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Manipulating Attention to Nonemotional Distractors Influences State Anxiety: A Proof-of-Concept Study in Low- and High-Anxious College Students

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Anxious individuals have difficulty inhibiting attention to salient, but nonemotional, distracting stimuli. The exact nature of this relationship remains unclear, however. In the present study, we tested the hypothesis that increasing attention to salient, but nonemotional, distracting stimuli would lead to increases in state anxiety by manipulating attentional strategies during a visual search task. We randomly assigned students low and high in trait anxiety to either a 1-session singleton detection training group or a feature search group. Singleton detection training increases distraction by salient, nonemotional stimuli whereas feature search training protects attention against distracting stimuli. Findings revealed that singleton detection training not only increased distraction by salient, nonemotional stimuli but also increased state anxiety. Moreover, this increase in state anxiety was most pronounced among high trait-anxious individuals. In contrast, feature search training protected attention against distracting stimuli and against increases in state anxiety, particularly in the high trait-anxious individuals. Together, the current findings provide initial support for the notion that distraction by salient, nonemotional stimuli can increase state anxiety levels. Furthermore, these results suggest that individuals already vulnerable to experience anxiety are most likely to be affected by distraction by salient, nonemotional stimuli, and that training anxious individuals to focus on specific shape features may be a viable attention modification intervention.

Keywords: anxiety; attention; attention training; attentional capture; search strategies

Anxious individuals are known to preferentially attend to threatening stimuli (Bar-Haim et al., 2007); however, they also demonstrate broader attentional deficits that manifest across a range of nonemotional cognitive tasks. In fact, such attentional problems represent core diagnostic features of many anxiety disorders in the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5; American Psychiatric Association, 2013). Numerous behavioral and neuroscientific studies have confirmed the robust relationship between anxiety and difficulties inhibiting distracting information even in the absence of threat (Berggren & Derakshan, 2013; Eysenck & Derakshan, 2011; Eysenck, Derakshan, Santos, & Calvo, 2007). To account for these broad attentional impairments, Attentional Control Theory (ACT; Eysenck et al., 2007) posits that anxiety is characterized by increased influence of the bottom-up stimulus-driven attention system that tracks salient and threatening stimuli and decreased influence of the volitional, top-down control system that sets and tracks goals

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(Corbetta & Shulman, 2002; Posner & Petersen, 1990). Thus, ACT suggests that this imbalance between salience- and goal-driven attention is at the root of impaired attentional control in anxiety and impacts performance on a variety of attentional tasks—both with and without affective stimuli.

We have recently argued (Moser, Becker, & Moran, 2012; Moran & Moser, 2015) that the ideal way to assess the imbalance between salience- and goal-driven attention in anxiety is through the use of the "additional singleton paradigm" (Theeuwes, 1991, 1992). In this task, participants are presented with a circular array consisting of simple shapes (see Figure 1 for an example array). On each trial, the participant is presented with an array containing one unique "singleton" shape (e.g., a circle; Figure 1), which serves as the target, and a homogeneous set of nontarget shapes (e.g., squares; Figure 1). The participant's task is to locate the unique target shape and identify whether the line segment contained within it is oriented vertically or horizontally. Color is irrelevant to the task; however, on half of the trials one of the nontarget shapes is presented in a different color (e.g., one square is displayed in red while the rest are displayed in green; Figure 1), making it a physically salient color singleton or distractor (Theeuwes, 1991, 1992). In this way, the additional singleton paradigm simultaneously pits bottom-up salience-driven attention against top-down goal-driven attention for the initial selection of attention. The primary finding across individuals is that response times to the target are longer when the color singleton is present than when the color singleton is absent (for a review see Theeuwes, 2010). Theeuwes argued that the slowed response times result from the automatic selection of the color singleton by the bottom-up salience-driven system that occurs before the target can be selected by the top-down goal-driven system.

Using the additional singleton task, we have shown that the distracting effects of the color singleton are exaggerated in trait-anxious undergraduates, suggesting that they are more susceptible to distraction by nonaffective physical salience than nonanxious individuals (Moran & Moser, 2015; Moser et al., 2012). This effect has also been replicated in a sample of patients diagnosed with posttraumatic stress disorder (PTSD; Esterman et al., 2013). Together, these results provide strong support for ACT's central claim that anxiety is associated with increased influence of the salience-driven attention system and decreased influence of the goal-driven attention system, resulting in preferential processing of salient stimuli—even those that are not threatening—and impaired task performance.

The exact nature of the relationship between this attention to nonemotional color singletons/distractors

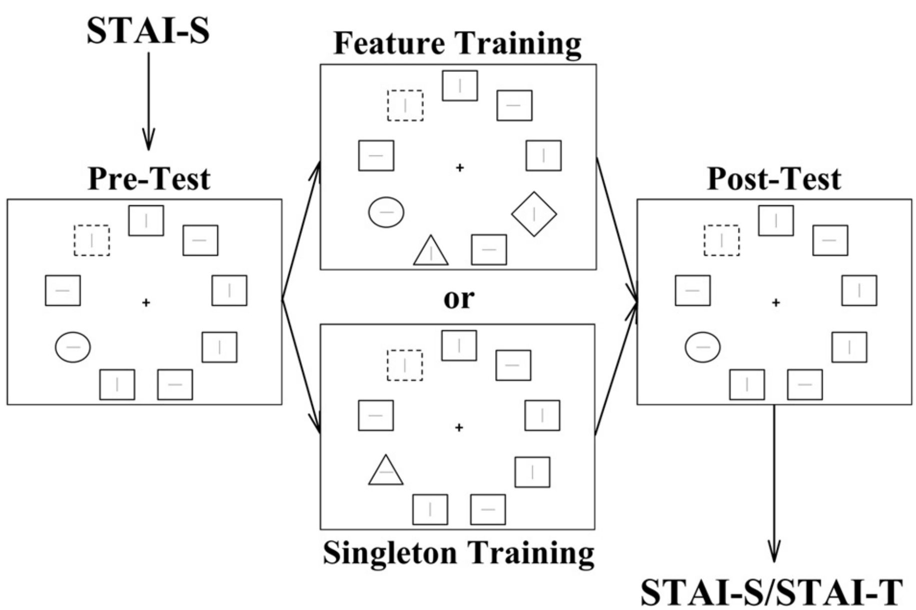

FIGURE 1 A schematic representation of the experimental procedure. Dashed-line objects represent the color singleton distractor. All participants first completed the state-anxiety questionnaire and the pretest phase. Participants were then randomly assigned to a singleton- or feature-mode training phase. Participants were always asked to report the orientation of the line segment in the target shape (determined by group assignment). Following training, participants completed the posttest phase and completed the state- and trait-anxiety questionnaires (see method for a description of tasks).