

The Effect of Test Anxiety on Attention and Memory Skills in Undergraduate Students

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Abstract

The effects of high levels of test anxiety on attention and memory skills were examined. Twenty-four undergraduate students answered questionnaires measuring their level of test anxiety, performed cognitive tasks measuring attention through a modified version of the Stroop task, and were assessed for hits and false alarms in a paradigm designed to evoke both neutral (e.g., “sweet”), and anxiety-related (e.g., “test”) false memories. Results indicated test anxiety had a negative impact on performance scores for high test-anxious individuals over low test-anxious individuals, though only on some cognitive measures. Individuals with higher levels of test anxiety displayed slower times on attention-measuring tasks than low-anxious individuals, and also were more apt to falsely remember memories related to anxiety. However, high-anxious individuals showed equivalent performance to low-anxious individuals on other attention-measuring tasks, recall of neutral false memories, and correct hits.

Most prominent researchers in the area of educational practice view test anxiety as a trait: a relatively stable personality characteristic that prompts an individual to react to threatening situations with some-

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times debilitating psychological, physiological, and behavioral responses (Hancock, 2001). Among these responses, the psychological effects on attention and memory have received much attention. Anxiety has been associated with cognitive interference on a wide range of cognitive tasks (MacLeod, 1996). High test-anxious individuals have been shown to report more intrusive thoughts and lower test performance relative to low test-anxious individuals (Blankstein, Toner and Flett, 1989). Similarly, high test-anxious individuals have consistently scored lower in tests of free (uncued) recall of memorized material (Hembree, 1988).

Eysenck (as cited in Dutke and Stober, 2001) formulated one possible hypothesis for this relationship between a high level of test anxiety and lowered cognitive performance. According to Eysenck, restriction in working memory capacity is responsible for the decrements in cognitive performance of highly test-anxious individuals. In test situations these individuals encounter task-irrelevant thoughts, such as worries and concerns about self-evaluative aspects of failure, which partially occupy working memory capacity. According to this interference model of test anxiety, anxiety disturbs the recall of prior learning and thus degrades performance (Hembree, 1988). In general, interference models are most applicable to complex tasks rather than to easy tasks, because in easy tasks the remaining memory capacity may suffice to fulfill task requirements (Dutke and Stober, 2001).

The responses to high levels of test anxiety have especially important implications in the educational setting. Identifying factors such as test anxiety that influence student achievement and motivation to learn in the classroom continues to be a goal of education researchers (Eggen and Kauchak, 1999). Hembree (1988) integrated the results of 562 studies via meta-analysis to show the nature, effects, and treatment of academic test anxiety. Hembree reported that test anxiety and performance are significantly related at grade three and above. High levels of test anxiety peak between grades three and five, remain fairly constant through high school, and are lower in college. This test anxiety can result in impaired performance in the classroom. Hill and Wigfield (1984) reported studies with correlations up to $-.60$ between test anxiety and achievement, suggesting that anxiety and achievement

share significant variance. High test-anxious individuals have an increased likelihood to perform poorly if a task is to be evaluated. Studies by both Maehr and Midgley (1991) and Pintrich and Schrauben (1992) have discovered the impact of test anxiety on students' performance is often influenced by the evaluation practices of the classroom teacher. In stressful conditions, as opposed to game-like conditions, high test-anxious children functioned poorly when expected to achieve, but low-anxious children performed well in this environment (Hembree, 1988).

In developing a measurement for gauging the level of test anxiety, Sarason (1978) devised the Test Anxiety Scale. This measure is used to determine a level of test anxiety among college-age students. It is typically administered to large groups of college students. Sarason determined that individuals with high test anxiety exhibited the following cognitions when facing an evaluative task: a) the situation is seen as difficult, challenging, and threatening; b) the individual sees himself or herself as ineffective in handling, or inadequate to, the task at hand; c) the individual focuses on undesirable consequences of personal inadequacy; d) self-deprecatory preoccupations are strong and interfere or compete with task-relevant cognitive activity; e) the individual expects and anticipates failure and loss of regard by others.

Given the paucity of information on the effects of test anxiety, and the strong impact it has on the educational domain, the present study examined whether or not high test-anxious individuals would show cognitive impairments on attention and/or memory skills. In accordance with Eysenck's interference model of test anxiety, it was hypothesized that high test-anxious individuals would encounter task-irrelevant thoughts that would partially occupy working memory capacity and leading to a decreased amount of recall. Similarly, it was hypothesized that high test-anxious individuals would have their attention drawn away from the task at hand, and focus instead on their worries and concerns. Therefore, the high test-anxious individuals were hypothesized to show cognitive impairments on tests of attention relative to low test-anxious individuals. In sum, it was expected that high test-anxious individuals would show lower performance scores on attention and memory tasks compared to low test-anxious individuals.

Methods

Participants

Twenty-four undergraduates, both men and women from the College of Charleston, participated in this experiment. In exchange for their help with the experiment, each participant either earned extra credit or fulfilled a course requirement for a psychology class at the college. Each participant signed up for an appointment using Experimetrix, a computer database. Nineteen students performed the experiment in order A format; the remaining five students followed order B format.

Materials

Six word lists modified by Roediger and McDermott (1995) containing 15 words each were utilized in this experiment. Additionally, one list of 15 test-anxiety words (exam, stress, pass, etc.) was created for this experiment. All 15 words in each list related to a critical lure which was never presented, for a total of seven critical lures. A subsequent recognition test containing 70 words was used to test subjects' recall. From each of the seven lists came five original words, four unrelated foils, and the critical lure. A derivative of Sarason's Test Anxiety Scale (1978) was used to rank subjects' level of test anxiety. The scale asked participants 12 questions related to test anxiety. These questions were selected from Sarason's Test Anxiety Scale because of their applicability to undergraduate college students. Possible responses included always (2 points), sometimes (1 point), and never (0 points). The responses were then scored and interpreted to determine the participants' level of test anxiety on a 24-point scale.

Three color naming tasks were used. The first test, the control, was a standard Stroop color naming task (Stroop, 1935), with 30 color patches in red, blue, green, or yellow. The second and third tasks were a modified version of the Stroop task. The second test, the interference-neutral task, contained 30 color words (red, blue, green, or yellow) printed in an incongruent ink color. Finally, the third test, the interference-anxiety task, contained 30 test-related words (pass, fail, grade, exam) printed in red, blue, green, or yellow color ink.

Procedure

Participants were assessed on their attention and memory skills as a function of their level of test anxiety. Each participant was tested individually. First, participants were given a paper describing the research study, and asked to provide informed consent for participation. Next, participants were assigned to either Group A or Group B. The only difference between the groups was the order of tasks presented to the participant. Group A (n=19) followed the procedure labeled Order A, and Group B (n=5) followed Order B.

Order A:

Participants were given the Test Anxiety Scale and asked to circle their response to each question. They were instructed to take their time and answer honestly. Participants were then asked to listen to a long list of words, trying to remember the list items. They were instructed that they would be tested on their memory of the items at a later point. The experimenter read the list of words (comprised of 7 memory lists) at a rate of one word per second, omitting the critical lure from each list.

After listening to the memory lists, participants were administered the Stroop task. Participants were told they would be timed. For the first task, the standard color patch card, participants were instructed to name the color patches they saw on the page starting in the upper left hand corner, and reading from left to right as quickly as possible. After completing this task, the second Stroop task was administered. Participants were instructed to ignore written words, and name only the color of the ink seen for each word in the same direction as the first task. Finally, the participants were given the anxiety/color card and asked to name the colors seen on the page, ignoring the written words, and following the same direction as in Tasks 1 and 2. For each task, instructions stressed speed and accuracy.

After administering the Stroop task, the recognition test was given. Participants were instructed to circle all words they recalled hearing from the long list previously presented. Before leaving, participants underwent a debriefing session during which the goals and purposes of the experiment were explained. Participants were asked

to keep all information about the experiment confidential.

Order B:

The same procedure was followed, with the exception that experimenters administered the anxiety questionnaire after the recognition test instead of before the memory lists were read.

Results

Comparisons were made between high test-anxious ($n=12$), and low test-anxious ($n=12$) groups. These two groups were formed by taking a median split of the entire group's scores on the Test Anxiety Scale. Mean scores for results on the Stroop Tasks are presented in Table 1. Mean scores for Memory Recognition Tests are presented in Table 2.

A standard T-test was used to assess the significance of the differences in cognitive functioning between high test-anxious and low test-anxious groups. The T-test indicated a significant difference in anxiety scores on the Test Anxiety Scales for the low vs. high test-anxious groups $t(22) = 32.5, p < .01$. High test-anxious subjects took more time to complete the Stroop color patch page, $t(22) = 2.9, p < .05$. However, other measures of attention for the high test- vs. low test-anxiety condition were non-significant. There was no significant difference in performance between the groups on the Stroop color word page or the Stroop effect (word score-color patch baseline). Similarly, there was no significant difference in the performance of the groups on the Stroop anxiety list. Finally, there was no significant correlation between scores on the Stroop anxiety condition and the color patch baseline.

Results of the attention tasks indicated both groups showed equivalent hit rates for correct recall of items from the original lists. Both groups also showed similar responses to the number of false alarms. In response to neutral items as critical lures, both groups obtained similar results. There was no significant difference in the number of neutral critical lures recalled by each group on the memory test. However, results of a T-test indicated the high-test anxiety group re-

called the critical lure of "test" more often than the low-anxiety group, $t(22) = 3.0, p < .05$.

Discussion

As predicted, high-anxious individuals showed some deficits in cognitive performance, though this impairment was not as generalized as expected. High test-anxious groups showed a small, but significant deficit in the attention task compared to low-test-anxious individuals, though on only one of the three tasks. On all other measures, the two groups showed similar susceptibility to distraction. Data indicated similar results in the area of memory. Relative to low test-anxious individuals, high test-anxious individuals showed evidence of elevated false memories, but only those related to test anxiety.

The results of the present study were similar to the results of Blankstein, Toner and Flett (1990), who found that high test-anxious individuals reported more intrusive thoughts relative to low-test anxious individuals. The present findings disagreed, however, with the second finding of Blankstein, Toner and Flett's study, that high test-anxious individuals report lower test performance relative to low test-anxious individuals. The present study indicated only a small difference in test performance between high and low test-anxious individuals, not enough to warrant the conclusion of overall lower test performance by high test-anxious individuals.

Results of the present investigation also were incongruent with results from the meta analysis of Hembree (1988), which indicated that high test-anxious individuals scored lower in recall of memorized material. This discrepancy could be a result of differences in the methods of testing used, in that the present study used a cued recall format, whereas previous studies used a free (uncued) recall format. Data from the present study do not support the interference model of test anxiety, in that the ability of high-anxious individuals to recall prior learning was not affected by test anxiety. This is understandable, however, since the interference model holds true more so for complex tasks than easy tasks (Dutke and Stober, 2001). The increased number of false memories related to test anxiety for high-test-anxious individuals

is consistent with Eysenck's theory (as cited in Dutke and Stober, 2001) that high test-anxious individuals encounter task-irrelevant thoughts such as worries and concerns about self-evaluative aspects of failure which partially occupy working memory capacity. These results suggest the need for a modified theory that incorporates the intrusive-thoughts theory of Eysenck, but without the outcome of total impairment of recall of prior learning.

Some degree of nervousness could have been responsible for high-anxious individuals' lower scores on some tasks, particularly the initial Stroop task. Though these data still show a difference in attention skills for high-anxious individuals, it could be because these individuals are more likely to exhibit anxious behavior, including discomfort, in an unfamiliar room versus neural interference as described in Eysenck's theory (as cited in Dutke and Stober, 2001). Contrary to our hypothesis, the present study did not support higher levels of cognitive interference for high test-anxious individuals in all areas of attention and memory. One reason for these results could be the non-evaluative setting in which the testing took place. Participants were aware that the results of the tests had no impact on their grades, and there were no incentives for the participants to perform better on the test. Without this evaluative setting, the high test-anxious individuals may have not actually felt a high level of anxiety.

The results of this study suggest that test anxiety may be related to a form of phobia: a strong irrational fear of an object or situation that does not objectively justify such a reaction (Bernstein et al., 2002). In this case, there is an intense, irrational fear of a test or exam. For all memory tasks, with the exception of the false memory for the word "test," scores of high test-anxious individuals did not significantly differ from those of low test-anxious individuals. Therefore, without the presence of the phobic stimuli, there may be no debilitating anxiety.

The implications of this finding are very important, specifically in the educational system. Studies by Maehr and Midgley (1991) and Pintrich and Schrauben (1992) have indicated that the impact of test anxiety on students' performance is often influenced by the evaluation practices of the classroom teacher. Results of the present study,

therefore, indicate that high-test-anxious students are likely to perform optimally under less stressful conditions, in which they are not worried about being evaluated.

Continued research focusing on the concept of test-anxiety as a possible phobic reaction is needed. Additional studies comparing cognitive functioning under the influence of phobic stimuli versus non-phobic stimuli in high test-anxious individuals are warranted. The present study also underscores the need for research on students' performance in more evaluative settings. A test for cognitive impairment in high-anxious individuals in a realistic, evaluative setting may produce different results than those in non-evaluative settings.

One limitation of the present study was the small number of participants. Due to this small sample size, the median split between lower anxious and higher anxious groups created a low-anxious group that may have included moderately anxious individuals, as classified by Sarason's Test Anxiety Questionnaire (1978). The low sample size also resulted in only five participants following Order B of the procedure. Therefore, no analysis of possible order effects could be made. It could be argued that the present study did not place students in a realistic setting that would incite test-anxious feelings. The setting was non-evaluative, possibly decreasing the level of cognitive impairment in high test-anxious individuals. Consequently, attempts to study the cognitive effects on attention and memory of high test-anxious individuals in an evaluative setting are suggested for future research.

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Table 1

Mean Scores for Memory Recognition Tests in High- vs. Low-Test-Anxious Individuals

Test	High Test Anxious	Low Test Anxious
Anxiety Questionnaire Score	8.917	15.25
% Correct hits	62.333	64.0833
% Easy False Alarms	6.25	5.58333
% Incorrect Neutral Critical Lures	74.91667	78.8333
% Incorrect Anxiety Critical Lures	66.66667	91.6667

Table 2

Mean Anxiety Questionnaire Scores and Mean Response Times in Seconds for the Stroop Measures

Test	High Test Anxious	Low Test Anxious
Anxiety Questionnaire Score	8.917	15.25
Stroop Color Patch Card	14.58333	17.8333
Stroop Word Card	27.33333	30.1667
Stroop Anxiety Card	18.5	24.1667