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Kaitlin Ferris

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The Influence of Anxiety on Attention and Short-Term Memory

Kaitlin Ferris
Huron University College

Previous research has shown that anxious individuals have impaired performance on cognitive tasks. However, other research has demonstrated that an attentional bias can improve anxious individuals’ performance if task requires attention to be directed toward threat-related stimuli. The present study examines the effects of anxiety level on attention and short-term memory. Forty participants, of either high or low anxiety received either a threat-related word list or a neutral word list to remember. Following a distraction task, participants recalled as many words from the list as they could. It was found that there was a significant main effect for term type ($F(1,36) = 5.83$, partial $\eta^2 = 0.14$), as well as a significant term by anxiety interaction effect ($F(1,36) = 6.61$, $p < .05$, partial $\eta^2 = 0.16$).

What is the uneasy feeling of worry and apprehension that many individuals feel when facing a new situation? Why do students often find that their hearts race and their palms sweat as they go into an examination? All of these unpleasant “symptoms” can be attributed to anxiety.

Anxiety is a common emotional state can vary in intensity between individuals. According to Spielberger (1972, p. 24), anxiety is a temporary aversive emotional state that is typically characterized by feelings of tension and physiological changes, for example increased heart rate. The term anxiety differs from the terms stress and threat, although the words are frequently used interchangeably. Spielberger clarified the difference between the terms, stating that stress refers to the properties of a situation, threat refers to the extent an individual perceives a situation as dangerous, and anxiety refers to the emotional response brought on by a threatening situation (p.30). His
research revealed two different constructs of anxiety: state anxiety and trait anxiety (Spielberger, 1972, p. 38). Spielberger believed that trait anxiety (A-Trait) is a general state of anxiety or anxiety proneness, whereas state anxiety (A-State) varies depending on the circumstances of the situation. He developed a subjective test, the State-Trait Anxiety Inventory (STAI), to measure both A-State and A-Trait anxiety.

Following the development of Spielberger's STAI, researchers examined the possible effects of anxiety on cognitive performance. The attentional control theory, developed by Eysenck, Derakshan, Santos, and Calvo (2007), claimed that anxiety can produce negative effects on performance as it tends to distract the individual from the task at hand. The theory predicted that anxiety, in the form of worry, would draw attentional focus to worrisome thoughts rather than to the performance task. Some researchers believe that the redirection of attention away from a task can be attributed to selective attention.

Selective attention in anxious individuals varies depending on the type of stimuli. For example, in their overview of the causal status between selective attention and anxiety, Kindt and Van Den Hout (2001) discussed a number of studies which demonstrated that threat-related stimuli, in comparison to neutral stimuli, increase selective attention. This selective attention results in a decrease in task performance. In some cases, enough attention is directed towards threat-related stimuli (rather than neutral stimuli) for an attentional bias to develop (Fox & Knight, 2005). This effect increases with higher levels of anxiety (Fox & Knight, 2005).

A recent study by Hayes, Hirsch and Mathews (2008) demonstrated that anxiety restricts working memory. They explained that working memory requires attention to
the task, and they acknowledged that anxiety limits the amount of attentional resources available for the task. More research is needed to test the precise influences of level of anxiety and to see how it affects performance on different types of cognitive tasks.

The current study will examine the influence of anxiety level and type of stimuli (threat-related or neutral) on short-term memory. It is expected that those with a high anxiety will perform better on the short-term memory task than those with low anxiety. It is also hypothesized that, based on an attentional bias, those with high anxiety will better remember threat-related terms than neutral terms.

Method

Participants

The participants in this study were conveniently selected from the University of Western Ontario campus. Data was collected for 40 participants, with a female to male ratio of approximately 4:1. All of the 40 booklets distributed were completed and returned. The majority of the participants were between the ages of 19 and 50. All participation was voluntary and there was no form of compensation for participation. Participants were grouped into high and low anxiety groups based on their STAI scores.

Materials

The current study consisted of a pen and paper task. Booklets A and B were distributed to the participants. The first page of each four-page booklet consisted of a self-evaluation questionnaire. This questionnaire, which can be retrieved from Spielberger, Gorsuch, Lushene and Jacobs’ *Manual for the State-Trait Anxiety (1983)*, consists of 20 statements relating to the participants present anxiety level. The STAI requires a participant to indicate, on a four-point rating scale, the degree to which each
statement represents how they feel. The ratings ranged from 1 meaning not at all, to 4 meaning very much so. Previous tests provide evidence that the STAI has good reliability, with alpha coefficients ranging from 0.83 to 0.92. There is also evidence that the STAI provides good construct validity (Spielberger et al., 1983, p. 11).

The third page of the booklet contained a list of either 20 neutral or 20 threat-related terms. The corresponding terms on each list had approximately equal ratings for concreteness, meaningfulness and frequency, based on Paivio, Yuille, and Madigan’s (1968) values for each noun. For example, “victim” and “bloom” were used as corresponding threat-related and neutral terms, respectively. The fourth page presented five simple math questions. The stopwatch application on an 8G Ipod Touch was used for all timed tasks. Short-term memory was measured by the number of words recalled within one minute, with a higher number of words recalled indicating better short-term memory.

Procedure

Following the course professor’s approval, selected participants were conveniently approached on the campus of the University of Western Ontario and were asked to voluntarily participate in the study. All participants were introduced to the single session study and informed as to what participation would entail. Those who volunteered were required to consent to the test before they were permitted to participate. Once the consent forms were collected, participants completed the STAI, which took approximately 10 minutes. Then each participant turned the page and was provided two minutes to read over the list of 20 terms. The type of word list provided was manipulated; alternating participants received the threat-related or neutral term list.
After two minutes, the participants were asked to turn to the next page, and attempt to solve the five simple math problems. After two minutes, the participants were asked to stop, regardless of whether they had completed all of the questions. The results for the math questions were irrelevant to the study and were used as a distraction task. The researcher then timed one minute while each participant wrote down, on the back of their completed self-evaluation questionnaire, as many words from the previous list as they could remember. Following the completion of the recall task, participants returned their booklet to the researcher and were debriefed as to the purpose of the study. A median split of STAI scores was used to divide participants into high and low anxiety groups (with a median of 41).

Results

A 2x2 between-subjects analysis of variance found a significant main effect for term type, $F(1,36)=5.83$, partial $\eta^2=0.14$, with the number of threat terms recalled ($M=6.2$, $SD=1.85$) significantly higher than the number of neutral terms recalled ($M=7.65$, $SD=1.98$). There was not a significant main effect for anxiety, $F(1,36)=0.07$, $p>.05$, partial $\eta^2=0.00$, with those who scored high on anxiety ($M=6.90$, $SD=2.30$) not differing significantly from those who scored low on anxiety ($M=6.95$, $SD=1.75$). There was also a significant term by anxiety interaction effect, $F(1,36)=6.61$, $p<.05$, partial $\eta^2=0.16$. For high anxiety, there was a large difference between the neutral term and threat term conditions, while for low anxiety the difference was small. Overall the participants who had high anxiety and were in the threat term condition had better recall than the other conditions. A graph showing the estimated marginal means for recall can
Discussion

The present study produced results that do not support the hypothesis that those with low anxiety would perform better on a short-term memory task than those with high anxiety. It was also found that there was significant difference in the recall of threat-related terms versus neutral term. The recall of threat-related terms was best in the high anxiety condition, which supports the notion of an attentional bias.

Much of the research in this area has been unable identify the precise influence of emotional state on short-term memory. One possible reason is that emotional state fluctuates with different situations. As well, extraneous variables, such as aversive stimuli (whether internal or external), may redirect attention away from a task.

The significant results of the recall depending on type of stimuli are supportive of the results of Fox and Knight (2005). Fox and Knight (2005) found that anxious older adults showed attentional biases towards threat words on the Stroop task. They explained that an attentional bias to threat hinders cognitive performance when it redirects attention away from the task, towards threat-related stimuli. Thus, when the task requires attention to be directed towards threat-related stimuli, high-anxiety individuals' cognitive performance is not hindered, but improved.

Contrary to the findings of Fox and Knight (2005), no main effect for anxiety was found. Previous research has shown that there is no significant interaction between level of anxiety and word type (Pishyar, Harris & Menzies, 2004). According to Pishyar, Harris and Menzies (2004), attentional bias effects are limited when words are used as
Figure 1. Estimated Marginal Means for Recall as a function of anxiety level and type of term.
stimuli. They argued that attentional bias effects are better assessed using other types of stimuli, for example emotional facial stimuli. Further research should explore possible influences of a variety of types of stimuli in order to gain a better understanding of attentional biases.

Previous research by Hayes, Hirsch and Mathews (2008) demonstrated that during worry, individuals had reduced working memory capacity, and therefore did not perform as well on the cognitive task. They argued that, since worry and anxiety correlate highly, the results could be attributed to differences in anxiety levels, with high anxiety resulting in less working memory capacity. The results of the present study did not support the notion that anxiety limits memory. Differences in recall for different levels of anxiety may have existed in the present study, but it is unclear in the random sample used.

A larger study may have produced different results as the sample was too small to see significant differences in recall between high and low anxiety. As well, age was not controlled, so it is unclear whether the findings would apply to all age populations. As suggested by Mather and Carstensen (2003), age differences exist in attention to and memory of different types of stimuli, including threat-related. The self-report measure did not allow for honesty to be controlled. As well, effort seemed to vary greatly between individuals in the memory task. In future, offering an incentive for “trying your best” may serve to control this issue. Another possible influence is the word lists that were used as task-relevant stimuli. For the purpose of the study, attempts were made to control the word lists for the following memory variables: meaningfulness, concreteness
and frequency. However, there are inevitably differences between the two lists that may have influenced the results. This issue remains to be resolved in future studies.

It is unclear whether the results of the present study were specific to the participant group, or if the results would be consistent across all ages and populations. However, based on a comparison with other related studies, there are many inconsistencies in the research on this topic. A further understanding of the influences of anxiety on cognitive performance, as well as of the role of an attentional bias, would benefit society as a whole. Research, including the present study, indicates that more thorough research in this field would have an impact in a variety of fields including, but not limited to, the academic field. In the future, research should continue to explore the effects of anxiety and attention on cognitive performance and memory. They should also examine the causal direction of anxiety attention to threat-related stimuli, as the results of studies in this area have been inconsistent. The specifics of the relationship between anxiety, attention and short-term memory remain for future studies.
References


### Appendix

**Table A1**

**ANOVA Summary Table**

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<th>df</th>
<th>F</th>
<th>Sig.</th>
<th>partial $\eta^2$</th>
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<td>.789</td>
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<td>5.830</td>
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<td>.139</td>
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<tr>
<td>Error</td>
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