Better Attend Here--Not There: Individual Differences in Orienting Predict Anxious Attention Bias and Defensive Driving

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Introduction

Individuals experiencing frequent episodes or chronically high levels of anxiety, i.e. "high Trait Anxiety" (Spielberger, 1983), often report problems with concentration and may be prone to distraction by irrelevant, affectively charged stimuli (Eysenck et al. 2007); however, these attentional atypicalities vary inconsistently across studies, such that both prioritization and avoidance of unpleasant stimuli are reported. What remains unclear concerns the *neurophysiological and/or cognitive mechanism(s) of attention* supporting these variable attentional atypicalities. Several influential perspectives (Bishop et al., 2004; Derryberry & Reed, 2002) subscribe to a "top down control deficit" view in suggesting that poorly functioning or inefficient mechanisms of executive attention contribute to anxiety related phenomena such as hypervigilance for negativity or delayed disengagement from task-irrelevant threat. An alternative view, foreshadowed by some proposals (Avila et al., 2002; Gray, 2004) is that at least in non-clinically significant anxiety, emotion related processes associated with sensitivity to potential threats act to co-opt *normally* functioning or even superior mechanisms of attention in the service of simultaneously active anxiety-related goals or priorities. We capitalized on the individual differences approach precipitated by Kosslyn et al. (2002) in order to determine whether less efficient executive attention, as indexed by subscores on a neuropsychologically validated affect-free task, the *Attention Network Test*, (Fan et al., 2002) predicts greater negativity bias on an affective dot probe task.

Specific Aims

(1) To evaluate whether high Trait Anxiety is associated with measurable inefficiencies of executive attention on an affect-free task (implicating a network of brain areas including the medial PFC and anterior cingulate), inefficient orienting, or inefficient alerting/vigilance.

(2)To evaluate 2 different hypotheses concerning biased attention to negative emotion:
(1) *Individual differences in efficiency of executive attention promote negativity bias*
(2) *Normal mechanisms of attention are used strategically to promote attention to potential threat among anxious individuals.*

(3)To examine whether ANT measures of attention are associated with adolescent/young adult real-world behavior (reported problems with attention in daily life, car accidents).

Method

Measures

• A version of the *Attention Network Test* (Fan et al., 2002), a cued Flanker task which yields RT based subscores to describe the efficiencies of three separable networks subserving basic functions of spatial orienting (*orienting,* higher score = more efficient) and vigilance (*alerting,* higher score = more efficient), as well as executive attention functions in response to flanker interference (*conflict,* lower score = more efficient), and changes in target orientation over trials (*dominant response modulation, DRM*, lower score = more efficient).

• An Affective Dot Probe task with positive and negative social images from the International Affective Picture Set (CSEA, 1999) matched for valence intensity and arousal.

•Self reported Attention Control (Derryberry & Reed, 2002),Trait Anxiety (Spielberger,1983), and driver history (involvement in car accidents as a driver/duration driving experience).

Data Analytic Strategy

• ANCOVA for Trait Anxiety related differences on the ANT and dot probe RT measures.
• A series of hierarchically well formed (Jaccard & Turrisi, 2003) multiple regression models to predict individual differences in negativity bias on the dot probe task. Centered predictors included Trait Anxiety, ANT subscores, and the interactions of Trait Anxiety with ANT subscores. Interaction cross products were entered sequentially and R^2 change evaluated.

• Quantile Maximum Likelihood Estimation (Heathcote et al., 2002) was used to obtain ex-Gaussian parameters characterizing individual participants' RT distributions for incongruent flanker and congruent flanker trials of the ANT in order to ensure that important differences in RT distributions were not obviated by reliance on RT means for creating difference scores.

Participants

Ninety-eight healthy young adults (29 males) with normal vision participated in exchange for extra credit in Introductory Psychology. Ages ranged between 18 and 28 (*M* = 19.1,*SD* = 1.9). Participants completed sleep logs for the three nights prior to participation and high and low anxious individuals did not differ with respect to sleep patterns, *t*(96) = .32 *p* = .75, or fatigue at time of testing, *t*(96) = .48, *p* = .63. Consistent with other reports, Trait Anxiety was correlated with poorer self reported Attention Control *r* (98) = -.37, *p* < .0001.

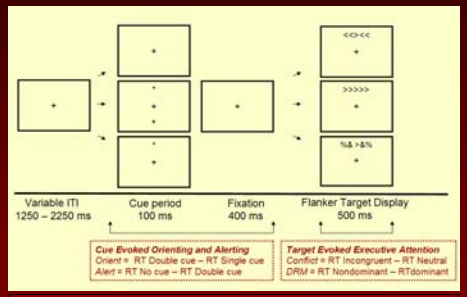

Figure 1. The *Attention Network Test.* Incongruent trials have conflicting flanker arrows around the imperative central arrow; congruent trials have compatible flanker arrows. Neutral trials have non-arrow flankers. DRM = dominant response modulation. Subscore derivation indicated in red.

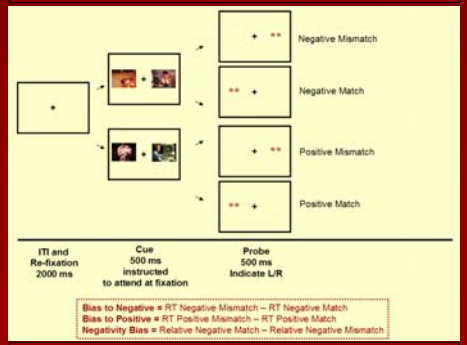

Figure 2. Affective dot probe task. Mismatch = target appears opposite the location of the preceding emotional picture; match = target asterisk appears at the location of the preceding emotional picture. Subscore derivation in red.

Results

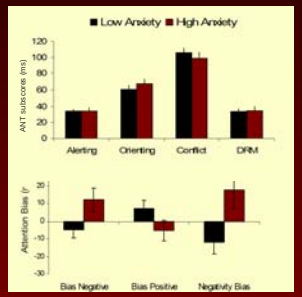

Figure 3a. Trait Anxiety and ANT. We observed no Trait Anxiety related differences in mean ANT subscores, nor was Trait Anxiety correlated with ANT subscores:

Alerting $r(98) = .02$, $p = .88$
Orienting $r(98) = .05$, $p = .66$
Conflict $r(98) = -.14$, $p = .17$
DRM $r(98) = .12$, $p = .24$

Figure 3b. Dot Probe bias as a function of Trait Anxiety. High Trait Anxiety was associated with increased dot probe Negativity Bias (Negative Bias – Positive Bias), $F(1, 97) = 8.89$, $p = .004$, $R^2 = .09$

		Dot Probe Negativity Bias	Attention Control Scale	Accidents Per Year of Driving
Low Anxiety n = 59	Alerting	.14	-.03	-.31*
	Orienting	.10	-.08	-.24
	Conflict	-.08	-.11	-.05
High Anxiety n = 39	Alerting	-.20	.01	.28
	Orienting	.45**	-.02	-.42**
	Conflict	-.18	-.38*	.25
	DR Modulate	-.05	-.34*	.03

Figure 4. Correlations of ANT subscores with Negativity Bias, Attention Control (Derryberry & Reed, 2002), and self reported involvement in car accidents for Low vs. High Anxiety.

Regression Analyses

The interaction of Trait Anxiety with ANT orienting accounted for an increase in Negativity Bias beyond that predicted by Trait Anxiety and Orienting alone (Step 2, $R^2 = .15$, $p = .001$, incremental $p = .009$). However, neither the first order contributions of ANT conflict, nor ANT DRM, nor their interactions with Trait Anxiety accounted for additional variance in Negativity Bias.

RT Distributional Analyses of ANT conflict

• High Trait Anxiety was associated with a more skewed, less symmetric distribution of responses on *congruent flanker* trials, reflected in an increased λ parameter for the ex-Gaussian RT distribution as modeled for each participant, *r* (98) = .29, *p* =.004. This is consistent with an anxiety related difference in incidence of inhibition applied when *congruent* flankers would otherwise "illegally" facilitate performance.

• There were no associations between Trait Anxiety and ex-Gaussian distributional parameters for conflict-laden *incongruent flanker* trials.

• Self reported high Attention Control was associated with generally slower RT (increased μ) for congruent and incongruent trials among low Trait Anxious individuals (suggesting a speed-accuracy tradeoff) but no such association was observed for high Trait Anxiety.

Conclusions

- ***Trait Anxiety is not associated with ANT subscores.***

Results are consistent with the proposal there is important heterogeneity in the efficiency of attentional functions among anxious individuals, and future work should respect this heterogeneity. Future work could address whether those known to be at increased risk for clinically significant anxiety due to family history of anxiety disorders or negative early life experiences are more likely to demonstrate difficulties with executive attention. We suggest, based on our distributional analyses, that it might be helpful to examine whether high Trait Anxiety is associated with differences in implementation of *evaluative* control, defined as the tendency to perceive or predict a *need* to configure the cognitive system to exert executive control, including processes of inhibition.

- ***Poorer executive attention doesn't promote an anxious negativity bias***.

We replicated the finding of lower self reported Attention Control in high Trait Anxiety and demonstrated that these reports are associated with less efficiency on two measures of executive attention. However, we found *no* evidence that anxious individuals with less efficient executive attention are *more* likely to demonstrate biased attention to potential threat on a dot probe task.

- ***Normal mechanisms of attention are used by anxious individuals to promote attention to potential threat***.

Rather than an inefficiency or deficit, it is ability to rapidly deploy and then maintain attention at a task-relevant spatial location that predicts dot probe negativity bias—but only for high anxious individuals. Low anxious individuals do not use orienting to prioritize negativity.

- ***Attention Network Test subscores are associated with meaningful aspects of adolescent/young adult behavior in the real world.***

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