Sex differences in the indirect effects of cognitive processes on anxiety through emotion regulation difficulties

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A B S T R A C T

Drawing on a gender roles theory of emotion regulation, we examined the specific facets of emotion regulation difficulties through which higher-order cognitive abilities may be related to anxiety. Participants (N = 225) completed self-report measures of emotion regulation difficulties and anxiety, and were administered neuropsychological tests assessing abstract reasoning and inhibition. PROCESS (Hayes, 2012) was used to estimate the direct and indirect effects of both inhibition and abstract reasoning on anxiety symptoms, with six dimensions of emotion regulation difficulties serving as multiple mediators operating in parallel. Results suggest that the relation between higher-order cognitive abilities and anxiety operate through distinct, sex-dependent emotion dysregulation mechanisms. For females, higher levels of inhibition and abstract thinking were associated with poorer clarity of emotions, which in turn, was associated with higher levels of anxiety symptoms. As such, over-attentiveness to, or over-analysis of, emotions may be particularly detrimental among females who have relatively higher abstract reasoning abilities. For males, higher inhibition was associated with greater perceived effectiveness in regulating negative emotions, which in turn, was associated with lower levels of anxiety symptoms. This finding suggests that mood regulation expectancies may be particularly important in understanding the pathogenesis of anxiety in males.

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Anxiety disorders are more prevalent than any other mental health disorder in the United States, affecting approximately 18% of the population in a given year (Kessler, Chiu, Demler, & Walters, 2005). In addition to the psychological suffering associated with anxiety, anxiety disorders also result in significant impairments in a variety of domains (e.g., family, social, and occupational functioning), and are predictive of poorer physical health and an overall reduction in quality of life (Hoffman, Dukes, & Wittchen, 2008). Further, anxiety disorders produce a substantial economic burden (e.g., treatment costs, costs associated with employee absenteeism and reduced productivity), with cost estimates exceeding 42 billion dollars per year (Kessler & Greenberg, 2002). Given the staggering levels of human suffering and economic burden that are associated with anxiety disorders, the identification of risk and resiliency factors for anxiety pathology is critically important so that we may ultimately remedy these negative outcomes. Of note, females are diagnosed with anxiety disorders at a significantly higher rate than males (Kessler, Berglund, et al., 2005). Thus, it is also extremely important to consider sex differences in the pathogenesis of anxiety.

One area which has begun to receive increasing attention in the anxiety literature is the study of individual differences in higher-order cognitive processes (e.g., inhibitory control, abstract reasoning), and the degree to which these processes influence the development and maintenance of anxiety (e.g., Bardeen & Read, 2010; Derryberry & Reed, 2002). For example, inhibitory control—the ability to inhibit and override dominant response tendencies in favor of goal-relevant, or subdominant, responding (Rothbart, Ellis, Rueda, & Posner, 2003)—has been suggested as a protective factor against the development of anxiety pathology. Conceptually, it seems that those with relatively higher inhibitory control would be better able to down-regulate dominant, bottom-up, emotional arousal, thus reducing the likelihood of experiencing prolonged negative affective states and subsequent anxiety pathology. However, to date, findings have been equivocal regarding the relation between behaviorally-based measures of inhibitory control (e.g., as measured by the Stroop task; Golden, 1978) and anxiety. For example, in line with the above rationale, Beaudreau and O’Hara (2009) found that inhibitory control was significantly negatively correlated with anxiety symptoms in a community sample.
of older adults (N = 102). In contrast, Price and Mohlman (2007) found inhibitory control to be significantly positively correlated with anxiety and worry among older adults with generalized anxiety disorder (GAD: n = 43), though it was not associated with either worry or anxiety among older adults without GAD (n = 15).

Price and Mohlman (2007) interpreted their findings as suggesting that deficits in inhibitory control are not associated with increased risk for GAD, but rather, greater levels of inhibitory control may actually increase anxiety by facilitating worry and rumination as a strategy to inhibit, or avoid, the processing of threat-related stimuli. Another possibility, as suggested by Price and Mohlman (2007), is that the observed effects may be the result of other related, but distinct, higher-order cognitive processes (e.g., sequence planning, abstract reasoning) which may be more likely to result in elevated levels of worry and rumination. This suggestion highlights the importance of differentiating between higher-order cognitive processes rather than using any one cognitive process as a proxy for a general executive functioning construct. Thus, equivocal findings in the research literature may be due, in part, to a third variable confound (i.e., other higher-order cognitive processes).

As described, higher-order cognitive abilities have been implicated in the regulation of internal experiences and the development of anxiety. Thus, individual differences in higher-order cognitive abilities may leave one vulnerable to experiencing difficulties in regulating emotion, which in turn, may result in psychological distress. For example, emotion dysregulation has been implicated in anxiety disorders in general (for a review, see Cisler, Olatunji, Feldner, & Forsyth, 2010), posttraumatic stress disorder (Bardeen, Kumpula, & Orcutt, 2013; Ehring & Quack, 2010), depression (Gross & Munoz, 1995), borderline personality disorder (Gart, Rosenthal, Tull, Lejuez, & Gunderson, 2006), alcohol dependence (Berking et al., 2011), and a host of other maladaptive outcomes (for a review, see Aldao, Nolen-Hoeksema, & Schweizer, 2010). Interestingly, a number of differences in emotion regulation have been observed between males and females. Males are significantly more likely to use suppression as an emotion regulation strategy than females (Gross & John, 2003). Females, however, are more likely than males to (a) view their emotions as important information, (b) pay attention to and analyze their emotions (Barrett & Bliss-Moreau, 2009: Nolen-Hoeksema, 2012), (c) use rumination in an attempt to regulate their distress (Tamres, Janicki, & Helgeson, 2002), and (d) use higher-order cognitive abilities to a greater degree to regulate negative emotions (McRae, Ochsner, Mauss, Gabrieli, & Gross, 2008), thus leaving females more vulnerable to cognitive resource depletion, especially when experiencing prolonged stress.

The noted findings are consistent with a gender roles theory of emotion regulation which presupposes that males and females adopt differential patterns of emotion regulation on the basis of societal norms. Specifically, cultural mores support emotion suppression in males (Nolen-Hoeksema, 2012), whereas females are customarily viewed as more emotional (Barrett & Bliss-Moreau, 2009), better at identifying emotions, and better at using emotion-related information to appropriately guide their actions (Petrides, Furnham, & Martin, 2004). Given these emotion regulation-related sex differences, one might surmise sex-specific higher-order cognitive mechanisms that underlie emotion regulation. Specifically, for males, who are prone to regulate emotional distress with emotion suppression, inhibitory control may be the dominant emotion regulation-related higher-order cognitive mechanism. For females, who are prone to regulating emotional distress by attending to and analyzing their emotions, abstract reasoning (i.e., the ability to identify patterns and relationships that underlie concrete concepts and extend these patterns and relations to novel problems and situations) may be the dominant emotion regulation-related higher-order cognitive mechanism. Importantly, failing to account for these sex differences in study design may also, at least partially, explain the disparate findings observed in the extant literature.

Moberly and Watkins (2006) describe an abstract evaluative style as being “focused on evaluating the higher-level causes, meanings, consequences, and implications of self experience” (p. 282), which is in contrast to a more concrete, present moment-focused, form of evaluation and problem solving style. An abstract, versus concrete, style has been shown to (a) increase repetitive negative thought (e.g., worry, rumination; Moberly & Watkins, 2006), (b) increase negative mood reactivity to task failure in a laboratory setting (Watkins, Moberly, & Moulds, 2008), (c) reduce the use of problem-solving (Watkins & Moulds, 2005), and (d) potentiate self-reflection even when doing so detracts from goal pursuit (Johnson, Nolen-Hoeksema, Mitchell, & Levin, 2009). Thus, females with relatively higher abstract reasoning abilities may be especially prone to putting substantial effort into analyzing their negative emotional experiences, which may become maladaptive (e.g., self-referential repetitive negative thoughts), and result in psychological distress. Paying an inordinate amount of attention to emotions may actually obscure emotional understanding and reduce the likelihood of using concrete problem solving to determine a course of action for alleviating emotional distress.

Given the equivocal nature of the findings described above, temporal precedence of associations among cognitive processes, emotion dysregulation, and internalizing pathology can be difficult to determine. However, evidence implicates individual differences in inhibitory control, as well as other higher-order cognitive abilities, in the later development of self-regulatory abilities (see Degnan & Fox, 2007), thus suggesting a temporal sequence in which the development of cognitive abilities precedes, and subsequently leads to, variation in self-regulatory abilities. Moreover, there is literature to suggest a temporal relation between emotion regulation abilities and anxiety. For example, in a longitudinal study, Bosquet and Egeland (2006) found that the ability to regulate emotion in response to a frustrating task among children at 42 months of age predicted the development of anxiety symptomatology at 64 months of age. Additionally, related to anxiety pathology, evidence suggests that deficits in effortful control—which broadly includes the higher-order processes of inhibitory control and attentional control—may put individuals at risk for the later development of anxiety pathology (Muris, 2006). And more broadly, intelligence in childhood has been shown to be associated with psychological distress, including anxiety and depressive symptoms, in adulthood (Gale, Hatch, Batty, & Deary, 2009). Gale et al. (2009) suggest that neurocognitive factors may affect one’s likelihood of future internalizing pathology.

As described, the discrepant findings surrounding associations between higher-order cognitive processes and anxiety may be due a lack of research on sex differences in this literature. Further, because individual differences in these higher-order cognitive abilities may leave one vulnerable to experiencing difficulties in regulating emotion, which in turn, may result in anxiety, we examined emotion regulation difficulties as the mechanism through which abstract reasoning and inhibitory control lead to anxiety. Media tion models were examined separately for males and females. Based on Gratz and Roemer’s (2004) conceptualization of emotion regulation, we examined the specific facets of emotion regulation difficulties that mediate the path from inhibitory control and abstract reasoning to anxiety. Gratz and Roemer’s (2004) comprehensive conceptualization of emotion regulation proposes that effective emotion regulation involves the following: identification of emotional experience and differentiation between emotions, acceptance of negative emotions, perceiving oneself as being able to strategically regulate negative emotions, and the ability to pursue goal-directed behavior and inhibit impulsive behaviors when
experiencing negative emotions. Based on the above logic, and a gender roles theory of emotion regulation (Nolen-Hoeksema, 2012), we predicted that higher levels of abstract thinking would be associated with higher levels of anxiety for females. Because paying an inordinate amount of attention to emotions may actually obscure emotional understanding, we hypothesized that this association would be mediated by greater difficulties in emotional clarity. Further, we predicted that higher levels of inhibitory control would be associated with lower levels of anxiety for males. Because males with a relative strength in inhibiting dominant responses may perceive themselves as being better able to regulate emotion, we hypothesized that this association would be mediated by perceived effectiveness in emotion regulation.

1. Method

1.1. Participants and procedure

Data for this institutional review board approved study was collected over the course of two study sessions (M between sessions = 6 days; range = 2–10 days). Participants were introductory psychology students recruited from a mass testing pool at a mid-sized university in the Midwest. The only prerequisite for participation was that participants be over the age of 18. At the first study session (T1), participants (N = 225) provided written informed consent prior to completing a battery of questionnaires, among which was a measure assessing emotion regulation difficulties. At the second study session (T2), returning participants (n = 169) completed questionnaires which assessed anxiety symptoms and were also administered a neurocognitive battery which included assessments of inhibition and abstract thinking. For their participation, students received partial course credit toward their undergraduate psychology course. Data from participants who were not fluent in English (n = 5), had previously participated in the study (n = 2), had visual impairments (n = 1), and had discontinued the session after consent (n = 1) were removed study analyses. Data, from a subset of participants in the present study, that are not central to the primary aims of the present study, are presented in (citation masked for blind review). In preliminary data analysis (see below for a description), three cases were identified as having undue influence on the primary analytic models, and thus, were removed from the sample. The final sample included 213 participants (55.3% females; age: M = 19.41 years; SD = 1.42), of which, 50.2% self-identified as White, 24.4% as Black, 13.1% as Hispanic/Latino(a), 7.5% as Asian, 4.2% as biracial, and 0.5% reported “other”. Race and ethnicity were demonstrated adequate psychometric properties, including internal consistency, as well as adequate predictive and construct validity (Gratz & Roemer, 2004). In the present study, all DERS subscales evidenced adequate internal consistency (α values ranging from .75 to .91).

2. Measures

2.1. Inhibition

Inhibition was assessed with the Delis–Kaplan Executive Function System Color-Word Interference Test (CWIT; Delis, Kaplan, & Kramer, 2001). During this clinician-administered subtest, participants were instructed to quickly and correctly name a series of colors (Condition 1: Color Naming) in order to establish the speed of baseline responding. In addition, participants were instructed to identify the color in which color-words (e.g., red, blue) were printed while paying no attention to word meaning (Condition 2: Inhibition). This condition is consistent with the traditional Stroop task (Golden, 1978) in which participants must inhibit the more automatic tendency to read in favor of naming the disinfectant ink color. Based on administration and scoring procedures from Delis et al. (2001), the amount of time participants take to complete each condition is recorded, and scaled scores are derived based on participant age. The Inhibition scaled score indicates one’s ability to inhibit dominant response tendencies, and higher scaled scores on this task reflect better inhibition. To account for individual differences in color-naming speed, the Color Naming scaled score served as a control variable in multivariate analyses.

2.2. Abstract reasoning

Abstract reasoning was assessed with the Delis–Kaplan Executive Function System Twenty Questions subtest (Delis et al., 2001). Scaled scores are derived based on participant age (Delis et al., 2001). During this clinician-administered subtest, participants were presented with 30 colored objects on a single page and asked to identify a target object by asking the fewest number of yes/no questions possible. Higher scores reflect better abstract reasoning.

2.3. Emotion regulation difficulties

The Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004) is a 36-item self-report measure which assesses six dimensions of emotion regulation for which one could experience difficulties, including Difficulty Engaging in Goal-Directed Behavior (Goals), Impulse Control Difficulties (Impulse), Nonacceptance of Emotional Responses (Nonacceptance), Lack of Awareness of Emotions (Awareness), Lack of Emotional Clarity (Clarity), and Limited Access to Strategies for Regulation (Strategies). Items are rated on a 5-point scale based on how often participants believe each item applies to them (I = almost never to 5 = almost always), and higher scores on the individual subscales reflect greater emotion regulation difficulties. Each of the DERS dimensions has evidenced good internal consistency, as well as adequate predictive and construct validity (Gratz & Roemer, 2004). In the present study, all DERS subscales evidenced adequate internal consistency (α values ranging from .75 to .91).

2.4. Anxiety

The Beck Anxiety Inventory (BAI; Beck, Epstein, Brown, & Steer, 1988) is a 21-item self-report measure that assesses common physical (e.g., “hands trembling”) and cognitive (e.g., “fear of worst happening”) symptoms of anxiety. Participants are instructed to indicate the degree to which they have been affected by each symptom over the past week. Items are rated on a 4-point scale (0 = not at all to 3 = severely, I could barely stand it). The BAI has demonstrated adequate psychometric properties, including internal consistency and retest reliability over a one week period (Beck et al., 1988), as well as concurrent, construct, and discriminant validity (Clarke, Steer, & Beck, 1994). In the present study, the BAI evidenced adequate internal consistency (α = .91).

3. Results

3.1. Preliminary analyses and descriptive statistics

Attrition analysis was conducted for all variables that were administered at T1. Results revealed no significant differences between T1 completers and those who completed both T1 and T2 assessment sessions on emotional regulation difficulties (i.e., sex, race, year in school) and anxiety symptoms. In regard to emotion regulation difficulties, participants who completed both T1 and T2 had significantly higher scores on the DERS–Nonacceptance subscale than those who only completed T1, t(214) = −2.54, p = .012 (M = 2.01,
emerged was through DERS–Clarity ($\beta = .11$, 95% CI [.02, .26]). Consistent with the pattern described above, higher levels of abstract thinking were associated with poorer clarity of emotions, which in turn, was associated with higher levels of anxiety symptoms.

In the second set of mediation analyses, which was conducted for males (see Fig. 2), the direct effects from both inhibition and abstract reasoning to anxiety were non-significant ($\beta = -.11$ and $\beta = .05$, respectively). A significant indirect effect emerged for the relation between inhibition and anxiety symptoms through DERS–Strategies ($\beta = -.13$, 95% CI $[-.31, -.03]$), such that higher levels of inhibition were associated with higher levels of perceived access to effective emotion regulation strategies, which in turn, was associated with lower levels of anxiety symptoms. None of the other DERS subscales mediated the relationship between inhibition and anxiety. Additionally, none of the DERS subscales mediated the relationship between abstract thinking and anxiety symptoms in males.

To test whether the aforementioned indirect effects significantly differed between males and females (i.e., sex as a moderator of the indirect effects), point estimates for each specific indirect effect (ab) were compared. Specifically, the difference between the ab paths was divided by the standard error of the estimate to form a z statistic (see Fairchild and MacKinnon, 2009). As noted by Fairchild and MacKinnon (2009), “If the point estimates in each group are statistically different from one another, there is significant moderation of the indirect effect (i.e., heterogeneity in the ab product), such that the mediated effect is moderated by group membership” (pp. 7-8). The indirect effect for the relation between abstract reasoning and anxiety through DERS–Clarity was significantly moderated by sex (z = 1.78, p = .037). For the relation between inhibition and anxiety symptoms, the indirect effect through DERS–Clarity was not significantly moderated by sex (z = 1.27, p = .101), though the indirect effect through DERS–Strategies was significantly moderated by sex (z = −1.72, p = .043). Thus, evidence of moderated mediation emerged for the indirect pathways from abstract reasoning to anxiety through DERS–Clarity, as well as from inhibition to anxiety through DERS–Strategies.

4. Discussion

In the present study, we sought to examine sex-dependent pathways from higher-order cognitive abilities to anxiety through emotion regulation difficulties. For females, two significant indirect effects were observed. Higher levels of both abstract reasoning and inhibitory control were associated with greater difficulties in emotion clarity, which in turn, was associated with higher levels of anxiety. Importantly, each of these indirect effects was significant even when accounting for the other higher-level cognitive ability, thus underscoring the unique and independent contributions of both inhibition and abstract reasoning on anxiety symptoms in females. For males, higher levels of inhibitory control were associated with a greater perceived ability to regulate emotional distress, which was associated with lower levels of anxiety. Abstract reasoning did not exert an indirect effect on anxiety for males. Of note, two out of three of these indirect effects were significantly different between males and females, thus suggesting moderated mediation. Specifically, the paths from abstract reasoning to anxiety through emotional clarity and the path from inhibitory control to anxiety through perceived ability to regulate emotional distress differed by sex.

Results are consistent with a gender roles theory of emotion regulation which presupposes that males and females adopt differential patterns of emotion regulation on the basis of societal norms. Specifically, males are significantly more likely than females to use expression suppression as an emotion regulation...
strategy (Gross & John, 2003), and this use of suppression is supported by cultural mores which dictate that it is a weakness, or 'unmanly', for males to express their emotions (Gross & John, 2003). Of note, the DERS–Strategies dimension is defined as “the belief that there is little that can be done to regulate emotions effectively, once an individual is upset” (Gratz & Roemer, 2004, p. 47). Thus, our results indicate that males who are particularly good at inhibiting dominant response tendencies appear to perceive themselves as being better able to alleviate emotional distress. In contrast, males with relatively lower levels of inhibitory control perceived themselves as lacking the ability to regulate negative emotions, which in turn, was associated with relatively higher anxiety symptoms.

Fig. 1. Path models of the relation between (a) inhibition and (b) abstract reasoning and anxiety symptoms through emotion regulation difficulties in females. Race, color-naming speed, and the alternative cognitive variable (i.e., inhibition or abstract reasoning) are included as covariates. Path coefficients are unstandardized (standardized coefficients in parentheses). *p < .05. **p < .01.
levels of anxiety. The present results highlight the important role of mood regulation expectancies in the development of anxiety. As described by Catanzaro and Greenwood (1994), “active coping efforts, even if they solve a problem, may have little effect on reducing negative moods unless the individual believes that such an outcome will result” (p. 42). Thus, among females who are taught that emotional awareness and expressivity is essential for maintaining psychological well-being, greater inhibitory control is likely not perceived as being a regulatory asset, but rather a detriment to emotional well-being. Indeed, in the present study, higher levels of inhibitory control were associated with greater difficulties in emotion clarity, which in turn, was associated with...
higher levels of anxiety in females. In other words, females who were relatively better at inhibiting dominant response tendencies reported being significantly worse at identifying the emotions that they experience. This emotional ambiguity, in turn, was associated with higher levels of anxiety.

A similar pattern was observed for the indirect effect of abstract reasoning on anxiety through difficulties in emotion clarity. This finding may also be understood in the context of a gender roles theory of emotion regulation. As described, females may be particularly prone to using an abstract evaluative style to regulate their internal experience due to a cultural indoctrination in which females are taught that they are the more emotionally expressive sex and that emotions provide valuable information for regulating one’s self and one’s environment. Further, an abstract, versus concrete, style has been shown to increase self-reflection to the detriment of goal-pursuit (Johnson et al., 2009) and reduce the use of concrete problem-solving in favor of negative repetitive thought (Moberly & Watkins, 2006; Watkins & Moulds, 2005). Thus, it is not surprising that females with relatively higher levels of abstract reasoning abilities reported being significantly worse at identifying the emotions that they experience, as inordinate attention to, and analysis of, emotions may be more likely to result in emotional ambiguity. Further, results from the present study suggest that females who perceive themselves as having difficulties in identifying and understanding their emotions have significantly higher levels of anxiety than females who perceive themselves as being clear about their emotional experiences. Thus, higher levels of analytical thinking are associated with relative deficits in emotional clarity for females, which appears to result in significantly higher levels of anxiety. As such, over-attentiveness to, or over-analysis of, emotions may be particularly detrimental among females who have relatively higher abstract reasoning abilities.

These findings must be considered with the following limitations in mind. Given that the sample consisted solely of college students, caution is warranted in generalizing study findings to the general population. In addition, the present results, which suggest sex-dependent pathways from cognitive processes through emotion regulation difficulties to anxiety symptoms (broadly conceptualized), may be transdiagnostic in nature, or may be specific to anxiety pathology. Thus, it will be important in future research to assess for specific anxiety pathology (e.g., panic, social phobia), as well as other forms of psychopathology that commonly co-occur with anxiety symptoms. Furthermore, a number of theoretical models and measures purport to capture the construct of emotion dysregulation. Thus, to extend the findings of the present study and further clarify the homological network of relations among cognitive abilities, emotion dysregulation, and anxiety, it will be important to incorporate other emotion regulation-related indices into this line of research. Finally, given the cross-sectional nature of the data, the extent to which mediation can be inferred is limited. It will be important to use longitudinal study designs in future research in order to determine the temporal relations among study variables.

Despite these limitations, the present study provides an important step in understanding relations among higher-order cognitive processes and anxiety symptoms. The present results highlight the importance of (a) testing sex-specific models, and (b) differentiating between higher-order cognitive processes, rather than using any one cognitive process as a proxy for a general executive functioning construct, in cognition and emotion research. Although the present results suggest sex-specific pathways from cognitive processes through emotion regulation difficulties to anxiety, the importance of emotion regulation expectancies for both males and females is striking. That is, the present results suggest that one’s perception of her/his ability to regulate emotional distress is important for understanding how higher-cognitive processes relate to anxiety symptoms. Importantly, evidence suggests that emotion regulation expectancies can be targeted through clinical intervention to alleviate psychological distress. For example, Berking et al. (2008) found support for training in emotion-focused self-efficacy, designed to increase one’s perceived emotion regulation abilities, as a method for significantly reducing psychological distress. Interestingly, and in line with the present results, Berking et al. (2008) found limited support for treatment approaches which emphasize the importance of emotion identification and understanding. In combination with these findings, results from the present study suggest that interventions emphasizing emotion-focused self-efficacy may be particularly beneficial for both males and females in alleviating anxiety symptoms.

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