The recent global pandemic (i.e., COVID-19) has had a serious impact on psychological health, as the stress associated with the pandemic increases the likelihood of developing clinically significant anxiety. Evidence suggests that attentional control may protect those individuals with outcome-specific vulnerabilities from developing maladaptive psychological outcomes. In the present study, attentional control was examined as a moderator of the relation between COVID-19 stress and generalized anxiety symptoms in a community sample (N = 359 adults). As predicted, the relationship between COVID-19 stress and anxiety was moderated by attentional control. Specifically, as attentional control decreased, the strength of the association between COVID-19 stress and anxiety increased. The results suggest that, among those with higher levels of COVID-19 stress, attentional control may act as a protective factor against developing anxiety. It may be beneficial as a matter of standard public health guidance to recommend that the general public engages in activities that are known to improve attentional control and alleviate emotional distress (e.g., mindfulness-based techniques) at the outset of a pandemic or other global catastrophe to reduce the likelihood that prolonged event-related stress will lead to impairing anxiety.
Keywords
Anxiety, attentional control, coronavirus, COVID-19, pandemic, stress, risk factor, protective factor

Introduction
Anxiety disorders are consistently identified as one of the most prevalent classes of psychiatric syndromes (Simpson et al., 2010) In addition to emotional suffering, individuals with anxiety (versus individuals without) experience more health problems, poorer quality of life, and greater functional impairment (Hoffman et al., 2008). Among disorder classes, anxiety disorders account for the second highest number of disability-adjusted life years (i.e., approximately 26.8 million; Whiteford et al., 2013). Unfortunately, clinically significant anxiety has nearly tripled in 2020, as the severe acute respiratory syndrome coronavirus 2 (COVID-19) pandemic has resulted in increased uncertainty and social isolation, as well as financial and family distress (Twenge & Joiner, 2020). In fact, several studies have shown that stress related to the COVID-19 pandemic is associated with significantly elevated levels of generalized anxiety and functional impairment (Gallagher et al., 2020; Lee et al., 2020; Montano & Acebes, 2020; Taylor et al., 2020a, 2020b). Elevated pandemic-related stress is not a new phenomenon; it was demonstrated during the SARS outbreak and the 2009 H1N1 pandemic (Cheng et al., 2004; Rubin et al., 2009; Wheaton et al., 2012). Although multiple effective vaccines have recently been developed to alleviate the suffering associated with COVID-19, it remains important to conduct research to better understand risk and resiliency factors for anxiety and related disorders during pandemics and other global catastrophes.

As described, several studies have shown that COVID-19 stress is associated with elevated levels of anxiety (Gallagher et al., 2020; Lee et al., 2020; Montano & Acebes, 2020; Taylor et al., 2020a, 2020b). Although nearly all of these studies have been cross-sectional in nature, some longitudinal research has been conducted in this area. For example, Magson et al. (2021) conducted a study in which adolescent participants (N = 248; M age = 14.4 years) completed measures of internalizing pathology in the 12 months prior to the pandemic (T1) and then again two months after the implementation of online learning and other government restrictions (T2). Additionally, COVID-19 stress, which consisted of items that assessed COVID-19 worries and hardships (e.g., online learning problems, conflicts with parents) in this study, was assessed at T2. As expected, anxiety and related symptoms significantly increased from T1 to T2. Importantly, those individuals who reported greater COVID-19 stress experienced significantly larger increases in anxiety from T1 to T2. Whereas elevated COVID-19 stress served as a risk factor for anxiety at T2, feeling socially
connected to friends, family, and society broadly, served as a protective factor. These findings are consistent with evidence that stay-at-home orders and social distancing (i.e., physical distancing of six feet or more) measures are associated with greater generalized anxiety and related symptoms (Marroquín et al., 2020). Given that social distancing is among the top public health recommendations in response to COVID-19 (Centers for Disease Control and Prevention, 2020), it may be particularly difficult to alleviate the impact of pandemic-related stress on anxiety by helping one to feel socially connected. It is important to consider alternate protective factors that may modulate the influence of COVID-19 stress on anxiety.

Attentional control may be one factor that is particularly relevant to the relationship between COVID-19 stress and anxiety. Attentional control is the effortful and flexible allotment of attention toward stimuli that are goal-relevant in the face of attentional demands that are conflicting and draw on more bottom-up, automatic responses tendencies (Sarapas et al., 2017). In Gross’s (1998) process model of emotion regulation, the ability to control attention in a flexible manner is important for maintaining psychological health. Specifically, volitional attention deployment is thought to serve as the gatekeeper of emotion regulation by directly impacting subsequent stages that are downstream in the emotion regulation process. Some evidence suggests that attentional control may be a transdiagnostic protective factor against maladaptive psychological outcomes (Bardeen et al., 2015). For example, attentional control reduces the likelihood that (a) the use of thought suppression and worry to alleviate emotional discomfort will result in anxiety (Fergus et al., 2012), and (b) those individuals with emotion regulation difficulties will engage in maladaptive avoidance behaviors when experiencing uncomfortable internal experiences (Bardeen et al., 2015).

Excessive conceptual processing is a hallmark feature of COVID-19 stress (e.g., worry; Taylor et al., 2020a). It may be particularly difficult for individuals experiencing excessive COVID-19-related worry and internally focused maladaptive behaviors to disengage attention from such internal experiences, especially if they also experience relative deficits in attentional control to begin with. In contrast, individuals with relatively better attentional control, may be able to use this ability to disengage from COVID-19-related worry and engage with stimuli related to more adaptive goal-relevant pursuits. Evidence suggests that using attentional control in this manner helps to reduce physiological arousal and short-term distress (Bardeen & Daniel, 2017). As such, attentional control may moderate the relationship between COVID-19 stress and anxiety.

Some preliminary evidence supports this hypothesis. Chahal et al. (2021) conducted a study in which child and adolescent participants (N = 85; 9 to 13 years old at Time 1 [T1] and 13–19 at Time 2 [T2]) completed measures of internalizing symptoms (e.g., anxiety, depression) prior to the COVID-19 pandemic (T1) and in April of 2020, during the pandemic (T2). Additionally,
participants underwent resting-state functional magnetic resonance imaging (fMRI) scanning at T1 to assess individual differences in the executive control network (ECN). The ECN is a brain network consisting of frontoparietal brain regions that support the same executive processes that underlie attentional control (e.g., set shifting, inhibition, working memory updating; Fernandez-Duque et al., 2000). Consistent with Magson et al. (2021), Chahal et al. (2021) found that internalizing symptoms increased from T1 to T2. However, this association was moderated by ECN, such that only youths with below-average ECN coherence experienced increases in internalizing symptoms from pre- to post-pandemic (T1 to T2). While this study sets the stage for the aims of the present study, it is worth noting that the relatively small sample and the fact that executive control processes were not assessed precludes making strong inferences regarding the role of these control processes in modulating the impact of COVID-19 stress on internalizing symptoms.

Based on the rationale described above, the purpose of the present study was to examine attentional control as a moderator of the relation between COVID-19 stress and anxiety. Specifically, we hypothesized that the strength of the positive relationship between COVID-19 stress and anxiety would decrease as attentional control increased. Generalized anxiety was chosen as the outcome of interest in this study because (a) there is a wealth of evidence supporting the relationship between COVID-19 stress and anxiety, and (b) preliminary evidence suggests that COVID-19 stress may be more influential in anxiety-related pathology than other commonly examined symptomatology (e.g., mood disorders; Asmundson et al., 2020). In addition, based on empirical evidence, several demographic and descriptive variables were examined as potential covariates for use in our primary analysis. For example, a diagnosis of COVID-19 at some point during the course of the pandemic (i.e., COVID diagnostic status) is associated with greater COVID-19 stress (Taylor et al., 2020a), and younger adults report significantly higher anxiety and COVID-19 stress than older participants (Jung et al., 2020; Montano & Acebes, 2020).

**Method**

**Participants**

Adult participants were recruited via an online employment market (Amazon Mechanical Turk [MTurk]). Data from MTurk samples is of high quality and these samples are more demographically diverse than samples of undergraduate students in the United States (Calkins et al., 2009; Chandler & Shapiro, 2016). Participants were required to be fluent in English, located in the United States, and between 18 and 64 years of age. To ensure the quality of the data, participants had to have completed at least 50 MTurk tasks and received at least a 95% approval rating from MTurk requesters. Additionally, participants
completed a CAPTCHA task at the beginning of the study and then provided
text responses to open-ended questions. Both of the procedures are used to aid
in the identification of “bots” (i.e., computer programs that automatically com-
plete self-report forms online; Yarrish et al., 2019). Participants that were iden-
tified as bots ($n = 33$) were excluded from further analysis. The average age of
the final sample ($N = 359$) was $37.9$ years ($SD = 10.4$), and the majority of par-
ticipants were female (50.1%). The majority of the sample identified their race as
White (78.6%), followed by Black (11.7%), Asian (6.4%), American Indian/
Alaska Native (1.4%), “other” (1.1%), and Native Hawaiian or other Pacific
Islander (0.8%). Additionally, 14.2% of the sample identified their ethnicity as
Hispanic or Latino.

**Measures**

**COVID Stress Scales (CSS).** The CSS is a self-report measure that assesses COVID-
19-related worry, maladaptive behaviors, and distress (Taylor et al., 2020b).
Participants were asked to use a 5-point scale ($0 =$ Not at all, or Never to
$4 =$ Extremely, or Almost Always) to indicate the frequency they experienced
specific COVID-19-related worries and behaviors from the following five
domains: 1) fear of the dangerousness of COVID-19 (e.g., “I am worried
about catching the virus.”), 2) worry about the socioeconomic costs of
COVID-19 (e.g., “I am worried about grocery stores running out of food”), 3)
COVID-19-related xenophobic worries (e.g., “I am worried that foreigners are
spreading the virus in my country”), 4) stress symptoms (e.g., nightmares, sleep
and concentration difficulties, intrusive thoughts) associated with vicarious or
direct exposure to COVID-19-related stressful events (e.g., “I had trouble sleep-
ing because I worried about the virus,” “Disturbing mental images about the virus
popped into my mind against my will”), and 5) COVID-19-related reassurance
seeking and compulsive checking (e.g., “Seeking reassurance from friends or
family about COVID-19”). High scores on the CSS indicate high levels of
COVID-19 stress. Despite being relatively new, the CSS has exhibited adequate
psychometric properties, including internal consistency and construct validity.
The magnitude of correlations between scores on the COVID Stress Scales and
scores on measures of general anxiety, depression, health anxiety, and obsessive
compulsive symptoms suggest that this relatively new measure assesses a con-
struct that is sufficiently distinct from these related constructs (Taylor et al.,
2020b). Moreover, COVID stress predicts criterion behaviors that are relatively
specific to COVID rather than being indicative of life stress in general (e.g.,
avoiding drug stores and supermarkets, avoiding healthcare workers, preparing
for self-isolation by stockpiling or panic buying supplies, greater use of personal
protective equipment; Taylor, 2021). The CSS demonstrated adequate internal
consistency in the present study ($\alpha = .98$, $M = 61.30$, $SD = 36.98$).
Attentional Control Scale (ACS). The ACS is a self-report measure that assesses attentional control (Derryberry & Reed, 2002). The 20 items of the ACS are rated on a 4-point scale (1 = Almost never to 4 = Always) based on the frequency each statement applies to the participant (e.g., “I can quickly switch from one task to another”). In terms of the psychometric properties of the ACS, the ACS total score has exhibited good internal consistency and concurrent validity (Derryberry & Reed, 2002). The ACS demonstrated adequate internal consistency in the present study (α = .80, M = 53.96, SD = 8.65).

Generalized Anxiety Disorder Scale-7 (GAD-7). The GAD-7 is a 7-item self-report measure of GAD symptoms (e.g., “Not being able to stop or control worrying,” “Trouble relaxing”; Spitzer et al., 2006). The GAD-7 instructs participants to use a 4-point scale (0 = not at all to 3 = nearly every day) to estimate how often, during the last two weeks, they have been bothered by each symptom. High scores are indicative of high levels of generalized anxiety symptoms. In terms of the psychometric properties of the GAD-7, the GAD-7 total score has exhibited adequate internal consistency, retest reliability, and convergent, discriminant, and criterion-related validity (Kertz et al., 2013; Spitzer et al., 2006). The GAD-7 demonstrated adequate internal consistency in the present study (α = .93, M = 6.40, SD = 5.81).

Procedure

The local institutional review board approved study procedures prior to data collection. Participants could complete informed consent and self-report measures from any computer device with internet access. A secure online survey program was used to collect data on December 3rd, 2020. Self-report measures were presented in a random fashion. Participants were debriefed and compensated with $1.50 after completing self-report measures. This level of financial compensation is consistent with amounts paid to participants in studies with similar completion durations (Crump et al., 2013).

Results

Preliminary analyses

Bivariate correlations were calculated to examine the association between demographics (e.g., age, sex, race/ethnicity, COVID-19 diagnosis status) and variables of interest and aid in identification of covariates. Race and ethnicity were collapsed into a single dummy coded variable (coded as non-Hispanic White [n = 251, 69.9%] versus Hispanic and/or non-White [n = 108, 30.1%]). As expected, generalized anxiety was significantly associated with COVID stress (r = .63, p < .001) and attentional control (r = -.47, p < .001). Additionally, COVID stress and attentional control were significantly associated (r = -.35,
Approximately 14% of the sample \((n = 51)\) reported being diagnosed with COVID-19 at some point during the course of the pandemic. COVID diagnostic status was significantly associated with COVID stress \((r = .34, p < .001)\), anxiety \((r = .34, p < .001)\) and attentional control \((r = -.15, p = .004)\). Specifically, participants who reported that they had been diagnosed with COVID-19 report high COVID stress and anxiety, and relatively low attentional control. Additionally, age was significantly associated with anxiety \((r = -.14, p = .009)\) and COVID stress \((r = -.18, p < .001)\), and race/ethnicity was significantly associated with COVID stress \((r = .14, p < .009)\). In other words, older participants reported significantly lower anxiety and COVID stress than younger participants, and participants who self-identified as White and non-Hispanic reported significantly lower COVID stress than participants who self-identified as a race other than White or as of Hispanic ethnicity. As such, the COVID-19 diagnostic status, age, and race/ethnicity served as covariates in the following analyses.

**Primary analyses**

Regression analysis was used to test the hypothesis that attentional control would moderate the relation between COVID stress and anxiety. The predictor (i.e., COVID stress) and moderator (i.e., attentional control) variables were centered on the mean and the product of the moderator and predictor variable served as the interaction term (Aiken et al., 1991). Covariates were entered in the first step of the model, the predictor and moderator variables were entered in the second step of the model, and the interaction term was entered in the third step of the model. Simple slopes analysis was used to explore the significant interaction (Aiken et al., 1991). In simple slopes analysis, the association between the predictor and the outcome variable is examined at both high (+1 SD) and low (−1 SD) levels of the moderator variable (i.e., attentional control).

As can be seen in Table 1, COVID-19 diagnostic status, race/ethnicity, COVID-19 stress, and attentional control predicted anxiety \((ps < .05)\), but age did not \((p = .32)\). Importantly, the interaction term (COVID stress x attentional control) significantly predicted anxiety \((p < .001)\). Simple slopes analysis revealed a positive association between COVID stress and anxiety that was significantly stronger at lower \((β = .66, p < .001)\), versus higher \((β = .32, p < .001)\), levels of attentional control (see Figure 1).

**Discussion**

The primary purpose of the present study was to test the hypothesis that attentional control would moderate the relationship between COVID-19 stress and generalized anxiety symptoms. As predicted, a moderation effect was observed in which the strength of the positive relationship between COVID-19 stress and anxiety decreased as attentional control increased. The interaction predicted
generalized anxiety even after controlling for age, race/ethnicity, and COVID-19 diagnostic status. These results are consistent with a growing body of evidence that attentional control may be a transdiagnostic protective factor against maladaptive psychological outcomes, even among those individuals who have vulnerabilities for developing such outcomes (Bardeen et al., 2015; Bardeen & Fergus, 2016, 2018; Fergus et al., 2012; Jones et al., 2012; Richey et al., 2012; Thomas & Bardeen, 2020). In combination with evidence that attentional control can be used to reduce physiological arousal and alleviate emotional distress in the short-term (Bardeen & Daniel, 2017), the results of the present study may be best understood by considering the role of attentional control in emotion regulation. Specifically, the ability to shift attention from internal (e.g., COVID-19-related worry) and external (e.g., COVID-19-related news) pandemic-relevant stimuli may help to reduce

Table 1. Regression analysis with generalized anxiety as the outcome variable.

<table>
<thead>
<tr>
<th>Predictor</th>
<th>ΔR²</th>
<th>Step 1 B</th>
<th>Step 1 β</th>
<th>Step 2 B</th>
<th>Step 2 β</th>
<th>Step 3 B</th>
<th>Step 3 β</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 diagnosis status</td>
<td>.13***</td>
<td>.34***</td>
<td>2.37</td>
<td>.14***</td>
<td>2.09</td>
<td>.13**</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>−.07</td>
<td>−.12*</td>
<td>−.01</td>
<td>−.02</td>
<td>−.02</td>
<td>−.04</td>
<td></td>
</tr>
<tr>
<td>Race/Ethnicity</td>
<td>−.61</td>
<td>−.05</td>
<td>−1.02</td>
<td>−.08*</td>
<td>−1.08</td>
<td>−.09*</td>
<td></td>
</tr>
<tr>
<td>COVID Stress</td>
<td>.36***</td>
<td>.50***</td>
<td>.08</td>
<td>.49***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attentional Control (AC)</td>
<td></td>
<td></td>
<td>−.19</td>
<td>−.28***</td>
<td>−.24</td>
<td>−.35***</td>
<td></td>
</tr>
<tr>
<td>COVID Stress X AC</td>
<td></td>
<td>.02***</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. N = 359.
* p < .05. ** p < .01. *** p < .001.

Figure 1. Moderating effect of attentional control (AC) on the relationship between COVID stress and anxiety.
sympathetic nervous system arousal, and emotional distress more broadly, which in turn, may increases engagement in more adaptive goal-relevant activities that are more likely to induce positive affect (à la behavioral activation; Jacobson et al., 2001).

The present study is not without limitations. The dimensional, rather than categorical, approach for assessing generalized anxiety symptoms that was used in this study is consistent with empirical evidence. Additionally, evidence suggests that MTurk is an appropriate platform to conduct clinical research and MTurk participants tend to report clinical symptoms (e.g., anxiety and depressive symptoms) to a significantly higher degree than participants from other commonly used convenience samples (Arditte et al., 2016; Chandler & Shapiro, 2016). This is consistent with the fact that a considerable proportion of the sample reported the presence of clinically relevant generalized anxiety symptoms (i.e., approximately 29% using the GAD-7 cut score of 10; Spitzer et al., 2006). Moreover, the quality control methods that were used in the present study have been shown to improve study data (e.g., identifying and removing bot responses; Peer et al., 2014; Yarrish et al., 2019). For example, Paolacci and Chandler’s (2014) recommendation to restrict MTurk worker approval ratings was used and this method has been shown to result in similar levels of data quality in comparison with using catch questions or attention checks (Peer et al., 2014). Despite these methodological strengths, findings from the present study should be replicated in clinical samples with more severe symptomatology to ensure that these findings generalize to individuals who meet diagnostic criteria for an anxiety disorder. Also of note, MTurk samples tend to be less diverse and more highly educated than the general population. As such, findings from the current study should be replicated in samples with more ethno-racial and socio-economic diversity in future research.

Despite longitudinal evidence showing that COVID-19 stress precedes increases in anxiety (Chahal et al., 2021; Montano & Acebes, 2020), the cross-sectional nature of this study does not allow us to make causal inferences. Instead, the results of this study highlight that the aggregate effect of the interaction (i.e., higher COVID-19 stress and lower attentional control) may be detrimental to generalized anxiety. Therefore, future research should use experimental and longitudinal study designs to clarify the temporal relations among study variables. Another potential limitation of this study is the way in which attentional control was assessed. Some have suggested that the ACS may assess beliefs about attentional control rather than actual attentional control abilities (Spada et al., 2010). Although there is some evidence that the ACS is significantly associated with performance-based measures of attentional control processes, (e.g., Judah et al., 2014), some studies have failed to replicate these findings (e.g., Quigley et al., 2017). As such, behavioral measures of attentional control should be used in this line of research in the future to ensure that the moderation effect of interest is the result of actual, rather than perceived, ability.
In addition, attentional control is thought to be supported by three top-down cognitive processes, which include inhibition, working memory updating, and set-shifting (Fernandez-Duque et al., 2000). These processes can be assessed in future studies in this line of research through the use of established behavioral assessments to determine whether one or more of these processes underlies the effect observed in the present study. Identifying the specific cognitive processes that moderate the effect of COVID-19 stress on anxiety may aid in the development of process-specific interventions.

The present study is the first to provide evidence that attentional control moderates the effect of COVID-19 stress on anxiety. Individuals with relative deficits in attentional control, who experience high levels of stress during a pandemic, may be at high risk of developing clinical levels of anxiety. Identifying those individuals who are at high risk is important because of the negative emotional, social, and economic impact that is associated with anxiety. Individuals who are identified as being at high risk, perhaps through mass screening procedures, can be given the option of receiving early intervention before the development of clinically significant anxiety. Moreover, it may be beneficial as a matter of standard public health guidance to recommend that the general public engages in activities that are known to improve attentional control (e.g., mindfulness training techniques; Bherer et al., 2008; Zylowska et al., 2008) at the outset of a pandemic to reduce the likelihood that pandemic-related stress will lead to anxiety. However, given the cross-sectional nature of this study, it will be important to extend the results of the present study using longitudinal and experimental study designs before changing treatment or public policy guidelines.

Declaration of Conflicting Interests
The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding
The author(s) received no financial support for the research, authorship, and/or publication of this article.

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Note
1. When the covariates (i.e., age, race/ethnicity, COVID-19 diagnosis status) were removed from the primary regression model, the pattern of effects was unchanged. Specifically, COVID stress, attentional control, and the interaction term significantly predicted generalized anxiety symptoms ($b$s = .49, -.35, and -.17, respectively, $ps < .001$).
References


**Author Biographies**

**Joseph R. Bardeen**, is an associate professor and director of the Trauma and Anxiety Research Laboratory at Auburn University. Under his guidance, graduate students in clinical psychology conduct cutting-edge research to better understand how anxiety- and fear-related disorders develop and how they can be treated. Dr. Bardeen has 80+ scientific publications to his credit and his research has been funded by the National Institute of Mental Health since 2017.

**Julia Y. Gorday**, is a second-year graduate student in the Clinical Psychology PhD program in the Department of Psychological Sciences at Auburn University. Julia is interested in cognitive factors that impact the etiology and maintenance anxiety disorders (e.g., repetitive negative thinking, information processing biases). Julia’s long-term goals include the development of interventions that target risk factors to mitigate anxiety and fear-based symptoms.

**Kate Clauss**, is a fifth-year graduate student in the Clinical Psychology PhD program in the Department of Psychological Sciences at Auburn University. She graduated from the University of North Carolina Wilmington with her Master’s degree in Psychological Science in May, 2017. Kate is interested in cognitive factors that influence trauma-related psychopathology and the application of cognitive research to interventions for trauma-related distress.