19 generally.

[1] An earlier version of this article included healthy and unhealthy behaviors. However, on peer review and reflection, we recognized that those behavioral outcomes do not fit into the same category as self-perceptions of well-being more broadly. As such, they no longer appear in the primary article but are available as part of the online supplemental materials.

Table 1

Study 1: Results From a Moderated Indirect Effect Model Predicting Well-Being

Measure	Anxiety b [95% CI]	Depression b [95% CI]	Positive emotions b [95% CI]	Negative emotions b [95% CI]	Life satisfaction b [95% CI]	Loneliness b [95% CI]	Sleep quality b [95% CI]
Outcome: Worry[a]							
Uncertainty[b]	**.33 [.30, .36]**	**.33 [.30, .36]**	**.33 [.30, .36]**	**.33 [.30, .36]**	**.33 [.30, .36]**	**.33 [.30, .36]**	**.29 [.26, .32]**
Outcome: Well-being							
Uncertainty[b]	**1.06 [.90, 1.22]**	**1.01 [.86, 1.16]**	**−.64 [−.81, −.47]**	**1.03 [.89, 1.18]**	**−.43 [−.65, −.21]**	**.03 [.01, .05]**	**−.08 [−.11, −.05]**
Worry[a]	**2.04 [1.91, 2.17]**	**1.31 [1.18, 1.43]**	**−.46 [−.59, −.32]**	**1.62 [1.51, 1.73]**	**−.34 [−.52, −.17]**	**.12 [.10, .13]**	**−.09 [−.12, −.07]**
Control[b]	**−.30 [−.37, −.23]**	**−.31 [−.37, −.24]**	**.94 [.87, 1.02]**	**−.25 [−.31, −.18]**	**.82 [.72, .91]**	**−.05 [−.06, −.04]**	**.04 [.03, .06]**
Control[b] × Worry[a]	**−.34 [−.41, −.27]**	**−.27 [−.34, −.21]**	**−.29 [−.36, −.22]**	**−.25 [−.31, −.19]**	**−.25 [−.34, −.16]**	**−.01 [−.02, −.01]**	**−.01 [−.03, −.00]**
Uncertainty[b] via worry[a]	**.66 [.58, .75]**	**.42 [.36, .49]**	**−.16 [−.21, −.10]**	**.52 [.46, .59]**	**−.12 [−.19, −.06]**	**.04 [.03, .05]**	**−.03 [−.04, −.02]**
Indirect Effect × Control	**−.11 [−.14, −.08]**	**−.09 [−.12, −.06]**	**−.10 [−.13, −.06]**	**−.08 [−.11, −.06]**	**−.08 [−.12, −.04]**	**−.005 [−.01, −.002]**	.004 [−.01, .00]
Conditional main effects of worry predicting well-being							
−1 *SD* control[b]	**2.69 [2.52, 2.86]**	**1.82 [1.66, 1.99]**	.10 [−.09, .28]	**2.10 [1.95, 2.25]**	.13 [−.10, .37]	**.15 [.13, .17]**	**−.07 [−.10, −.04]**
+1 *SD* control[b]	**1.67 [1.52, 1.82]**	**1.01 [.86, 1.16]**	**−.77 [−.94, −.60]**	**1.34 [1.21, 1.48]**	**−.61 [−.83, −.40]**	**.10 [.08, .12]**	**−.11 [−.15, −.08]**
Conditional indirect effect: Uncertainty via worry predicting well-being							
−1 *SD* control[b]	**.88 [.77, 1.01]**	**.60 [.51, .70]**	.03 [−.05, .12]	**.69 [.60, .78]**	.04 [−.05, .13]	**.05 [.04, .06]**	
+1 *SD* control[b]	**.55 [.47, .63]**	**.33 [.26, .40]**	**−.25 [−.32, −.19]**	**.44 [.38, .51]**	**−.20 [−.28, −.12]**	**.03 [.03, .04]**	

Note. Bolded estimates $p < .05$.
[a] Specific to COVID-19. [b] Specific to COVID-19 risk.

Method

Participants and Procedure

Participants were 12,365 residents of the United States (68.2% women, 29.6% men, 1.0% nonbinary or other gender, 1.1% unreported; $M_{\text{age}} = 35.29$ years, $SD_{age} = 14.79$, $\text{min}_{\text{age}} = 19$ years, $\text{max}_{\text{age}} = 99$ years; 71.8% White, 7.9% Black/African American, 7.1% Asian, 5% Mixed-Race/Multiple Selections for race, 6.9% other or unknown; 11.3% Hispanic/Latino[a/x], 4.4% Unknown). Participants were volunteers from the Project Implicit Health website (https://www.projectimplicithealth.com) participating in a research study about their cognitions regarding and experiences with the COVID-19 pandemic. Data were collected April 1 through November 1, 2020. For context, the pandemic outbreak in the United States started in March of 2020; the initial surge of cases started around March 23. On April 1, there were 26,930 new cases. The number of daily cases remained around that rate until late June, peaking at 73,525 on July 24 and dropping slowly into the low 40,000s until, in early September, they started to climb again. Statistics were not available for the ending day of our sample (November 1), but there were 94,006 new cases reported on November 2. The cases climbed from there, peaking (for that rise) at over 300,000 new cases on January 8, 2021.

Given the focus on uncertainty regarding COVID-19 risk, we did not analyze data from any participant who reported that they had been diagnosed with COVID-19 or believed they had already had COVID-19 ($n = 1048$). These cases were removed prior to all analyses reported here. The sample size was determined by the number of volunteers who agreed to participate. Data are available on request. Our final sample provided us with power at $1 - \beta = .80$ to detect any bivariate effect of $r = .003$ or greater. The study was approved by the Institutional Review Board at the University of Virginia.

Measures

Predictors.

Uncertainty Regarding COVID-19 Risk. Participants responded to the question, "How likely are you to get COVID-19?" using the scale 1 = *I definitely will not*, 2 = *I probably will not*, 3 = *I might not*, 4 = *I am unsure*, 5 = *I might*, 6 = *I probably will*, 7 = *I definitely will*. Similar to Study 1, we recoded 1 and 7 as low uncertainty (1), 2 and 6 as slight uncertainty (2), 3 and 5 as moderate uncertainty (3), and 4 as high uncertainty (4; $M = 2.90$, $SD = .88$).

Worry About COVID-19 Risk. We measured worry about COVID-19 using one item, "I am worried about my COVID-19 risk," on a scale ranging from 1 = *strongly disagree* to 7 = *strongly agree* ($M = 4.39$, $SD = 1.80$). Unlike in the first study, this measure focuses on personal risk, rather than COVID-19 in general.

Moderator: Control Over COVID-19 Risk. Participants responded to the item, "I can control whether I contract COVID-19" using a scale ranging from 1 = *strongly disagree* to 7 = *strongly agree* ($M = 4.15$, $SD = 1.07$).

Criterion Variables: Psychological Well-Being.

Anxiety and Depression. Participants completed the four-item version of the Patient Health Questionnaire (Kroenke et al., 2009), in which they indicated if they had experienced "Feeling nervous, anxious, or on edge," "Not being able to stop or control worrying," "Feeling down, depressed, or hopeless," and "Little interest or pleasure in doing things" over the last week using the scale 0 = *not at all*, 1 = *several days*, 2 = *more than half of the days*, 3 = *nearly*

every day. We summed the first two items to create an index of anxiety (M = 1.71, SD = 1.68) and the latter two items to create an index of depression (M = 1.28, SD = 1.50). We recognize that our measure of anxiety includes clinical worry and thus may have some overlap with the worry measure used in this study, but they are distinct in that one focuses on a tendency to worry in general whereas the other is focused on worry about personal COVID-19 risk.

Stress. Participants completed the stress portion of the 21-item Depression, Anxiety, and Stress Scale (Lovibond & Lovibond, 1995) indicating the extent to which they felt seven symptoms of stress in the past week (e.g., "I found it hard to wind down," "I found myself getting agitated"). The current study used a scale ranging from 1 = *did not apply to me at all*, 2 = *applied to me to some degree, or some of the time*, 3 = *applied to me to a considerable degree or a good part of the time*, 4 = *applied to me very much or most of the time* (M = 1.72, SD = .52).

Criterion Variables: Physical Well-Being.

Self-Rated Health. Participants reported the quality of their health using a modified version of the single-item measure of global health from the SF-36 health survey (Ware, 1999): "Right now, would you say your physical health is:" 1 = *excellent*, 2 = *very good*, 3 = *good*, 4 = *fair*, 5 = *poor* (M = 2.83, SD = .98). Note that higher scores indicate poorer health.

Poor Sleep. Participants reported poor sleep using a modified version of the single-item measure of sleep quality from the Pittsburgh Sleep Quality Index (Buysse et al., 1989): "During the past 7 days, how would you rate the quality of your sleep overall?" 1 = *excellent*, 2 = *very good*, 3 = *good*, 4 = *fair*, 5 = *poor* (M = 3.26, SD = 1.03). Note that higher scores indicate poorer sleep.

Results

Given that the study took place over several months and the nature of people's actual risk and recommendations for preventative behaviors changed, we controlled for day of the year in the analyses.

Table 2 presents the results for all analyses predicting psychological and physical well-being from uncertainty, worry, and control.

Direct Effects of Worry About and Control Over COVID-19 Risk on Well-Being

As Table 2 indicates, there were main effects of worry about and perceived control over COVID-19 risk on all outcomes: People who felt more worried about and less in control of their risk for COVID-19 experienced higher levels of anxiety, depression, and stress and poorer sleep and heath.

Indirect Effect of Uncertainty on Well-Being

There were significant negative indirect effects of uncertainty regarding COVID-19 risk on well-being via worry about COVID-19 risk for all indicators of well-being, suggesting that uncertainty regarding COVID-19 risk was related to higher worry about COVID-19 risk, and this worry in turn predicted poorer well-being.

Moderating Role of Control

The direct effect of worry and the indirect effect of uncertainty via worry were moderated by control for anxiety, depression, and stress. Specifically, as the bottom four rows in Table 2 show, when perceived control over COVID-19 risk was low (but not when perceived control was high), higher levels of worry about COVID-19 and higher levels of uncertainty regarding COVID-19 risk (via worry) related more strongly to higher levels of anxiety, depression, and stress. Perceived control over COVID-19 risk did not emerge as a significant moderator of either the direct or indirect effect for sleep disruption or poor health.

Study 3

Taken together, Studies 1 and 2 suggested that worry about COVID-19 risk, perceived control over COVID-19 risk, and uncertainty regarding COVID-19 risk (via COVID-19-related worry)

Table 2
Study 2: Results From a Moderated Indirect Effect Model Predicting Well-Being

Measure	Anxiety *b* [95% CI]	Depression *b* [95% CI]	Stress *b* [95% CI]	Sleep disruption *b* [95% CI]	Poor health *b* [95% CI]
Outcome: Worry[b]					
Uncertainty[b]	**.40 [.36, .44]**	**.40 [.36, .44]**	**.40 [.37, .44]**	**.40 [.36, .44]**	**.40 [.36, .44]**
Day of year[a]	−.02 [−.03, .003]	−.02 [−.03, .003]	−.02 [−.03, .003]	−.02 [−.03, .003]	−.02 [−.03, .003]
Outcome: Well-being					
Uncertainty[b]	.03 [−.01, .07]	.01 [−.02, .05]	−.007 [−.02, .004]	**.02 [.00, .04]**	**.06 [.03, .08]**
Worry[b]	**.16 [.14, .18]**	**.08 [.06, .10]**	**.04 [.04, .05]**	**.05 [.04, .06]**	**.07 [.06, .08]**
Control[b]	**−.08 [−.10, −.06]**	**−.06 [−.08, −.05]**	**−.03 [−.03, −.02]**	**−.04 [−.05, −.03]**	**−.03 [−.04, −.02]**
Control[b] × Worry[b]	**−.02 [−.02, −.01]**	**−.01 [−.02, .00]**	**−.004 [−.01, −.001]**	−.001 [−.01, .01]	.000 [−.01, .01]
Day of year[a]	.01 [−.01, .03]	**−.04 [−.05, −.02]**	**−.003 [−.01, .003]**	−.003 [−.01, .01]	.000 [−.01, .01]
Uncertainty via worry[b]	**.06 [.05, .07]**	**.03 [.03, .04]**	**.02 [.01, .02]**	**.02 [.02, .03]**	**.03 [.02, .03]**
Indirect Effect × Control	**−.01 [−.01, −.002]**	**−.004 [−.01, −.001]**	**−.002 [−.003, −.000]**	.000 [−.003, .002]	.000 [−.002, .002]
Conditional main effects of worry predicting well-being					
−1 *SD* control[b]	**.18 [.16, .21]**	**.10 [.08, .12]**	**.05 [.04, .06]**	—	—
+1 *SD* control[b]	**.13 [.11, .16]**	**.06 [.04, .08]**	**.04 [.03, .04]**	—	—
Conditional indirect effect: uncertainty via worry predicting well-being					
−1 *SD* control[b]	**.07 [.06, .09]**	**.04 [.03, .05]**	**.02 [.02, .02]**	—	—
+1 *SD* control[b]	**.05 [.04, .06]**	**.03 [.02, .03]**	**.01 [.01, .02]**	—	—

Note. Bolded estimates $p < .05$.
[a] Coefficients for day of year are multiplied by 30, so their size represent the effect of a 1-month change, even though the estimate is based on daily rates. [b] Specifically regarding COVID-19 risk.

consistently predicted poorer well-being generally. It also largely supported the notion that the direct effect of worry about COVID-19 risk and indirect effect of uncertainty via worry were strongest among those who felt they lacked control over their COVID-19 risk.

Of course, both studies measured all parts of the proposed theoretical model at a single time point. In Study 3, we aimed to establish some temporal precedent in our model by conducting a longitudinal study in which we examined the model across four weeks. We assessed uncertainty and perceptions of control during the first week, worry over the following two weeks, and well-being in a final week.

Method

Participants and Procedure

Participants were 201 adults living in the United States (51.5% identified as women, 44.6% identified as men, 1.5% identified as trans women, 1.5% identified as other, and 1.5% did not respond; M_{age} = 30.08 years, SD_{age} = 10.68 years; Participants could select more than one racial category, and they identified as follows: 21.6% Asian, 9.8% Black/African American, 65.7% White/Caucasian, 2% Native American/Alaska Native, 10.8% Hispanic/Latino [a/x], 2% other or unknown). They were recruited via the online crowd-sourcing platform Prolific (Prolific.co) starting May 7, 2020, and ending on June 3, 2020. For context, COVID-19 new-daily cases were relatively stable throughout the duration of the study, hovering around 20,000 and 30,000 new cases per day.

Participants received $2.00 for each of four short weekly surveys they completed, and those who completed at least three of the four surveys received a $2.00 bonus. One participant who indicated they had been diagnosed with COVID-19 was removed prior to all analyses.[2] All participants completed the first survey, 167 (83%) completed the second survey, 171 (85%) completed the third survey, and 155 (77%) completed the final survey—leaving 155 listwise for the final analyses in the present study. Participant absence at time 2, 3, or 4 did not predict uncertainty regarding, worry about, nor perceived control over their risk for COVID-19. Data were collected as part of a broader exploratory investigation into experiences with, and well-being during, the COVID-19 pandemic. We had economic resources to recruit 200 people for the broader study. Our final sample provided us with power at $1 - \beta = .80$ to detect any bivariate effect of $r = .03$ or greater. A full list of measures is available at https://osf.io/c2bxw/.

Measures

Predictors.

Uncertainty Regarding Risk for COVID-19. In Week 1, we used participants' responses regarding their uncertainty about COVID-19. Instead of asking them about risk and then calculating uncertainty, as in Studies 1 and 2, we directly asked participants, "How uncertain are you about getting COVID-19?" They responded using a scale ranging from 1 = *not at all* to 7 = *very* (M = 4.00, SD = 1.52).

Worry About Risk for COVID-19. In Weeks 2 and 3, we measured worry about COVID-19 risk using one item, "How worried are you about getting COVID-19?" on a scale ranging from 1 = *not at all* to 7 = *very.* We averaged responses to these items during Weeks 2 and 3 to create an index of worry during the middle of the study (M = 4.04, SD = 1.82).

Moderator: Control Over Risk for COVID-19. In Week 1, participants responded to the item, "I can control my risk for COVID-19" using a scale ranging from 1 = *strongly disagree* to 7 = *strongly agree* (M = 4.23, SD = 1.21). Note that this item differs from the earlier studies which asked participants to directly report whether they could control whether they contracted COVID-19.

Criterion Variables: Psychological Well-Being.

Anxiety and Depression Because of COVID-19. In Week 4, participants read the prompt, "Indicate how much each of the statements below apply to you in the past week. Because of the COVID-19 pandemic, in the past week." and then responded to single-item measures of anxiety ("I felt anxious"; M = 2.14; SD = .92) and depression ("I felt depressed"; M = 1.91; SD = .99) on the scale 1 = *never,* 2 = *some of the time,* 3 = *often,* 4 = *most of the time.* This measure was different from those in the first two studies in that it focused on the experience of anxiety and depression that participants attributed to the COVID-19 pandemic.

Stress. In Week 4, participants completed the four-item Perceived Stress Scale (Cohen, 1988). Specifically, they responded to the prompt, "In the past week how often did you feel . . . " and four specific questions (e.g., " . . . that you were unable to control the important things in your life," ". . . difficulties were piling up so high that you could not overcome them?") on the scale 1 = *never,* 2 = *almost never,* 3 = *sometimes,* 4 = *fairly often,* 5 = *very often* (M = 2.37, SD = .84).

Criterion Variables: Physical Well-Being.

Health. In Week 4, participants responded to the item, "During the past week, because of the COVID-19 pandemic, would you say your health has been." on the scale 1 = *poor*, 2 = *fair*, 3 = *good*, 4 = *very good*, 5 = *excellent* (M = 3.28, SD = .99).

Poor Sleep. In Week 4, participants responded to the item, "During the past week, how would you rate the quality of your sleep overall?" on the scale 1 = *very good*, 2 = *fairly good*, 3 = *fairly bad*, 4 = *very bad* (M = 2.37, SD = .79). Note that higher scores indicate poorer sleep.

Results

Table 3 presents the results for all analyses predicting well-being from uncertainty, worry, and control.

Direct Effects of Worry About and Control Over COVID-19 Risk on Well-Being

As Table 3 shows, there were direct effects of worry and perceived control on all outcomes. People who felt more worried about and less in control of their risk for COVID-19 experienced more anxiety and depression because of COVID-19, more stress, poorer sleep, and poorer heath.

Indirect Effect of Uncertainty About COVID-19 Risk on Well-Being

As in Studies 1 and 2, there were significant indirect effects of uncertainty about COVID-19 risk via worry about COVID-19 risk for all outcomes. Greater uncertainty about COVID-19 risk during

[2] Only participants in Studies 2 and 3 reported whether they had a prior COVID diagnosis.

Table 3
Study 3: Results From a Moderated Indirect Effect Model Predicting Well-Being

Measure	Anxiety[b] *b* [95% CI]	Depression[b] *b* [95% CI]	Stress *b* [95% CI]	Health[b] *b* [95% CI]	Sleep disruption *b* [95% CI]
Outcome: Worry[a]					
Uncertainty[a]	**.71 [.56, .86]**	**.71 [.56, .86]**	**.71 [.56, .86]**	**.71 [.56, .86]**	**.71 [.56, .86]**
Outcome: Well-being					
Uncertainty[a]	.02 [−.09, .13]	−.05 [−.17, .07]	−.02 [−.12, .08]	.04 [−.07, .16]	.017 [−.08, .12]
Worry[a]	**.17 [.07, .26]**	**.17 [.06, .27]**	**.11 [.02, .20]**	**−.18 [−.29, −.08]**	**.05 [−.04, .14]**
Control[a]	**−.14 [−.28, −.001]**	**−.19 [−.34, −.04]**	**−.16 [−.29, −.04]**	**.20 [.05, .34]**	**−.13 [−.25, −.003]**
Control[a] × Worry[a]	−.02 [−.08, .04]	−.04 [−.11, .02]	−.05 [−.10, .01]	.03 [−.03, .10]	−.05 [−.10, .01]
Uncertainty via worry[a]	**.12 [.05, .19]**	**.12 [.04, .20]**	**.08 [.005, .15]**	**−.13 [−.21, −.06]**	**.04 [−.03, .10]**
Indirect Effect × Control	−.02 [−.06, .02]	−.03 [−.07, .01]	−.03 [−.08, .004]	.02 [−.03, .07]	−.03 [−.08, .01]

Note. Bolded estimates $p < .05$.
[a] Specific to COVID-19. [b] Attributed to the circumstances of the pandemic.

Week 1 predicted greater worry about COVID-19 risk during Weeks 2 and 3, which in turn predicted poorer health and well-being in Week 4.

Moderating Role of Control

Unlike Studies 1 and 2, there was no evidence that control over COVID-19 risk moderated the direct (worry) or indirect (uncertainty via worry) effects.

Study 4

Study 3 represented a conceptual replication of Studies 1 and 2 but differed from those studies in two meaningful ways. First, Study 3 used more direct measures of the constructs. For example, we asked people to directly report their uncertainty regarding COVID-19 risk rather than asking people to report their perceived risk and inferring uncertainty, and we inquired about depression, anxiety, and health specifically in response to the pandemic. Second, Study 3 was longitudinal, allowing us to examine the pattern of the indirect effect when the measure of uncertainty temporally precedes worry, and the measure of worry temporally precedes well-being and behavioral outcomes—though the study was still correlational.

Notably, the moderating effect of perceived control over COVID-19 risk was not observed in Study 3. We suspect that this is because the final sample was rather small (n = 155 completing all outcome measures) and thus might have been underpowered to detect moderating effects. So, in Study 4 we aimed to conceptually replicate the findings in another longitudinal study with a larger sample. We also offered a robust test of the effects by examining them during a time when many were experiencing an acute stressor: awaiting the impending results of the 2020 U.S. presidential election.

Method

Participants and Procedure

Participants were 310 adults living in the United States (54.2% Female, 45.2% Male, 0.8% some other gender identity, 0.4% did not respond; M_{age} = 36.68 years, SD_{age} = 14.53 years; 74.9% White, 8.9% Hispanic/Latino[a/x], 8.8% Asian, 5.5% Black, 1.1% Native Alaskan/American Indian, 0.6% Middle Eastern, 0.8% Other) recruited via the online crowd sourcing platform Prolific (Prolific.co). Although Studies 3 and 4 used the same recruitment platform, no Study 3 participant enrolled in Study 4. They were a subsample of a broader longitudinal sample of 443 adults participating in a four-week study about the 2020 U.S. Presidential election. We restricted analyses in this study to participants who participated in Waves 3 (hereafter referred to as the first time point; October 26–28, 2020) and 4 (second time point; November 2–8, 2020), because those were the only waves that contained all measures of interest. For context, COVID-19 cases in the United States were rising at that moment, ranging from 74,636 on October 26 to 130,449 on November 9. Participants received $1 for each of four short weekly surveys they completed. All participants completed measures in both surveys. Sample size was determined by the funds available for the broader study. Our final sample provided us with power at $1 - \beta = .80$ to detect any bivariate effect of r = .02 or greater. A full list of measures is available here: https://osf.io/7xaq3/. Data are available on request.

Measures

Predictors.

Uncertainty Regarding COVID-19 Risk. At the first time point, participants responded to the item, "How uncertain are you about your risk for COVID-19?" They responded using a scale ranging from 1 = *not at all* to 7 = *very* (M = 2.61, SD = 1.12).

Worry About COVID-19 Risk. At the first time point, participants responded to the item, "I am worried about my risk for COVID-19" on a scale ranging from 1 = *strongly disagree* to 7 = *strongly agree* (M = 4.98, SD = 1.84).

Moderator: Control Over COVID-19 Risk. At the first time point, participants responded to the item, "I can control my risk for COVID-19" using a scale ranging from 1 = *strongly disagree* to 7 = *strongly agree* (M = 5.37, SD = 1.25).

Criterion Variables: Psychological Well-Being.

Mental Health. At the second time point, participants indicated their mental health by responding to the item "Over the past week, my mental health has been . . . " using a scale ranging from 1 = *terrible* to 7 = *excellent* (M = 4.31, SD = 1.53).

Coping. At the second time point, participants indicated the extent to which they agreed with the item, "I am coping well with the COVID-19 pandemic" on a scale ranging from 1 = *strongly disagree* to 7 = *strongly agree* (M = 5.19, SD = 1.37).

Emotions. At the second time point, participants indicated the extent to which they experienced nine positive emotions (e.g., "happiness," "love"; $M = 3.67$, $SD = 1.07$, $\alpha = .91$) and 15 negative emotions (e.g., "disgust," "hurt"; $M = 2.54$, $SD = 1.09$, $\alpha = .93$) over the past week on a scale from 1 = *not at all* to 7 = *extremely.*

Stress. At the second time point, participants completed the four-item Perceived Stress Scale (Cohen, 1988). Specifically, they responded to the overall prompt, "In the past week how often have you felt . . . " and four specific questions (e.g., " . . . that you were unable to control the important things in your life," "that difficulties were piling up so high that you could not overcome them?") on the scale 1 = *never,* 2 = *almost never,* 3 = *sometimes,* 4 = *fairly often,* 5 = *very often* ($M = 2.67$, $SD = .92$, $\alpha = .90$).

Criterion Variables: Physical Well-Being.

Physical Health. At the second time point, participants indicated their physical well-being by responding to the item, "During the past week, would you say your health has been." using a scale ranging from 1 = *terrible* to 7 = *excellent* ($M = 4.42$, $SD = 1.29$).

Sleep Quality. At the second time point, participants responded to the item, "During the past week, how would you rate the quality of your sleep overall?" on the scale 1 = *very bad*, 2 = *fairly bad*, 3 = *fairly good*, 4 = *very good* ($M = 2.75$, $SD = .75$).

Results

Table 4 presents the results for all analyses predicting psychological and physical well-being from uncertainty, worry, and control.

Direct Effects of Worry and Control on Well-Being

As the table indicates, there were main effects of worry about COVID-19 risk and perceived control over COVID-19 risk on most outcomes, such that people reported poorer mental health, coping, and physical health and more negative emotions to the extent that they felt greater worry and less control. Participants also reported poorer sleep to the extent that they felt worried about their COVID-19 risk. Those who perceived greater control over their COVID-19 risk also reported greater positive emotions.

Indirect Effect of Uncertainty on Well-Being

Uncertainty about COVID-19 had the predicted negative indirect effect (via worry) on mental health, coping, negative emotions, sleep, and physical health. However, the indirect effect did not emerge for positive emotions or stress.

Moderating Role of Control

The predicted interactions between control over COVID-19 risk and worry about COVID-19 risk emerged for coping, stress, and sleep, such that the relationship between worry about COVID-19 risk and poorer well-being emerged only among those low in perceived control over their COVID-19 risks. The indirect effect of uncertainty about COVID-19 risk on coping and sleep via worry was also moderated by control over COVID-19 risk, such that uncertainty about COVID-19 risk related to poorer coping and worse sleep among those low, but not high, in perceived control over their COVID-19 risk.

Table 4
Study 4: Results From a Moderated Indirect Effect Model Predicting Well-Being

Measure	Mental health *b* [95% CI]	Coping *b* [95% CI]	Positive emotions *b* [95% CI]	Negative emotions *b* [95% CI]	Stress *b* [95% CI]	Sleep quality *b* [95% CI]	Physical health *b* [95% CI]
Outcome: Worry[a]							
Uncertainty[a]	**.73 [.55, .92]**	**.74 [.56, .92]**	**.74 [.57, .92]**	**.74 [.57, .92]**	**.74 [.56, .92]**	**.73 [.55, .92]**	**.73 [.55, .92]**
Outcome: Well-being							
Uncertainty[a]	.12 [−.06, .30]	−.04 [−.19, .10]	.10 [−.03, .22]	.01 [−.11, .13]	.02 [−.09, .13]	−.007 [−.10, .08]	.02 [−.13, .18]
Worry[a]	**−.22 [−.33, −.11]**	**−.17 [−.26, −.08]**	−.07 [−.15, .002]	**.11 [.03, .18]**	.04 [−.03, .11]	**−.07 [−.12, −.01]**	**−.10 [−.20, −.01]**
Control[a]	**.21 [.07, .36]**	**.30 [.18, .42]**	**.11 [.01, .21]**	**−.15 [−.25, −.05]**	**−.17 [−.26, −.08]**	.07 [−.003, .14]	**.20 [.08, .32]**
Control[a] × Worry[a]	.04 [−.02, .10]	**.10 [.04, .15]**	.04 [−.01, .08]	−.03 [−.07, .02]	**−.04 [−.08, −.005]**	**.04 [.01, .07]**	.05 [−.001, .11]
Uncertainty via Worry[a]	**−.16 [−.25, −.08]**	**−.13 [−.21, −.05]**	−.06 [−.11, .005]	**.08 [.02, .14]**	.03 [−.03, .09]	**−.05 [−.10, −.01]**	**−.08 [−.15, −.01]**
Indirect Effect × Control	.03 [−.02, .09]	**.07 [.02, .12]**	.03 [−.01, .07]	−.02 [−.06, .02]	−.03 [−.07, .01]	**.03 [.003, .06]**	.04 [−.01, .09]
Conditional main effects of worry predicting well-being							
−1 *SD* control[a]	—	**−.29 [−.42, −.17]**	—	—	**.09 [.004, .18]**	**−.12 [−.19, −.05]**	—
+1 *SD* control[a]	—	−.06 [−.16, .05]	—	—	−.02 [−.10, .06]	−.02 [−.08, .05]	—
Conditional indirect effect: Uncertainty via worry predicting well-being							
−1 *SD* control[a]	—	**−.21 [−.33, −.10]**	—	—	—	**−.09 [−.15, −.04]**	—
+1 *SD* control[a]	—	−.04 [−.13, .04]	—	—	—	−.01 [−.06, .04]	—

Note. Bolded estimates $p < .05$.
[a] Specific to COVID-19 risk.

Perceived control over COVID-19 risk did not moderate the direct effect of worry about COVID-19 risk nor the indirect effect of uncertainty about personal COVID-19 risk via worry on mental health, positive emotions, negative emotions, or physical health.

Project Meta-Analysis

Because we included some measures across multiple (or all) studies, we conducted a within-project meta-analysis to summarize the evidence for those outcomes: anxiety (Studies 1–3), depression (Studies 1–3), stress (Studies 2–4), health (Studies 2–4), and sleep quality (Studies 1–4). We conducted two forms of analysis: (a) fixed-effects analysis: This is meta-analysis weighted by sample size. Here, it is an analysis including all possible participants from each study. In other words, each participant in each study equally informs the estimate. (b) Fully-random-effects analysis: This is a meta-analysis that ignores sample size, taking the arithmetic mean of the sample sizes. Doing so allows each study to inform the effect equally, so that the effects are not driven primarily by our two large-sample studies (see Goh et al., 2016).

Table 5 presents the results of this meta-analysis, where the top rows are the fixed-effect analysis, and the bottom rows are the random-effect analysis. Because measures of each construct differed across studies, prior to this analysis we *z*-scored all variables. As such, the coefficients represent standardized units (i.e., they represent how many *SD*s *y* changes given 1 *SD* change in *x*) and can be compared directly.

The results from both approaches were consistent when it came to mental well-being (i.e., anxiety, depression, stress): We found a main effect of uncertainty about the pandemic/risk on worry about COVID-19 and of worry about COVID-19 on diminished well-being, as well as an indirect path from uncertainty to diminished well-being via worry. The paths to mental well-being were moderated by perceived control, such that the relationship was weaker when people felt they had control over their COVID-19 risk.

When it came to physical well-being (i.e., self-reported health and sleep quality), the pattern was the same for the random- but not the fixed-effect meta-analysis. In the fixed-effect analysis, the direct and indirect paths were identical; however, these paths were not moderated by control.

General Discussion

In four studies with samples of Chinese (Study 1) and U.S. (Studies 2–4) residents, we examined the roles of uncertainty about, worry about, and perceived control over one's risk for COVID-19 in predicting psychological and physical well-being. Our hypotheses were grounded in an extension of the feeling-is-for-doing approach to emotions, one that anticipates negative consequences of emotional experiences when the motivation that accompanies an emotion is obstructed. Specifically, we proposed that uncertainty triggers the quasi-emotion of worry, which fuels one's motivation to prevent the target of that worry—in the present studies, contracting COVID-19. When people feel that they cannot control their risk of contracting COVID-19, the worry-driven motivation to prevent that outcome is obstructed, and well-being is likely to take a hit.

Consistent with this reasoning, people in our study generally experienced greater worry about their risk for COVID-19 to the extent that they felt uncertain about their risk for COVID-19 and, in turn, reported poorer health and well-being, particularly if they felt they lacked control over their risk for COVID-19. To our knowledge, these studies are the first to demonstrate an indirect path from uncertainty to well-being via worry and the first to demonstrate the role of perceived control in moderating whether uncertainty and worry manifest in poor health and well-being.

Of course, some findings were more consistent across studies than others. For instance, worry about risk for COVID-19 predicted poorer health and well-being, controlling for all other predictor variables, on 22 of 24 outcome measures. Control over risk performed similarly, predicting 23 of 24 health and well-being outcome measures. Similarly, an indirect effect of uncertainty about COVID-19 risk on well-being via worry about COVID-19 emerged on 22 of 24 well-being measures.

By contrast, the moderating effect of perceived control on worry and on the indirect effect of uncertainty (via worry) were less consistent: In our two larger studies (Studies 1 and 2), the interaction effects emerged for 10 of 12 outcome measures and consistently suggested that uncertainty regarding COVID-19 risk (via worry about COVID-19 risk) and worry reliably related to poorer well-being, particularly to the extent that people felt they lacked control over their risk. However, perceived control did not moderate any of the direct or indirect effects in Study 3 and only moderated the direct effect of worry for three out of seven outcomes (coping, stress, and sleep) and the indirect effect of uncertainty about COVID-19 risk (via worry) for two outcomes out of seven (coping and sleep) in Study 4.

Potential Explanations for Inconsistent Findings

We think the primary reason we did not observe these perceived control effects as consistently, though perhaps theoretically uninteresting, was one of power.[3] In fact, an informal examination of all of the worry and uncertainty effects at high (+1 *SD*) and low (−1 *SD*) levels of perceived control over COVID-19 risk revealed that the effects were routinely numerically larger (though, of course, not significantly so) to the extent that people lacked control. This consistency suggests that a better-powered Study 3 (and to some extent, Study 4) might have yielded the predicted effects. Increased power can be achieved in future studies in two ways: (a) increasing the sample size, and (b) decreasing measurement error. In both Studies 3 (initial $N = 201$) and 4 (initial $N = 310$), we recruited as many people as we could given time and financial constraints. Nevertheless, we would have much preferred to have larger samples (at least 400–500 participants), particularly to detect a moderation of the indirect effect over time. Similarly, the measures for the present study were included as additions to broader data collection efforts in all cases. As such, we often measured the constructs of interest with only one item. Although we chose highly face-valid measures, and using short measures reduced participant burden and allowed for data collection in multiple contexts, this approach likely increased measurement error and certainly narrowly defined the constructs of interest. Relatedly, these studies all represented conceptual rather than direct replications, as no two studies used identical measures of all of the

[3] Given the problems with post hoc power analysis (specifically, that it is mathematically synonymous with the observed *p* value; Lakens, 2014), we neither examine nor report observed power.

Table 5
Meta-Analysis Across Studies of a Moderated Indirect Effect Model Predicting Well-Being

Measure	Anxiety *b* [95% CI]	Depression *b* [95% CI]	Stress *b* [95% CI]	Health *b* [95% CI]	Sleep quality *b* [95% CI]
			Fixed effects (Informed by sample size)		
Outcome: Worry					
Uncertainty	**.26 [.24, .27]**	**.26 [.24, .27]**	**.21 [.19, .23]**	**.21 [.19, .23]**	**.22 [.20, .23]**
Outcome: Well-being					
Uncertainty	**.08 [.06, .09]**	**.08 [.07, .10]**	−.01 [−.03, .01]	**−.05 [−.07, −.03]**	**−.04 [−.05, −.02]**
Worry	**.24 [.23, .25]**	**.17 [.15, .18]**	**.14 [.12, .16]**	**−.13 [−.15, −.11]**	**−.10 [−.11, −.08]**
Control	**−.08 [−.09, −.06]**	**−.08 [−.09, −.06]**	**−.09 [−.11, −.07]**	**.07 [.05, .09]**	**.08 [.07, .10]**
Control × Worry	**−.06 [−.07, −.04]**	**−.04 [−.05, −.03]**	**−.03 [−.04, −.01]**	.004 [−.01, .02]	−.003 [−.02, .01]
Uncertainty via worry	**.06 [.06, .07]**	**.04 [.04, .05]**	**.03 [.02, .03]**	**−.03 [−.03, −.02]**	**−.02 [−.03, −.02]**
Indirect Effect × Control	**−.01 [−.02, −.011]**	**−.01 [−.01, −.007]**	**−.01 [−.01, −.002]**	.001 [−.003, .005]	−.001 [−.004, .003]
Conditional main effects of worry predicting well-being					
−1 *SD* control	**.30 [.28, .32]**	**.21 [.19, .23]**	**.17 [.15, .20]**	—	—
+1 *SD* control	**.18 [.17, .20]**	**.13 [.11, .14]**	**.12 [.09, .14]**	—	—
Conditional indirect effect: Uncertainty via worry predicting well-being					
−1 *SD* control	**.08 [.07, .08]**	**.05 [.05, .06]**	**.04 [.03, .04]**	—	—
+1 *SD* control	**.05 [.06, .07]**	**.03 [.04, .05]**	**.02 [.02, .03]**	—	—
			Random effects (Uninformed by sample size)		
Outcome: Worry					
Uncertainty	**.37 [.35, .39]**	**.37 [.35, .39]**	**.41 [.40, .43]**	**.41 [.39, .43]**	**.37 [.35, .39]**
Outcome: Well-being					
Uncertainty	**.08 [.06, .10]**	**.05 [.03, .07]**	−.01 [−.03, .01]	.005 [−.01, .02]	**−.04 [−.06, −.02]**
Worry	**.28 [.26, .30]**	**.21 [.19, .23]**	**.15 [.14, .17]**	**−.20 [−.22, −.18]**	**−.12 [−.14, −.10]**
Control	**−.10 [−.12, −.08]**	**−.13 [−.15, −.11]**	**−.18 [−.20, −.16]**	**.17 [.16, .19]**	**.12 [.10, .14]**
Control × Worry	**−.06 [−.08, −.05]**	**−.06 [−.08, −.04]**	**−.08 [−.10, −.07]**	**.05 [.03, .07]**	**.05 [.03, .07]**
Uncertainty via worry	**.11 [.10, .12]**	**.09 [.08, .09]**	**.07 [.07, .07]**	**−.09 [−.10, −.09]**	**−.05 [−.05, −.04]**
Indirect Effect × Control	**−.03 [−.03, −.02]**	**−.03 [−.03, −.02]**	**−.04 [−.05, −.04]**	**.02 [.02, .03]**	**.03 [.02, .03]**
Conditional main effects of worry predicting well-being					
−1 *SD* control	**.35 [.32, .37]**	**.27 [.24, .30]**	**.24 [.21, .26]**	**−.25 [−.27, −.22]**	**−.17 [−.20, −.15]**
+1 *SD* control	**.22 [.20, .25]**	**.15 [.13, .18]**	**.07 [.05, .10]**	**−.15 [−.18, −.13]**	**−.07 [−.10, −.04]**
Conditional indirect effect: Uncertainty via worry predicting well-being					
−1 *SD* control	**.13 [.12, .14]**	**.11 [.10, .12]**	**.11 [.11, .12]**	**−.12 [−.12, −.11]**	**−.08 [−.08, −.07]**
+1 *SD* control	**.09 [.08, .09]**	**.06 [.05, .07]**	**.03 [.02, .03]**	**−.07 [−.08, −.06]**	**−.02 [−.03, −.01]**

Note. Bolded estimates $p < .05$.

constructs. As such, we suggest the use of more extensive and established measures of the relevant constructs in future research.

When considering the random effects meta-analysis, it appears as though power was, indeed, the likely culprit in undermining the interaction effects, as all interactions appear robust when considering the studies in concert. Additionally, detecting moderation of the proposed indirect effect with power of $1 - \beta \geq .80$ requires approximately 450 participants (see Preacher et al., 2007; Sim et al., 2021). At the same time, an examination of the fixed effects meta-analysis suggests an even more nuanced perspective: It seems that our model applies better to mental well-being than to physical well-being. Specifically, control does not seem to moderate the effect of worry (and uncertainty indirectly) on physical well-being. It may be that the effects on physical well-being are simply more indirect; losing sleep and experiencing poor health likely result from earlier degradation of mental well-being (e.g., stress). Nevertheless, it could also be that simply feeling in control does not stave off negative health effects of uncertainty and worry. Perhaps actions that actually exert control (e.g., getting a vaccine) are more influential.

Related to the issue of power, the smaller effect size of the interaction effects suggests that the primary processes by which worry and uncertainty relate to well-being may be, in practice, only mildly affected by a sense of control. Indeed, these processes were rather consistent and robust, whereas the moderating effect was not. This suggests that, from a practical standpoint, those wishing to intervene to promote well-being in the context of uncertainty might focus specifically on stemming uncertainty or worry, rather than on creating a sense of control.

Of course, the studies differed in ways other than statistical power, perhaps leading one to wonder whether these differences explain differences in the effects observed. We can generate four possible alternative explanations. First, the populations differed: one of the samples was in China and the others were collected in the United States. Notably, the effects did not differ between our large Chinese and our large U.S. sample, suggesting that cultural differences were likely not the reason for differences between effects across studies.

Second, in Study 3, three of the outcomes were specific to COVID-19—that is, for anxiety, depression, and health, the questions were modified by the phrase "because of the COVID-19 pandemic." Although this nuance might explain differences from other studies on these three variables (specifically the lack of moderation), the other measures (stress, sleep) were not specific to COVID-19 and showed the same (lack of) effect, suggesting that COVID-specificity cannot fully account for the differences.

Third, we found many fewer instances of moderation in the two (smaller-sample) longitudinal studies (Studies 3 and 4) than in the

(larger-sample) cross-sectional studies (Studies 1 and 2). Although we recognize that this difference might suggest that the model does not work as well longitudinally, that the mini meta-analysis suggests that it is more likely an issue of power—we were underpowered to detect the average effect size for moderation of an indirect paths. Additionally, we measured all of the relevant constructs at the final time point in both longitudinal studies, and we found a substantially similar pattern of results when only considering single time-point cross-sectional data in those studies (e.g., using only data from Time 4). This consistency suggests that the lack of moderation was more likely attributable to the small sample size than to a loss of power from assessing the constructs longitudinally.

Finally, the studies differed in terms of when they were conducted during the pandemic. Studies 1 and 3 took place during initial phases of the pandemic when many government restrictions were starting to be widely enacted (February 2020 for China, April/May 2020 for the United States); Study 2 collected data from April through October of 2020; and Study 4 collected data in late October/early November of 2020. Nevertheless, if we restrict Study 2 to include only participants completing the study in May and October (n = 2,900), we still observe the moderating effects observed in the full sample, suggesting that the findings were unlikely to be the result of the particular historical timepoint and, instead, likely reflect a power issue.

In addition to the inconsistent moderation patterns, two puzzling findings emerged. In Study 1, greater worry about COVID-19 and uncertainty regarding COVID-19 risk (via worry) related to lower positive emotion and satisfaction with life among people who reported high perceived control over their COVID-19 risk, but not among people who reported low perceived control. These findings, though emerging in only one study and requiring replication, challenge our notion that control might buffer well-being from the effects of worry. Instead, it suggests that worry only relates to these positive outcomes among people who perceive control.

Implications and Open Questions

One of the strengths of the present study was the replication in two different nations, particularly two that are characterized in the literature as representing cultural poles in the individualism-collectivism dichotomy. It is perhaps simultaneously surprising and not at all surprising that we found similar patterns in both cultures. On the one hand, people from the United States and China can have very different emotional responses to the same stimuli and think about emotions in different ways (Schimmack et al., 2002). However, given that the feeling-is-for-doing approach to emotions is based in evolutionary theory (Zeelenberg et al., 2008) and is intentionally cross-cultural, the shared responses across cultures is less surprising. Still, it will certainly be worthwhile to examine our proposed model across cultures as it applies to other emotions (e.g., love) and other situations of uncertainty (e.g., caregiving).

From a theoretical standpoint, these findings point to the utility of the feeling-is-for-doing framework in understanding how emotions can lead to well-being (or lack thereof), including when people encounter stressors. Moreover, it suggests the need to consider contextual factors that might disrupt the action tendency of a given emotion. Doing so will provide clearer insight into when an emotion should increase versus decrease well-being. For instance, love is a positive emotion that makes people want to draw close to, care for, and connect romantically with beloved others (Shaver et al., 1996). Moreover, love is generally seen as good for well-being (Kim & Hatfield, 2004; Oravecz et al., 2020). However, when love's action tendency is blocked (e.g., after an unexpected breakup), greater love should actually be associated with diminished well-being.

Of course, our theoretical approach involves one important construct that was not measured here: prevention motivation. Although the literature widely implicates worry in prevention motivation, including in COVID-19-prevention motivation (Erceg et al., 2022), future research is needed to examine whether the effects observed here are, indeed, the consequence of thwarted prevention motivation. We believe that perceived lack of control over COVID-19 clearly indicates an inability to prevent personal infection, but we might have observed stronger moderating effects if we focused on prevention motivation rather than worry. As such, we recommend future endeavors examining worry during periods of uncertainty to include a measure of prevention motivation.

From a practical standpoint, the present findings suggest that although COVID-19 was a novel stressor and a threat to well-being, interventions that mitigate distress during other periods of uncontrollable uncertainty might also promote well-being for those worried about their risk of COVID-19 (e.g., Wang et al., 2021). For instance, research suggests that mindfulness meditation (Sweeny & Howell, 2017), as well as engaging in activities that facilitate a flow state (i.e., a state of complete absorption in an appropriately challenging activity; Rankin et al., 2019; Sweeny et al., 2020), help people to cope better with stressful uncertainty when they lack control over their outcomes. Moreover, in the clinical literature, a key component of some interventions for generalized anxiety disorder (GAD) focuses on increasing tolerance of uncertainty and teaching skills to reduce worry (i.e., scheduling or postponing worry strategies, for a COVID-19 related example see Whalley & Kaur, 2020).

The findings also point to strategies that increase perceptions of control as particularly fruitful targets for intervention. For example, educating people about effective methods for reducing their likelihood of infection (e.g., handwashing, social distancing) may both prevent the spread of disease and bolster well-being among those who would have otherwise lacked self-efficacy around prevention. Of course, our investigation was limited by its self-report measures and correlational nature, which renders causal assumptions tentative at best. Nonetheless, our findings provide an initial test of our theorized framework during a critically important period of risk and uncertainty.

References

Andrews, G., Hobbs, M. J., Borkovec, T. D., Beesdo, K., Craske, M. G., Heimberg, R. G., Rapee, R. M., Ruscio, A. M., & Stanley, M. A. (2010). Generalized worry disorder: A review of *DSM–IV* generalized anxiety disorder and options for *DSM–V*. *Depression and Anxiety*, *27*(2), 134–147. https://doi.org/10.1002/da.20658

Behar, E., Zuellig, A. R., & Borkovec, T. (2005). Thought and imaginal activity during worry and trauma recall. *Behavior Therapy*, *36*(2), 157–168. https://doi.org/10.1016/S0005-7894(05)80064-4

Bolger, N., & Schilling, E. A. (1991). Personality and the problems of everyday life: The role of neuroticism in exposure and reactivity to daily

stressors. *Journal of Personality*, *59*(3), 355–386. https://doi.org/10.1111/j.1467-6494.1991.tb00253.x

Brewer, N. T., Weinstein, N. D., Cuite, C. L., & Herrington, J. E., Jr. (2004). Risk perceptions and their relation to risk behavior. *Annals of Behavioral Medicine*, *27*(2), 125–130. https://doi.org/10.1207/s15324796abm2702_7

Buhr, K., & Dugas, M. J. (2006). Investigating the construct validity of intolerance of uncertainty and its unique relationship with worry. *Journal of Anxiety Disorders*, *20*(2), 222–236. https://doi.org/10.1016/j.janxdis.2004.12.004

Buysse, D. J., Reynolds, C. F., III, Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). The Pittsburgh Sleep Quality Index: A new instrument for psychiatric practice and research. *Psychiatry Research*, *28*(2), 193–213. https://doi.org/10.1016/0165-1781(89)90047-4

Centers for Disease Control and Prevention. (2020, February 11). *Coronavirus disease 2019 (COVID-19)*. https://www.cdc.gov/coronavirus/2019-ncov/index.html

Cohen, S. (1988). Perceived stress in a probability sample of the United States. In S. Spacapan & S. Oskamp (Eds.), *The social psychology of health* (pp. 31–67). Sage.

Derogatis, L. R., & Fitzpatrick, M. (2004). The SCL-90-R, the Brief Symptom Inventory (BSI), and the BSI-18. In M. E. Maruish (Ed.), *The use of psychological testing for treatment planning and outcomes assessment: Instruments for adults* (pp. 1–41). Erlbaum Publishers.

Diener, E., Emmons, R. A., Larsen, R. J., & Griffin, S. (1985). The satisfaction with life scale. *Journal of Personality Assessment*, *49*(1), 71–75. https://doi.org/10.1207/s15327752jpa4901_13

Diener, E., Wirtz, D., Biswas-Diener, R., Tov, W., Kim-Prieto, C., Choi, D., & Oishi, S. (2009). New measures of well-being. In E. Diener (Ed.), *Assessing well-being* (pp. 247–266). Springer. https://doi.org/10.1007/978-90-481-2354-4_12

Dugas, M. J., Freeston, M. H., & Ladouceur, R. (1997). Intolerance of uncertainty and problem orientation in worry. *Cognitive Therapy and Research*, *21*(6), 593–606. https://doi.org/10.1023/A:1021890322153

Erceg, N., Ružojčić, M., & Galić, Z. (2022). Misbehaving in the Corona crisis: The role of anxiety and unfounded beliefs. *Current Psychology*, *41*(8), 5621–5630. https://doi.org/10.1007/s12144-020-01040-4

Goh, J. X., Hall, J. A., & Rosenthal, R. (2016). Mini meta-analysis of your own studies: Some arguments on why and a primer on how. *Social and Personality Psychology Compass*, *10*(10), 535–549. https://doi.org/10.1111/spc3.12267

Hay, J. L., McCaul, K. D., & Magnan, R. E. (2006). Does worry about breast cancer predict screening behaviors? A meta-analysis of the prospective evidence. *Preventive Medicine*, *42*(6), 401–408. https://doi.org/10.1016/j.ypmed.2006.03.002

Hayes, A. F. (2018). The PROCESS Macro for SPSS and SAS (Version 3.4) [Computer software]. afhayes.com

Howell, J. L., & Sweeny, K. (2019). Fulfilling psychological needs predicts less sleep disruption and worry while awaiting uncertain news. *Stress and Health*, *35*(3), 277–288. https://doi.org/10.1002/smi.2860

Howell, J. L., & Sweeny, K. (2020). Health behavior during periods of stressful uncertainty: Associations with emotions, cognitions, and expectation management. *Psychology & Health*, *35*(10), 1163–1183. https://doi.org/10.1080/08870446.2020.1713323

Hua, J. (2022). *Well-being during COVID-19*. https://doi.org/10.17605/OSF.IO/C2BXW

Hughes, M. E., Waite, L. J., Hawkley, L. C., & Cacioppo, J. T. (2004). A short scale for measuring loneliness in large surveys: Results from two population-based studies. *Research on Aging*, *26*(6), 655–672. https://doi.org/10.1177/0164027504268574

Kim, J., & Hatfield, E. (2004). Love types and subjective well-being: A cross-cultural study. *Social Behavior and Personality*, *32*(2), 173–182. https://doi.org/10.2224/sbp.2004.32.2.173

Koh, H. K., Geller, A. C., & VanderWeele, T. J. (2021). Deaths from COVID-19. *JAMA*, *325*(2), 133–134. https://doi.org/10.1001/jama.2020.25381

Kroenke, K., Spitzer, R. L., Williams, J. B., & Löwe, B. (2009). An ultra-brief screening scale for anxiety and depression: The PHQ-4. *Psychosomatics*, *50*(6), 613–621. https://doi.org/10.1176/appi.psy.50.6.613

Ladouceur, R., Gosselin, P., & Dugas, M. J. (2000). Experimental manipulation of intolerance of uncertainty: A study of a theoretical model of worry. *Behaviour Research and Therapy*, *38*(9), 933–941. https://doi.org/10.1016/S0005-7967(99)00133-3

Lakens, D. (2014, December 19). The 20% statistician: Observed power, and what to do if your Ed. asks for post-hoc power analyses. http://daniellakens.blogspot.com/2014/12/observed-power-and-what-to-do-if-your.html

Lee, S. Y., & Hawkins, R. P. (2016). Worry as an uncertainty-associated emotion: Exploring the role of worry in health information seeking. *Health Communication*, *31*(8), 926–933. https://doi.org/10.1080/10410236.2015.1018701

Lovibond, P. F., & Lovibond, S. H. (1995). The structure of negative emotional states: Comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. *Behaviour Research and Therapy*, *33*(3), 335–343. https://doi.org/10.1016/0005-7967(94)00075-U

McCaul, K. D., & Goetz, P. (n.d.). *Worry | Division of Cancer Control and Population Sciences (DCCPS)*. Retrieved March 25, 2021, from https://cancercontrol.cancer.gov/brp/research/constructs/worry

McCaul, K. D., Magnan, R. E., & Mead, M. P. (2020). Disease-specific worry. In K. Sweeny & M. L. Robbins (Eds.), *The Wiley encyclopedia of health psychology: The social bases of health behavior* (Vol. 2). Wiley. https://doi.org/10.1002/9781119057840.ch55

McLaughlin, K. A., Borkovec, T. D., & Sibrava, N. J. (2007). The effects of worry and rumination on affect states and cognitive activity. *Behavior Therapy*, *38*(1), 23–38. https://doi.org/10.1016/j.beth.2006.03.003

Oravecz, Z., Dirsmith, J., Heshmati, S., Vandekerckhove, J., & Brick, T. R. (2020). Psychological well-being and personality traits are associated with experiencing love in everyday life. *Personality and Individual Differences*, *153*, 109620. https://doi.org/10.1016/j.paid.2019.109620

Preacher, K. J., Rucker, D. D., & Hayes, A. F. (2007). Addressing moderated mediation hypotheses: Theory, methods, and prescriptions. *Multivariate Behavioral Research*, *42*(1), 185–227. https://doi.org/10.1080/00273170701341316

Rankin, K., Walsh, L. C., & Sweeny, K. (2019). A better distraction: Exploring the benefits of flow during uncertain waiting periods. *Emotion*, *19*(5), 818–828. https://doi.org/10.1037/emo0000479

Rehman, U., Shahnawaz, M. G., Khan, N. H., Kharshiing, K. D., Khursheed, M., Gupta, K., Kashyap, D., & Uniyal, R. (2021). Depression, anxiety and stress among Indians in times of Covid-19 lockdown. *Community Mental Health Journal*, *57*(1), 42–48. https://doi.org/10.1007/s10597-020-00664-x

Rosen, N. O., & Knäuper, B. (2009). A little uncertainty goes a long way: State and trait differences in uncertainty interact to increase information seeking but also increase worry. *Health Communication*, *24*(3), 228–238. https://doi.org/10.1080/10410230902804125

Salari, N., Hosseinian-Far, A., Jalali, R., Vaisi-Raygani, A., Rasoulpoor, S., Mohammadi, M., Rasoulpoor, S., & Khaledi-Paveh, B. (2020). Prevalence of stress, anxiety, depression among the general population during the COVID-19 pandemic: A systematic review and meta-analysis. *Globalization and Health*, *16*(1), 57. https://doi.org/10.1186/s12992-020-00589-w

Schimmack, U., Oishi, S., & Diener, E. (2002). Cultural influences on the relation between pleasant emotions and unpleasant emotions: Asian dialectic philosophies or individualism-collectivism? *Cognition and Emotion*, *16*(6), 705–719. https://doi.org/10.1080/02699930143000590

Schneider, T. R., Rench, T. A., Lyons, J. B., & Riffle, R. R. (2012). The influence of neuroticism, extraversion and openness on stress responses. *Stress and Health*, *28*(2), 102–110. https://doi.org/10.1002/smi.1409

Shaver, P. R., Morgan, H. J., & Wu, S. (1996). Is love a "basic" emotion? *Personal Relationships*, *3*(1), 81–96. https://doi.org/10.1111/j.1475-6811.1996.tb00105.x

Sim, M., Kim, S.-Y., & Suh, Y. (2021). Sample size requirements for simple and complex mediation models. *Educational and Psychological Measurement*, *82*(1), 76–106. https://doi.org/10.1177/0013164421100 3261

Sutton, S. R., & Eiser, J. R. (1990). The decision to wear a seat belt: The role of cognitive factors, fear and prior behaviour. *Psychology & Health*, *4*(2), 111–123. https://doi.org/10.1080/08870449008408145

Sweeny, K. (2018). On the experience of awaiting uncertain news. *Current Directions in Psychological Science*, *27*(4), 281–285. https://doi.org/10 .1177/0963721417754197

Sweeny, K. (2022a). COVID-19 China survey Feb 2020. https://doi.org/10 .17605/OSF.IO/VUWG3

Sweeny, K. (2022b). Materials. https://doi.org/10.17605/OSF.IO/RNFW9

Sweeny, K., & Howell, J. L. (2017). Bracing later and coping better: Benefits of mindfulness during a stressful waiting period. *Personality and Social Psychology Bulletin*, *43*(10), 1399–1414. https://doi.org/10.1177/ 0146167217713490

Sweeny, K., Howell, J. L., & Kwan, V. W. (2020). Losing control: Comparing the role of personality during two types of stressful life experiences. *Personality and Individual Differences*, *156*, 109771. https://doi .org/10.1016/j.paid.2019.109771

Sweeny, K., Rankin, K., Cheng, X., Hou, L., Long, F., Meng, Y., Azer, L., Zhou, R., & Zhang, W. (2020). Flow in the time of COVID-19: Findings from China. *PLoS ONE*, *15*(11), e0242043. https://doi.org/10.1371/ journal.pone.0242043

The New York Times. (2020, March 16). Tells governors to seek out respirators on their own. https://www.nytimes.com/2020/03/16/world/ coronavirus-news.html

Tiedens, L. Z., & Linton, S. (2001). Judgment under emotional certainty and uncertainty: The effects of specific emotions on information processing. *Journal of Personality and Social Psychology*, *81*(6), 973–988. https://doi.org/10.1037/0022-3514.81.6.973

Wang, K., Goldenberg, A., Dorison, C. A., Miller, J. K., Uusberg, A., Lerner, J. S., Gross, J. J., Agesin, B. B., Bernardo, M., Campos, O., Eudave, L., Grzech, K., Ozery, D. H., Jackson, E. A., Garcia, E. O. L., Drexler, S. M., Jurković, A. P., Rana, K., Wilson, J. P., . . . Moshontz, H. (2021). A multi-country test of brief reappraisal interventions on emotions during the COVID-19 pandemic. *Nature Human Behaviour*, *5*(8), 1089–1110. https://doi.org/10.1038/s41562-021-01173-x

Ware, J. E., Jr. (1999). SF-36 health survey. In M. E. Maruish (Ed.), *The use of psychological testing for treatment planning and outcomes assessment* (pp. 1227–1246). Erlbaum Publishers.

Watkins, E. R. (2008). Constructive and unconstructive repetitive thought. *Psychological Bulletin*, *134*(2), 163–206. https://doi.org/10.1037/0033-2909.134.2.163

Werntz, A. (2022). *COVID-19 & mental health (PIH)*. https://doi.org/10 .17605/OSF.IO/Z9Y6U

Whalley, M., & Kaur, H. (2020). *Living with worry and anxiety amidst global uncertainty*. Psychology Tools Limited.

World Health Organization. (2021a). *China: WHO coronavirus disease (COVID-19) dashboard with vaccination data*. https://covid19.who.int

World Health Organization. (2021b). *WHO coronavirus (COVID-19) dashboard*. https://covid19.who.int

Zeelenberg, M., Nelissen, R. M., Breugelmans, S. M., & Pieters, R. (2008). On emotion specificity in decision making: Why feeling is for doing. *Judgment and Decision Making*, *3*(1), 18–27.

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