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BIS, BAS, and Bias: The Role of Personality and Cognitive Bias in Social Anxiety

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ABSTRACT

The goal of the present research was to test the hypothesis that cognitive biases for negative and threatening social information mediate the effects of behavioral inhibition system (BIS) and behavioral approach system (BAS) sensitivity on social anxiety. Participants completed self-report measures of BIS and BAS and then underwent a social-threat induction procedure in which they were told they would have to perform a speech. A battery of cognitive bias measures was then administered, followed by a battery of state anxiety measures. Audience members also rated participants' anxiety during the speech. Structural equation modeling was used to test the hypothesized model. As predicted, the fully-mediated model showed the best fit to the data, and higher BIS and lower BAS were found to have significant indirect effects on social anxiety via cognitive bias.

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1. Introduction

Among the many models of social anxiety proposed, Kimbrel's (2008) model of social anxiety is unique because it integrates a wide range of factors (i.e., personality, genetic, biological, environmental, cognitive) into a unified model. While research on this model has emerged in recent years (e.g., Kimbrel, Mitchell, & Nelson-Gray, 2010), many aspects of the model remain untested. The objective of the present research was to provide the first direct test of Kimbrel's hypothesis that cognitive biases for negative and threatening social information mediate the effects of behavioral inhibition system (BIS) and behavioral approach system (BAS) sensitivity on social anxiety.

1.1. Reinforcement sensitivity theory

Kimbrel's model is based largely upon the revised Reinforcement Sensitivity Theory of personality (rRST; Gray & McNaughton, 2000), which is a biologically-based model of personality. rRST proposes that individual differences in three major brain subsystems—the BIS, BAS, and, fight-flight-freeze system (FFFS)—are responsible for many of the individual differences observed in personality, psychopathology, and reinforcement sensitivity. The BAS is proposed to underlie reward-seeking behavior and impulsivity, whereas the FFFS is proposed to motivate avoidance and escape behaviors in response to conditioned and unconditioned aversive stimuli. In contrast, the primary task of the BIS is to resolve conflicts among competing goals (e.g., approach–avoidance conflicts). The BIS is proposed to accomplish this task by inhibiting behavior, increasing arousal, and assessing for risk. The BIS is also proposed to underlie the emotion of anxiety and the personality trait of neuroticism. Consistent with the position of Gray and McNaughton (2000) and contemporary research in this area (e.g., Tull, Gratz, Latzman, Kimbrel, & Lejuez, 2010), the current paper takes the position that existing self-report inventories of BIS and neuroticism assess combined BIS–FFFS sensitivity. Accordingly, the term "BIS–FFFS" is used throughout to refer to self-report measures of BIS based on earlier versions of the theory, whereas the terms "BIS" and "FFFS" refer to the neurobiological systems proposed by Gray.

1.2. BIS–FFFS and social anxiety

The current paper also takes the position that social anxiety is a dimensional construct, and that this dimension is positively associated with BIS–FFFS functioning (e.g., Kimbrel, Cobb, Mitchell, Hundt, & Nelson-Gray, 2008). For example, Kimbrel et al. (2010) reported positive associations between continuous measures of BIS–FFFS and social anxiety across three samples of adults, and Hundt, Mitchell, Kimbrel, and Nelson-Gray (2010) reported BIS–FFFS predicted decreased romantic activities, decreased social activities, and fewer leadership roles among college students. In addition, imaging studies report increased regional cerebral blood flow in key components of the BIS and FFFS (e.g., amygdala, hippocampus) among social phobics during anticipation of a public-speaking task (Tillfors et al., 2001).

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1.3. Cognitive bias and social anxiety

Socially-anxious individuals often exhibit cognitive biases for negative social information (Kimbrel, 2008). For example, they tend to believe they will be negatively evaluated in social situations (Leary, Kowalski, & Campbell, 1988), expect more negative social events and fewer positive social events (Lucock & Salkovskis, 1988), and exhibit an attentional bias for threatening social information (Asmundson & Stein, 1994). Evidence regarding a memory bias among socially-anxious individuals has been more mixed. Breck and Smith (1983) reported a memory bias for negative social information among socially-anxious individuals using a free-recall task, but only when they thought they would have to interact with a stranger later on in the experiment. Similarly, Mansell and Clark (1999) reported individuals high on social anxiety recalled fewer positive self-referent words than individuals low on social anxiety when told they would have to give a speech prior to recall, but the bias did not occur when the social threat induction procedure was not used. In contrast, Rapee, McCallum, Melville, Ravenscroft, and Rodney (1994) did not employ a social threat induction procedure and failed to find a memory bias among individuals with social phobia across a variety of memory tasks. Together, these findings suggest memory biases for negative and social threatening information may only occur among socially-anxious individuals under conditions of imminent social threat (Kimbrel, 2008).

1.4. BIS and bias

Building upon the work of Gray and McNaughton (2000) and Eysenck (1997), Kimbrel (2008) proposed that the cognitive biases observed among socially-anxious individuals are the result of heightened BIS sensitivity. Specifically, because the BIS is proposed to engage in external and internal scanning for threat-relevant information in response to potentially threatening situations (Gray & McNaughton, 2000), Kimbrel proposed that the BIS is the personality/biological basis for many of the cognitive biases (e.g., memory bias, negative expectancies and beliefs, increased perception of threat) observed among socially-anxious individuals. Thus, cognitive biases for negative and threatening social information are proposed to mediate the effect of BIS on social anxiety under conditions of imminent social threat. While this model has not been tested directly, there is some indirect support for this proposal. For example, BIS–FFFS has been associated with a tendency to focus on negative information (Noguchi, Gohm, & Dalsky, 2006) and recall negatively-valenced words in a free-recall task (Gomez & Gomez, 2002).

1.5. BAS and social anxiety

While Kimbrel's model primarily focuses on the role of BIS, low BAS is also proposed to play a significant, albeit modest, role in social anxiety due to the interdependent nature of the BIS–FFFS and BAS systems. This proposal is based on Corr's (2002) joint-subsystems hypothesis, which posits that the BIS and BAS have antagonistic and facilitatory effects upon behavior and are functionally interdependent. Kimbrel (2008) proposed that low BAS represents an additional risk factor for social anxiety, and there is some evidence to support this position (e.g., Kimbrel et al., 2010).

1.6. Objective and hypotheses

The objective of the present research was to test whether cognitive biases for negative and threatening social information mediate the effects of BIS–FFFS and BAS on social anxiety. It was hypothesized that BIS–FFFS would be positively associated with negative cognitive bias and social anxiety, and that the effects of BIS–FFFS on social anxiety would be fully mediated by cognitive biases. BAS was predicted to be negatively associated with cognitive bias and social anxiety, and the effects of BAS on social anxiety were predicted to be mediated by cognitive biases as well. While no previous study has directly examined the relationship between BAS, bias, and social anxiety, the latter hypothesis is consistent with previous research demonstrating that decreased positive expectancies mediate the effect of low BAS on depression (Beevers & Meyer, 2002).

2. Methods

2.1. Participants

A total of 219 college students were recruited. Twelve participants scored above the recommended cut-off score of three or higher on the Infrequency Scale (Chapman & Chapman, 1986), which is indicative of a random response set. These participants were excluded from the analyses, yielding a final sample of 207 participants. The final sample was 67% female and 70% Caucasian, both of which were consistent with the university's demographic profile. Participants' mean age was 19.1 years ($SD = 5.8$). Fifty participants (24%) scored at or above the clinical cut-off score of 24 ($M = 17.36$, $SD = 13.35$) on the Social Phobia Scale (SPS; Heimberg, Mueller, Holt, Hope, & Liebowitz, 1992).

2.2. Procedure

In all, 24 separate study sessions were conducted. The mean number of participants per group was 9.1 ($SD = 5.4$). Participants initially completed measures of BIS–FFFS, BAS, and trait social anxiety. Next, participants underwent a social-threat induction procedure in which they were told they would be required to give an impromptu speech at the end of the study. Afterwards, participants completed a counter-balanced battery of cognitive bias measures assessing memory bias, belief bias, expectancy bias, and perception of threat, as each of these constructs is included in Kimbrel's (2008) mediated model of social anxiety. Participants' state anxiety was also assessed via self-report. Finally, participants performed brief impromptu speeches while audience members rated their level of anxiety during their speeches. Structural equation modeling (SEM) was used to compare the hypothesized model with several alternative models.

2.3. Self-report measures

The Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ; Torrubia, Avila, Molto, & Caseras, 2001) was used to assess individual differences in BIS–FFFS and BAS sensitivity. The *SPS* (Mattick & Clarke, 1998) was used to assess trait social anxiety. The state version of the State-Trait Anxiety Inventory (STAI; Spielberger, Lushene, Vagg, & Jacobs, 1983) was used to assess state anxiety in anticipation of the speech task. The Negative Affect scale from the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) and the Beck Anxiety Inventory (BAI; Beck, Epstein, Brown, & Steer, 1988) were also used to assess state anxiety and negative affect, respectively. The directions for the BAI and PANAS were altered so that participants were asked to rate the degree to which they were currently experiencing the items while they anticipated the impending speech task. *Audience ratings of anxiety* were obtained by having audience members rate participants' state anxiety during the speech task on a five-point Likert scale that ranged from 1 = "not nervous at all" to 5 = "very nervous." The audience ratings of anxiety for each participant were averaged across all available raters to produce an average

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