Cognitive Therapy and Research, Vol. 27, No. 6, December 2003 (© 2003), pp. 671–680

Relationships of Distinct Affective Dimensions to Performance on an Emotional Stroop Task

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Few studies have examined the nature of enhanced selective attention to threatening stimuli with regard to distinct affective dimensions in nonclinical samples. No study to date has explored the relationships of multiple anxiety-related dimensions to performance on an emotional Stroop task. An adult sample without history of spontaneous panic attacks ($N = 138$) participated in an emotional Stroop task, and performance was analyzed in light of several types of self-reported anxiety. Only anxiety sensitivity distinguished individuals who showed a pattern of interference to threat information from those who showed a pattern of facilitation. No anxiety type was associated with reaction time patterns to appetitive distractors. These results highlight the importance of deconstructing anxiety into separate dimensions such that unique relationships between anxiety types and cognitive processing can be examined.

KEY WORDS: anxiety sensitivity; anxious apprehension; anxious arousal; emotional Stroop; selective attention.

Numerous cognitive theories of anxiety have emphasized the role of attentional biases in the etiology and maintenance of anxiety (for review, see Mogg et al., 2000). According to such models (e.g., Mathews, 1990), there are individual differences in the degree to which one selectively attends to danger-laden stimuli, with high trait anxious individuals being more disposed to threat-related hypervigilance than low trait anxious individuals. While the literature relating the effects of emotion to patterns of attentional capture is growing, care should be taken not to consider anxiety as a monolithic emotion.

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A corpus of literature has shown that anxiety comprises multiple components that are distinguishable in both clinical and nonclinical populations. For example, previous theoretical and empirical work has made distinctions between constructs such as somatic versus cognitive anxiety and panic versus worry. Heller and Nitschke (1998) proposed subsuming these distinctions under the terms “anxious arousal” (after Watson & Clark, 1991) and “anxious apprehension” (after Barlow, 1991), respectively. Psychometric and psychophysiological data support this distinction (Heller, Nitschke, Etienne, & Miller, 1997; Nitschke, Heller, Imig, McDonald, & Miller, 2001), and results of correlational and confirmatory factor analyses suggest that anxious arousal and anxious apprehension represent distinct affective dimensions that can be distinguished from depression as well as from negative affect in nonclinical samples (Nitschke et al., 2001).

Recent research suggests that another construct known as anxiety sensitivity (the tendency to fear and catastrophize anxiety-related sensations) is a theoretically and phenomenologically distinct individual difference variable (Cox, Borger, & Enns, 1999; Lilienfeld, 1999) and is associated with information-processing biases believed to serve as cognitive risk factors for panic pathology (MacLeod, Rutherford, Campbell, Ebsworthy, & Holker, 2002; Mathews & Sebastian, 1993; McNally, 1999). Despite the importance of disentangling affective dimensions in research on emotion and cognitive processing, the relationship of anxiety sensitivity to anxious arousal and anxious apprehension has not been thoroughly studied. In fact, few studies have systematically examined the relationships between specific dimensions of anxiety and patterns of selective attention, and no study to date has explored the relationships of multiple anxiety-related constructs to performance on an emotional Stroop task.

In this study, we investigated these relationships using an approach established in previous work on distinguishing dimensions of anxiety and depression (Nitschke et al., 2001). We selected nonpatient participants in order to obtain a sample of adequate size in which to examine the relationships between various affective dimensions and behavioral indices of attentional capture. Given that the constructs of anxiety sensitivity and anxious arousal both pertain to emotional responses associated with perceived danger, it was hypothesized that scores on measures of anxiety sensitivity and anxious arousal would be positively associated with degree of attentional capture by negative (threat) but not positive (appetitive) stimuli. Since anxious apprehension refers to the tendency to worry about task performance regardless of the emotional valence of the task, it was predicted that anxious apprehension would show no relationship to degree of interference to either threat or appetitive stimuli. In other words, if highly anxious apprehensive individuals are worried about task performance in general, then they should be equally slow to respond to emotional and nonemotional stimuli.

METHODS

Participants

Participants were 165 (96 female) right-handed, native English speakers recruited from the Introductory Psychology pool of the University of Illinois at

Urbana–Champaign who received partial course credit for their participation. Participants ranged in age from 17 to 22 ($M = 18.3$, $SD = 0.7$) years, with 79.4% reporting their ethnicity as White/Caucasian, 7.9% as Asian American, 7.9% as Black/African American, 3.0% as Latina(o)/Hispanic, and 1.8% as biracial.

Questionnaires

Participants were given the following questionnaires: the Anxiety Sensitivity Index (ASI; Peterson & Reiss, 1992), the Mood and Anxiety Questionnaire—Anxious Arousal and Anhedonic Depression scales (MASQ; Watson & Clark, 1991), the Penn State Worry Questionnaire (PSWQ; Meyer, Miller, Metzger, & Borkovec, 1990), the State–Trait Anxiety Inventory—Trait scale (STAI-T; Spielberger, Gorusch, Lushene, Vagg, & Jacobs, 1983), and a portion of the Panic Attack Survey—Revised (PAQ-R; Cox, Norton, & Swinson, 1992).

The ASI is a 16-item self-report questionnaire that measures fear of anxiety-related sensations, emphasizing fear of somatic sensations, mental dyscontrol, and public scrutiny. It has demonstrated adequate internal consistency (Peterson & Heilbronner, 1987) and test–retest reliability (Maller & Reiss, 1992) in college samples.

The PSWQ is a 16-item self-report questionnaire used to assess anxious apprehension and has been shown to possess high internal consistency and good test–retest reliability in college samples (Meyer et al., 1990). Items index the extent of worrying across time and situations as well as the severity of worrying as perceived by the individual.

The Anxious Arousal scale, containing 17 items, is one of five scales comprising the 90-item long form of the MASQ and was included in this study to measure somatic anxiety. Although depression was not a primary focus of this study, previous research indicates that it is crucial to assess depression when studying anxiety (see Nitschke et al., 2001); the rate of co-occurring depression and anxiety is high not only in patient samples but also in samples where severity of presentation does not warrant a mood disorder diagnosis (Akiskal, 1990; Hiller, Zaudig, & Rose, 1989).

The 22-item MASQ Anhedonic Depression scale was used to assess depression in the current sample. Confirmatory factor analysis on an independent sample revealed two separable structures within this set of items, 8 of which tap depression and 14 of which tap positive affect (Nitschke et al., 2001). Due to this lack of homogeneity, present analyses used the eight depression items.

The STAI-T is a 20-item self-report questionnaire that assesses frequency of trait anxiety-related symptoms. It has demonstrated adequate test–retest reliability and internal consistency in samples of high school and college students (Spielberger et al., 1983). Critics have argued that the item content of the STAI-T actually better assesses depression than it does trait anxiety (Watson et al., 1995). In addition to showing correlations of 0.5 or higher with depression measures, the STAI-T appears to measure anxious apprehension, given its strong correlation with the PSWQ (Nitschke et al., 2001). Furthermore, given moderate to high correlations between the ASI and the STAI-T, critics have questioned whether anxiety sensitivity and trait anxiety are distinguishable constructs (e.g., Lachlan & Cox, 2001). Although there is general agreement in the field that the ASI possesses incremental validity beyond the STAI-T in predicting a variety of anxiety-related behaviors (for review, see Lilienfeld, 1999), we followed the recommendation of Lilienfeld (1999) to include the STAI-T in the questionnaire battery.

Participants also completed an 8-item survey assessing episodes of spontaneous panic, with items drawn from the PAQ-R. We followed the method of McNally, Hornig, Hoffman, and Han (1999) and Norton, Cox, and Malan (1992) of categorizing individuals based on a history of spontaneous panic. Data from such individuals were excluded from statistical analyses. A panic-free sample was desired in order to ascertain whether attentional biases to threat are associated with anxiety dimensions premorbidly.

Emotional Stroop Task

The emotional Stroop is a color-naming task in which the participant is instructed to identify the ink color of the word as quickly and accurately as possible and to ignore the meaning of the word. In this study, participants were instructed to press a button on a response pad to indicate their response.[7] The task consisted of 256 trials in 16 blocks of 16 trials. After every fourth block, there was a 1-min rest period. Trials within the same block were of the same word category, such that a block contained all threat words, all appetitive words, or all neutral words. No word was repeated throughout the experiment. A blocked presentation rather than a randomized presentation was used because of data suggesting that random presentation of threat words among other word types evokes less interference (Holle, Neely, & Heimberg, 1997). Each trial was 2-s long with the stimulus word appearing for the first 1.5 s, followed by a small, white fixation cross centered on the screen for the remaining 0.5 s.

Participants were randomly assigned to one of two orders of presentation. Within a block, each color appeared four times, and trials were pseudorandomized such that no more than two trials featuring the same color appeared in a row. Combinations of color-to-button mapping on the response pad were counterbalanced within each of the two levels of the order of presentation, yielding eight color-mapping/block-order combinations. Approximately one eighth of the participants received each combination.

Word Stimuli

Of the 256 words, 64 were appetitive (e.g., *birthday*, *ecstasy, laughter*), 64 were threat (e.g., *suicide, war, victim*), and two sets of 64 were neutral (e.g., *hydrant, moment*, *carpet*).[8] The words were carefully selected on the basis of established norms for valence, arousal, and frequency of usage in the English language (Bradley &

[7] Although Stroop-like paradigms typically direct the participant to give a verbal response to color identification, a manual button-press procedure was developed for this study so that the experimental paradigm could be easily adapted for use in subsequent functional magnetic resonance imaging (fMRI) studies in which it is essential to minimize head movement. Brown and Besner (2001) have shown that the nature of semantic processing in Stroop tasks is the same regardless of whether the response is verbal or manual in nature.

[8] The full list of words used as stimuli is available upon request.

Lang, 1999) as well as for number of letters. Words ranged from three to eight letters in length. Given that the neutral word sets were nearly identical to each other in terms of valence, arousal, frequency, and word length, it was arbitrarily decided that neutral set 1 would serve as the baseline reference for the appetitive word set and that neutral set 2 would serve as the baseline reference for the threat word set.

Words were presented in capital letters using Tahoma 72-point font. Each word appeared in one of four colors (red, yellow, green, and blue) and was centered on top of a black background.

Apparatus

Word stimuli were presented using STIM software (James Long Company) on a 17-inch monitor connected to an IBM-compatible computer. The color-identification response latency for each trial was detected by a button press on a 4-button, handheld response pad (James Long Company) where each button represented a color.

Procedure

After written informed consent was obtained, participants were asked to complete a questionnaire packet containing the following scales: PSWQ, ASI, and STAI-T. Upon completion of the questionnaires, participants were scheduled to come to the laboratory individually for a $^1/_2$-hr computer task session. The delay between questionnaire testing and the individual lab session ranged from two to eight weeks. Immediately before beginning the emotional Stroop task, each participant completed a second questionnaire packet containing the MASQ-AA, MASQ-AD, and the portion of the PAQ-R. The participant was then given instructions for the emotional Stroop task and seated 115 cm from the computer monitor at eye level in a semi-darkened room. Before the task started, the participant was given 24 practice trials for familiarization with task demands.

RESULTS

On the basis of the participants' responses to the PAQ-R, we excluded data from 26 participants (13 female) with a positive history of spontaneous panic from analyses. For the remaining sample ($N = 139$), mean (SD) questionnaire scores were 49.2 (14.2) for the PSWQ, 39.0 (9.9) for STAI-T, 15.5 (7.4) for the ASI, 28.3 (8.0) for the MASQ-AA, and 17.6 (5.1) for the MASQ-AD. Among these five variables, women scored higher on the PSWQ, $F(1, 137) = 7.48$, $p < .01$, and the ASI, $F(1, 135) = 12.65$, $p < .01$, than did men.

Average color-naming accuracy across the entire sample was 95.2%. The data of one additional participant were dropped from subsequent analyses because of accuracy below 80% for a final $N = 138$ (77 female) in this sample. Response latencies for incorrect trials were not included when calculating average reaction times. Stroop effects were calculated following a standard method to adjust for individual differences in overall color-naming speed (McNally, Rieman, & Kim, 1990). For a

Table I. Descriptive Statistics for Color-naming Latencies and Stroop Effects (ms)

	Mean (*SD*)		
Word type	Women	Men	Total
Appetitive	649.9 (91.9)	646.0 (99.5)	647.8 (94.7)
Neutral set 1	635.6 (91.3)	640.8 (94.5)	637.6 (92.2)
Threat	650.8 (98.6)	657.5 (102.6)	653.8 (99.7)
Neutral set 2	637.1 (94.8)	639.7 (92.5)	638.4 (93.1)
Appetitive Stroop effect	14.3 (47.6)	5.3 (34.5)	10.3 (42.3)
Threat Stroop effect	13.8 (45.5)	17.8 (51.2)	15.6 (48.0)

Note. A $2 \times 4 \times 4$ repeated measures analysis of variance (ANOVA) was performed to detect whether there were main effects for order of presentation, word type, or color-to-button mapping or significant interactions. As expected, there was a main effect for word type, $F(1, 3) = 9.37$, $p < .001$. Planned comparisons revealed that participants were slower to respond to threat words than to corresponding neutral words ($p < .001$) and slower to respond to appetitive words than to corresponding neutral words ($p = .001$). There was no significant difference in response latency between the two sets of neutral words. There were no significant main effects for order of presentation or color-to-button mapping, nor any interactions.

given individual, the "threat Stroop effect" was calculated by subtracting the average reaction time for neutral set 2 from the average reaction time for the threat word set. Similarly, the "appetitive Stroop effect" was derived by subtracting the average reaction time for neutral set 1 from the average reaction time for the appetitive word set. These difference scores reflect the degree of interference (denoted by a positive difference score) or facilitation (denoted by a negative difference score) produced by threat and appetitive words relative to neutral words. Appetitive and threat Stroop effects are shown in Table I.

Across the entire sample, the Stroop effect for threat words ranged from 205 ms of interference to 96 ms of facilitation, such that individuals could be classified on the basis of their average Stroop threat effect as either *threat interferers* ($n = 85$: 47 female, 38 male) or *threat facilitators* ($n = 53$: 30 female, 23 male). Similarly, given the spread of scores for the appetitive Stroop effect ranging from 120 ms of interference to 148 ms of facilitation, participants could be categorized as either *appetitive interferers* ($n = 82$: 53 female, 29 male) or *appetitive facilitators* ($n = 56$: 24 female, 32 male).[9]

To determine whether threat interferers (vs. threat facilitators) and appetitive interferers (vs. appetitive facilitators) differed significantly in their self-reported emotional functioning, two multivariate analyses of variance (MANOVAs) were performed with threat response bias as the between-subjects factor in the first MANOVA, appetitive response bias as the between-subjects factor in the second MANOVA, and scores on the PSWQ, MASQ-AA, STAI-T, MASQ-AD, and ASI as

[9]Examination of variable distributions showed no significant departure from normality for the threat Stroop effect, Kolmogorov-Smirnov test statistic = .07, $df = 138$, $p = ns$, or the appetitive Stroop effect, Kolmogorov-Smirnov test statistic = .07, $df = 138$, $p = ns$. While there was no association between gender and threat Stroop effect, there was an association between gender and appetitive Stroop effect, $\chi^2(1) = 8.17$, $p < .005$, such that there were more women than men in the appetitive interferer group and more men than women in the appetitive facilitator group.

the response variables in both analyses.[10] The assumption that the covariance matrix is similar for each group was upheld for both the first, Box's $M = 54.60$, $F(45, 24990) = 1.12$, $p = ns$, and second MANOVA, Box's $M = 55.25$, $F(45, 25476) = 1.13$, $p = ns$. Likewise, the assumption of similar error variances across groups for each response variable was upheld in both MANOVA procedures (all p values = ns). Results of the first MANOVA revealed a main effect, Wilks's $\lambda = .90$, $F(5, 132) = 2.97$, $p = .01$, for threat response bias such that threat interferers scored higher on the ASI than did the threat facilitators, $F = 5.56$, $p = .02$ with Bonferroni correction. No other response variables contributed to the multivariate main effect. There was no main effect for appetitive response bias in the second MANOVA.

To assess the relative contribution of the ASI to predicting threat response bias, a hierarchical regression analysis was conducted across the entire sample using the Model 1 error term to test increments in R^2. Results showed that anxiety sensitivity contributed a small but reliable increment in variance, R^2 change = .034, $F(1, 137) = 4.55$, $p < .05$, above and beyond that accounted for by the combination of the other four self-report variables: STAI-T, PSWQ, MASQ-AA, and MASQ-AD, $F(4, 134) = 0.75$, $p = ns$.

DISCUSSION

Results of this study are threefold. First, individual differences emerged in the threat and appetitive Stroop effects such that approximately 63% of the sample displayed interference to threat, whereas approximately 37% displayed facilitation to threat, and approximately 59% showed interference to appetitive words, whereas approximately 41% showed facilitation to appetitive words. Results indicated that threat interferers were distinguishable from threat facilitators in their responses on the ASI; individuals who were slower to respond to threat words relative to neutral words reported more anxiety sensitivity than individuals who were faster to respond to threat words relative to neutral words. This finding is compatible with the report by Stewart, Conrod, Gignac, and Pihl (1998) that high anxiety sensitive participants demonstrated more threat-related interference on a selective attention task than did low anxiety sensitive participants. However, McNally et al. (1999) found no evidence of a relation between anxiety sensitivity and attentional bias using a similar paradigm in a nonpatient sample. Although McNally et al. stated that their nonsignificant effects could not be attributed to lack of power, their sample size was such that a correlation between ASI score and threat Stroop effect of 0.25 or higher would be significant at alpha of .05. In our sample, the correlation between ASI score and threat Stroop effect was 0.21 and was significant at the same alpha level. Given this comparison, it does appear that McNally et al. lacked sufficient power to uncover this small-to-medium effect size (Cohen, 1992).

[10]We conducted additional analyses in which the ASI was parsed into three theoretically derived subscales (i.e., fear of somatic sensations, fear of cognitive dyscontrol, and fear of publicly observable anxiety reactions). When entered as response variables in each MANOVA, none of the subscales distinguished between the facilitator and interferer groups. We also conducted MANOVAs in which gender was added as a grouping variable; there were no interactions between gender and response bias variables.

Second, across the entire sample, none of the emotion-related variables was associated with reaction time patterns to appetitive cues. Similarly, individuals who showed a pattern of interference to appetitive information were not distinguishable from those who showed a pattern of facilitation in terms of self-reported anxiety or depression. These data, taken together with those described above, suggest that the attentional bias associated with anxiety sensitivity is specific to *negatively* valenced, highly arousing words.

Third, women scored higher in anxious apprehension and anxiety sensitivity, replicating patterns reported elsewhere (Nitschke et al., 2001; Peterson & Plehn, 1999). These gender effects did not interact with either threat or appetitive Stroop effects. Unlike the findings reported by Stewart et al. (1998), in the present sample female threat interferers and facilitators did not differ from their male counterparts with regard to anxiety sensitivity scores. Panickers (i.e., those with a history of spontaneous panic attacks) were excluded from the present sample, whereas Stewart et al. (1998) did not do this, and it is possible that gender differences emerged in their study because of disparate proportions of male and female panickers in their high ASI group (50% vs. 30%, respectively).

These findings support two of the three hypotheses. As expected, we found that anxiety sensitivity (ASI) was positively associated with degree of attentional capture by threat but not appetitive stimuli. We also found that anxious apprehension (PSWQ) showed no relationship to degree of interference to either threat or appetitive stimuli. However, we did not find the predicted association between anxious arousal (MASQ-AA) and threat interference.

Despite the significant correlation between the ASI and the MASQ-AA, anxious arousal and anxiety sensitivity are distinct constructs, and it is likely that the differences between the two dimensions speak to the dissociation in findings in the present study. Anxious arousal refers to the degree to which one experiences somatic anxiety, and the MASQ-AA, as a measure of anxious arousal, assesses the frequency and subjective intensity of certain bodily symptoms. Anxiety sensitivity does not refer to either the frequency or the subjective intensity of anxiety sensations. Instead, it refers to how much one *fears* these sensations whenever they occur. If the ASI measures intensity, then it is the intensity of the *fear* of symptoms and not the intensity of the symptoms themselves. Given the present results, it appears that, when multiple anxiety dimensions are examined in samples of panic-free adults such as this one, it is not enough to experience frequent, intense somatic anxiety in order to demonstrate an attentional bias to arousing threat words. What is necessary (although not necessarily sufficient) is a marked fear of these sensations. That such an effect was found in a panic-free sample is important in that it highlights the fact that an attentional bias to threat is associated with anxiety sensitivity premorbidly. However, given data suggesting that levels of anxiety sensitivity may vary as a function of ethnic background (Carter, Miller, Sbrocco, Suchday, & Lewis, 1999) and student status (Schmidt, Lerew, & Jackson, 1997), additional studies are needed to determine whether these findings generalize to a nonstudent, ethnically diverse sample. Results are also tempered by the fact that anxiety sensitivity explains a relatively small percentage of the overall variance of cognitive risk factors in this study as well as in other studies (e.g., Schmidt et al., 1997; Weems, Hayward, Killen, & Taylor, 2002).

Continuing research should strive to quantify other individual difference variables that uniquely identify individuals at risk for panic disorder.

Although this study demonstrates a relationship between anxiety sensitivity and impaired selective attention to task-relevant information, it is important to situate this finding in the context of emotion processing and emotion regulation (see Gross, 1993). The emotional Stroop task directs the participant to ignore emotional aspects of a stimulus. It is clear that people with high anxiety sensitivity are not particularly successful at self-distraction when the emotional aspect of a stimulus is negative in valence. This study does not address, however, the ability (or inability) of highly anxiety sensitive individuals to employ other strategies of attentional deployment or to shift between strategies when such a need arises. Using a variety of information-processing paradigms, it will be important to resolve whether individuals with high levels of anxiety sensitivity demonstrate aberrant emotion regulation mechanisms beyond attention deployment. Such research will provide groundwork that is crucial in determining which additional emotional and cognitive processes serve as risk factors for the development of panic pathology.

ACKNOWLEDGMENTS

This research was supported in part by NIDA Grant R21 DA14111, NIMH Grant R01 MH61358, and NIMH Grant T32 MH14257 to the University of Illinois. The research was conducted while the first author was a predoctoral trainee in the Quantitative Methods program of the Department of Psychology, University of Illinois at Urbana–Champaign.

We gratefully acknowledge Aprajita Mohanty, Joscelyn E. Fisher, Jennifer L. Stewart, John D. Herrington, Jennifer L. Crowe, Mari E. Meyer, Kristyn L. Fix, Ryan Kole, and Andrew Sodergren for their assistance in collecting the data reported in this paper.

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