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The Buffering Effect of Attentional Control on the Relationship between Cognitive Fusion and Anxiety

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Abstract

Cognitive fusion has been identified as a risk factor for anxiety. Evidence suggests that those with better attentional control may be able to flexibly shift attention from an internal to external focus, thus reducing contact with negative self-referent thoughts. As such, attentional control was examined as a moderator of the relation between cognitive fusion and anxiety in this two-part study. Adult participants ($N = 597$) completed self-report measures in Study 1. In Study 2, adult student participants ($N = 173$) completed self-report measures of cognitive fusion and anxiety, as well as behavioral measures that assessed three specific attentional control processes (i.e., inhibition, shifting, working memory updating). As predicted, attentional control moderated the relation between cognitive fusion and anxiety such that the strength of the relation decreased as attentional control increased. The results of Study 2 suggest that inhibitory ability is the attentional control process that accounts for this effect. Taken together, results suggest the possibility that attentional control (especially inhibitory ability) may be a protective factor against the development of anxiety among those with higher levels of cognitive fusion. The use of experimental and longitudinal study designs will be an important next step in this line of research to further clarify the nature of relations among cognitive fusion, attentional control, and anxiety. Results from an exploratory analysis, in which depressive symptoms served as the outcome variable, will also be discussed.

**Keywords:** attentional control, cognitive fusion, anxiety, depression, inhibition, inhibitory, top-down
1. Introduction

The 12-month prevalence of any anxiety disorder for adults in the United States is approximately 19%, with approximately 31% of adults experiencing an anxiety disorder at some point in their lives (National Institute of Mental Health, 2017). These estimates do not include individuals who live with symptoms of anxiety that fall below diagnostic thresholds even though these individuals may experience functional impairment and quality of life decrements that are comparable to those who meet full criteria for an anxiety disorder diagnosis (Barrera & Norton, 2009; Olatunji, Cisler, & Tolin, 2007). The economic burden of anxiety disorders is staggering, resulting in a direct cost of approximately 40 billion dollars per year in the United States, which does not take into account indirect costs such as work-related productivity (DuPont et al., 1996; Greenberg et al., 1999). There are a number of effective evidence-based treatments available to those suffering from anxiety, though for a sizeable proportion of those who seek help, these treatments are not effective and/or have high drop-out rates (Carpenter et al., 2018; Herbert et al., 2018; Springer, Levy, & Tolin, 2018; Twohig & Levin, 2017). Given the substantial suffering associated with anxiety, as well as the financial and societal burden resulting from anxiety-related behaviors, it is important to identify risk and protective factors that contribute to the development and maintenance of anxiety.

One factor that has recently been implicated as an important target in third-wave, acceptance-based treatments for anxiety is cognitive fusion. Cognitive fusion is the psychological phenomenon by which thoughts are not viewed as transient internal states, but instead, individuals believe the literal meaning of their thoughts (Hayes, 2016). For example, an individual who has a specific phobia related to small spaces may have the thought that they are suffocating when confined to a small space. If this person is fused to this thought, they will
experience the psychological suffering associated with suffocating. Alternatively, cognitive defusion is a way of changing how one relates to their thoughts in order to lessen the influence of those thoughts on the person’s behavior (Twohig, 2012). Previous research has demonstrated that cognitive defusion, used both on its own and as a component of larger treatment packages (e.g., Acceptance and Commitment Therapy [ACT]) positively impacts treatment outcomes for individuals with mood and anxiety disorders (Arch, Wolitzky-Taylor, Eifert, & Craske, 2012; Barrera, Szafranski, Ratcliff, Garnaat, & Norton, 2016; Twohig & Levin, 2017). Cognitive defusion is one component of third-wave, acceptance-based treatments that distinguishes it from first- and second-wave cognitive behavioral therapies and contributes uniquely to positive treatment outcomes (Forman et al., 2012; Levin, Hildbrandt, Lillis, & Hayes, 2012). Notably, while initial evidence suggests that cognitive fusion seems to be broadly related to mood and anxiety disorder symptoms (Fergus, 2015; Gillanders et al., 2014), the conditions under which cognitive fusion relates to these forms of pathology has received relatively little attention in the extant literature.

Attentional control is one factor that may be particularly relevant to the relationship between cognitive fusion and anxiety. Attentional control is the purposeful and flexible allocation of attention toward goal-relevant stimuli in the face of conflicting prepotent attentional demands that draw on more automatic responses tendencies (Sarapas, Weinberg, Langenecker, & Shankman, 2017). Theory and empirical evidence suggest that attentional control can be used to reduce emotional distress and threat-related physiological arousal (Bardeen & Daniel, 2017a; Zelazo & Cunningham, 2007). Researchers have identified three cognitive processes as being central to attentional control: (a) inhibition of prepotent task-irrelevant stimuli and associated responses, (b) flexibly orienting of attention toward task-relevant stimuli (i.e., shifting), and (c)
updating working memory (Eysenck, Derakshan, Santos, & Calvo, 2007; Miyake, Friedman, Emerson, Witzki, & Howarter, 2000). Evidence suggests that these three top-down cognitive processes belong to the same overarching higher-order factor (i.e., attentional control) and are also sufficiently distinct to be assessed on their own (Miyake et al., 2000).

While research examining the effects of cognitive fusion on anxiety symptoms is in its early stages, the relationship between attentional control and anxiety has been more frequently studied (Booth & Peker, 2017; Derryberry & Reed, 2002; Eysenck et al., 2007; Shi, Sharpe, & Abbott, in press). Self-reported attentional control and anxiety have been shown to be inversely related in a number of studies (e.g., Albanese et al., 2018; Fergus, Bardeen, & Orcutt, 2011; Liang, 2018; Spada, Georgiou, & Wells, 2010). In addition to cross-sectional associations, evidence from longitudinal research suggests that attentional control deficits put one at risk for developing anxiety-related pathology (Bardeen, Fergus, & Orcutt, 2015).

It may be important to consider the role that attentional control plays in the relationship between cognitive fusion and anxiety. The intrusive thoughts to which people are commonly fused tend to be more difficult to disengage from than other types of internal experiences (Clark & Purdon, 1995). However, some evidence suggests that through use of techniques designed to improve attentional control (i.e., the attention training technique, Wells, 1990), individuals with high trait worry can more easily shift attention from an internal to external focus, which results in a reduction in anxiety (Fergus & Wheless, 2018). This is consistent with theory (i.e., Attentional Control Theory; Eysenck et al., 2007) and a wealth of evidence from the anxiety literature showing that, even among those with relatively higher anxiety and anxiety-related distress, individuals with relatively better attentional control can disengage and shift attention away from threat stimuli faster than those with relatively worse attentional control (Bardeen &
Daniel, 2017a; Bardeen & Orcutt, 2011; Bardeen et al., 2016; Ho, Yeung, & Mak, 2016; Taylor, Cross, & Amir, 2015). Preliminary evidence suggests that disengaging from threat in this manner down-regulates physiological arousal and alleviates short-term emotional distress (Bardeen & Daniel, 2017a). As such, attentional control may reduce the impact of cognitive fusion on anxiety.

Based on this rationale, and in line with attentional control theory (Eysenck et al., 2007), the primary outcome of interest in the present set of studies is anxiety. However, some have suggested a somewhat similar rationale that may apply to depressive symptoms. Unlike the literature on attentional control and anxiety, the corresponding depression literature does not draw its theoretical basis from attentional control theory. Nor does it consider the relevance of threat-related arousal. Instead, some have suggested that those who have greater difficulty disengaging from ruminative thoughts, may be more likely to experience prolonged negative affect and depressed mood (Joormann & Gotlib, 2010; Joorman & Quinn, 2014). Following from this logic, we included depression as a second outcome of interest. However, we chose to consider this an exploratory aim, with no a-priori hypotheses, because of the relative dearth of research in which attentional control has been examined as a moderator of the relation between vulnerability factors for depression and depressive symptoms. If the moderation effect of interest is observed consistently for both outcomes (i.e., anxiety and depression) it might suggest that the effect has trandagnostic value.

1.1. Study 1

The primary purpose of Study 1 was to examine attentional control as a moderator of the relationship between cognitive fusion and anxiety. Consistent with previous research (Barrera et al., 2016; Gillanders et al., 2014), we expected that cognitive fusion would evidence a strong
positive association with anxiety. However, based on the logic described above, we expected this main effect to be qualified by a significant interaction between attentional control and cognitive fusion in predicting anxiety. Specifically, we expected that the positive association between cognitive fusion and anxiety would become increasingly stronger as attentional control abilities decreased. As mentioned above, attentional control was also examined as a moderator of the relationship between cognitive fusion and depressive symptoms in a post-hoc exploratory analysis.

2. Methods

2.1. Participants and Procedure

Participants ($N = 597$) were recruited via Amazon Mechanical Turk (MTurk) to complete a battery of self-report measures. MTurk is an online platform that provides potential participants with the opportunity to participate in research studies for financial compensation. Researchers have found MTurk to be a reliable source of quality data with a participant pool similar to the general population and more diverse than student samples (Behrend, Sharek, Meade, & Wiebe, 2011; Chandler & Shapiro, 2016). Additional research has indicated that MTurk workers are more attentive than participants from collegiate subject pools (Hauser & Schwarz, 2016). The average age of participants was 35.22 years ($SD = 10.83$, range 19 to 65). The majority of the sample was female (58.3%) and identified as white (81.1%). Individuals also identified themselves as Asian (8.4%), Black (7.5%), American Indian/Alaska Native (1.7%), and “Other” (1.3%). Additionally, 7.7% of the sample also identified their ethnicity as Hispanic or Latinx.

Research procedures were approved by the local Institutional Review Board prior to recruitment. Participants could complete the study from any computer with internet access via Qualtrics, a secure online survey platform. Participants were paid $1.50 to complete the
questionnaire battery, which was consistent with amounts paid to participants in studies of similar lengths (Buhrmester, Kwang, & Gosling, 2011; Crump, McDonnell, & Gureckis, 2013).

2.2. Self-Report Measures

The Cognitive Fusion Questionnaire (CFQ; Gillanders, et al., 2014) is a 7-item self-report measure of the degree to which one experiences their thoughts as literal truth rather than transient internal stimuli. Each item is rated on a 7-point scale based on the degree to which participants believe that each item pertains to them (e.g., “I tend to get very entangled in my thoughts”). Higher scores are indicative of greater cognitive fusion. Internal consistency for the CFQ in this study was excellent ($\alpha = .96$, $M = 21.11$, $SD = 10.80$, range = 7 to 49). Previous research has demonstrated adequate internal consistency, test-retest reliability, and validity (Gillanders et al., 2014).

The short form of the Attentional Control Scale (ACS; Derryberry & Reed, 2002; Judah Grant, Mills, & Lechner, 2014) was used to measure participants’ ability to focus, shift, and flexibly control attention. The measure consists of 12 items rated on a four-point scale ranging from “almost never” to “always.” Examples of ACS items include “I can quickly switch from one task to another” and “When I am working hard on something, I still get distracted by events around me.” Higher scores on the ACS are indicative of relatively better attentional control. The 12-item ACS total score has exhibited adequate psychometric properties, including internal reliability and concurrent validity (Judah et al. 2014). Internal consistency for the ACS total score was high in the current sample ($\alpha = .85$, $M = 33.68$, $SD = 6.77$, range = 14 to 48).

The Depression, Anxiety, and Stress Scales-21 (DASS-21; Lovibond & Lovibond, 1995) was used to assess anxiety and depression symptoms over the past week. Fourteen items of the DASS-21 assess anxiety (e.g. “I was worried about situations in which I might panic and
make a fool of myself”) and depression (e.g. “I couldn’t seem to experience any positive feeling at all). Items are rated on a 4-point scale (0 = Did not apply to me at all to 3 = Applied to me very much, or most of the time). The DASS-21 Anxiety and Depression Scales have shown adequate psychometric properties, including convergent validity (Antony, Bieling, Cox, Enns, & Swinson, 1998) and the ability to discriminate between anxiety and mood disorders (Brown, Chorpita, Korotitsch, & Barlow, 1997). Additionally, the DASS-21 Anxiety and Depression Scales are well suited for use in nonclinical samples because the factor structure and performance of items are consistent across clinical and nonclinical participants (Antony, Bieling, Cox, Enns, & Swinson, 1998; Crawford & Henry, 2003). Internal consistency was excellent for both the DASS-21 Anxiety (α = .90, M = 3.45, SD = 4.63, range = 0 to 21) and Depression (α = .94, M = 4.71, SD = 5.59, range = 0 to 21) Scales in the current sample.

2.3. Results

An a-priori power analysis, based on precedent for the proposed interaction (i.e., effect size of a cognitive fusion by attentional control interaction), was not feasible because no such precedent exists. As such, we conducted a power analysis based on the conservative assumption that the proposed interaction would be small in size (i.e., $f^2 \geq 0.02$). Power analysis (G*Power 3.1 software; Faul et al., 2009) suggested that a sample size of 391 would provide sufficient power (i.e., 0.80) to detect a small interaction effect (i.e., $f^2 \geq 0.02$) with three predictors in the model when alpha was set at .05. We oversampled by 30% to increase the likelihood of detecting the effect should we decide to explore additional predictor variables in the same model.

Zero-order correlations were calculated for Study 1 variables (see Table 1). Next, a hierarchical regression was conducted to test the hypothesis that attentional control would moderate the relationship between cognitive fusion and anxiety. Predictor variables (i.e.,
cognitive fusion and attentional control) were mean centered and entered into the first step of the model (Aiken & West, 1991). DASS-21 Anxiety served as the outcome variable. An interaction term, calculated as the product of the centered predictors (cognitive fusion and attentional control) was entered as a predictor variable in the second step of the model. Significant interaction effects were further explored via simple slopes analysis (Aiken & West, 1991).

Simple slopes analysis consists of constructing two simple regression equations in which the relationship between the predictor variable and the outcome variable is tested at both high (+1 SD) and low (-1 SD) levels of the moderating variable (i.e., attentional control).

In the first step of the regression model, attentional control ($\beta = -.08$, $p = .04$) and cognitive fusion ($\beta = 0.58$, $p < .001$) significantly predicted anxiety ($R^2 = .39$, $p < .001$). As predicted, the interaction term (cognitive fusion by attentional control) significantly predicted DASS-21 Anxiety ($\beta = -.07$, $p = .045$) and accounted for a significant amount of unique variance in this outcome variable ($\Delta R^2 = .004$, $p = .045$). Results of the simple slopes analysis indicated that the association between cognitive fusion and anxiety was significantly stronger at low ($\beta = .63$, $p < .001$), versus high ($\beta = .51$, $p = .001$), levels of attentional control. The interaction effect was small in size (Cohen’s $f^2 = .01$; Aiken & West, 1991).

This regression analysis was conducted a second time with the only difference in models being that depression replaced anxiety as the outcome to address the secondary exploratory aim of this study. In the first step of the regression model, attentional control ($\beta = -.12$, $p = .001$) and cognitive fusion ($\beta = .64$, $p < .001$) significantly predicted DASS-21 Depression. In the second step of the model, the interaction term significantly predicted DASS-21 Depression ($\beta = -.07$, $p = .018$) and accounted for a significant amount of unique variance in this outcome variable ($\Delta R^2 = .005$, $p = .018$). Results of the simple slopes analysis indicated that the relationship between
cognitive fusion and DASS-21 Depression was significantly stronger at low ($\beta = .69, p < .001$), versus high ($\beta = .57, p < .001$), levels of attentional control. The interaction effect was small in size (Cohen’s $f^2 = .01$; Aiken & West, 1991).

3. Study 1 Discussion

As predicted, attentional control moderated the relationship between cognitive fusion and anxiety. The pattern of relations indicated that as attentional control decreased, the strength of the association between cognitive fusion and anxiety increased. This result is consistent with a conceptualization in which individuals with relatively worse attentional control may not be able to flexibly shift attention from an internal to external focus, thus reducing contact with negative self-referent thoughts and increasing goal-directed behavior. Alternatively, relatively better attentional control appears to buffer the effect of cognitive fusion on anxiety. The results of our exploratory analysis with depression as the outcome variable resulted in a similar pattern of findings. This suggests the possibility that the interaction effect of interest may have transdiagnostic value. These findings may be especially valuable when considered in the context of previous research, which has suggested that attentional control is malleable and can be improved over time with training (Knowles, Foden, El-Deredy, & Wells, 2016). If these effects are replicated in future research, it may be important to consider attentional control as a treatment target to reduce the impact of cognitive fusion on anxiety.

One important limitation of this study is that attentional control was assessed via self-report. It might be especially difficult for participants to report on cognitive processes that can occur so rapidly as to go unnoticed on a moment-by-moment basis. In fact, some have suggested that self-report measures of attentional control may be a better indicator of beliefs about attentional control rather than providing an index of attentional control ability (Spada et al.,
2010). Additionally, as described above, attentional control relies on three underlying cognitive processes: inhibition, shifting, and working memory updating. As such, it seems important to assess attentional control processes using objective measures to (a) ensure that ability is being assessed rather than beliefs about ability, and (b) identify the specific attentional control process(es) that account for the observed moderation effect.

4. Study 2

The purpose of Study 2 was to address the limitation of assessing attentional control via self-report. Consistent with previous research (Bardeen & Daniel, 2017a), we included performance-based measures of the three top-down cognitive processes that are thought to underlie the attentional control construct to address this limitation (i.e., inhibitory ability, set shifting, working memory updating). Among these three cognitive processes, inhibitory ability has stood out in previous research as being central to the modulatory effect of attentional control on relations among anxiety-related vulnerability factors and anxiety (Bardeen & Daniel, 2017a; Gorlin & Teachman, 2015). Additionally, some evidence suggests inhibition may be the attentional control process primarily responsible for prolonged rumination among those who are depressed (Joormann & Gotlib, 2010). However, it is important to note that while inhibitory ability has emerged as relevant in previous research, shifting and working memory updating have received less attention and are also important to consider, especially within the context of an unexplored interaction effect (i.e., cognitive fusion by attentional control) on anxiety and depression. Based on preliminary evidence from the existing literature, we tentatively predicted that inhibitory ability would stand out as driving the interaction effects observed in Study 1.

5. Methods

5.1. Participants
As part of a larger study (Bardeen & Daniel, 2017b), participants (N = 173) were recruited via an undergraduate research pool at a large southeastern university. Participants were considered eligible if they were between the ages of 18-64, fluent in English, and had no visual impairments. The average age of the sample was 20.53 years (SD = 3.39, range 19 to 55). The majority of the sample was female (72.8%) and identified as white (90.6%). Individuals also identified themselves as Black (5.0%), Asian (1.7%), American Indian/Alaska Native (1.1%), and “Other” (1.7%). Additionally, 4.4% of participants identified their ethnicity as Hispanic or Latinx.

5.2. Self-Report Measures

As in Study 1, participants completed the Cognitive Fusion Questionnaire (CFQ; Gillanders et al., 2014), and the Depression, Anxiety, Stress Scales-21 (DASS-21; Lovibond & Lovibond, 1995). In the current sample, the CFQ (α = .93) and DASS-21 Anxiety (α = .80) and Depression (α = .88) Scale scores exhibited adequate internal consistency (α = .93 and .80, respectively). Descriptive statistics are similar to that which was observed in Study 1 (CFQ total score: $M = 22.92$, $SD = 9.71$, range = 7 to 49; DASS-21 Anxiety Scale total score: $M = 3.14$, $SD = 3.60$, range = 0 to 16; DASS-21 Depression total score: $M = 2.66$, $SD = 3.53$, range = 0 to 19).

5.2. Assessing Attentional Control Processes

Participants completed a battery of computerized cognitive tasks designed by Lumos Labs, Inc. to assess cognitive abilities relevant to attentional control. Each task was modeled after commonly used neuropsychological assessment measures. There is extensive psychometric evidence to support the use of these measures in their original forms. Importantly, the computerized versions have also exhibited adequate psychometric properties, including retest reliability and convergent and discriminant validity (see Morrison, Simone, Ng, & Hardy, 2015).
Digital Symbol Coding. The digit symbol coding task is a measure of working memory based on Digit Symbol Substitution (Jaeger, 2018; Royer, 1971). Participants are provided with a legend of digit-symbol pairs at the top of the computer screen throughout the task. During each trial, one symbol appears at the bottom of the screen and the participant is instructed to enter the corresponding number as quickly and accurately as possible. Raw scores for this task were calculated as the number of correct trials minus the number of incorrect trials ($M = 51.87$, $SD = 9.70$, range = 36 to 97).

Attentional Cuing. Participants completed an attentional cuing task based on Posner’s (1980) cuing task. The task consisted of 100 trials during which an arrow pointing either left or right appeared at the center of the computer screen for approximately 500ms. After the arrow disappeared, a star appeared on either the left or right side of the screen. Participants were instructed to use the arrow keys on the keyboard to indicate the location of the star on the screen as quickly and accurately as possible. The task consists of 80% congruent trials in which the star appears on the side of the screen indicated by the arrow and 20% incongruent trials in which the star appears in the position opposite the arrow’s direction. Difference scores (reaction time on congruent trials minus reaction time on incongruent trials) serve as an indicator of attentional inhibition ($M = 23.45$, $SD = 68.46$, range = -157 to 195).

Trail Making. The Trail Making Test, one of the most commonly used neuropsychological assessments measures (Army Individual Test Battery [AITB], 1944), serves as a measure of set-shifting or task-switching (Sanchez-Cubillo et al., 2009). The task consists of two parts (A and B). Part A requires the participant to connect numbers (1-24; part A), in order, as quickly as possible. Part B requires the participant to connect numbers and letters, in order (i.e., 1 to A, 2 to B, etc.), as fast as possible. A difference score (part B raw score minus part A
raw score) was calculated for use in the present study as a measure of set-shifting (M = 14,974.42, SD = 9,191.97, range = 1,252 to 52,305).

5.3. Procedure and Equipment

All study tasks were completed in a single laboratory session conducted in a private room. Participants completed informed consent, a battery of self-report measures, and a computerized battery of cognitive tasks. Following the completion of all study tasks, participants were debriefed and given credit for the psychology course of their choosing. Self-report and performance-based measures were completed on a Hewlett-Packard Z230 desktop computer with a 24-inch BenQ XL2430 monitor. Self-report measures were presented via the Qualtrics interface (http://www.qualtrics.com/).

6. Results

As in Study 1, an a-priori power analysis, based on precedent for the proposed interaction effects (i.e., effect size of cognitive fusion by three attentional control processes [assessed via performance based tasks]) was not feasible because no such precedent exists. Sample size for this laboratory study was primarily the result of practical considerations (completion of data collection over the course of two academic semesters). Zero-order correlations were calculated for Study 2 variables (see Table 1).

A hierarchical regression was conducted to test the hypothesis that the cognitive processes underlying attentional control would moderate the relationship between cognitive fusion and anxiety. Predictor variables (i.e., cognitive fusion, attentional inhibition, working memory, and task switching) were mean centered and entered into the first step of the model (Aiken & West, 1991). DASS-21 Anxiety served as the outcome variable. Three interaction terms, calculated as the product of cognitive fusion with each of the other three centered
predictors (e.g., inhibition, switching, working memory updating) were entered as predictor variables in the second step of the model. Significant interaction effects were further explored via simple slopes analysis (Aiken & West, 1991).

In the first step of the regression model, cognitive fusion ($\beta = .43, p < .001$) significantly predicted DASS-21 Anxiety ($R^2 = .19, p < .001$), while inhibition ($\beta = .09, p = .22$), working memory ($\beta = .02, p = .82$), and task switching ($\beta = -.03, p = .70$) were not significant predictors.

In the second step of the regression model, the interaction between cognitive fusion and inhibition significantly predicted DASS Anxiety ($\beta = .15, p = .04$), while the interactions between cognitive fusion and working memory ($\beta = .02, p = .82$) and cognitive fusion and task shifting ($\beta = -.03, p = .70$) did not. Results of the simple slopes analysis indicated that the association between cognitive fusion and anxiety was significantly stronger at low ($\beta = .58, p = < .001$), compared to high ($\beta = .29, p = .005$), levels of inhibitory ability. The interaction effect was small in size (Cohen’s $f^2 = .03$; Aiken & West, 1991).

An additional hierarchical regression was conducted to explore the effect of the cognitive processes underlying attentional control on the relationship between cognitive fusion and depression. In the first step of the regression model, cognitive fusion ($\beta = .55, p < .001$) significantly predicted DASS-21 Depression ($R^2 = .30, p < .001$), while inhibition ($\beta = .06, p = .35$), working memory ($\beta = -.05, p = .45$), and task switching ($\beta = .03, p = .70$) were not significant predictors. In the second step of the regression model, none of the interactions between cognitive fusion and inhibition ($\beta = .06, p = .41$), working memory ($\beta = .07, p = .27$), or task shifting ($\beta = .04, p < .57$) significantly predicted DASS-21 Depression.

7. Study 2 Discussion
Concerns about the limitations of assessing attentional control via self-report were addressed in Study 2 by capturing three different components of attentional control with performance-based measures. As predicted, inhibitory ability was the component of attentional control that moderated the relationship between cognitive fusion and anxiety. Specifically, as level of inhibitory ability decreased, the strength of the association between cognitive fusion and anxiety increased. This pattern of effects is consistent with that which was observed in Study 1 when a self-report measure was used to assess the larger construct of attentional control. Interestingly, none of the performance-based measures of the three top-down cognitive processes that underlie the attentional control construct moderated the relationship between cognitive fusion and depression. This is inconsistent with the effect that was observed in Study 1 when attentional control was assessed via self-report.

8. General Discussion

The primary purpose of this set of studies was to examine attentional control as a moderator of the relationship between cognitive fusion and anxiety. As predicted, a buffering effect was observed between cognitive fusion and anxiety for those with relatively higher levels of attentional control, while this relationship was stronger for those with relatively lower attentional control. Importantly, the effect of interest was replicated when performance-based measures of the components of attentional control were used instead of assessing attentional control via self-report. As predicted, inhibitory ability appears to be the attentional control process that most clearly accounts for this effect. The results of Study 2 are important because they suggest that the moderation effect of interest is not solely a function of one’s beliefs about their abilities, but are actually associated with the abilities in question. These results are consistent with a growing body of evidence that suggests that attentional control may protect
those who are vulnerable to maladaptive psychological outcomes (e.g., those high in cognitive fusion) from experiencing such outcomes (e.g., Bardeen & Fergus, 2016; Fergus et al. 2012; Jones, Fazio, & Vasey, 2012). Moreover, results from this set of studies align with theory that proposes that cognitive fusion is most problematic, and most likely to cause emotional distress, when an individual lacks the resources to deploy attention in a flexible manner (Bond, Hayes, & Barnes-Holmes, 2006; Hayes, Strosahl, & Wilson, 2012).

The results of the exploratory secondary aim of this study, examining the proposed moderation effect in relation to depressive symptoms, are less clear. The results of Study 1, when attentional control was measured via self-report, were similar when depression was substituted for anxiety as the outcome. Specifically, the positive association between cognitive fusion and depression became increasingly stronger as self-reported attentional control (i.e., perceived ability) decreased. In contrast, when performance-based measures were used to assess attentional control processes in Study 2, none of the interaction terms significantly predicted depressive symptoms. It is not entirely clear why the effect did not replicate using these performance-based measures. However, it is important to consider that some have argued that in the assessment of attentional control, performance-based tasks and self-report are assessing two different things (i.e., actual versus perceived ability; Spada et al., 2010). It may be that objectively assessed attentional control abilities are less effective in helping one to disengage from intrusive ruminative thoughts than they are for inhibiting fear-related (worry, future-oriented) thoughts. As such, there may be some level of specificity regarding the buffering effect of attentional control on cognitive fusion and maladaptive psychological outcomes. It will be important to examine this moderation effect in relation to a wide variety of maladaptive outcomes in future research to test this hypothesis. Given the inconsistencies related to depression between Studies 1 and 2, we
cannot draw firm conclusions regarding this outcome variable. Importantly, the fact that the results of our primary analyses from Study 1 replicated when performance-based measures of attentional control were substituted for self-report should increase confidence in study findings related to anxiety.

Longitudinal evidence suggests that attentional control deficits and cognitive fusion are risk factors for the development of anxiety-related distress (e.g., Arch et al., 2012; Bardeen et al., 2015). Also, as noted above, Fergus and Wheless (2018) found that individuals with relatively lower attentional control have greater difficulty disengaging and shifting the focus of their attention from internal processes, such as maladaptive ruminative thoughts, in order to maintain attention on goal-relevant stimuli and associated behaviors. The results of the primary analyses from the present set of studies, in combination with this previous work which provides temporal evidence of associations among study variables (Arch et al., 2012; Bardeen et al., 2015; Fergus & Wheless, 2018), suggests the possibility that those who have greater difficulty distancing themselves, or disengaging (through the use of top-down inhibition), from internal stimuli may be at risk of developing anxiety-related pathology. In contrast, those with relatively better inhibitory ability may be better able to distance themselves from distressing thoughts and images, thus maintaining attention on goal-relevant stimuli and increasing the likelihood of engaging in adaptive goal-relevant behavior.

Despite the fact there is some evidence of the temporal relations among cognitive fusion and anxiety and attentional control and anxiety, the cross-sectional nature of the present set of studies precludes confirmation of causal inferences. For example, given our study design, we cannot be sure that cognitive fusion precedes attentional control in a temporal chain of causality. One could just as easily make a case for cognitive fusion as the moderator variable. Thus, we
believe that it is important to emphasize the aggregate effect of the interaction, that the combination of lower attentional control and higher cognitive fusion may be particularly detrimental in relation to anxiety. In addition to considering the temporal nature of relations among study variables in future research, it will be important to consider that variables that were not measured in this set of studies may account for the significant relations that were observed. We of course cannot account for any/every potentially confounding variable, but there are several variables and design considerations that should be considered for inclusion in this line of research in future studies (e.g., assessment of state affect and state anxiety, consideration of the type of top-down inhibition that is being assessed; Hallion, Tolin, Assaf, Goethe, & Diefenbach, 2017). Ultimately, it will be important to use longitudinal and experimental methods in future research to clarify the temporal nature of relations among study variables, as well as to make inferences regarding causality.

While the cross-sectional nature of both studies is a significant limitation, our multi-method assessment of attentional control is worth highlighting. The fact that the primary results of Study 1 replicated when performance-based measures of attentional control were substituted for self-report should increase confidence in study findings. Although the effect sizes that were observed in Study 1 may have been artificially inflated due to the use of self-report for all variables, the correlated measurement error that is often associated with monomethod measurement tends to attenuate interaction effects rather than inflating them (Evans, 1985; Siemsen, Roth, & Oliveira, 2010). This, in combination with the results of Study 2, increases confidence that the significant interaction related to anxiety in Study 1 is not due to method bias.

Despite the significance of the primary findings, and replication using multi-method assessment, the magnitude of the interaction effects in both studies was small in size (Aiken and
West, 1991) and these interaction effects explained only a modest amount of variance in anxiety. However, a couple of points are worth highlighting regarding these interactions. First, as we note above, the correlated measurement error that is associated with monomethod measurement tends to attenuate interaction effects rather than inflating them (Evans, 1985; Siemsen et al., 2010). In line with this assertion, a slight increase in the effect size of the interaction from the primary analysis was observed in Study 2 when performance-based measures of attentional control processes were used in place of self-reported attentional control. Importantly, the amount of variance in anxiety symptoms that was accounted for by both of these interaction effects meets the threshold considered to be meaningful (i.e., $\geq 1\%$; Evans, 1985). Although the limitations of retrospective power analysis have been well documented (e.g., Faul, Erdfelder, Lang, & Buchner, 2007), we believe that providing the results of such analyses may be of value in terms of providing methodological guidance in future research studies. Based on data from Study’s 1 & 2, sample sizes of 620 (Study 1 interaction) and 208 (Study 2 interaction) would provide sufficient power (i.e., 0.80) to detect these interaction effects when alpha is set at .05 (G*Power 3.1 software; Faul et al., 2009).

Although the bivariate correlations presented in Table 1 were not the primary focus of this study, a few points related to these correlations are worth noting. First, self-reported attentional control was not significantly associated with the performance-based measures of attentional control processes. Similar findings have been observed in previous research (Quigley, Wright, Dobson, & Sears, 2017). One potential explanation for this is that self-report measures of attentional control may be assessing perceived ability, whereas performance-based tasks may more accurately assess actual ability (Spada et al., 2010). Second, the performance-based measures of attentional control processes were not significantly associated with anxiety. While
the significant association between self-reported anxiety and self-reported attentional control has been well established, empirical research has provided mixed findings regarding whether individuals with anxiety exhibit relative deficits in attentional control processes measured via objective tasks, especially in the absence of threat or increased cognitive load (Dennis & Chen, 2007; Reinholdt-Dunne, Mogg, & Bradley, 2013; Shi, Sharpe, & Abbot, 2019). When impairments are observed, it is typically in the context of momentary threat or distress (Booth & Peker, 2017), and/or increased cognitive load (Shi et al., 2019). In the present study (Study 2), participants completed a battery of computerized cognitive tasks in the absence of threat or a negative mood manipulation. Under conditions such as these, theory (i.e., Attentional Control Theory; Eysenck & Derakshan, 2011) and empirical evidence suggests that those with relatively higher levels of anxiety can compensate through increased effort, especially if they are relatively younger (Shi, et al., 2019). Additionally, the undergraduate sample in Study 2 had an average age of 20.5 and 93% of the sample was between the ages of 19-22. This is relevant because there is a positive associate between age and attentional control deficits in behavioral studies (Shi et al., 2019). Taken together, a lack of significant associations between the three attentional control processes measured in Study 2 and self-reported anxiety may be a function of the use of objective measures of attentional control processes, a relatively younger sample who was better able to compensate (draw on reserve top-down abilities) to effectively engage in the cognitive battery tasks, and/or a lack of threat or negative mood manipulation prior to or during the completion of these tasks.

Additional study limitations are worth considering. The use of self-report to assess anxiety symptoms may not be ideal. Utilizing tools specific to various anxiety disorders may enable clearer conclusions to be drawn about the relevance of this research to clinical
populations. It is important to note that while neither of the samples were screened for anxiety disorders as per the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association [APA], 2013), there was a reasonable amount of variability in DASS Anxiety scores in both Study 1 and 2, with approximately 25% of participants in each of the samples reporting anxiety symptoms that were outside of the “normal” range (Lovibond & Lovibond, 1995). It may be beneficial to assess anxiety symptoms via structured clinical interviews in future research to ensure that the results of the present study generalize to clinical samples. Additionally, the use of objective measures of anxious arousal (e.g., electrodermal response) may be an important next step in replicating and extending the current findings. It is also pertinent to note that unlike self-report measures of attention that are unable to capture the vital information occurring in preconscious moments, self-report measures of emotion allow for participants to share valuable subjective information about their experiences.

To our knowledge, this set of studies is the first to provide evidence of attentional control as a moderator of the relationship between cognitive fusion and anxiety. The results of Study 2 suggest that it may be particularly important to focus on inhibitory ability in this line of research. Taken together, results of this set of studies suggest the possibility that attentional control (especially inhibitory ability) may be a protective factor against the development of anxiety among those with higher levels of cognitive fusion. The use of experimental and longitudinal study designs will be an important next step in this line of research to further clarify the nature of relations among cognitive fusion, attentional control, and anxiety, and to identify potential treatment targets (e.g., enhancing inhibitory ability to reduce anxiety among those with higher cognitive fusion).


bias and pupillary reactivity to threat stimuli. *Cognitive Therapy & Research, 41*, 853-866.


COGNITIVE FUSION, ATTENTIONAL CONTROL, AND ANXIETY


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Table 1
Zero-Order Correlations for Variables of Interest from Study’s 1 and 2

<table>
<thead>
<tr>
<th>Variables</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Anxiety</td>
<td>--</td>
<td>.75***</td>
<td>.62***</td>
<td>-.40***</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>2. Depression</td>
<td>.62***</td>
<td>--</td>
<td>.71***</td>
<td>-.48***</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>3. Cognitive Fusion</td>
<td>.42***</td>
<td>.54***</td>
<td>--</td>
<td>-.56***</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>4. Attentional Control</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>5. Memory</td>
<td>.07</td>
<td>-.01</td>
<td>.10</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>6. Inhibition</td>
<td>.07</td>
<td>.05</td>
<td>-.03</td>
<td>--</td>
<td>.10</td>
<td>--</td>
</tr>
<tr>
<td>7. Switching</td>
<td>-.04</td>
<td>.02</td>
<td>-.04</td>
<td>--</td>
<td>-.27***</td>
<td>.09</td>
</tr>
</tbody>
</table>

Note. Intercorrelations for Study 1 (N = 597) are presented above the diagonal and intercorrelations for Study 2 (N = 173) are presented below the diagonal. Anxiety = DASS-21 (Depression Anxiety Stress Scale-21) Anxiety Scale score; Depression = DASS-21 Depression Scale score; Cognitive Fusion = total score of the Cognitive Fusion Questionnaire; Attentional Control = total score of the Attentional Control Scale-Short Form; Memory = the number of correct trials minus the number of incorrect trials on the Digit Symbol Coding task; Inhibition = the difference score (reaction time on congruent trials minus reaction time on incongruent trials) from the attentional cuing task; Shifting = the difference score (part B raw score minus part A raw score) from the Trail Making Test.

Note. * p < .05, ** p < .01, *** p < .001.
Highlights

• Examined associations among attentional control (AC), cognitive fusion (CF), and anxiety
• AC was assessed via self-report and behavioral tasks of AC processes
• AC moderated association between CF and anxiety
• Strength of relation between CF and Anxiety decreased as AC increased
• Inhibitory ability is the component of AC that accounts for this effect
Conflicts of Interest Disclosure

I wish to confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome.

I confirm that the manuscript has been read and approved by all named authors and that there are no other persons who satisfied the criteria for authorship but are not listed.

I confirm that we have given due consideration to the protection of intellectual property associated with this work and that there are no impediments to publication, including the timing of publication, with respect to intellectual property. In so doing I confirm that I have followed the regulations of my institution concerning intellectual property.

I further confirm that any aspect of the work covered in this manuscript that has involved either experimental animals or human patients has been conducted with the ethical approval of all relevant bodies and that such approvals are acknowledged within the manuscript.

I understand that the Corresponding Author is the sole contact for the Editorial process (including Editorial Manager and direct communications with the office). I confirm that I have provided a current, correct email address which is accessible by the Corresponding Author and which has been configured to accept email from jbardeen@auburn.edu.

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