

RESEARCH ARTICLE

Co-rumination and intrapersonal cognitive processes predict distress: Longitudinal evidence from the COVID-19 pandemic

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Abstract

Perseverative thinking and catastrophizing have well established associations with fear and distress. However, less is known about the impact of interpersonal dynamics, such as co-rumination, on these intrapersonal cognitive processes and subsequent stress. The present study addresses this knowledge gap. A sample of 433 adults from across the United States was recruited online and completed measures of co-rumination, perseverative thinking, catastrophizing, and demographic characteristics early in the COVID-19 pandemic, and the COVID Stress Scales (CSS) at six month follow up. Co-rumination, perseverative thinking, catastrophizing, and CSS scores were correlated in the expected direction. Regression analyses revealed all three independently predicted CSS worry about the dangerousness of COVID-19 subscale. Co-rumination was the strongest predictor of CSS worry about the socioeconomic impact and CSS compulsive checking scales. Perseverative thinking and catastrophizing predicted CSS traumatic stress symptoms subscale. Finally, perseverative thinking was the strongest predictor of CSS xenophobia subscale. Structural equation modelling indicated that co-rumination had a significant indirect effect on CSS scores through perseverative thinking and catastrophizing. Interpersonal dynamics, such as co-rumination, are relevant for understanding stress and are promising targets for intervention research to prevent or attenuate fears and distress, in addition to traditional intrapersonal cognitive processes such as perseverative thinking and catastrophizing.

KEYWORDS

catastrophizing, co-rumination, COVID-19 pandemic, perseverative thinking, stress

1 | INTRODUCTION

Distress increased worldwide with the onset of the COVID-19 pandemic. Global estimates of anxiety symptomatology increased from 8.9% to 22.6% and from 8.7% to 18.3% for symptoms of depression (Schafer et al., 2022). Within the United States, stress

increased during the pandemic (APA, 2021), and adults were three times more likely to screen positive for depression and/or anxiety disorders in 2020 compared to 2019 (Twenge & Joiner, 2020). These changes are notable as clinicians and researchers anticipate responding to these growing mental health needs with innovative solutions, such as brief interventions and interventions delivered in a

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telehealth format (Gruber et al., 2021). Research underscores the important role that intrapersonal processes, such as perseverative thinking, play in predicting and exacerbating stress as well as poorer psychological, behavioural, and physiological health outcomes (Bailey et al., 2019; Brosschot et al., 2006; Clancy et al., 2016; Ottaviani et al., 2016).

1.1 | Intrapersonal cognitive processes

Perseverative thinking is a state or trait-level cognitive process characterised by repetitive negative thinking (rumination or worry) that is typically intrusive and difficult to control (Brosschot et al., 2006). While the target or content of perseverative thinking varies by person and across time, the process and subsequent negative effects on psychological (e.g., stress) and physiological health (e.g., blood pressure) are consistent (Birk et al., 2019; Ehring et al., 2011; Van Laethem et al., 2016). As such, perseverative thinking is considered a transdiagnostic cognitive process present in a variety of mental health conditions, including: post-traumatic stress disorder, insomnia, depression, generalised anxiety disorder, obsessive-compulsive disorder, eating disorders, and panic disorder (Ehring & Watkins, 2008; Smith et al., 2018; Wahl et al., 2019). Catastrophizing is another intrapersonal cognitive process relevant to stress and mental health.

Catastrophizing or catastrophic thinking is characterised by 'the anticipation without evidence of extreme and terrible consequences or outcomes of an event' (Traeger, 2013). Catastrophic thinking shares features with perseverative thinking, such as rumination, but importantly also encompasses a sense of helplessness and magnification of the severity of the situation or event (Sullivan et al., 1995). Like perseverative thinking, catastrophizing varies by person and across time (e.g., Campbell et al., 2012) and has a negative impact on physical and psychological health. Greater catastrophizing predicts heightened pain intensity in response to laboratory and clinic-based tasks (Sullivan et al., 1995). Catastrophizing also has well documented effects in relation to depression, panic disorder, social anxiety disorder, and post-traumatic stress disorder (Benedict et al., 2020; Chen et al., 2020; Nieto et al., 2020; Ohst & Tuschen-Caffier, 2018). Catastrophizing is positively associated with perseverative thinking (Davey & Levy, 1998; Dash et al., 2020; Schütze et al., 2019), but both independently predict negative physical and mental health outcomes, such as pain, poorer sleep, and anxiety (Barclay & Gregory, 2010; Schütze et al., 2019; Whitfield et al., 2020).

Most physical and mental health research focuses on individual-level processes. This focus on the individual has been fruitful in understanding how these cognitive processes affect emotional state and mental health (e.g., anxiety, fear, distress). However, humans are social beings (Aronson, 2004) that operate within daily social networks. Thus, while the extant research increases our understanding of intrapersonal cognitive processes, we understand less about how interactions with one's social world impact these individual-level processes. Co-rumination is a promising interpersonal dynamic

process to help elucidate the impact of social interactions on stress and mental health.

1.2 | Interpersonal dynamics

Co-rumination is the process of 'excessively discussing personal problems' within a social relationship (Rose, 2002). While co-rumination has been associated with positive relational outcomes, such as feelings of closeness or relationship quality (Calmes & Roberts, 2008; Waller & Rose, 2010; but see Müller et al., 2019 for exception), studies have also shown concurrent and prospective associations with distress (e.g., Hankin et al., 2010; Spindel et al., 2017). In a meta-analysis of 38 studies with a total of 12,829 children, adolescents, and young adults, greater co-rumination was associated with heightened anxiety and depression (Spindel et al., 2017). Experimental induction of co-rumination with dyads of healthy young adult friends showed both the positive relational outcome of enhanced perceived partner responsiveness and the negative outcome of heightened stress, compared to natural conversation (Tudder et al., 2023). In line with socioecological frameworks, which measure determinants of physical and mental health across multiple levels (e.g., intrapersonal, interpersonal, environmental, policy; see Aruta, 2021; Hennein & Lowe, 2020; Hennien et al., 2021 for application to COVID-19), co-rumination can be conceptualised as an interpersonal level determinant that influences individual or intrapersonal processes. Though few studies simultaneously consider co-rumination and intrapersonal cognitive processes, emerging data indicate that perseverative thinking (an intrapersonal process) is one pathway by which co-rumination may contribute to distress, such as depressive symptoms, in adolescents (Bastin et al., 2021; Stone & Gibb, 2015). Importantly, cross-lagged analyses testing directionality between co-rumination and intrapersonal brooding rumination demonstrated that brooding rumination did not predict increases in co-rumination (Bastin et al., 2021). Consideration of both interpersonal dynamics and intrapersonal cognitive processes is necessary to fully acknowledge how relational contexts contribute to individual health and well-being.

1.3 | The COVID-19 pandemic

After first emerging in late 2019, the SARS-CoV-2 virus responsible for COVID-19 was designated a pandemic by the World Health Organization (WHO) on 11 March 2020 (WHO, 2020a), and policies restricting movement, and heightened uncertainty ensued. The pandemic experience has varied by person, with at a minimum, stress experienced due to disruption of normal routines, while others experienced trauma associated with witnessing increased death (e.g., health care workers), risk to the self, or the death of close others (APA, 2020, 2021; Li et al., 2021; Nagarajan et al., 2022). The first years of the COVID-19 pandemic produced research documenting heightened fear, stress, anxiety, depression, and trauma due to the

pandemic (e.g., Alimoradi et al., 2022; Asmundson & Taylor, 2020; Metin et al., 2022). Developed early in the COVID-19 pandemic, the COVID Stress Scales provide a psychometrically strong assessment of five dimensions of stress specific to COVID-19 (e.g., fear regarding economic impact, traumatic stress symptoms; Taylor, Landry, Paluszek, Fergus, et al., 2020). Most research examining fear and stress during the pandemic emphasised models where constructs are observed at only one level (i.e., intrapersonal). However, intrapersonal processes and interpersonal dynamics influence one another as interactions with others impact one's thoughts and feelings. Thus, incorporating measures of intra- and interpersonal variables is necessary to understand how these concurrent processes affect one another to produce potentially negative outcomes. Research examining co-rumination and intrapersonal processes among adolescents typically finds co-rumination predicting intrapersonal processes and having an indirect effect on health through these intrapersonal processes as described above (Bastin et al., 2021; Rose, 2021). Given the collective experience of the COVID-19 pandemic, interpersonal dynamics early in the pandemic likely influenced intrapersonal processes, and together had downstream effects on fear and stress. Research examining these processes would inform innovative and sustainable clinical interventions as clinicians and researchers respond to the growing mental health needs (e.g., Gruber et al., 2021).

1.4 | The present study

The aim of the present study was to test the impact of COVID-19-related co-rumination, perseverative thinking, and catastrophizing on subsequent distress. We hypothesised that greater co-rumination, perseverative thinking, and catastrophizing would predict heightened COVID-19 Stress Scales scores including: (1) COVID-related danger and contamination worry, (2) socioeconomic consequences, (3) compulsive checking and reassurance seeking, (4) traumatic stress symptoms, and (5) xenophobia (Taylor, Landry, Paluszek, Fergus, et al., 2020). Informed by research on co-rumination and perseverative thinking predicting depressive symptoms (Bastin et al., 2021), we tested an exploratory model with direct effects of co-rumination on the five COVID-19 Stress Scales and indirect effects of co-rumination through intrapersonal cognitive processes of perseverative thinking and catastrophizing.

2 | METHOD

2.1 | Sample recruitment and study design

A sample of 1100 participants was recruited online on 19 March 2020, 8 days post-pandemic designation by the World Health Organization, using MTurk. After excluding cases due to duplicate survey response ($n = 13$), failed bot screen (per ReCAPTCHA score; $n = 24$) or missed attention check item ($n = 256$), 807 participants

remained. Of the 517 participants who initiated the six month follow up survey ($M = 186.8$ days, $SD = 6.1$), 455 participants completed and could be matched to their first survey. After removing cases who reported having their responses influenced by others ($n = 2$) or missed attention check ($n = 20$), a final analytic sample of 433 remained. Sensitivity analyses using G*Power 3.1.9.7 (Faul et al., 2007) indicated that for linear multiple regression analyses with $n = 433$, $\alpha = 0.05$, and power = 0.95, we were able to detect small effects ($f^2 = 0.04$).

Qualtrics software (Provo, UT) was used to administer the study consent form and surveys. The Ohio State University approved the study protocol as exempt due to the anonymous survey design (IRB #2020E0285, #2020E0949). Study measures, deidentified data, syntax, and output are available on Open Science Framework (https://osf.io/t25hf/?view_only=91289-d10aeb44fd4aae631a06dfcd115). The data reported in the present manuscript are part of a larger study predicting behavioural and psychological reactions to the COVID-19 pandemic. Demographic characteristics for the sample have been previously reported (Kowalsky et al., 2023); all other variables reported in the present manuscript have not been previously published.

2.2 | Measures

Participants completed a self-report survey assessing demographic characteristics (age, gender, race, education, income), co-rumination (Rose, 2002), and intrapersonal cognitive processes (perseverative thinking and catastrophizing; Ehring et al., 2011; Sinclair & LoCicero, 2007). COVID-19 related fears and distress (Taylor, Landry, Paluszek, Fergus, et al., 2020) were assessed using self-report at six month follow-up. Items, scale reliability, and factor loadings are available in Supporting Information S1.

2.3 | Co-rumination

Co-rumination was measured using the re-hashing scale from the Co-Rumination Questionnaire (Davidson et al., 2014; Rose, 2002). The 15-item, 5-point Likert-type re-hashing scale has excellent reliability (original $\alpha = 0.94$; present study $\alpha = 0.97$) and validity has been supported by associations in the expected directions with more re-hashing associated with greater intrapersonal rumination, depression, and worry (Davidson et al., 2014; Rose, 2002; Starr, 2015). A subscale approach to assessing co-rumination over the total score has been advocated for by Davidson et al. (2014) and the re-hashing subscale was specifically selected due to it having the strongest association with intrapersonal factors compared to the other subscales (i.e., encouraging problem talk and mulling). For the present study, the scale instructions and items were tailored for COVID-19 such that 'the problem' was replaced with 'COVID-19' (e.g., 'We try to figure out every one of the bad things that might happen because of COVID-19', 1 = not at all true, 5 = really true).

2.4 | Perseverative thinking

Perseverative thinking was assessed using the Perseverative Thinking Questionnaire (PTQ; Ehring et al., 2011), a 15-item (e.g., 'The same thoughts keep going through my mind again and again.') five-point Likert-type (0 = never, 4 = almost always) measure with strong reliability (original $\alpha = 0.94$ – 0.95 ; current study $\alpha = 0.97$). Measure validity has been supported based on associations with measures of worry, anxiety, depression, and a brooding response style, in the expected directions, among both clinical and non-clinical samples (Ehring et al., 2011). The PTQ assesses repetitive and intrusive thinking in response to negative events in general, and for the present study, the instructions were adapted such that COVID-19 was the target negative event (e.g., '...how you typically think about COVID-19').

2.5 | Catastrophizing

Given the unpredictability and potential mortality at the onset COVID-19 pandemic, catastrophizing was measured using an adapted Terrorism Catastrophizing Scale (Sinclair & LoCicero, 2007). The instructions and items were modified to reflect COVID-19, instead of terrorism, and consisted of 13 Likert-type items with 5-point scaling (range 0–4). Due to copyright restrictions, example items cannot be provided here, but the full scale is available in Sinclair and LoCicero (2007). A limited licence was purchased to use the scale within the present study (Copyright Clearance Centre #5150311466147). Good to excellent internal consistency and test-retest reliability have been documented with the original scale psychometrics (Sinclair & LoCicero, 2007). Validity has been supported with significant associations in the expected directions with self-esteem, social connection, anxiety, stress, and depression (Sinclair & LoCicero, 2007). Consistent with the original scale, the adapted catastrophizing measure demonstrated excellent reliability in the current sample ($\alpha = 0.91$).

2.6 | COVID-19 fears and distress

COVID-19 fears and distress were assessed using the COVID Stress Scales (Taylor, Landry, Paluszek, Fergus, et al., 2020). This 36-item, 5-point Likert-type measure consists of five scales reflecting worry about the dangerousness of COVID-19 and contamination (e.g., 'I am worried that people around me will infect me with the virus' 0 = not at all, 4 = extremely), worry about the socioeconomic impact of COVID-19 (e.g., 'I am worried about grocery stores running out of food' 0 = not at all, 4 = extremely), COVID-19 related compulsive checking and reassurance seeking behaviours (e.g., 'How much have you checked the following because of concerns about COVID-19?' 'Checking your own body for signs of infection' 0 = never, 4 = almost always), COVID-19 related traumatic stress symptoms (e.g., 'Reminders of the virus caused me to have physical reactions, such as sweating or a pounding heart' 0 = never, 4 = almost always), and

COVID-19 related xenophobia (e.g., 'I am worried that foreigners are spreading the virus in my country' 0 = not at all, 4 = extremely). The scales have demonstrated strong reliability (original $\alpha = 0.83$ – 0.95 ; present study $\alpha = 0.87$ – 0.94), and convergent validity with associations in the expected direction with general trait-based measures reflecting the obsessive-compulsive checking, contamination concerns, and health anxiety (Taylor, Landry, Paluszek, Fergus, et al., 2020). Strong model fit using a five-factor structure and excellent reliability of the COVID Stress Scales has been documented within both clinical and non-clinical samples (Asmundson et al., 2022; Taylor, Landry, Paluszek, Fergus, et al., 2020).

2.7 | Statistical analysis

Descriptive statistics, scale reliability (Cronbach's alpha), Spearman's correlations, and hierarchical linear regressions were calculated using IBM SPSS Statistics version 27 (IBM Corp.). One person self-described their race as 'Caucasian/European American' and was recoded as White for the analyses. Selections of prefer not to answer for income and education were recoded as missing, and age was missing for one person. A series of hierarchical linear regression analyses predicted each of the five COVID Stress Scales scores. Due to documented variation in distress experienced during the pandemic by demographic characteristics (APA, 2021; Metin et al., 2022), age, gender, race, income, and education were entered as covariates in step 1. Next, rumination was entered into step 2, followed by perseverative thinking and catastrophizing (steps 3 and 4, respectively).

Because of the skewed distribution of the variables, partial least squares structural equation modelling was conducted using WarpPLS 7.0 (Hair et al., 2011; Kock, 2021). Recommended standards were followed (i.e., data were standardized, Stable3 estimation method computed model parameters and standard errors, stochastic hierarchical regression imputed missing data; Kock, 2021). WarpPLS provides multiple indicators of model quality and fit. The model's explanatory power is reported using the Tenenhaus goodness-of-fit index (GoF; < 0.1 indicates insufficient explanatory power, $0.1 =$ small effect, $0.25 =$ medium effect, $0.36 =$ large effect; Kock, 2021). The average path coefficient (APC), average R-squared (ARS), and average adjusted R-squared (AARS) average the model parameters and are indicators of model fit. APC uses absolute values for the path coefficients, while AARS adjusts for spurious increases in R-squared coefficients due to unnecessary predictors (Kock, 2021). p -values for these indicators are computed through resampling estimations with a Bonferonni-type correction (Kock, 2021). Ideal model fit is supported when all three indicators have p -values ≤ 0.05 . Average block variance inflation factor (AVIF) and average full collinearity VIF (AFVIF) assess multicollinearity among latent constructs, with values ideally ≤ 3.3 , while values ≤ 5.0 are considered acceptable. Finally, remaining model fit statistics test for potential causality concerns. Simpson's paradox ratio (SPR) and the statistical suppression ratio (SSR) test if a hypothesised path within the model is implausible or reversed. The nonlinear bivariate causality direction

ratio (NLBCDR) provides partial evidence for possible causal paths and support for the direction of effects within the model. For SPR, SSR, and NLBCDR, values equal to 1 are ideal; however, values ≥ 0.7 are acceptable (Kock, 2021). To test for overlap in predictor and outcome variables, normalised pattern loadings and cross-loadings using oblique rotation and Kaiser normalisation were examined within WarpPLS (Kock, 2021).

3 | RESULTS

3.1 | Sample characteristics

The sample was on average 42.9 years old (SD = 12.9, range 18–74). As detailed in Table 1, the majority of the sample identified as White females, had completed an Associate's degree or higher, and had an annual income of greater than \$50,000.

3.2 | Correlations among demographic characteristics, interpersonal dynamics, intrapersonal processes, and COVID Stress Scales

Moderate to strong significant associations in the expected direction were present such that greater co-rumination, more perseverative thinking, greater catastrophizing, and higher scores on the five COVID Stress Scales were all positively correlated (Table 2). Although these constructs were correlated, the normalised pattern loadings and cross-loadings indicated that they reflect distinct factors (e.g., items for perseverative thinking and COVID-related danger and contamination worry did not load on the same factor; Supporting Information S1). However, one item from the catastrophizing scale loaded strongly on CSS-Danger; analyses were re-run without that item and the pattern of results were not changed (Supporting Information S2). Demographic characteristics were weakly correlated with interpersonal dynamics, intrapersonal processes, and the five COVID Stress Scales (Table 2).

3.3 | Predicting COVID stress scales scores at 6 month follow up

Hierarchical linear regression analyses, controlling for demographic characteristics (step 1), were conducted using co-rumination (step 2), perseverative thinking (step 3), and catastrophizing (step 4) to predict COVID Stress Scales scores at 6 month follow up (see Table 3). Tests of collinearity were acceptable (Tolerance ≥ 0.438 , VIF ≤ 2.284).

3.4 | Demographic characteristics

Demographic characteristics, entered in step 1 of the regression, significantly predicted COVID Stress Scales scores, except for worry

TABLE 1 Sample demographic characteristics ($n = 433$).

Variable	M (SD) or n (%)
Age ^a	42.9 (12.9)
Gender	
Female	233 (53.8%)
Male	194 (44.8%)
Non-Binary	3 (0.7%)
Prefer not to answer	3 (0.7%)
Race	
Asian	23 (5.3%)
Black or African	33 (7.6%)
American	
White	361 (83.4%)
Other ^b	16 (3.7%)
Education	
Less than high School	3 (0.7%)
High School diploma	37 (8.5%)
Some college	76 (17.6%)
Technical degree or certification	21 (4.8%)
College graduate (Associate or Bachelor degree)	234 (54.0%)
Graduate degree	60 (13.9%)
Prefer not to answer	2 (0.5%)
Income	
\$10,000 or less	22 (5.1%)
\$10,001 - \$20,000	39 (9.0%)
\$20,001 - \$35,000	56 (12.9%)
\$35,001 - \$50,000	82 (18.9%)
\$50,001 - \$100,000	163 (37.6%)
\$100,001 - \$150,000	48 (11.1%)
\$150,001 or more	18 (4.2%)
Prefer not to answer	5 (1.2%)

^a $n = 432$.

^bIncludes American Indian/Alaska Native, Native Hawaiian or Other Pacific Islander, more than one race, prefer to self-describe, prefer not to answer.

about the socioeconomic impact of COVID-19, which was marginally significant ($p = 0.055$). Younger age predicted greater symptoms of COVID-19 related traumatic stress as well as compulsive checking and reassurance seeking. Females reported greater worry about the dangerousness of COVID-19 and contamination concerns, higher worry about the socioeconomic impact of COVID-19, and more symptoms of COVID-19 related traumatic stress symptoms compared to males. People of Colour reported higher scores on all COVID Stress Scales, except for worry about the socioeconomic impact compared to White participants. More education predicted

TABLE 2 Spearman correlations and descriptive statistics for interpersonal dynamics, intrapersonal processes, COVID stress, and demographic characteristics ($n = 427\text{--}433$).

Variable	M	SD	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1. Co-rumination	2.57	1.0	0.54***	0.57***	0.36***	0.36***	0.34***	0.50***	0.26***	-0.18***	0.11*	0.18***
2. PTQ	1.33	1.0	-	0.71***	0.44***	0.31***	0.53***	0.37***	0.30***	-0.18***	0.17***	0.05
3. Catastrophizing	2.65	0.8	-	-	0.49***	0.35***	0.45***	0.38***	0.27***	-0.11*	0.14**	0.08
4. CSS-danger	1.38	0.9	-	-	-	0.52***	0.63***	0.50***	0.48***	-0.05	0.03	-0.05
5. CSS-socioeconomic	0.82	1.0	-	-	-	-	0.45***	0.44***	0.37***	-0.03	-0.04	-0.03
6. CSS-trauma	0.57	0.8	-	-	-	-	-	0.55***	0.33***	-0.16**	0.08	-0.003
7. CSS-checking	0.90	0.8	-	-	-	-	-	-	0.36***	-0.23***	0.10*	0.002
8. CSS-xenophobia	0.67	0.9	-	-	-	-	-	-	-	0.05	0.07	-0.02
9. Age			-	-	-	-	-	-	-	-	-0.01	-0.04
10. Education			-	-	-	-	-	-	-	-	-	0.35***
11. Income			-	-	-	-	-	-	-	-	-	-

Abbreviations: CSS, COVID Stress Scales; PTQ, Perseverative Thinking Questionnaire.

** $p < 0.05$. *** $p < 0.001$.

greater scores on COVID-19 related traumatic stress symptoms as well as compulsive checking and reassurance seeking. Finally, greater income predicted fewer symptoms of traumatic stress associated with COVID-19.

3.5 | Co-rumination predicting COVID Stress Scales scores

The addition of co-rumination significantly improved all models and accounted for 8%–20% additional variance in COVID Stress Scales scores indicating that co-rumination predicts a significant amount of the variability in COVID Stress Scale scores above and beyond demographic characteristics. Greater engagement in co-rumination with family and close friends related to the COVID-19 pandemic predicted more worry about the dangerousness of COVID and contamination concerns, greater worry about the socioeconomic impact, more traumatic stress symptoms, heightened compulsive checking and reassurance seeking, and higher scores on COVID-19 related xenophobia. Next, intrapersonal processes were added to the models, beginning with perseverative thinking.

3.6 | Perseverative thinking predicting COVID Stress Scales scores

The addition of perseverative thinking significantly improved most models, accounting for an additional 1%–12% of variability in COVID Stress Scales scores, with one exception (compulsive checking and reassurance seeking behaviours). In line with co-rumination, greater perseverative thinking about COVID-19 predicted more worry about the dangerousness of COVID and contamination concerns, greater worry about the socioeconomic impact of COVID, more traumatic

stress symptoms, and higher scores on COVID-19 related xenophobia. Importantly, co-rumination remained significant across all models suggesting it holds unique predictability independent of perseverative thinking.

3.7 | Catastrophizing predicting COVID stress scales scores

Catastrophic thinking about COVID-19 was added in the final step of the models, and significantly improved the prediction of worry about the dangerousness of COVID, worry about the socioeconomic impact, and traumatic stress symptoms, accounting for an additional 4%, 1%, and 2% of the variance, respectively. Not surprisingly, greater catastrophic thinking predicted heightened worry about the dangerousness of COVID, greater worry about the socioeconomic impact of COVID, and more severe traumatic stress symptoms.

3.8 | Patterns across prediction of COVID Stress Scales scores

Interestingly, across the final models, co-rumination, perseverative thinking, and catastrophizing were each significant, independent predictors of worry about the dangerousness of COVID. In contrast, co-rumination, and to a lesser extent catastrophizing, predicted worry about the socioeconomic impact, while co-rumination alone was a significant predictor of compulsive checking and reassurance seeking. Intrapersonal processes (perseverative thinking and catastrophizing) alone predicted traumatic stress symptoms. Finally, it was co-rumination and perseverative thinking that predicted COVID-19 related xenophobia. Because hierarchical linear regression analyses test direct effects, partial least squares structural equation

TABLE 3 Hierarchical linear regression analyses predicting COVID stress with interpersonal dynamics and intrapersonal processes, controlling for demographic characteristics, with model change statistics (n = 423).

	CSS-danger			CSS-socioeconomic			CSS-trauma			CSS-checking			CSS-xenophobia		
	B	SE	β	B	SE	β	B	SE	β	B	SE	β	B	SE	β
Step 1	$\Delta F = 4.6^{***}, \Delta R^2 = .05$			$\Delta F = 2.2, \Delta R^2 = .03$			$\Delta F = 7.5^{***}, \Delta R^2 = .08$			$\Delta F = 7.6^{***}, \Delta R^2 = .08$			$\Delta F = 2.9^*, \Delta R^2 = .03$		
Age	-0.00	0.00	-0.05	-0.00	0.00	-0.05	-0.01	0.00	-0.19^{***}	-0.02	0.00	-0.24^{***}	0.00	0.00	0.04
Gender ^a	-0.35	0.09	-0.19^{***}	-0.23	0.09	-0.12*	-0.20	0.07	-0.13**	-0.06	0.08	-0.04	0.14	0.09	0.08
Race ^b	-0.28	0.12	-0.11*	-0.19	0.13	-0.07	-0.26	0.10	-0.12*	-0.25	0.11	-0.11*	-0.35	0.12	-0.14**
Education	0.03	0.04	0.04	-0.01	0.04	-0.02	0.08	0.03	0.12*	0.07	0.03	0.10*	0.05	0.04	0.07
Income	-0.05	0.03	-0.08	-0.05	0.03	-0.07	-0.06	0.03	-0.10*	-0.02	0.03	-0.04	-0.05	0.03	-0.08
Step 2	$\Delta F = 78.2^{***}, \Delta R^2 = .15$			$\Delta F = 88.3^{***}, \Delta R^2 = .17$			$\Delta F = 53.4^{***}, \Delta R^2 = .10$			$\Delta F = 113.8^{***}, \Delta R^2 = .20$			$\Delta F = 36.4^{***}, \Delta R^2 = .08$		
Age	0.00	0.00	0.02	0.00	0.00	0.02	-0.01	0.00	-0.13**	-0.01	0.00	-0.16^{***}	0.01	0.00	0.09
Gender ^a	-0.33	0.08	-0.18^{***}	-0.21	0.09	-0.11*	-0.18	0.07	-0.12**	-0.04	0.07	-0.02	0.16	0.09	0.08
Race ^b	-0.24	0.11	-0.09*	-0.14	0.12	-0.05	-0.23	0.10	-0.11*	-0.21	0.09	-0.09*	-0.32	0.12	-0.13**
Education	0.02	0.04	0.03	-0.03	0.04	-0.04	0.07	0.03	0.11*	0.05	0.03	0.08	0.05	0.04	0.06
Income	-0.09	0.03	-0.14**	-0.09	0.03	-0.13**	-0.08	0.03	-0.15**	-0.06	0.03	-0.11*	-0.08	0.03	-0.12*
Co-rumination	0.36	0.04	0.40^{***}	0.39	0.04	0.43^{***}	0.25	0.03	0.33^{***}	0.36	0.03	0.46^{***}	0.26	0.04	0.29^{***}
Step 3	$\Delta F = 41.9^{***}, \Delta R^2 = .07$			$\Delta F = 6.7^*, \Delta R^2 = .01$			$\Delta F = 70.0^{***}, \Delta R^2 = .12$			$\Delta F = 3.4, \Delta R^2 = .01$			$\Delta F = 14.9^{***}, \Delta R^2 = .03$		
Age	0.00	0.00	0.06	0.00	0.00	0.04	-0.01	0.00	-0.09*	-0.01	0.00	-0.15**	0.01	0.00	0.11*
Gender ^a	-0.27	0.08	-0.14**	-0.18	0.09	-0.09*	-0.12	0.07	-0.08	-0.02	0.07	-0.01	0.19	0.09	0.10*
Race ^b	-0.24	0.11	-0.10*	-0.14	0.12	-0.05	-0.23	0.09	-0.11**	-0.21	0.09	-0.09*	-0.32	0.12	-0.13**
Education	-0.02	0.03	-0.02	-0.04	0.04	-0.06	0.03	0.03	0.05	0.04	0.03	0.07	0.02	0.04	0.03
Income	-0.07	0.03	-0.10*	-0.08	0.03	-0.12*	-0.06	0.02	-0.11*	-0.06	0.03	-0.10*	-0.06	0.03	-0.09
Co-rumination	0.20	0.05	0.22^{***}	0.33	0.05	0.35^{***}	0.08	0.04	0.11*	0.32	0.04	0.41^{***}	0.15	0.05	0.17**
PTQ	0.32	0.05	0.33^{***}	0.14	0.05	0.14*	0.34	0.04	0.42^{***}	0.08	0.04	0.09	0.21	0.05	0.22^{***}
Step 4	$\Delta F = 24.6^{***}, \Delta R^2 = .04$			$\Delta F = 4.2^*, \Delta R^2 = .01$			$\Delta F = 9.4^{**}, \Delta R^2 = .02$			$\Delta F = 1.4, \Delta R^2 < .001$			$\Delta F = 0.2, \Delta R^2 < .001$		
Age	0.00	0.00	0.04	0.00	0.00	0.03	-0.01	0.00	-0.10*	-0.01	0.00	-0.15**	0.01	0.00	0.11*
Gender ^a	-0.24	0.08	-0.13**	-0.17	0.09	-0.09*	-0.11	0.07	-0.07	-0.02	0.07	-0.01	0.20	0.09	0.11*
Race ^b	-0.24	0.10	-0.10*	-0.14	0.12	-0.05	-0.23	0.09	-0.11**	-0.21	0.09	-0.09*	-0.32	0.12	-0.13**

(Continues)

TABLE 3 (Continued)

	CSS-danger			CSS-socioeconomic			CSS-trauma			CSS-checking			CSS-xenophobia		
	B	SE	β	B	SE	β	B	SE	β	B	SE	β	B	SE	β
Education	-0.02	0.03	-0.03	-0.05	0.04	-0.06	0.03	0.03	0.04	0.04	0.03	0.06	0.02	0.04	0.03
Income	-0.07	0.03	-0.10*	-0.08	0.03	-0.12*	-0.06	0.02	-0.11*	-0.06	0.03	-0.10*	-0.06	0.03	-0.09
Co-rumination	0.13	0.05	0.15**	0.30	0.05	0.32***	0.05	0.04	0.06	0.31	0.04	0.39***	0.15	0.05	0.17**
PTQ	0.15	0.06	0.16*	0.06	0.07	0.06	0.25	0.05	0.31***	0.04	0.05	0.05	0.19	0.07	0.20**
Catastrophizing	0.35	0.07	0.30***	0.16	0.08	0.13*	0.18	0.06	0.19**	0.08	0.06	0.07	0.01	0.08	0.01

Abbreviations: CSS, COVID Stress Scales; PTQ, perseverative thinking questionnaire.

^aGender is coded 1 = female, 2 = male.

^bRace is coded 1 = Person of Colour, 2 = White.

* $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$.

modelling was used to test the indirect effects of co-rumination on COVID Stress Scales scores.

3.9 | Model evaluation

Informed by existing research demonstrating co-rumination having a direct effect on depression, and indirect effect on depression through intrapersonal processes (i.e., brooding rumination; Bastin et al., 2021), we tested direct effects of co-rumination on the five COVID Stress Scales, and indirect effects through intrapersonal factors of perseverative thinking and catastrophizing (Figure 1). Because the COVID Stress Scales reflect a broader syndrome, they were examined simultaneously (Taylor, Landry, Paluszek, Rachor, et al., 2020). The model met criteria for acceptable to ideal model fit (Tenenhaus GoF = 0.461; APC = 0.123, $p = 0.002$; ARS = 0.265, $p < 0.001$; AARS = 0.253, $p < 0.001$; AVIF = 1.291; AFVIF = 1.755, SPR = 0.895, SSR = 0.930; RSCR = 0.993; and NLBCDR = 0.886). While most direct effects were significant, notable paths with a medium effect size included: (1) co-rumination with a direct effect on perseverative thinking and catastrophizing; (2) co-rumination with a direct effect on checking and reassurance seeking; (3) perseverative thinking with a direct effect on traumatic stress symptoms; and (4) catastrophizing with a direct effect on worry about the dangerousness of COVID and contamination concerns. Significant indirect effects were present for co-rumination on all five COVID Stress Scales through perseverative thinking and catastrophizing (all $ps < 0.05$), with small effect sizes (ES = 0.04 - 0.10). All direct and indirect path coefficients with standard errors, effect sizes, and p -values are available in Supporting Information S3. Given that there is likely a reciprocal association between interpersonal and intrapersonal factors, the model was re-run with perseverative thinking and catastrophizing having (1) direct effects on co-rumination and (2) indirect effects on COVID Stress Scales through co-rumination. While model fit was acceptable, indicators of model fit and multicollinearity were poorer for this alternate model Supporting Information S3.

4 | DISCUSSION

The current study examined the roles of clinically relevant interpersonal dynamics and intrapersonal cognitive processes in the prediction of subsequent COVID Stress Scales scores (reflecting COVID-19 related danger and contamination, socioeconomic consequences, compulsive checking, traumatic stress symptoms, and xenophobia; Taylor, Landry, Paluszek, Fergus, et al., 2020). As expected, interpersonal dynamics, intrapersonal cognitive processes, and subsequent fears and distress were moderately to strongly positively correlated. Despite being intercorrelated, interpersonal dynamics and intrapersonal cognitive processes were each independent predictors of different facets of COVID-19-related fears and distress. This highlights the importance of considering both

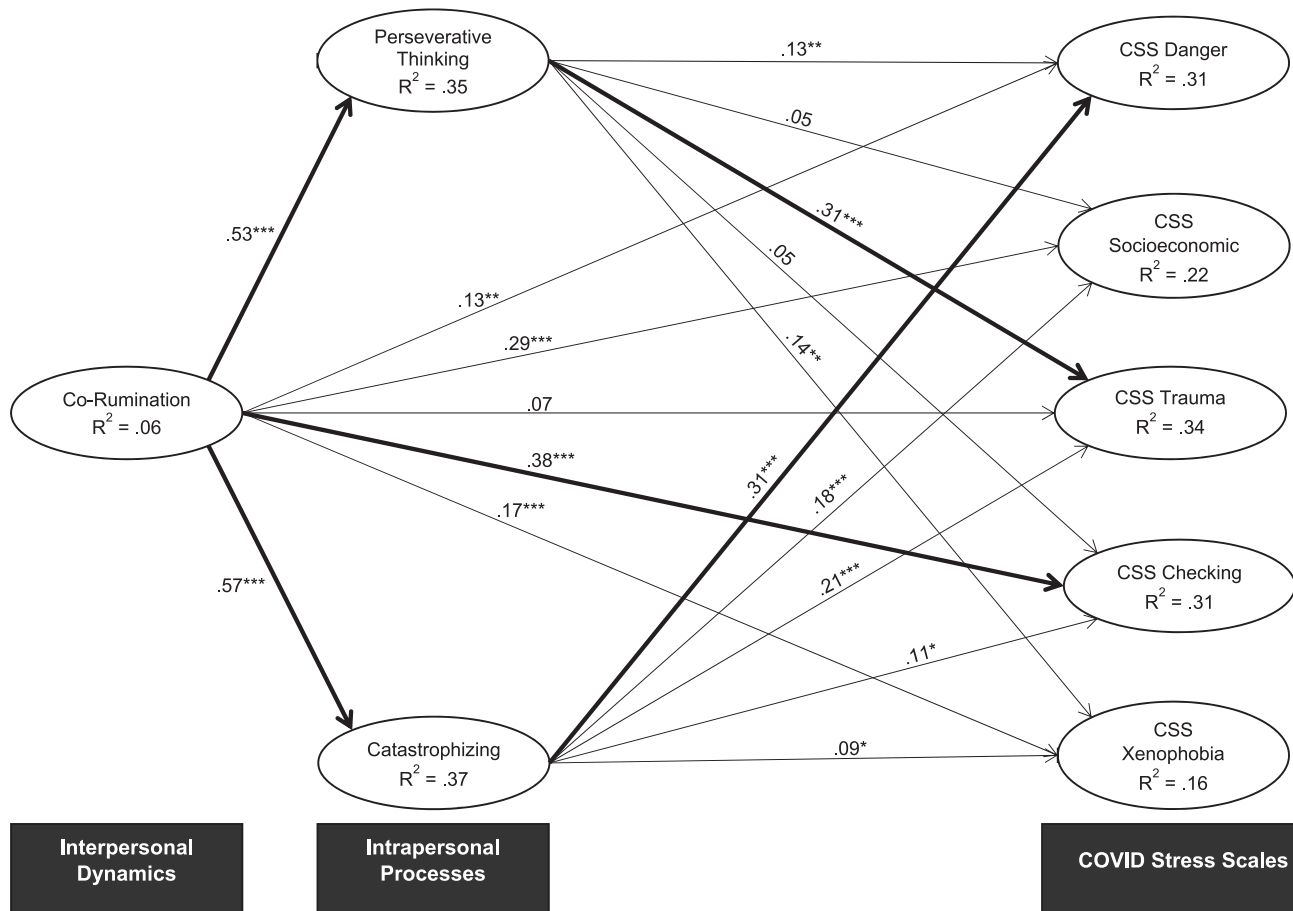


FIGURE 1 Path analysis of interpersonal dynamics and intrapersonal processes predicting subsequent COVID Stress Scales scores, controlling for age, gender, race, education and income. Heavier weight paths reflect medium effect sizes. CSS, COVID stress scales. $*p < 0.05$. $**p < 0.01$. $***p < 0.001$.

intrapersonal *and* interpersonal processes within stress and health research. In line with socioecological models which highlight the need to consider multiple levels of determinants of health, this study also showed that intrapersonal cognitive processes (perseverative thinking and catastrophizing) served as pathways by which co-rumination, an interpersonal process, contributed to subsequent COVID-19 related fears and distress.

4.1 | Intrapersonal cognitive processes and COVID Stress Scales scores

Perseverative thinking about COVID-19 early in the pandemic was the strongest predictor of traumatic stress symptoms and xenophobia six months later. The deleterious impact of perseverative or repetitive negative thinking on traumatic stress symptoms documented in the present study is consistent with research following natural disasters and meta-analyses. During 2010 in Chile, nearly 2 million people experienced loss of or substantial damage to housing due to a high magnitude earthquake and subsequent tsunami (Garcia et al., 2015). Rumination and brooding related to the natural disaster

mediated the relationship between perceived severity of the disaster and posttraumatic stress symptoms, highlighting the key role of these perseverative cognitive processes on traumatic stress symptoms (Garcia et al., 2015). A meta-analytic review of 64 studies found a moderate relationship between greater rumination and heightened symptoms of post-traumatic stress across a range of traumatic experiences, such as loss, assault, and traffic accidents (Szabo et al., 2017). In addition to predicting traumatic stress symptoms, perseverative thinking was also a significant predictor of COVID-19 related xenophobia in the present study.

The association between perseverative or repetitive negative thinking and being the target of discrimination is well documented (Brownlow et al., 2019); however, limited research has examined the association between perseverative thinking and xenophobic attitudes. Nevertheless, our findings are consistent with literature documenting a relationship among disease epidemic occurrence and a rise in xenophobia (e.g., Silva et al., 2022). With regard to COVID-19, perceived threat (She et al., 2022), worry about the virus (Reny & Barreto, 2022), and actively seeking or avoiding information about the virus (Lambe et al., 2021) have all been associated with xenophobia, particularly directed at Asian populations. She et al. (2022)

also found that negative emotions were a pathway by which the perceived threat of COVID-19 was related to xenophobia towards people in Wuhan. Similar to the conceptualisation of negative emotions as an avoidance reaction to disease risk, as proposed by She et al. (2022), perseverative thinking may be an avoidance-based cognitive reaction in response to disease risk (Faulkner et al., 2004) or negative emotions (Ehring et al., 2011) that engenders or maintains xenophobic attitudes. Taken together, future research should incorporate perseverative thinking to prevent or attenuate traumatic stress symptoms and to aid in understanding and reducing xenophobia.

Catastrophizing about COVID-19, the second intrapersonal cognitive process assessed in the present study, was the strongest predictor of worry about the dangerousness of COVID-19 and contamination six months later. Although limited research has examined the impact of catastrophizing about the COVID-19 pandemic or possible symptoms of COVID-19 on subsequent distress, a similar pattern has been documented cross-sectionally with greater catastrophizing associated with more depressive symptoms, heightened symptoms of anxiety, greater contamination fear, and poorer subjective sleep quality (Labadi et al., 2022; Zsido et al., 2022). Additionally, the present study adds support to the distinct nature of perseverative thinking and catastrophizing. Thus, catastrophizing warrants consideration in research examining intrapersonal cognitive processes and health outcomes and, in the context of distress related to pandemics, should be considered as an intervention target.

4.2 | Interpersonal dynamics and COVID stress scales scores

Co-rumination was the key predictor of subsequent COVID stress related to (1) socioeconomic consequences and (2) compulsive checking and reassurance seeking. This is consistent with emerging data linking greater COVID-19 related co-rumination with perceived financial risk, COVID-19 fears, and mental health concerns (e.g., depressive symptoms; Starr et al., 2021; Zhou et al., 2020). Considering the present study, the content of these two COVID Stress Scales is especially salient in a relational context. The socioeconomic consequences scale captured worry that grocery stores may close or not have enough important supplies (e.g., prescription medication, water, food; Taylor, Landry, Paluszek, Fergus, et al., 2020). People may have reached out to others in their support network to process the likelihood or actuality of these concerns in their geographic area. In addition, several of the items related to compulsive checking and reassurance seeking embody direct or indirect action that involves other people, including health professionals, friends or family, and social media (Taylor, Landry, Paluszek, Fergus, et al., 2020). The evidence in the present study for co-rumination predicting downstream reassurance seeking, is consistent with Tudder et al., 2023 finding that co-rumination elicited responsive behaviours from partners. In contrast to the socioeconomic consequences and compulsive

checking and reassurance seeking scales, other COVID Stress Scales (i.e., COVID danger and contamination, traumatic stress symptoms) reflect worry, distress, or fear that may not emerge in conversations with one's support network as a result of social desirability. That said, understanding the ways in which intrapersonal cognitive processes and interpersonal dynamics differentially relate to stress and mental health concerns warrants further investigation.

4.3 | Intrapersonal cognitive processes as pathways linking co-rumination and distress

When assessed in a comprehensive model, indirect effects were present for co-rumination impacting subsequent distress through perseverative thinking and catastrophizing. Existing data have shown that intrapersonal rumination is a pathway by which co-rumination contributes to depressive symptoms among adolescents (Bastin et al., 2021; Stone & Gibb, 2015). The current study extends this work by demonstrating that this pathway is relevant for fear and distress among adults. In addition, the present study provides some support for a potential cyclical pattern between co-rumination and stress. Co-rumination may increase intrapersonal stress, leading the individual to seek short term comfort through social interactions (such as reassurance seeking and the responsive behaviours documented by Tudder et al., 2023). Those interactions may include co-rumination, which could subsequently exacerbate stress. Finally, this study documents the role that intrapersonal catastrophizing plays in the association between co-rumination and distress. Given the direct and indirect downstream effects on distress, these data underscore the importance of co-rumination as a target of intervention.

4.4 | Intervention opportunities

A rise in stress and mental health needs are critical consequences of the COVID-19 pandemic (APA, 2021; Schafer et al., 2022; Twenge & Joiner, 2020). Scholars, clinicians, and our health care systems need to be responsive to the increased mental health demands, and implement novel solutions, such as brief and/or telehealth clinical interventions (Gruber et al., 2021). Our data suggest the interpersonal and intrapersonal constructs outlined in the current study are relevant to consider when developing or adapting such interventions. While addressing perseverative thinking has been shown to be beneficial in brief (e.g., Ruiz et al., 2020) and telehealth (e.g., Joubert et al., 2021) formats, application of a socioecological framework encourages us to consider constructs at broader levels for intervention (e.g., Aruta, 2021; Hennein & Lowe, 2020; Hennien et al., 2021). These data, in addition to literature on the mental health effects of co-rumination (Hankin et al., 2010; Spindel et al., 2017), suggest that targeting co-rumination within clinical interventions could be a fruitful way to affect interpersonal dynamics, intrapersonal processes and stress. Couples and group counselling may be clinical formats in which co-rumination could be clearly observed and addressed;

however, interpersonal processes can be explored and processed in individual therapy (e.g., interpersonal therapies) as well as other formats more conducive to large groups (e.g., prevention programs, psychoeducation workshops).

4.5 | Strengths, limitations, and future directions

Strengths of the study include a longitudinal assessment over six months at critical moments of the COVID-19 pandemic using psychometrically strong measures, and inclusion of constructs at both the intrapersonal and interpersonal levels. That co-rumination and intrapersonal cognitive processes predict distress 6 months later underscores the strength of the relationship between these constructs and distress. Another key strength of the present study is the evaluation of co-rumination among an adult sample. While most research has employed child or adolescent samples (Rose, 2021), the present study highlights that co-rumination is relevant in understanding intrapersonal processes and distress among adults.

Study results should be considered within the context of limitations; these areas also highlight potential future research directions. Co-rumination and intrapersonal cognitive processes were captured at the same study period and causal conclusions cannot be made. The ideal study to identify causal effects would involve repeated assessment over three or more timepoints, which would allow for latent variable panel analyses (Little et al., 2007). Longitudinal data with adolescents have supported the directional relationship tested in the current study between co-rumination and intrapersonal cognitive processes (Bastin et al., 2021; Felton et al., 2019; Stone et al., 2015; see Jose et al., 2012 for an exception). Additional studies conducted with adult populations are needed. Further, a more frequent assessment of interpersonal dynamics and intrapersonal cognitive processes (e.g., through ecological momentary assessment), along with the inclusion of ambulatory physiological data (e.g., Tudder et al., 2023), would offer greater insight into dynamic changes across time and opportunities for interventions. Attrition is a challenge for longitudinal data collection, and the present study saw 53% attrition between survey periods, and the final analytic sample was 39% of the originally recruited sample, potentially biasing the results. This level of attrition is consistent with early pandemic survey research (e.g., 74.6% attrition with a 2 months follow up; Kowalski & Black, 2021). Online recruitment was conducted using MTurk. Concerns related to MTurk include participant inattention, high attrition, and vulnerability to bots (Aguinis et al., 2021). The present study sought to mitigate inattention concerns by including attention checks and bot concerns by including a reCAPTCHA bot screen available within the survey software.

For the co-rumination scale, the current study asked participants to reflect on experiences in conversations about COVID-19 with family and friends. This is consistent with other studies examining COVID-19 co-rumination in that participants have not been asked to reflect on specific relationships (Starr et al., 2021; Zhou et al., 2020). However, data suggest that characteristics of the relationship may be

important in the co-rumination process (Rose, 2021), and future studies may want to consider this when assessing co-rumination. The present study assessed co-rumination using the re-hashing subscale alone. Future studies should consider incorporating the remaining two subscales (i.e., encouraging problem talk and mulling) to evaluate the impact of these different facets of co-rumination on intrapersonal processes and subsequent distress. Finally, while the current study captured the interpersonal and intrapersonal levels of the socioecological framework, studies which also include environmental-, societal-, and policy-level factors better reflect the many ways in which communities and people experience fear, distress, and well-being during the context of a pandemic (see Aruta, 2021; Hennein & Lowe, 2020; Hennien et al., 2021). For example, in addition to intrapersonal (e.g., pre-existing mental health diagnosis) and interpersonal (i.e., social support needs) factors, team cohesion, hospital policies, media stigma, healthcare worker stigma, and satisfaction with national government response to COVID-19 were associated with mental health outcomes in a sample of healthcare workers in the United States (Hennien et al., 2021). Studies which incorporate all levels of the socioecological framework will better inform interventions that address the ways in which systems and structures contribute to interpersonal dynamics and intrapersonal health. The current study is a first step in this process by its incorporation of both intra and interpersonal variables in the same sample of participants.

In sum, given that the threat of infectious diseases will continue to be a global health challenge and certain universal threats are being experienced, such as climate change (Morens et al., 2008), consideration of clinically relevant processes that can be targeted to reduce fears and distress among people is needed. Our data suggest that in times of stress, those individuals who ruminate about the cause of the stress with others have increased propensity to engage in catastrophizing and perseverative thinking leading to heightened fear and stress. These insights provide avenues for intervention research to better understand how targeting these processes may attenuate fear and distress and ultimately improve the health and well-being of people during such circumstances.

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CONFLICT OF INTEREST STATEMENT

The authors report no conflict of interest.

DATA AVAILABILITY STATEMENT

Study measures, deidentified data, syntax, and output are available on Open Science Framework at https://osf.io/t25hf/?view_only=91289d10aeb44fd4aae631a06dfcd115.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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