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Threat Interference Biases Predict Socially Anxious Behavior: The Role of Inhibitory Control and Minute of Stressor

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The current study brings together two typically distinct lines of research. First, social anxiety is inconsistently associated with behavioral deficits in social performance, and the factors accounting for these deficits remain poorly understood. Second, research on selective processing of threat cues, termed *cognitive biases*, suggests these biases typically predict negative outcomes, but may sometimes be adaptive, depending on the context. Integrating these research areas, the current study examined whether conscious and/or unconscious threat interference biases (indexed by the unmasked and masked emotional Stroop) can explain unique variance, beyond self-reported anxiety measures, in behavioral avoidance and observer-rated anxious behavior during a public speaking task. Minute of speech and general inhibitory control (indexed by the color-word Stroop) were examined as within-subject and between-subject moderators, respectively. Highly socially anxious participants (N = 135) completed the emotional and color-word Stroop blocks prior to completing a 4-minute videotaped speech task, which was later coded for anxious behaviors (e.g., speech dysfluency). Mixed-effects regression analyses revealed that general inhibitory control moderated the relationship between both conscious and unconscious threat interference bias and anxious behavior (though not avoidance), such that lower threat interference predicted higher levels of anxious behavior, but only among those with relatively weaker (versus stronger) inhibitory control. Minute of speech further moderated this relationship for unconscious (but not conscious) social-threat interference, such that lower social-threat interference predicted a steeper increase in anxious behaviors over the course of the speech (but only among those with weaker inhibitory control). Thus, both trait and state differences in inhibitory control resources may influence the behavioral impact of threat biases in social anxiety.

Keywords: social anxiety; inhibitory control; speech performance; emotional Stroop interference; threat bias

THE FACT THAT SOCIAL ANXIETY IS OFTEN ASSOCIATED with observable impairments in social performance, especially in high-stakes social situations (e.g., Alden & Wallace, 1995; Thompson & Rapee, 2002), presents a difficult challenge for the study and treatment of social anxiety. In addition to the considerable interpersonal and professional costs of underperforming in social contexts, such experiences also likely reinforce socially anxious individuals' already negative beliefs about their social competence, which in turn are likely to maintain and further fuel their social anxiety (see Clark & Wells, 1995). However, behavioral manifestations of anxiety are only partly accounted for by self-reported anxiety measures (e.g., Asendorpf, Banse, & Mücke, 2002), suggesting our understanding of this impairing feature of social anxiety remains limited. Thus, it is important to identify valid predictors of socially anxious behavior, beyond the limited prediction provided by self-reported anxiety measures, that may help advance theoretical models of social anxiety and be fruitfully targeted in future treatments.

Toward this end, the current study examines two theoretically plausible cognitive factors—conscious

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and unconscious threat interference biases—as unique predictors of anxious behavior during a videotaped public speaking task. As a particularly tough test of cognitive models that posit a unique role for threat-related cognitive biases in predicting anxious behavior (e.g., Beck & Clark, 1997), we control for self-reported trait and state social anxiety as well as self-rated speech performance.

THREAT INTERFERENCE BIASES AS PLAUSIBLE PREDICTORS OF ANXIOUS BEHAVIOR

A growing body of research indicates that relatively automatic threat-related attentional biases—such as selective attention to or difficulty disengaging from threatening words or faces—play key roles in the etiology and maintenance of social anxiety (see Bar-Haim et al., 2007) and are likely malleable (see Hallion & Ruscio, 2011, for a meta-analysis). Further, the relatively habitual, hard-to-control nature of these biases (see Beck & Clark, 1997) makes them particularly promising candidates as predictors of similarly hard-to-control anxious behavior during social performance. For instance, the relatively automatic tendency to associate the "self" with "anxiety" on an Implicit Association Test (IAT) has already been shown to uniquely predict spontaneous anxious behavior (such as fidgeting and tense body posture) during a social performance task, beyond self-reported anxiety measures (e.g., Asendorpf et al., 2002; Egloff & Schmukle, 2002). Similarly, it is plausible that a habitual tendency to selectively focus on threat information could manifest itself in the form of heightened discomfort or other observable signs of anxiety during a social performance task. For instance, focusing on a nonsmiling face in the crowd, or on intrusive thoughts about how poor an impression one is making during one's speech, may lead to poorer performance and visible signs of anxiety. Indeed, as posited by Attentional Control Theory (Eysenck, Derakshan, Santos, & Calvo, 2007), such habitual threat-related attentional processing may divert one's cognitive resources away from the goal-directed attentional system (see also McNally, 1995), thus impairing performance on attentionally demanding tasks, such as the likely stressful and difficult public speaking task used in the current study.

However, forecasting when and how selective threat processing biases will predict anxious behavior is complicated by the apparently nuanced, context-sensitive role of these biases in social anxiety. Of note, our use of the term "bias" here refers to any preferential processing of certain types of stimuli over others (following Mathews & MacLeod, 2005, among others), regardless of the accuracy or inaccuracy of the resulting judgments. For instance, an individual with a threat-related attentional bias may be more likely to notice the bored faces in the audience than the interested ones, but this need not always lead to a false or distorted conclusion. The speaker could hypothetically conclude that "some people are getting bored—I should pick up the pace a bit," versus generalizing to a global interpretation like "everyone must be bored with me—this talk is going terribly."

As such, it is perhaps unsurprising that there appear to be some contexts in which selective processing of threat cues contributes to maladaptive social anxiety outcomes, and other contexts in which this same bias is protective. This inconsistency is perhaps most evident when reviewing prior findings for the emotional Stroop (e-Stroop) task, a widely used threat bias measure adapted from the classic color-word Stroop paradigm (Stroop, 1935). Though the e-Stroop has been controversial as a measure of threat-related attentional bias (see Mathews & MacLeod, 2005), it was selected in the present study because it affords a unique opportunity to examine threat interference in a context where the threat cue (the word meaning) and the task-relevant cue (the ink color) are presented *simultaneously*, thus putting these features directly in conflict and allowing for a more direct assessment of unintentional, goal-irrelevant processing (see Teachman, Joormann, Steinman, & Gotlib, 2012). Specifically, the e-Stroop assesses individuals' relative response latencies when naming the colors of words or pictures that have a threatening versus nonthreatening meaning. Slower color-naming latencies for socially threatening (e.g., "lonely") relative to nonthreatening (e.g., "couch") stimuli are interpreted as threat *interference* effects, thought to reflect a selective vigilance bias for social-threat cues (e.g., Hope, Rapee, Heimberg, & Dombeck, 1990). The e-Stroop allows both conscious and unconscious threat biases to be assessed, using either supraliminal (unmasked) or subliminal (masked) stimulus presentation, respectively. Studies directly comparing the masked and unmasked versions of the e-Stroop have found no reliable correlations between the two tasks (e.g., Kim, Lundh, & Harvey, 2002), suggesting that they index largely distinct features of biased threat processing. In light of these findings, conscious and unconscious threat interference biases on the e-Stroop were analyzed separately in the current study.

With respect to conscious e-Stroop bias, most studies have found that high socially anxious (relative to nonanxious) individuals show a threat interference effect (e.g., Hope et al., 1990). However, this finding is suppressed or even reversed under certain task conditions (e.g., elevated state anxiety; Amir et al., 1996). With respect to unconscious