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Research paper

# Anxiety sensitivity prospectively predicts pandemic-related distress

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ABSTRACT

*Background:* Anxiety sensitivity (AS) is a well-studied transdiagnostic risk construct that is believed to amplify responses to many forms of stress. The COVID-19 pandemic is a broad stressor with significant physical and social threats. In the current study, we were interested in ascertaining the degree to which AS would relate to distress and disability in the context of COVID-19. We hypothesized that AS would be associated with increased distress and disability. Moreover, we hypothesized that AS would be uniquely predictive while controlling for other relevant risk factors such as age, race, and perceived local COVID-19 infection rates.
*Method:* Participants ($N = 249$) were U.S. adults assessed using online data resourcing and re-assessed one month later.
*Results:* At the first time point, during the beginning phases of the COVID-19 pandemic, AS was significantly related to COVID-19 distress and disability with a moderate effect size. AS was longitudinally associated with higher COVID-19 worry and depression.
*Limitations:* Our findings are limited by the use of a relatively small online sample. Additionally, assessment of pre-pandemic and post-pandemic symptoms and functioning would be beneficial for future research.
*Conclusions:* Taken together, the current study provided evidence consistent with AS as a causal risk factor for the development of distress and depression during the COVID-19 pandemic.

In late 2019, a new coronavirus illness (COVID-19) was identified in Wuhan, China and quickly spread across the globe, resulting in a pandemic (World Health Organization, 2020). In addition to impacting the physical health of millions of Americans, the COVID-19 pandemic is a significant psychological stressor due to both the threat of the illness and the mitigation strategies used to contain its spread (e.g., social distancing). It is imperative to understand cognitive, emotional, and behavioral responses to the pandemic, as such data are crucial for informing population-level interventions. Several authors have made calls for researchers to rapidly gather data regarding the effects of the pandemic on psychological and social functioning, highlighting that increases in overall distress, incidence of psychiatric conditions, and unhealthy coping behaviors (e.g., substance use) are likely to occur (Cullen et al., 2020; Holmes et al., 2020; Pfefferbaum and North, 2020; Reger et al., 2020). Research from past viral outbreaks, such as SARS and Ebola, supports these hypotheses, showing increases in distress, disability, and significant mental health issues, even several months after quarantine and other protective measures have ended (Brooks et al., 2020; Hawryluck et al., 2004; Jeong et al., 2016; Mazumder et al., 2020; Mihashi et al., 2009; Sprang and Silman, 2013; Taylor, 2019).

Early reports regarding COVID-19 indicate that people are indeed reporting significant concern about the pandemic and its consequences (Holmes et al., 2020). Within the U.S., in particular, early estimates suggest that approximately 65-70% of individuals may be experiencing moderate to severe levels of psychological distress due to the pandemic (Hsing et al., 2020; Nelson et al., 2020; Rosen et al., 2020; Twenge and Joiner, 2020). There also have been noted increases in feelings of hopelessness, sadness, and worthlessness (Twenge and Joiner, 2020), as well as decreases in feelings of social connection (Hsing et al., 2020). Initial studies have shown that more people are seeking psychiatric care and calling national crisis lines (Bharath, 2020; Lakhani, 2020; Levine, 2020), providing further evidence that the pandemic is posing a significant threat to mental well-being.

Although COVID-19 is a ubiquitous stressor, the perception of and reactions to this stress are likely to vary significantly across individuals, which in turn will dictate distress responses. In particular, people with a propensity to magnify stress are likely to experience more severe and disabling consequences to the COVID-19 pandemic. Anxiety sensitivity

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(AS) is a construct that captures individual differences in this tendency. AS refers to the fear of negative consequences stemming from maladaptive interpretations related to their experience of anxious arousal (Reiss et al., 1986). Previous research (Taylor et al., 2007; Zinbarg et al., 1997) has identified three lower-order dimensions of AS including fears of physical, cognitive, and social consequences of anxious arousal. For example, trouble concentrating or racing thoughts may be interpreted as "going crazy" or "losing one's mind" (i.e., cognitive concerns). Physiological arousal, such as chest pain or shortness of breath, may be interpreted as an impending heart attack (i.e., physical concerns). Observable symptoms of anxiety, such as sweating or blushing, may be interpreted as potentiating a negative evaluation by others (i.e., social concerns). Together, these subfactors combine to represent one of the most well studied risk factors in the development of anxiety and mood pathology (Naragon-Gainey, 2010; Olatunji and Wolitzky-Taylor, 2009; Schmidt et al., 2006).

Individuals high in AS tend to show amplified stress reactions in the context of novel, uncontrollable, and unpredictable stress. For example, AS has been found to predict acute panic attack responses during basic training (Schmidt et al., 1997, 1999) as well as posttraumatic stress symptoms (PTSS) following childbirth (Keogh et al., 2002). Elevated AS also predicts stress reactions to novel laboratory stresses including biological challenges (e.g. Asmundson et al., 1994; McNally and Eke, 1996; Schmidt, 1999) as well as trauma films (Boffa et al., 2016; Olatunji and Fan, 2015) and exposure to actual trauma such as a campus shooting (Boffa et al., 2016). Further, AS is associated with a range of maladaptive coping behaviors including compulsive behaviors such as hoarding and excessive washing (e.g. Medley et al., 2013; Raines et al., 2014) as well as avoidance (e.g. Norton and Asmundson, 2004; Stewart et al., 2002).

Given that AS has been well-established as a causal risk factor for adverse responses to a wide array of stressors, we would expect AS to be predictive of amplified stress responses to the COVID-19 pandemic. Indeed, recent cross-sectional findings support the idea that AS is associated with COVID distress (Manning et al., 2021; Rogers et al., 2021). However, these reports are significantly limited due to their cross-sectional nature. A more powerful test of the influence of AS on pandemic distress would be to demonstrate longitudinal effects of this purported risk variable. Thus, the primary aim of the present study is to document the degree to which AS is prospectively associated with elevated distress and disability in the context of the pandemic. Given that the pandemic differentially affects individuals based on age, race, and exposure to COVID-19, we were interested in examining whether AS is associated with distress and disability after controlling for these factors. We hypothesized that AS would be significantly associated with increased COVID-19 related worry, behaviors (e.g., stockpiling), and disability both cross-sectionally and longitudinally. In addition, we explored whether this pattern of effects was differentially related to AS facets. In particular, we expected that AS physical concerns, which involves the amplification of physical sensations, may be particularly predictive of distress given that COVID-19 presents in a wide array of cardiorespiratory sensations that may mimic normal stress responses.

## 1. Method

### 1.1. Participants and procedures

Participants ($N$ = 249) were recruited from Amazon's Mechanical Turk (MTurk), an online crowdsourcing platform designed to provide access to a diverse pool of research participants. All participants had to be 18 years of age or older, live in the United States (U.S.), and have an approval rating of at least 95% with a minimum of 100 surveys completed (Peer et al., 2014). Data collection involved completion of self-report questionnaires administered using Qualtrics Survey Software at two timepoints (i.e. Wave 1 and Wave 2). Wave 1 data collection began on April 13th, 2020; the Wave 2 survey was sent to the same participants on May 14th, 2020. For both surveys, modal completion occurred on the same day. A variety of attention check items were included in the Wave 1 questionnaire battery to ensure validity of the data, and participants who failed any attention check items were excluded from analyses. Participants were compensated $4.00 per timepoint for completion of Wave 1 and Wave 2 surveys, through their Amazon account as per Mechanical Turk guidelines. Study procedures were approved by the Institutional Review Board of Florida State University and the study was conducted in accordance with the 1964 Helsinki declaration and its later amendments.

The final sample, excluding individuals who failed one or more attention check items, ($n$ = 175; $M_{age}$ = 39.05, SD = 11.79) identified as 51.4% female, 48.0% male, and 0.6% non-binary at Wave 1. The majority of participants identified as White (n = 135; 77.1%) followed by Black (n = 21; 12.0%) and Asian (n = 14; 8.0%), with a small proportion identifying as Hispanic (n = 15; 8.6%). Most participants endorsed at least some college (89.1%) and 65.1% reported a yearly family income of $75,000 or less. Approximately half (51.4%) of the sample was married and 47.4% has at least one child. Due to attrition, data was available for 122 participants (Mage = 40.93, SD = 12.18) at Wave 2 and demographics breakdowns were similar (e.g. 79.5% White; 8.2% Hispanic; 50.8% married).

### 1.2. Measures

#### 1.2.1. Demographics

Participants provided demographic information including age, gender identity, sexual orientation, race (White vs Non-white minority), ethnicity, education level, marital status, family income, number of children, and zip code. Demographic information was used to characterize the sample and select demographic variables (i.e. age, racial/ethnic minority status) were included in regression analyses.

#### 1.2.2. COVID-19 impact battery (CIB; *Schmidt et al., manuscript submitted for publication*)

The CIB is a 30-item self-report measure that contains three subscales: Behaviors, Worry and Disability (see Apendix A).. The CIB was developed and validated using a stepwise procedure in line with best-practice measurement procedures (Boateng et al., 2018; DeVellis, 2016). The initial pool of potential items was based on clinical expertise and polling research on psychological distress during the pandemic. Both expoloratory (EFA) and confirmatory factor analyses (CFA) were conducted to validate the structure across three independent samples. Internal consistency, test-retest reliability, convergent, discriminant, and construct validity were evaluated and deemed acceptable for all scales.

*1.2.2.1. CIB behaviors scale.* This 12-item scale measures behavioral responses (e.g., "Hand washing;" "Using hand sanitizer") to the COVID-19 outbreak. Participants responded to this scale by rating the extent to which they "have engaged in the following behaviors in response to COVID-19" using a five-point scale (from 0 = "Not at all" to 4 = "Very much"). The overall scale can be decomposed to three subscales assessing stockpiling, cleaning, and avoidance behaviors. The overall scale and each subscale have good internal consistency (total scale α = .83 at Wave 1 and .82 at Wave 2).

*1.2.2.2. CIB worry scale.* This 11-item scale measures worry related to the outbreak of COVID-19. The items on this measure use a five-point scale (from 0 = "Not at all" to 4 = "Very Much"). Participants used this scale to rate each item (e.g., "I worry that I will lose my employment"). The worry scale consists of three subscales assessing worry related to health, finances, and catastrophic worry (e.g., "I worry that if I go into quarantine, I will go crazy") based on the degree to which it has caused distress. The overall scale and each subscale have excellent internal

consistency (total scale α = .89 at Wave 1 and .89 at Wave 2).

*1.2.2.3. CIB disability scale.* Seven items from the WHODAS II were adapted to measure difficulties resulting from the outbreak of COVID-19 (World Health Organization, 2000). Instructions asked participants to consider difficulties "due to the COVID-19 outbreak" rather than those "due to health conditions." Item wording reflected the adaptation to the COVID-19 outbreak (e.g., "How much have you been emotionally affected by the COVID-19 outbreak?"). Items ask participants to rate difficulties on a five-point scale from 0 ("None") to 4 ("Extreme or cannot do"). Participants used this scale to rate the degree of difficulties experienced in the preceding 30 days that are due to the COVID-19 outbreak. In the current study, this scale had good internal consistency (α = .84 at Wave 1 and α = .82 at Wave 2).

*1.2.3. Perceived COVID-19 outbreak size (PCOS; Schmidt et al., 2021)*

Ratings of perceived threat were obtained from a single item asking participants "What is the approximate size of the COVID-19 outbreak in your area?" Scores ranged from 0 (*No cases*) to 7 (*Very Large*). At Wave 1, ratings for this item were normally distributed with sample endorsement of 12.0% for "No cases" or "Very small," 34.8% for "Small" and "Small to medium," 39.5% endorsing "Medium" and "Medium to large," and 13.7% endorsing "Large" or "Very large." At Wave 2, ratings were 9.0% for "No cases" to "Very small," 37.7% "Small" and "Small to medium," 35.2% endorsed "Medium" or "Medium to Large," and 18.0% reporting "Large" and "Very large."

*1.2.4. Anxiety sensitivity index-3 (ASI-3; Taylor et al., 2007)*

The ASI is an 18-item self-report questionnaire designed to measure fear of anxious arousal. The ASI-3 demonstrates strong psychometric properties (Taylor et al., 2007) and is comprised of three subscales: physical (e.g., "It scares me when my heart beats rapidly"), cognitive (e.g., "When I cannot keep my mind on a task, I worry that I might be going crazy"), and social concerns (e.g., "It is important for me not to appear nervous"). Participants rated how much they agreed with each item on a 5-point scale ranging from 0 (*very little*) to 4 (*very much*). In the present study, the ASI-3 demonstrated excellent internal consistency at both Wave 1 (α = .94) and Wave 2 (α = .95).

*1.2.5. Depression anxiety stress scales (DASS-21; Lovibond and Lovibond, 1995)*

The DASS-21 is a 21-item self-report measure used to assess depression, anxiety, and stress. For the current study, only the depression subscale was used. Participants were asked to use a four-point scale from 0 (*did not apply to me at all*) to 3 (*applied to me very much, or most of the time*) to rate their experiences over the past week. The DASS-21 has shown excellent internal consistency and validity (Antony et al., 1998). Only the DASS-21 depression scale was used in the current study. The DASS-21 depression scale demonstrated good internal consistency at both Wave 1 (α = .92) and Wave 2 (α = .94).

*1.2.6. Generalized anxiety disorder 7 (GAD-7; Spitzer et al., 2006)*

The GAD-7 is a 7-item self-report measure used to assess anxiety symptoms over the past two weeks. Participants were asked to use a four-point scale from 0 (*not at all*) to 3 (*nearly every day*) to rate their anxiety symptoms. The GAD-7 has shown high levels of internal consistency and test-retest reliability (Spitzer et al., 2006). The GAD-7 demonstrated good internal consistency at both Wave 1 (α = .91) and Wave 2 (α = .92).

## 2. Results

### 2.1. Descriptive data

See Table 1 for descriptive statistics and zero-order correlations among the main study variables including ASI-3, CIB behavior scale, CIB worry scale, CIB disability scale, DASS-21 depression scale, and GAD-7 at Wave 1 and Wave 2. Overall, mean scores tended to decrease slightly from Wave 1 to Wave 2 potentially reflecting adaptation to COVID-19 related threat and regulations. Of note, the decrease was significant for GAD-7 scores from Wave 1 to Wave 2 ($t = 3.22$, $p = .002$). Consistent with our hypotheses, AS was significantly correlated with COVID-19 related behaviors, worry, and disability as well as anxiety and depression symptoms across timepoints. Notably, the level of association suggests fairly robust cross-sectional associations between the ASI, COVID scales, and symptom measures with most correlations in the .5–.6 range. Though still statistically significant, the association with the COVID behaviors scale was somewhat lower (.36–.44).

### 2.2. Hierarchical regression analyses

Hierarchical linear regressions were conducted to determine whether Wave 1 AS prospectively predicted COVID-19 related behaviors, worry, disability or anxiety/depression at Wave 2 when controlling for corresponding Wave 1 scores and relevant covariates (see Table 2). In Step 1, Wave 1 scores corresponding with the outcome variable were entered. In Step 2, covariates including perceived COVID-19 outbreak size, age, and racial minority status were entered. Finally, in Step 3, ASI-

**Table 1**
Descriptive data and zero-order correlations across W1 and W2.

| | Variable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | W1 ASI-3 | - | - | - | - | - | - | - | - | - | - | - | - |
| 2. | W1 CIB-behav | .44** | - | - | - | - | - | - | - | - | - | - | - |
| 3. | W1 CIB-worry | .64** | .42** | - | - | - | - | - | - | - | - | - | - |
| 4. | W1 CIB-dis | .63** | .45** | .64** | - | - | - | - | - | - | - | - | - |
| 5. | W1 DASS-dep | .56** | .08 | .46** | .48** | - | - | - | - | - | - | - | - |
| 6. | W1 GAD-7 | .64** | .26** | .55** | .55** | .69** | - | - | - | - | - | - | - |
| 7. | W2 ASI-3 | .72** | .33** | .47** | .55** | .48** | .48** | - | - | - | - | - | - |
| 8. | W2 CIB-behav | .36** | .82** | .41** | .41** | .07 | .07 | .31** | - | - | - | - | - |
| 9. | W2 CIB-worry | .58** | .31** | .74** | .60** | .50** | .50** | .60** | .41** | - | - | - | - |
| 10. | W2 CIB-dis | .49** | .34** | .48** | .66** | .53** | .53** | .58** | .32** | .67** | - | - | - |
| 11. | W2 DASS-dep | .53** | .12 | .42** | .42** | .76** | .76** | .58** | .10 | .54** | .54** | - | - |
| 12. | W2 GAD-7 | .55** | .20* | .49** | .47** | .65** | .83** | .70** | .20* | .58** | .54** | .76** | - |
| | **Mean** | 24.72 | 30.00 | 18.06 | 9.56 | 6.05 | 17.63 | 22.85 | 28.86 | 17.46 | 8.98 | 5.76 | 16.41 |
| | **SD** | 15.36 | 8.20 | 9.58 | 6.03 | 5.44 | 6.42 | 15.72 | 7.96 | 9.55 | 5.64 | 5.58 | 6.84 |

Note. W1 = Wave 1; W2 = Wave 2; ASI-3 = Anxiety Sensitivity Index-3; CIB-behav = COVID-19 Impact Battery, behavior scale; CIB-worry = COVID-19 Impact Battery, worry scale; CIB-dis = COVID-19 Impact Battery, disability scale; DASS-dep = Depression Anxiety Stress Scales-21, depression scale; GAD-7 = Generalized Anxiety Disorder-7.

* $p < .05$.

** $p < .01$

**Table 2**
Anxiety sensitivity as a predictor of changes in COVID-19 impact, depression, and anxiety.

| Outcome | Step | Predictor | *t* | *β* | *p* | $R^2$ | *F* | *p* |
|---|---|---|---|---|---|---|---|---|
| W2 CIB-behav | 1 | – | - | - | - | .68 | 254.62 | <.001 |
| | | W1 CIB-behav | 15.96 | .82 | <.001 | - | - | - |
| | 2 | – | - | - | - | .69 | 66.13 | <.001 |
| | | PCOS | 2.12 | .12 | .036 | - | - | - |
| | | Age | 0.31 | .02 | .758 | - | - | - |
| | | Minority status | -1.02 | -.05 | .311 | - | - | - |
| | 3 | – | - | - | - | .70 | 53.64 | <.001 |
| | | W1 ASI-3 | -1.35 | -.08 | .181 | - | - | - |
| W2 CIB-worry | 1 | – | - | - | - | .55 | 144.30 | <.001 |
| | | W1 CIB-worry | 12.01 | .74 | <.001 | - | - | - |
| | 2 | – | - | - | - | .55 | 36.31 | <.001 |
| | | PCOS | 1.33 | .09 | .187 | - | - | - |
| | | Age | -0.33 | -.02 | .744 | - | - | - |
| | | Minority status | -0.37 | -.02 | .713 | - | - | - |
| | 3 | – | - | - | - | .57 | 30.63 | <.001 |
| | | W1 ASI-3 | 2.02 | .17 | .046 | - | - | - |
| W2 CIB-dis | 1 | – | - | - | - | .44 | 93.76 | <.001 |
| | | W1 CIB-dis | 9.68 | .66 | <.001 | - | - | - |
| | 2 | – | - | - | - | .45 | 24.05 | <.001 |
| | | PCOS | 0.50 | .04 | .618 | - | - | - |
| | | Age | -1.49 | -.11 | .140 | - | - | - |
| | | Minority status | -0.49 | -.04 | .626 | - | - | - |
| | 3 | – | - | - | - | .46 | 19.36 | <.001 |
| | | W1 ASI-3 | 0.88 | .08 | .383 | - | - | - |
| W2 DASS-dep | 1 | – | - | - | - | .58 | 167.08 | <.001 |
| | | W1 DASS-dep | 12.93 | .76 | <.001 | - | - | - |
| | 2 | – | - | - | - | .60 | 43.84 | <.001 |
| | | PCOS | -0.29 | -.02 | .774 | - | - | - |
| | | Age | -2.16 | -.14 | .033 | - | - | - |
| | | Minority status | -1.17 | -.07 | .243 | - | - | - |
| | 3 | – | - | - | - | .62 | 37.13 | <.001 |
| | | W1 ASI-3 | 2.17 | .15 | .032 | - | - | - |
| W2 GAD-7 | 1 | – | - | - | - | .68 | 254.17 | <.001 |
| | | W1 GAD-7 | 15.94 | .83 | <.001 | - | - | - |
| | 2 | – | - | - | - | .69 | 65.03 | <.001 |
| | | PCOS | 0.55 | .03 | .584 | - | - | - |
| | | Age | -0.89 | -.05 | .374 | - | - | - |
| | | Minority status | -1.86 | -.10 | .065 | - | - | - |
| | 3 | – | - | - | - | .69 | 52.02 | <.001 |
| | | W1 ASI-3 | 0.83 | .06 | .411 | - | - | - |

Note. W1 = Wave 1; W2 = Wave 2; PCOS = Perceived COVID Outbreak Size; Minority status coded: 0 = White, 1=Non-white; ASI-3 = Anxiety Sensitivity Index-3; CIB-behav = COVID-19 Impact Battery, behavior scale; CIB-worry = COVID-19 Impact Battery, worry scale; CIB-dis = COVID-19 Impact Battery, disability scale; DASS-dep = Depression Anxiety Stress Scales-21, depression scale; GAD-7 = Generalized Anxiety Disorder-7.

3 total score was entered. Results indicated that in each model the Wave 1 autoregressive variable was highly associated with the corresponding variable at Wave 2 and accounted for a large proportion of the variance ($R^2$ = .44–.68). In regard to covariates, greater perceived outbreak size was associated with higher levels of COVID-19 behaviors ($t = 2.12$, $\beta = .12$, $p < .05$) and age had a significant effect on depressive symptoms with younger individuals reporting more symptoms ($t = -2.16$, $\beta = -.14$, $p < .05$). In terms of the final step in the models, AS predicted increases in worry ($t = 2.02$, $\beta = .17$, $p < .05$) and depressive symptoms ($t = 2.17$, $\beta = .15$, $p < .05$), but not behaviors ($t = -1.35$, $\beta = -.08$, $p = .18$), disability ($t = 0.88$, $\beta = .08$, $p = .38$), or anxiety symptoms ($t = 0.83$, $\beta = .06$, $p = .41$).

We followed up these analyses by conducting exploratory analyses of the COVID Impact subscales as well as the first order facets of the ASI-3 (physical, cognitive, social). Results indicated differential associations between the ASI-3, ASI-3 subscales, and COVID Impact subscales. Specifically, when examining total ASI-3 scores, Wave 1 AS was significantly associated with increases in catastrophic ($t = 2.53$, $\beta = .22$, $p < .05$), but not health ($t = 1.61$, $\beta = .14$, $p = .11$) or financial ($t = 1.59$, $\beta = .11$, $p = .12$) worries. In terms of COVID-19 related behaviors, AS did not significantly predict changes in stockpiling ($t = -1.63$, $\beta = -.10$, $p = .11$), avoiding ($t = -0.82$, $\beta = -.06$, $p = .41$), or cleaning ($t = -0.64$, $\beta = -.04$, $p = .52$). When examining individual facets of AS, worry findings were specific to cognitive AS. Cognitive AS predicted increases in worry ($t = 2.72$, $\beta = .22$, $p < .05$); catastrophic ($t = 3.30$, $\beta = .27$, $p < .05$) and health ($t = 2.11$, $\beta = .17$, $p < .05$) worries in particular. On the other hand, increases in depressive symptoms were associated with physical AS ($t = 2.15$, $\beta = .14$, $p < .05$). Social AS was not uniquely related to any of the outcomes.

## 3. Discussion

As hypothesized, we found that AS was associated with pandemic related distress. Our findings replicate recent reports showing that AS is cross-sectionally associated with COVID-19 distress (Manning et al., 2021; Rogers et al., 2021). However, we extend these findings by showing that higher levels of AS at the beginning of the pandemic was associated with COVID-19 distress approximately one month later. Upon further exploration, AS was found to be uniquely associated with catastrophizing worries as opposed to those related to health or finances.

The longitudinal aspect of the current study supports AS being considered a variable risk factor in the development of pandemic related distress, as it precedes ongoing or later distress symptoms. This is an important step in confirming AS as a causal risk factor for pandemic distress and depression. The remaining hurdle is to demonstrate that manipulating AS in the context of ongoing pandemic distress can mitigate later symptoms, and there is evidence to suggest that AS is generally malleable through intervention (Schmidt et al., 2017). Given the particular utility in cognitive AS's ability to prospectively predict this COVID-related distress, it may be the prime target for such an

intervention. Consistent with this, a brief computerized AS intervention program designed specifically to reduce AS cognitive concerns found reductions in AS to be associated with reduced PTSS at one-month follow-up in a mixed veteran/civilian sample (Mitchell et al., 2014). Finally, a previous study reported that a single-session AS intervention led to greater reductions in PTSS than a control condition after one month in a trauma-exposed sample; moreover, this effect was mediated by pre-to-post intervention reductions in AS (Allan et al., 2015). Given that AS is malleable, and this malleability is related to change in stress symptoms, it is plausible that an AS intervention administered during the pandemic could prospectively mitigate the development of later symptoms.

Cross-sectionally, AS was significantly positively associated with each outcome measure assessed. The weakest of these associations at each timepoint was that with CIB behaviors, but the remaining correlations were rather strong (.56–.70). This falls in line with previous research which finds AS to be significantly related to depression and generalized anxiety symptoms (Allan et al., 2014a, 2014b; Warren et al., 2021). Additionally, previous research has found that AS is significantly associated with COVID-related fear (Hashemi et al., 2020; McKay et al., 2020; Warren et al., 2021), as well as COVID-related functional impairment (Manning et al., 2021). However, this is first study (to the authors' knowledge) to assess the relationship between AS and COVID behaviors in addition to these other outcomes in tandem.

Further analyses on the subscales of the ASI-3 and the CIB revealed some similarly interesting findings. While AS did not predict changes in specific pandemic related behaviors or general worry as indexed by the GAD-7, there was an association between AS and changes in worries, particularly catastrophic worries such as being worried they would not have enough money or resources to survive or worry that quarantine would result in them going crazy. While the linkage between cognitive AS and catastrophic pandemic related worry shows nice specificity, it is interesting that cognitive but not physical AS is strongly associated with negative health outcomes given the similarity between COVID-19 respiratory symptoms and physical sensations of anxiety. This may speak to the importance of the mental stressors involved with dealing with the pandemic and is somewhat consistent with prior AS findings where cognitive AS outperformed physical AS in predicting negative outcomes during a stressor (i.e., basic military training) involving a combination of both physical and mental challenges (Schmidt et al., 1997, 1999). Moreover, this pattern of findings suggests cognitive AS may be a particularly relevant target for intervention as a way to mitigate the negative effects of the COVID-19 pandemic (Boffa and Schmidt, 2019; Schmidt et al., 2017).

Findings of the current study must be considered in the context of several limitations. First, we necessarily relied on online data sources for the acquisition of study participants. Although use of online crowdsourcing mechanisms is increasingly common and the procedures are generally well-accepted (Sheehan, 2017; Thomas and Clifford, 2017), there are some concerns about these procedures including the contamination of data from automated or "bot" responses and the representativeness of such samples (Pei et al., 2020). To mitigate some of these concerns, we utilized reliability checks, which are commonly recommended for these data sources (Peer et al., 2014; Pei et al., 2020). However, the findings from this sample should be interpreted with caution as they may not be generalizable to the entire U.S. population. Additionally, the sample size was relatively small. Thus, additional research examining COVID-19 related outcomes within more diverse and clinically relevant samples is indicated. Additionally, the current study utilized two timepoints during the COVID-19 pandemic. Therefore, AS was not assessed prior to the pandemic and implications for post-pandemic functioning are unclear. While we were able to assess changes over time, future research would benefit from including participants for whom pre-pandemic measurements are available as well as examining post-pandemic symptoms and functioning. Finally, distress associated with the COVID-19 pandemic cannot be fully disentangled from that related to other significant stressors including large-scale political unrest and acts of violence in the U.S.

Despite these limitations, the current study was an important step forward in establishing AS as a causal risk factor for the development of distress and depression during the COVID pandemic. This adds to the considerable evidence that AS acts as a general risk factor for a broad array of negative outcomes, and it confirms that AS may play a role in exacerbating distress during the COVID pandemic, which represents both a novel and a multifaceted stressor. Future research should determine whether ameliorating elevated AS, particularly among vulnerable and highly affected individuals, can successfully reduce the development of distress and depression. Appendix A

## Author contributions

All authors have contributed to and approved the final manuscript. Dr. Norman B. Schmidt designed the initial study and took primary responsibility for writing and editing the manuscript. Danielle Morabito conducted all analyses and co-wrote the manuscript. Brittany Mathes and Alex Martin contributed to the initial study design, data collection, manuscript development, and manuscript editing.

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## Declaration of Competing Interest

The authors of this manuscript declare no conflicts of interest.

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## Appendix A

*COVID-19 Impact Battery (CIB)*

CIB-Behaviors

To what extent have you engaged in the following behaviors in response to the COVID-19 outbreak?

0 = Not at all
1 = Very little
2 = Some
3 = Much
4 = Very much

| | | | | | | |
|---|---|---|---|---|---|---|
| 1. | Stockpiling food and water | 0 | 1 | 2 | 3 | 4 |
| 2. | Stockpiling cleaning supplies | 0 | 1 | 2 | 3 | 4 |
| 3. | Stockpiling protective gear (e.g. masks, gloves) | 0 | 1 | 2 | 3 | 4 |
| 4. | Stockpiling non-essentials (e.g. toilet paper) | 0 | 1 | 2 | 3 | 4 |
| 5. | Using hand sanitizer | 0 | 1 | 2 | 3 | 4 |
| 6. | Disinfecting home | 0 | 1 | 2 | 3 | 4 |
| 7. | Disinfecting items like grocery carts before use | 0 | 1 | 2 | 3 | 4 |
| 8. | Disinfecting packages/mail | 0 | 1 | 2 | 3 | 4 |
| 9. | Avoided small group gatherings | 0 | 1 | 2 | 3 | 4 |
| 10. | Avoided hospitals/clinics | 0 | 1 | 2 | 3 | 4 |
| 11. | Avoided taxis or ride-sharing (e.g. Uber, Lyft) | 0 | 1 | 2 | 3 | 4 |
| 12. | Avoided travelling | 0 | 1 | 2 | 3 | 4 |

CIB-Worry

During this time of heightened vigilance of COVID-19, some individuals may experience worry at greater levels than others. Please read through the following items and rate how distressing each item has been to you due to the COVID-19 outbreak.

0 = Not at all
1 = Very little
2 = Some
3 = Much
4 = Very much

| | | | | | | |
|---|---|---|---|---|---|---|
| 1. | I worry I will be unable to provide for my family during this time of COVID-19 | 0 | 1 | 2 | 3 | 4 |
| 2. | I worry that I will lose my employment | 0 | 1 | 2 | 3 | 4 |
| 3. | I worry that my family will not have enough food | 0 | 1 | 2 | 3 | 4 |
| 4. | I worry that I will get sick and be unable to take care of my family | 0 | 1 | 2 | 3 | 4 |
| 5. | I worry that I am not going to get the medical attention I need | 0 | 1 | 2 | 3 | 4 |
| 6. | I worry that my family members will not receive adequate help during this time | 0 | 1 | 2 | 3 | 4 |
| 7. | I worry that I will not have enough money or access to resources to survive this time | 0 | 1 | 2 | 3 | 4 |
| 8. | I worry that if I go into quarantine, I will go crazy | 0 | 1 | 2 | 3 | 4 |
| 9. | I am worried I will not be able to handle being in quarantine | 0 | 1 | 2 | 3 | 4 |
| 10. | I worry that I am going to contract COVID-19 | 0 | 1 | 2 | 3 | 4 |
| 11. | I am worried I will lose friends due to social distancing | 0 | 1 | 2 | 3 | 4 |

CIB-Disability

This questionnaire asks about difficulties due to the COVID-19 outbreak. Think back over the *past 30 days* and answer these questions, thinking about how much difficulty you had doing the following activities.

0 = None
1 = Mild
2 = Moderate
3 = Severe
4 = Extreme or cannot do

| | | | | | | |
|---|---|---|---|---|---|---|
| 1. | Taking care of household responsibilities? | 0 | 1 | 2 | 3 | 4 |
| 2. | Joining in on community activities in the same way as others can? | 0 | 1 | 2 | 3 | 4 |
| 3. | How much have you been emotionally affected by the COVID-19 outbreak? | 0 | 1 | 2 | 3 | 4 |
| 4. | Concentrating on doing something for ten minutes? | 0 | 1 | 2 | 3 | 4 |
| 5. | Dealing with people you do not know? | 0 | 1 | 2 | 3 | 4 |
| 6. | Maintaining a friendship? | 0 | 1 | 2 | 3 | 4 |
| 7. | Your day to day work? | 0 | 1 | 2 | 3 | 4 |

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