



# Relationships between Intolerance of Uncertainty, Worry, Rumination, and Distress in College Students During the Coronavirus Pandemic: the Role of COVID-19 Threat Appraisals

Amanda M. Marín-Chollom<sup>1</sup> · Aliza A. Panjwani<sup>2</sup>

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## Abstract

**Background** In two conditional process models, we examined whether intolerance of uncertainty (IU) had both direct and indirect effects on coronavirus anxiety (through worry) and depressive symptoms (through rumination) among college students; these associations were hypothesized to be more likely among students who appraised COVID-19 as highly threatening.

**Method** Data were collected during the COVID-19 pandemic from September 2020 to November 2020 in the USA. Participants ( $n = 134$ ) completed measures of IU, COVID-19 specific threat appraisal, rumination, worry, coronavirus anxiety, and depressive symptoms. The PROCESS macro (Model 8) was used for analyses with gender as a covariate.

**Results** IU had a direct positive effect on coronavirus anxiety and the effect was strongest among students who perceived COVID-19 as more threatening. Threat appraisal did not moderate the IU–depressive symptoms relationship. IU had an indirect effect on depressive symptoms through rumination at all levels of threat appraisal. Unexpectedly, this indirect effect was strongest among students who perceived the pandemic as less threatening.

**Conclusion** Results may inform interventions that address IU, threat appraisals, and repetitive negative thinking to mitigate symptoms of coronavirus anxiety and depression.

**Keywords** Intolerance of uncertainty · Worry · Rumination · Threat appraisal · COVID-19 · Coronavirus anxiety · Depressive symptoms

## Introduction

During the first wave of the COVID-19 pandemic in the USA, a call for health psychology research was issued to examine and address its psychosocial impact [1]. Two years later, individuals in the USA and around the world continue to cope with uncertainties of new variants, access to and effectiveness of vaccines, and evolving health guidelines. In this context, how people appraise and regulate reactions to uncertainty may influence their mental and physical health [2–5]. An intrapersonal factor that may be relevant in this

context is intolerance of uncertainty (IU). IU refers to “an individual’s dispositional incapacity to endure the aversive response triggered by the perceived absence of salient, key, or sufficient information, and sustained by the associated perception of uncertainty” [6]. IU may be heightened in undergraduate students because of several pandemic-related changes affecting college campuses across the USA, including method of course delivery, financial aid cutbacks, employment layoffs, living status, and obtaining gainful employment.

Prior research on pandemics such as SARS [7] and H1N1 [4] has examined psychological factors that contribute to psychological distress, although there is a need to focus on underlying mechanisms. Taha and colleagues [4] found that IU was associated with elevated anxiety during the H1N1 pandemic, which is consistent with other research that examines how IU impacts negative life events (i.e., daily hassles) and anxiety [8]. Individuals with high IU who perceived previous pandemics (H1N1) as more threatening may utilize more emotion-focused coping strategies [4]. These earlier

✉ Amanda M. Marín-Chollom  
amarin-chollom@ccsu.edu

<sup>1</sup> Department of Psychological Science, Central Connecticut State University, Marcus White, Room 216, 1615 Stanley Street, P.O. Box 4010, New Britain, CT 06053, USA

<sup>2</sup> Department of Supportive Care, Psychosocial Oncology, Princess Margaret Cancer Centre, Toronto, ON, Canada

findings have been corroborated by recent studies demonstrating IU's positive relationship with depression and anxiety during COVID-19 [9, 10]. A study conducted in the UK, for example, found that maladaptive coping responses partially mediated the positive relationship between IU and health and generalized anxiety [2].

From an emotion regulation perspective, repetitive negative thinking, such as worry and rumination, may mediate the relationship between IU and psychological distress. Worry, a form of cognitive avoidance, is defined as a sequence of negatively valenced thoughts or images designed to anticipate, prevent, and/or prepare for possible threats [11]. In excess, worry tends to be unsuccessful in reducing distress. Although it may temporarily suppress affective or physiological arousal, worry prevents successful emotional processing and fear extinction [12]. Rumination is also a form of cognitive avoidance and repetitive negative thinking. Unlike worry which is focused on future threat, ruminative content tends to center on past negative events or personal characteristics [13].

Experimental studies have shown that IU not only is correlated with but also contributes to the development of worry [14], a key feature of anxiety disorders. Similarly, IU precipitates the tendency to ruminate [15] a vulnerability for depressed mood and negative affect [16]. Both the IU–worry–anxiety and IU–rumination–depressive symptoms relationships may be exacerbated by severity of threat appraisal. Research specific to the COVID-19 pandemic has indeed found that more severe threat appraisals are associated with reduced mental well-being [17], more negative affect, and increased reports of stressful events [17, 18].

According to some experimental evidence, individuals who are highly intolerant of uncertainty may interpret the unknown as cause for concern irrespective of the relevance of threat [19]. Other research has found that IU may not only operate independently of threat but also interact with threat perceptions [20]. To achieve clarity on how these relationships may apply to undergraduate students during COVID-19, the current study examines the direct and indirect effects of IU on psychological distress. We also explore whether and how IU interacts with COVID-19 threat appraisal.

Informed by stress and coping [21] and cognitive avoidance theories [11], two conditional process models for both coronavirus anxiety and depressive symptoms are tested (Fig. 1). Given that depression and anxiety have been found to vary as a function of gender [22], this covariate will be controlled for in study hypotheses. Specifically, we hypothesize the following: (1) IU will be related to greater coronavirus anxiety and depressive symptoms and that these relationships will be stronger among those who appraise the pandemic as more threatening; (2) worry will mediate the relationship between IU and coronavirus anxiety and this indirect effect will be stronger for individuals who appraise the pandemic as more threatening; (3) rumination will mediate the relationship between IU and depressive symptoms and this indirect effect will be stronger for individuals who appraise the pandemic as more threatening.

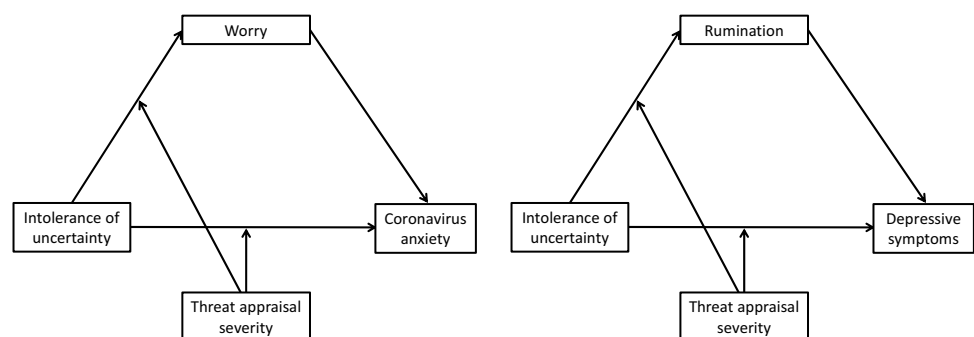
## Methods

This study was IRB-approved and online passive consent was obtained from participants. The online passive consent informed participants that the purpose of the study was to understand how uncertainty impacts stress, coping, and mental health in college students during the COVID-19 pandemic. Participants were recruited at a university in the Northeastern United States via the Psychology Department online subject pool managed by SONA. Students from different majors taking psychology courses were eligible to participate and receive credit in their courses. Participants were granted 1 SONA credit for 30 min of their time to complete the questionnaire administered online via Qualtrics. Data were collected during the COVID-19 pandemic from September 2020 to November 2020.

## Measures

**Demographics** Basic demographics of age, gender, employment status, class standing, and relationship status were collected. Subjective socioeconomic status (SES) was reported using the MacArthur Scale of Subjective Social Status

**Fig. 1** Conceptual diagrams of conditional process models for coronavirus anxiety and depressive symptoms



(MacArthur SSS Scale) [23]. Scores range from 1 to 10, with higher scores indicating higher perceived social status.

**Intolerance of Uncertainty** The Intolerance of Uncertainty Scale 12-item measure was used to measure participant's IU [24]. Items (e.g., “unforeseen events upset me greatly”) were measured on a 5-point Likert scale ranging from 1 (*not at all characteristic of me*) to 5 (*entirely characteristic of me*). Scores can range from 12 to 60, with higher scores indicating greater IU (Cronbach's  $\alpha=0.79$ ).

**Threat Appraisal** The Stress Appraisal Measure (SAM) [25] assesses stress appraisals and consists of 24 items. Students were prompted to respond to the SAM with the following prompt: “What are your perceptions about COVID-19? Please mark the choice that best corresponds to how you perceive/view COVID-19.” The measure assesses six dimensions of stress appraisals (i.e., threat, challenge, centrality, controllable-by-self, controllable-by-others, uncontrollable-by-anyone). The threat appraisal subscale was used for analyses presented in this paper. Items are answered on a 5-point Likert scale, ranging from 1 (*not at all*) to 5 (*extremely*). A total sum score was calculated with the four items that comprised the threat subscale (e.g., “how threatening is this situation”). Scores on the threat appraisal subscale can range from 4 to 20, with higher scores indicating a more threatening perception of COVID-19 (Cronbach's  $\alpha=0.72$ ).

**Rumination** Rumination was measured with the 10-item Ruminative Responses Scale [26]. Participants were asked to indicate how much they do what the 10-items state when they generally feel down, sad, or depressed (e.g., “I \_\_\_\_\_ analyze recent events to try to understand why I am depressed”). The questions were answered on a 4-point Likert scale ranging from 1 (*almost never*) to 4 (*almost always*). Scores can range from 10 to 40, with higher scores indicating greater rumination (Cronbach's  $\alpha=0.89$ ).

**Worry** The 11-item Penn State Worry Questionnaire (PSWQ-11; [27]) was used to measure worry. Participants rated each of the statements on a scale of 1 (*not at all typical of me*) to 5 (*very typical of me*). Scores can range from 11 to 55, with higher scores indicating greater worry (Cronbach's  $\alpha=0.96$ ).

**Coronavirus Anxiety** The Coronavirus Anxiety Scale (CAS; [28]) was used to measure symptoms of COVID-specific anxiety. Participants were asked to report the frequency of the times they have experienced COVID-specific anxiety over the last 2 weeks. The five items (e.g., “I felt dizzy, lightheaded, or faint, when I read or listened to news about the coronavirus”) were answered on a 5-point Likert scale ranging from 0 (*not at all*) to 4 (*nearly every day*). Scores

can range from 0 to 20, with higher scores indicating greater coronavirus anxiety (Cronbach's  $\alpha=0.88$ ).

**Depressive Symptoms** The Patient Health Questionnaire (PHQ-9; [29]) was used to measure symptoms of depression. Participants are asked to indicate how often they have been bothered by any of the symptoms of depression over the last 2 weeks (e.g., “little interest or pleasure in doing things”). The 9 items are answered on a 4-point Likert scale from 0 (*not at all*) to 3 (*nearly every day*). Scores can range from 0 to 27, with higher scores indicating greater depressive symptoms (Cronbach's  $\alpha=0.89$ ).

## Data Analysis

Of the 139 students who provided data for the study, one participant did not provide data on subjective social status, whereas another did not complete the IU measure; their data were not included. Additionally, four students identified as transgender and did not specify if they were transgender men or women. Due to the small number preventing meaningful subgroup analysis for the gender covariate, these individuals' data were also removed. The final sample included data from 134 undergraduate students.

Descriptive statistics were computed on main study variables, including means of the total scores, standard deviations, and observed ranges. Pearson's correlation coefficients were calculated for continuous variables. Point-biserial correlation coefficients were calculated for associations between dichotomous and continuous variables, specifically the relationship between gender and other study variables. In the gender variable, men were coded as 0 and women were coded as 1.

To identify the direct and indirect influence of IU on psychological distress, ordinary least-square (OLS) path analysis was used to estimate coefficients in two theoretically grounded conditional process models for coronavirus anxiety and depressive symptoms, respectively. Gender was included as a covariate in both models. The PROCESS macro (Model 8) for SPSS V21 was utilized to run analyses [30]. Model 8 is a conditional process model that estimates whether both the (1) direct and (2) indirect influence of IU on distress are contingent on values of the moderator; these effects are known as conditional direct and conditional indirect effects. A conditional indirect effect is simply moderation of the mediation effect, also known as moderated mediation. If moderated mediation was not significant, we fit a simple mediation model (Model 4) to test whether there was evidence of an indirect effect when no moderator was included in the analysis [31].

The first conditional process model tested whether the direct effect of IU on coronavirus anxiety was moderated by COVID-19 threat appraisal severity. Further, the model

tested whether the indirect association between IU and coronavirus anxiety was contingent on severity of COVID-19 threat appraisal. The second conditional process model with depressive symptoms was identical, except rumination replaced worry as the mediator between IU and depressive symptoms. The mediator (i.e., worry in the conditional process model for coronavirus anxiety; rumination in the conditional process model for depressive symptom) and the moderator (i.e., COVID-19 threat appraisal severity) variables formed the interaction terms and were mean-centered prior to analyses. Data points to plot the statistically significant interaction terms are provided by the PROCESS macro in SPSS: one standard deviation below the mean (low threat), the mean (moderate threat), and one standard deviation above the mean. Statistical diagrams for both conditional process models can be found in Fig. 2. Bootstrapping ( $k = 10,000$ ) was used to generate a confidence interval (CI) for the conditional indirect and direct effects. As is consistent with current OLS recommendations, regression coefficients are unstandardized [31].

### Results

The mean age of the sample was 19.91 years ( $SD = 3.36$ ). Approximately 71% of the participants were white, 61% identified as women, 84% described their sexual orientation as heterosexual, and 72% indicated they were single. Over 85% of participants in the study were enrolled as full-time students and over 65% were employed full-time. Full sample characteristics are reported in Table 1.

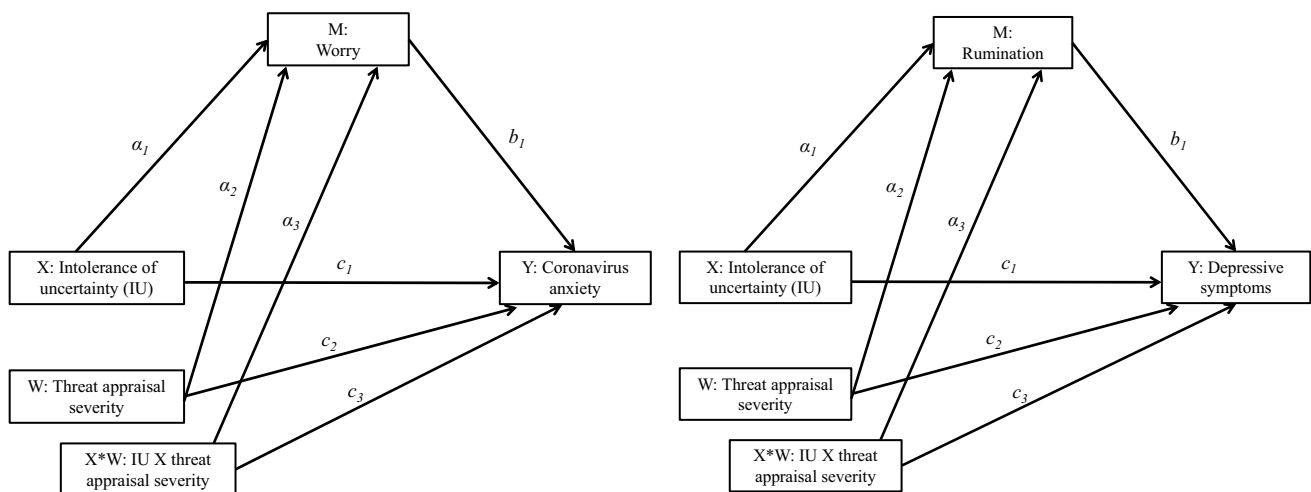
Using the standard cutoff of 10 for the PHQ-9 [29] and 9 for the CAS [32], 37.3% and 15.5% of participants met

**Table 1** Sample characteristics

Characteristic	<i>n</i>	%
Age, <i>M</i> ( <i>SD</i> ) = 19.909 (3.355)	-	-
Women	82	61.2
Race/ethnicity		
White	95	70.9
Hispanic or Latino/a	13	9.7
Black	11	8.2
Asian	8	6.0
Other <sup>a</sup>	7	5.1
Sexual orientation		
Straight/heterosexual	112	83.6
Bisexual	17	12.7
Other <sup>b</sup>	5	3.7
Relationship status		
Single	96	71.6
In a relationship or married	38	28.3
Subjective social status		
Low (steps 1 to 3)	9	6.7
Average (steps 4 to 7)	110	82.1
High (steps 8 to 10)	15	11.2
Enrollment status		
Full-time	117	87.3
Part-time	17	12.7
Employment		
Employed	91	67.9
Unemployed	43	32.1

<sup>a</sup>Includes the categories Native Hawaiian/Pacific Islander, biracial, and other

<sup>b</sup>Includes the categories lesbian and questioning



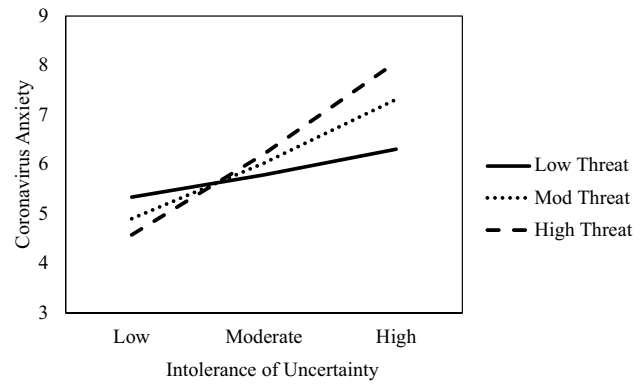
**Fig. 2** Statistical diagrams of conditional process models for coronavirus anxiety and depressive symptoms. *Note.* X, focal predictor; M, mediator; W, moderator; X\*W, interaction term; Y, outcome

criteria for clinically significant depressive and coronavirus anxiety symptoms, respectively. Gender was positively correlated with main study variables, with women more likely to report higher IU, perceived threat, worry, rumination, coronavirus anxiety, and depressive symptoms than men. Subjective SES evidenced small positive correlations with IU, worry, and depressive symptoms. Bivariate correlations among main study variables are reported in Table 2.

### Conditional Process Analysis with Coronavirus Anxiety

The total variance in coronavirus anxiety accounted for by this conditional process model was 33.740% ( $F(5, 128) = 13.034, p < 0.001$ ). Below are results for both (1) moderation of the direct effect and (2) moderation of the indirect effect (moderated mediation).

**Moderation of Direct Effect** The direct effect of IU on coronavirus anxiety was significant ( $c_1 = 0.094, SE = 0.026, 95\% CI: 0.043, 0.144$ ). The test of highest order unconditional interactions indicated a significant interaction between IU and threat appraisal ( $R^2\Delta = 0.061, F(1, 128) = 11.862, p = 0.0008$ ). Holding constant the mediator (i.e., worry) and other variables in the model, the interaction term remained significant ( $c_3 = 0.015, SE = 0.004, 95\% CI: 0.006, 0.023$ ). Given these results, we subsequently examined the influence of IU on coronavirus anxiety at three values of threat appraisal: one standard deviation below the mean (low threat), the mean (moderate threat), and one standard deviation above the mean (high threat; [33]). At both moderate and high severity of threat appraisal, the positive association between IU and coronavirus anxiety was significant; the association was strongest among those who perceived pandemic as most threatening. At low perceived threat, there was no association between IU and coronavirus anxiety (Fig. 3). Table 3 reports these regression results in full.



**Fig. 3** Moderating effect of threat appraisal severity on the relationship between intolerance of uncertainty and coronavirus anxiety (conditional direct effect). *Note.* This figure depicts the moderating effect of threat appraisal severity on the relationship between intolerance of uncertainty and coronavirus anxiety at low (−1 SD below the mean), moderate (mean), and high (+1 SD above the mean) levels of threat appraisal. The solid line indicates a nonsignificant slope

**Moderation of Indirect Effect** The index of moderated mediation, which quantifies the relationship between the moderator and the indirect effect, was not significant ( $\alpha_3b = -0.0001, SE = 0.0007, 95\% CI: -0.002, 0.001$ ), indicating that indirect effect of IU on coronavirus anxiety through worry was not dependent on threat appraisal. Therefore, these results were not interpreted further.

A simple mediation model was computed to test whether there was an indirect influence of IU on coronavirus anxiety through worry, controlling for gender and without any moderator. IU was positively associated with worry, controlling for gender ( $a = 0.737, SE = 0.076, 95\% CI: 0.587, 0.887$ ). Controlling for IU and gender, worry did not have an influence on coronavirus anxiety ( $b = 0.007, SE = 0.022, 95\% CI: -0.037, 0.051$ ). Although there was a significant direct effect of IU on coronavirus anxiety, controlling for

**Table 2** Descriptive statistics and intercorrelations among main study variables

Variable	2	3	4	5	6	7	8	Mean of sums (SD)	Range
1. Gender <sup>a</sup>	.139	.341**	.193*	.437**	.457**	.198*	.288**	-	-
2. Subjective SES	-	.174*	.072	.173*	.164	.040	.354**	5.610 (1.531)	1–9
3. Intolerance of uncertainty	-	-	.498**	.697**	.639**	.505**	.636**	30.800 (11.349)	12–60
4. Threat appraisal severity	-	-	-	.367**	.369**	.376**	.375**	10.649 (3.574)	4–20
5. Worry	-	-	-	-	.675**	.373*	.581**	33.291 (13.490)	11–55
6. Rumination	-	-	-	-	-	.219*	.573**	21.515 (6.791)	10–40
7. Coronavirus anxiety	-	-	-	-	-	-	.453**	6.381 (2.706)	5–23
8. Depressive symptoms	-	-	-	-	-	-	-	8.164 (6.318)	0–24

\*\* $p \leq .001$ ; \* $p \leq .05$

<sup>a</sup>As gender is a dichotomous variable, its associations with other variables were calculated through point-biserial correlations, wherein men were coded as 0 and women were coded as 1

**Table 3** Regression results of conditional process model for coronavirus anxiety, controlling for gender: threat appraisal moderates the direct effect of intolerance of uncertainty on coronavirus anxiety

Predictor	$\beta$	SE	<i>T</i> -statistic	<i>p</i> -value	95% CI
Worry					
Intolerance of uncertainty (IU; $a_1$ )	.723	.086	8.390	<.001	.553, .894
Threat appraisal severity ( $a_2$ )	.119	.270	.440	.661	-.415, .652
IU $\times$ Worry ( $a_3$ )	-.013	.018	-.738	.462	-.048, .022
Coronavirus anxiety					
Intolerance of uncertainty ( $c_1$ )	.094	.026	3.643	<.001	.043, .144
Worry ( $b_1$ )	.011	.021	.500	.618	-.031, .052
Threat appraisal severity ( $c_2$ )	.072	.065	1.108	.270	-.056, .200
IU $\times$ Threat appraisal severity ( $c_3$ )	.015	.004	3.444	<.001	.006, .023
Conditional direct effects at threat appraisal severity values: $M - 1$ SD, $M$ , $M + 1$ SD					
	$\beta$	SE	95% CI		
$M - 1$ SD (-3.649)	.400	.030	-.020, .100		
$M$ (.351)	.099	.026	.048, .150		
$M + 1$ SD (3.351)	.143	.029	.085, .201		

95% CI 10,000 bootstrapped confidence intervals, SE standard error, *M* mean, SD standard deviation

worry and gender ( $c_1 = 0.113$ , SE: 0.025, 95% CI: 0.063, 0.163), no indirect effect through worry was observed (indirect effect (IE): 0.005, SE: 0.019, 95% CI: -0.040, 0.036). The total effect of IU on coronavirus anxiety was significant ( $c = 0.118$ , 0.019, 95% CI: 0.080, 0.156) and the variance accounted for in coronavirus anxiety by this model was 25.530% ( $F(2, 131) = 22.452$ ,  $p < 0.001$ ).

### Conditional Process Analysis with Depressive Symptoms

The total variance in depressive symptoms accounted for by this conditional process model was 46.850% ( $F(5, 128) = 22.044$ ,  $p < 0.001$ ). Below are results for both (1) moderation of the direct effect and (2) moderation of the indirect effect (moderated mediation).

**Moderation of Direct Effect** The direct effect of IU on depressive symptoms was significant ( $c_1 = 0.234$ , SE = 0.050, 95% CI: 0.134, 0.334). The test of highest order unconditional interactions indicated that the interaction between IU and threat appraisal was not significant ( $R^2\Delta = 0.014$ ,  $F(1, 128) = 3.319$ ,  $p = 0.071$ ). Holding constant the mediator (i.e., worry) and other variables in the model, the interaction term remained nonsignificant ( $c_3 = 0.017$ , SE = 0.009, 95% CI: -0.001, 0.035). These results indicate that although there was a direct positive association between IU and depressive symptoms, it was not dependent on COVID-19 threat appraisal severity.

**Moderation of Indirect Effect** The index of moderated mediation was significant ( $\alpha_3 b = -0.005$ , SE = 0.004, 95% CI: -0.014, -0.0002). The test of highest order unconditional interactions indicated a significant interaction between IU and

threat appraisal ( $R^2\Delta = 0.017$ ,  $F(1, 129) = 4.226$ ,  $p = 0.042$ ). Controlling for the influence of IU, threat appraisal, and gender, the interaction term of IU and threat appraisal remained significant in the model ( $a_3 = 0.019$ , SE = 0.009, 95% CI: 0.003, 0.02). This conditional indirect effect was subsequently examined at three values of threat appraisal: one standard deviation below the mean (low threat), the mean (moderate threat), and one standard deviation above the mean (high threat). As hypothesized, there was a conditional indirect influence of IU, albeit in an unexpected direction. At all levels of threat appraisal severity, there was a significant positive association between IU and rumination (all  $ps < 0.001$ ); however, this relationship was strongest and evidenced the steepest slope at low levels of threat appraisal severity, followed by moderate levels (Fig. 4). Table 4 reports the regression results of this moderated mediation analysis.

### Supplementary Analyses

As subjective SES was associated with some of the study outcomes, we ran two additional conditional process models for coronavirus anxiety and depressive symptoms, respectively, with subjective SES as the covariate instead of gender (Tables S1–S2, Supplementary Material). The pattern of results was consistent with what we obtained from the models where gender was the covariate.

### Discussion

Adding to the existing literature on COVID-19 and mental health by testing a model informed by stress and coping [21] and cognitive avoidance [11] theories, the current



**Fig. 4** Moderating effect of threat appraisal severity on the relationship between intolerance of uncertainty and rumination (conditional indirect effect). *Note.* This figure depicts the moderating effect of threat appraisal severity on the relationship between intolerance of uncertainty and rumination at low (−1 SD below the mean), moderate (mean), and high (+1 SD above the mean) levels of threat appraisal. All lines indicate significant slopes

study elucidated relationships between IU, COVID-19 threat appraisal, worry, rumination, and psychological distress among undergraduate students during the pandemic. The study hypotheses were partially supported for coronavirus anxiety and depressive symptoms, controlling for gender.

We observed a direct effect of IU on both coronavirus anxiety and depressive symptoms. Perceptions of COVID-19 threat appraisal severity moderated the direct effect of IU on coronavirus anxiety, such that the positive relationship between IU and coronavirus anxiety was only significant at moderate and highly threatening appraisals of COVID-19. In contrast, threat appraisal did not influence the relationship between IU and depressive symptoms.

A positive association between IU and anxiety and depressive symptoms is consistent with the extant literature on IU and mental health [9, 10]. However, to our knowledge, this is the first study to demonstrate both a direct association between IU and coronavirus anxiety and that COVID-19 threat appraisal severity moderates this relationship. This finding not only has implications for young adults’ mental health [17, 18], but also may be relevant for uptake of health behaviors [34]. Research has shown that compared to older adults, younger adults are less likely to feel motivated by threatening appraisals of the pandemic in engagement of protective behaviors. Instead, perceptions related to effectiveness of pandemic safety measures and self-efficacy may be more influential in increasing uptake of public health measures in this age group [34].

Although worry has been established as mediator between IU and anxiety [14], no indirect or conditional indirect effect of IU on coronavirus anxiety through worry was found in our study. This lack of mediation effect may point to the fact that worry as a mechanism is perhaps more relevant to generalized anxiety and other anxiety disorders rather than such a context-specific construct of distress. Moreover, the CAS taps into somatic symptoms of coronavirus anxiety [28], whereas worry is conceptualized as a cognitive mechanism [12] and thus may be less likely to mediate this type of distress.

In the conditional process model for depressive symptoms, we did observe conditional indirect effects. At all levels of threat appraisal severity, there was a significant positive association between IU and rumination; however, this relationship was strongest at lower levels of threat appraisal severity. As these data were collected during what was termed the “second wave” in North America, it is possible that the threat

**Table 4** Regression results of conditional process model for depressive symptoms, controlling for gender: threat appraisal moderates the indirect effect of intolerance of uncertainty on depressive symptoms

Predictor	$\beta$	SE	T-statistic	p-value	95% CI
Rumination					
Intolerance of uncertainty (IU; $a_1$ )	.306	.045	6.770	<.001	.217, .396
Threat appraisal severity ( $a_2$ )	.181	.142	1.278	.204	−.099, .461
IU × Rumination ( $a_3$ )	−.019	.009	−2.056	.042	−.038, −.001
Depressive symptoms					
Intolerance of uncertainty ( $c_1$ )	.234	.050	4.649	<.001	.134, .334
Rumination ( $b_1$ )	.283	.084	3.363	.001	.116, .449
Threat appraisal severity ( $c_2$ )	.041	.136	.303	.762	.228, .310
IU × Rumination ( $c_3$ )	.017	.009	1.82	.071	−.001, .035
Conditional indirect effects at threat appraisal severity values: $M - 1 SD, M, M + 1 SD$					
	$\beta$	SE	95% CI		
$M - 1 SD (-3.649)$	.107	.044	.031, .207		
$M (.351)$	.085	.037	.023, .168		
$M + 1 SD (3.351)$	.068	.035	.014, .147		

95% CI 10,000 bootstrapped confidence intervals, SE standard error, M mean, SD standard deviation

appraisal, as it applies to the IU–rumination relationship, was less about the dangers of contracting COVID-19 and instead represented the negative impact of measures such as social distancing, distance learning, and quarantining requirements over which students may be ruminating. In many youths across the world, these events have evoked helplessness and demoralization [35–37], both of which are feeling states that are closely linked to and can predict depression [38, 39]. The term *epidemic rumination* has in fact been proposed to denote ruminative tendencies specific to events surrounding COVID-19 pandemic and has been associated with greater fatigue and depressive symptoms in undergraduate students [40].

The direct association between IU and depressive symptoms (i.e., without rumination as a mediator), however, did not depend on threat appraisal. With respect to the direct link between IU and depression, college students and young adults may not perceive the possibility of contracting COVID-19 as especially threatening. Instead, their concerns may center on the potential impacts of COVID-19 policies, restrictions, and guidelines on their sense of confinement and isolation, academic performance, career trajectories, finances, and employment [41]. As noted earlier, these potential impacts may be more likely to evoke depressive symptoms than anxiety due to a sense of helplessness or lack of control.

### Clinical Implications

A growing body of literature is showing the detrimental impact of COVID-19 on college students' mental health. During December 2019 to October 2020, a meta-analysis including studies across the world estimated a 39% prevalence rate of clinically significant depressive symptoms [42], comparable to the estimate of 37.3% in our sample. In contrast, 15.5% of our sample reported clinically significant coronavirus anxiety. The average coronavirus anxiety score in this study, 6.381, is comparable to the seminal CAS study that collected data in the USA during March 2020 [28], where a mean of 8.620 was reported. Notably, the lower prevalence rate of coronavirus anxiety found in this study may be because it was conducted during the second wave of the pandemic in the USA.

As evidenced by the COVID-19 variants, pandemic-related challenges are likely to continue and addressing the mental health needs of undergraduate students will remain an important concern. The current study has identified several intervention targets, including IU, threat appraisals, and rumination. Cognitive behavioral therapy and mindfulness interventions may be used in combination to address repetitive negative thinking and IU [43, 44]. However, such protocols are likely to benefit from adaptations that include

COVID-19-specific content [45] tailored to young adults. In addition to modifying threat perceptions, a focus on building self-efficacy [46] encouraging adaptive coping [47] and education on health measures that have been proven effective [48] may be a useful approach. Incorporating virtual care into college wellness and counseling centers may allow for assisting a wider range of at-risk students. Posting and notifying students about online, crisis, and community resources on school websites would increase accessibility to support systems both within the institution and in the community.

### Limitations

Several limitations in the present study should be noted. Though the models used were theoretically grounded, the data are cross-sectional and do not allow for interpretations of causality. The sample was relatively homogenous with the majority being White, employed, and enrolled full-time in college. Well-validated self-report measures were used; however, these can be subject to bias. Although factors' analyses have shown that six stress appraisal dimensions in SAM are independent and the threat appraisal subscale is closely related to distress [25], the use of the threat appraisal subscale alone may be considered a limitation. One item on the threat appraisal subscale asks whether this situation (i.e., COVID-19) makes the participant feel anxious, which may be potential limitation given one of the outcomes is coronavirus anxiety. As expected, there is a relationship between threat appraisal anxiety item and coronavirus anxiety ( $r=0.378$ ,  $p<0.001$ ); however, the correlation coefficient is well under 0.70, indicating that multicollinearity was not a concern.

Although conducting a power analysis for moderated mediation was not feasible, a post hoc power analysis for mediation was conducted. With 10,000 replications, 20,000 draws, and a 95% confidence level, this sample of 134 participants permitted a power of 0.91 to detect the parameter ab or mediation (IU–rumination–depressive symptoms) [49]. For the detection of mediation with worry as the mediator and anxiety as the outcome, the power was much lower at 0.07 and may have prevented detection of some significant findings. Despite this limitation, the pattern of results remained consistent when we ran the conditional process models with subjective SES as the covariate instead of gender (S1–S2, Supplementary Material), further supporting that our findings reflect reliable effects. Future studies would benefit from longitudinal designs and recruitment of larger, more diverse samples, allowing for these models to be tested across multiple waves of the pandemic and student cohorts as well as the inclusion of additional covariates.



## Conclusion

This study is the first to conceptually link concepts from stress and coping and cognitive avoidance theories within the context of the COVID-19 pandemic to examine the relationship between IU and psychological distress among college students. The results demonstrated two key findings: the direct effect of IU on coronavirus anxiety is moderated by COVID-19 threat appraisal severity; and the indirect effect of IU on depressive symptoms through rumination is moderated by COVID-19 threat appraisal severity. Results can be used to inform interventions that target IU, stress appraisals, and repetitive negative thinking to mitigate symptoms of anxiety and depression in young adults.

**Supplementary Information** The online version contains supplementary material available at <https://doi.org/10.1007/s12529-022-10116-3>.

**Data and Code Availability** Data and code for main analyses are available upon request from author.

## Declarations

**Ethics Approval** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

**Informed Consent** Informed consent was obtained from all individual participants included in the study.

**Conflict of Interest** The authors declare no competing interests.

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