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AUTHOR Everson, Howard T.; And Others
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ABSTRACT

This study explored the relationship between test anxiety and metacognitive word knowledge on performance on a reading comprehension test. One hundred and seventeen college students completed four paper and pencil measures: (1) a self-report measure of test anxiety; (2) an archival test of reading ability; (3) a metacognitive word knowledge task; and (4) a standardized measure of reading comprehension. A series of multiple regression analyses suggest that the cognitive component of test anxiety (worry) exerted a negative influence on students' performance on the metacognitive word knowledge task, independent of overall reading ability. Analyses of performance on three reading comprehension subscales suggests that when reading ability is controlled statistically, students' level of anxious worrying and their metacognitive word knowledge influenced performance on all three reading comprehension subscales. However, on the most demanding reading comprehension subscale (understanding the writers' assumptions, opinions and tone) metacognitive word knowledge interacted with worry, such that when anxious worrying was low increases in metacognitive word knowledge were associated with higher performance and, conversely, when anxious worrying was high increases in metacognitive word knowledge were associated with lower levels of performance. Findings are discussed within the framework of a cognitive capacity formulation of test anxiety. Six tables and one figure are included. One appendix contains a word list. (Contains 44 references.) (Author)

EXPLORING THE RELATIONSHIP OF TEST ANXIETY AND METACOGNITION ON READING TEST PERFORMANCE: A COGNITIVE ANALYSIS

Howard T. Everson
The College Board

Ivan Smodlaka
College of Staten Island
City University of New York

Sigmund Tobias
City College of New York
City University of New York

Running Head: EXPLORING THE RELATIONSHIP BETWEEN TEST ANXIETY AND METACOGNITION

Address correspondence to: Howard T. Everson, the College Board, NYC, NY 10023

ABSTRACT

This study explored the relationship between test anxiety and metacognitive word knowledge on performance on a reading comprehension test. One hundred and seventeen (117) college students completed four paper and pencil measures: (1) a self-report measure of test anxiety; (2) an archival index of reading ability; (3) a metacognitive word knowledge task; and (4) a standardized measure of reading comprehension. A series of multiple regression analyses suggest that the cognitive component of test anxiety (worry) exerted a negative influence on students' performance on the metacognitive word knowledge task, independent of overall reading ability. Analyses of performance on three reading comprehension subscales suggests that when reading ability is controlled statistically, students' level of anxious worrying and their metacognitive word knowledge influenced performance on all three reading comprehension subscales. However, on the most demanding reading comprehension subscale (understanding the writers' assumptions, opinions and tone) metacognitive word knowledge interacted with worry, such that when anxious worrying was low increases in metacognitive word knowledge were associated with higher performance and, conversely, when anxious worrying was high increases in metacognitive word knowledge were associated with lower levels of performance. Findings are discussed within the framework of a cognitive capacity formulation of test anxiety.

Key Words: Test anxiety, metacognition, cognitive interference, reading comprehension

AUTHOR NOTES

An earlier version of this paper was presented at the annual meeting of the American Psychological Association, Washington, D.C., August, 1992. This work was carried out while the first author was a Postdoctoral Fellow at the Educational Testing Service, Princeton, New Jersey, USA.

More than four decades of research on test anxiety has made it quite clear that highly test-anxious examinees do not perform as well as their less anxious counterparts on most standardized tests (Hembree, 1988; McKeachie, 1984; Sieber, O'Neil, & Tobias, 1977). The reasons for these observed performance differences, however, are much less clear. Some researchers argue that test anxiety interferes with the ability to retrieve previously learned information or to engage otherwise well developed skills and abilities during testing (Sarason, 1972, 1980, 1984; Wine, 1971, 1980). Others have challenged the interference model of test anxiety and argue that the relatively poor performance of test anxious examinees is attributable directly to skill deficits (Culler & Holahan, 1980; Kirkland & Hollandsworth 1979, 1980). More recently, Naveh-Benjamin, McKeachie, & Lin (1987; 1991) provided an information-processing model which suggests that both the interference and deficit models apply, but to different populations of students.

Research designed specifically to explore both the independent and joint influences of anxiety and cognitive ability is needed. The present study begins that exploration by examining the role of test anxiety within the context of reading comprehension. Performance on reading comprehension tasks, where discrete abilities such as word knowledge, reasoning, and metacognitive skill can be identified, provides a rich domain for studying the complex interplay of affect and cognition, i.e., the interaction between anxious worry and the higher order cognitive skills demanded by reading comprehension. Thus, in this study we explored the relationship between cognitive ability (reading ability and metacognitive word knowledge) and test anxiety in an effort to gain insight into the subtleties of the performance differences between high and low anxious test takers.

THE ROLE OF METACOGNITION

Over the last decade or so, increasing attention has been given to the role that metacognitive knowledge and skill play in learning from text. Metacognition was defined by Flavell (1976) as "cognition about cognition". This includes the knowledge and executive processes the student uses to be aware of, to monitor, and to control his/her processing of learning and reading (Baker and Brown,1984; Garner, 1987). Investigations of the role of metacognition in reading, or what

people know about their own reading strategies, have demonstrated its centrality to reading comprehension (Garner, 1987, 1991).

Like anxiety, metacognition is seen not as a unitary but a multi-faceted concept. Research has shown that the characteristics of successful readers include an ability to identify what they know and do not know, an ability to monitor the extent to which they grasp meaning, and a willingness to make successive attempts to read accurately. According to Paris (cited in Marzano, 1987), metacognition involves two dimensions: information necessary for metacognition and executive management. Within the dimension of necessary information is declarative or factual information-- knowing what one knows. Brown (1975) and Brown and Smiley (1977) differentiated between "knowledge about cognition", stable and statable information about one's own cognitive processes, and the "regulation of cognition", a dynamic function which includes planning, monitoring, and checking activities which affect cognitive processes. McLain, Gridley, and McIntosh (1991) identify the knowledge about cognitive resources which refer to a "child's awareness of his/her cognition in the learning situation" and the second aspect of metacognition, self-regulation of cognition which has a monitoring and regulatory function. Better readers seem to be aware of a greater variety of learning strategies and also understand which ones are most appropriate for different types of tasks including reading (Paris and Cross, 1983; Paris, Lipson and Wixson, 1983; Pressley, Borkowski, and O'Sullivan, 1984) making them more effective learners from written texts.

Comparisons of good and poor readers suggest that metacognitive skills enhance reading comprehension (Brown ,1980; Wong, 1985). Good readers plan and use strategies for increasing their comprehension and, for the most part, are aware of reading task demands and what they need to do to meet those demands. Poor readers, on the other hand, are often ineffectual when it comes to using metacognitive strategies for monitoring and adjusting their comprehension (Baker & Brown, 1984). Less proficient readers apparently do not realize when comprehension has broken down, and do little to redirect their efforts to enhance comprehension. They often approach

reading passively, with little understanding of how to apply their skills most effectively, or even what skills are most useful for increasing comprehension (Tobias, 1985; Wong, 1985).

Tobias (1992) suggests that "the relationship between test anxiety and metacognition may be a worthwhile field for research, while simultaneously helping to establish links between affect and cognition more generally" (pp. 15-16). Tobias (1992) assumes, for example, that..."the central representation of test anxiety absorbs some portion of cognitive capacity, reducing the remaining intellectual resources that could be devoted to task demands" (p. 4). Following Tobias's model (1985, 1992) we hypothesized that anxiety interferes with reading comprehension by reducing the cognitive capacity available to process text effectively by engaging metacognitive processes. In this study we set out to examine this hypothesis by exploring the independent and joint influences of test anxiety and metacognition on reading comprehension tasks that varied with respect to cognitive complexity. Thus, the present study had two objectives: a) to address the question of how metacognition and the cognitive aspect of test anxiety (worry) interact to affect performance on reading comprehension tasks that vary in difficulty; and b) to assess the utility of a group administered, objectively scored measure of metacognition for use in educational and psychological research. This latter goal stems from a continuing research program focusing on the assessment of metacognition and its relationship to test anxiety and other variables related to academic achievement and learning from instruction (Tobias, Hartman, Everson, & Gourgey, 1991; Everson, Hartman, Tobias, and Gourgey, 1991).

Assessing Metacognition

A method for assessing metacognition was designed following the strategy used by Worden and Sladewski-Awig (1982) and was based on signal detection theory (see also Slife, Weiss, and Bell, 1985 for a similar approach). The purpose of this paper and pencil task is to assess individual differences in the sensitivity and discrimination for memorability of the meaning of discrete words. The metacognitive task designed for this study consisted of two parts: the first simply asks students whether they know or do not know the meaning

of a number of words (thirty-five, in all); the second part of the task asks students to identify the actual meaning of the same set of words as presented in a typical, standardized vocabulary test (i.e., in random order, using a four-item, multiple choice format).

Following the theory of signal detection (Green and Swets, 1966) and the strategy used by Worden and Sladewski-Aweg (1982), and Slife et al. (1985), and Lachman, Lachman, and Thronesbery (1979) students' responses are categorized as 'hits' or 'false alarms'. The 'hits' (correct) include those words which students identify as those they know or do not know and which were are confirmed by their corresponding performance on the subsequent vocabulary test. Similarly, 'false alarms' are those words students originally indicated they knew or did not know but which are not confirmed by the vocabulary task. From these response patterns two measures of metacognition, d' and β, are computed. The parameter d' is an individual difference measure of metacognitive sensitivity and accuracy, the higher the value of d', the more 'hits' and fewer 'false alarms', and, consequently, the more metacognitive accuracy. Beta (β), a measure of response bias, is also computed to assess the general approach a student employed to make their metacognitive decisions; high β values indicate a conservative approach and lower β values would indicate a liberal tendency to make metacognitive decisions based on a 'weak signal' (Warden et al., 1982, p. 346). More details on the measurement properties of this approach can be found in the work on signal detection theory (Green and Swets, 1966; Grier, 1971; Pastore and Scheirer, 1974) and its application to metamemory tasks (see Lachman et al., 1979; Slife et al.,1985; and Worden and Sladewski-Aweg, 1982).

METHOD

Participants

A total of 117 students participated in this study. All participants were drawn from advanced Psychology classes at a major urban university. Our sample was 65% female and ranged in age from 18 to 60, with a mean age of 28 years old.

Instruments

Four measures were used in this study: (1) a self-report measure of test anxiety; (2) an archival index of reading ability; (3) a pencil and paper metamemory task; and (4) a standardized, multiple-choice measure of reading comprehension. Each is described below.

Test anxiety (worry)

The cognitive component of test anxiety, worry, was measured by the Test Anxiety Inventory TAI), a self-report scale designed to measure individual differences in test anxiety. The reliability estimate (Cronbach, 1951) for the worry subscale is .88 (Spielberger, Gonzalez, Taylor, Anton, Algaze, Ross, & Westberry, 1980).

Prior reading ability

A baseline measure of reading ability was retrieved from students' college records. This index derives from scaled scores on a 40-item standardized multiple-choice test of reading comprehension (College Board, 1978) administered to students prior to enrolling in the college. The reliability estimate (Cronbach, 1951) for this scale is .89. Scaled scores on this measure range from 0 to 24.

Metacognitive word knowledge task

This measure consisted of two subtasks: a word list task and vocabulary task. In the word list task, participants were presented with a list of thirty-one words drawn from a health sciences text and were asked whether the knew the definition of the word. They responded simply by indicating yes or no. The subsequent vocabulary task required participants to identify the correct definition of the words that had been presented earlier as part of the word list. The accuracy of their earlier identifications were assessed by computing their "hits" (e.g., they said they knew the word and correctly identified its meaning on the vocabulary task) and "false alarms" (e.g., they said they knew the word but did not correctly identify the word on the vocabulary task) rates. As noted

earlier, the "hit" and "false alarm" rates provide the data for calculating two basic indices based on signal detection theory (Green and Swets, 1966; Grier, 1971; Pastore and Scheirer, 1974): (1) d' which provides an index of the participants metacognitive sensitivity or skill, and (2) β which provides an index of the participant's response bias. In this study, d' indexed a measure of metacognitive word knowledge sensitivity which ranged from -2.5 (low) to +2.5 (high). In addition, two other measures related to metacognitive word knowledge were also computed, correct rejections (i.e., when a student said he/she did not know a word and, indeed, did not correctly identify its meaning on the vocabulary task) and misses (i.e., when a student indicated he/she did not know a word but correctly identified its meaning on the vocabulary task). The reliability estimates (Cronbach, 1951) for the word list task was .92; for the vocabulary task the reliability was estimated at .67. See Appendix A for a sample form of the experimental task.

Reading Comprehension

Three subscales of reading comprehension, derived from the Reading Comprehension Test (RCT) of the Descriptive Test of Language Skills (College Board, 1989). were used in this study. The RCT is a forty-five item test comprised of individual questions and sets of questions based on reading passages, and presented in a multiple-choice format. The RCT yields three subscale scores designed to measure: (1) the identification of word or phrase meanings through context--11 items; (2) understanding of literal and interpretive meaning--18 items; and understanding the writer's assumptions, opinions, and tone--16 items. The reliability estimates (Cronbach, 1951) for the three subscales are .63, .81. and .67, respectively (College Board, 1989). In addition, the difficulty of the items comprising each of the three subscales were estimated using item response theory methods (Mislevy & Bock, 1989). Mean item difficulty estimates derived from the logistic item response method of analysis suggests that the most difficult subscale contained items measuring the reader's ability to understand the writer's assumptions, opinions and tone. The least difficult subscale contained items measuring word or phrase meaning in context (Everson, Gourgey and Rodriguez, 1992).

Procedure

This study was carried out in two one-hour experimental sessions administered over a two-week period in both the Fall and Spring semesters. In the first session participants completed the Test Anxiety Inventory, a brief background questionnaire, and part I of the Metacognitive Word Knowledge Task--the word list task. One week later, during the second session participants completed Part II of the Metacognitive Word Knowledge Task (the vocabulary task), and were administered the standardized reading comprehension test. Following the reading test, participants were debriefed and informed of their individual reading test results.

Design

The aims of this study--as outlined above-- suggested the use of a research design which allowed for an analysis of the pattern of correlations among and between variables such as, prior reading ability, level of anxious worry, metacognition and performance on a number of standardized reading comprehension subscales. Following Aiken and West (1991), a two stage analysis, each employing a series of multiple regression equations, was used to explore the interrelationships among the variables. The first stage of the analysis, which used a limited set of variables, focused on the of metacognitive word knowledge on test anxiety (worry) and prior reading ability. Similarly, the second stage of analysis regressed reading comprehension scores on test anxiety (worry) and metacognitive word knowledge. Two and three-way interactions were tested at each stage of analysis.

RESULTS

The first stage of our analysis focused on exploring the relationship between prior reading ability, metacognitive word knowledge and anxious worry. We began by simply dividing our sample into high and low anxious worry groups using a median split (median = 15) of the scores derived from

the worry subscale of the TAI. Table 1 presents the means and standard deviations for the metacognitive word knowledge subscores for high and low anxious subjects.

INSERT TABLE 1 HERE

The less anxious students achieved a significantly higher number of "hits" than those prone to higher levels of anxious worry ($t = 4.92$, $df = 107$, $p<.001$). On the other hand, those with relatively higher levels of anxious worry tended to more often correctly reject those words they did not know ($t = -3.66$, $df = 72$, $p<.001$). There were no significant differences between high and low anxious students on the measures of "false alarms" and "misses".

Table 2 summarizes the descriptive statistics of the major variables in our study, including the measure of metacognitive word knowledge (d') derived from signal detection theory Mean scores on the Worry subscale of the TAI indicate moderate levels of anxious worry, while the other measures suggest moderately high performance on both the metacognitive scale and on all four measures of reading comprehension.

INSERT TABLE 2 HERE

Table 3 presents the zero-order correlations of the metacognitive measure and the anxiety measure with all four reading comprehension measures. All the correlations presented in Table 3 were statistically significant at the $p = .01$ level with the exception of the correlation between d' and the Assumption subscale score which was significant at the $p = .05$ level.

INSERT TABLE 3 HERE

equation. The nature of this interaction was explored further by inspecting the interactions within each of the RCT subscales.

Although no interactions were found when we inspected the results of the regression analyses for the Context and Literal RCT subscale scores, essentially the same pattern of contrasting influences from anxious worry and metacognitive word knowledge were found. No significant interactions were found on either of these two RCT subscales. Tables 4 and 5 summarize these results.

INSERT TABLES 4 & 5 HERE

Analysis of the subscale measuring understanding of the writer's assumptions, tone and opinions, the RCT subscale judged as most difficult in prior empirical analyses (see Everson, et al., 1992), suggested that worry and metacognitive word knowledge interact, once prior reading ability was controlled. See Table 6 below.

INSERT TABLE 6 HERE

When the interaction term is added to the regression results reported in Table 6 the R^2 change=.04, (F=7.70, p=.006) is statistically significant; and, although modest, this interaction accounts for the interaction detected earlier in the analysis of overall performance on the RCT. Figure 1 depicts the interaction of worry and metacognitive word knowledge on performance on the RCT Assumption subscale.

INSERT FIGURE 1 HERE

To explore further the relationship of metacognitive word knowledge and anxiety, a series of hierarchical multiple regression analyses were performed which regressed the measure of metacognitive word knowledge, d', on prior reading ability, worry and their interaction term. Although the regression equation explains only a minor portion of the variance in metacognitive word knowledge, R^2= .15, $F(3,113) = 7.03$, p=.002, it is nevertheless informative. For example, once the influence of reading ability is controlled statistically, the negative effect of anxious worry remains relatively strong (β= -.20, t=-2.20, p=.029). The relationship between anxiety and metacognitive skill deficits is apparent from this analysis: once reading ability is controlled for, anxious worry is negatively related metacognitive word knowledge. The interaction between prior reading ability and anxious worry was not significant.

A series of regression analyses were performed to explore further the complex interplay of the skills variables, metacognitive word knowledge and prior reading ability, and anxiety on overall performance on the RCT, as well as on performance on the three distinct subscales of the RCT. These analyses were informative in view of the varying levels of difficulty among the three RCT subscales (see Everson, et al., 1992 for details).

In all analyses the archival measure of prior reading ability was used as a covariate. In addition to exploring the data for possible gender differences, all two and three-way interactions were also tested. No gender differences were found, and only a single two-way interaction (d' x worry) was significant. Analysis of overall performance on the RCT indicated that both metacognitive word knowledge and anxious worry influenced achievement, albeit in different ways and in somewhat different magnitudes, R^2 = .41, $F(3,113) = 26.46$, p=.000. As expected, the negative effect of anxious worry was relatively strong (β= -.32, t=-4.08, p=.000), while the influence of metacognitive word knowledge was positive (β= .17, t=-2.23, p=.027). More importantly, a modest but statistically significant R^2 change=.02, (F=4.81, p=.03) was found when the interaction between worry and metacognitive word knowledge was added to the regression

DISCUSSION

In sum, these analyses suggest that anxious worry influences performance on the metacognitive word knowledge task, even when reading ability is controlled statistically. In general, those with high levels of anxious worry also had lower levels of metacognitive word knowledge. With respect to performance on both the Context and Literal subscales, for example, anxious worrying was associated with decreased performance at all levels of metacognitive skill. Similarly, increases in metacognitive word knowledge were associated with increases in performance at all levels of anxious worrying. Thus, these two individual difference measures contributed independently--albeit in different directions--to performance on these two subscales. Analysis of performance on the Assumption subscale, in contrast, suggests that when anxious worrying is low the expected facilitative effects of metacognitive skill are apparent. However, when anxious worrying is high those with weaker metacognitive word knowledge skills tended to outperform those with stronger metacognitive skills.

Tobias (1985, 1992) has argued that a limited cognitive processing capacity notion provides a theoretically consistent way of accounting for the effects of both anxiety and skill deficits. According to Tobias (1985), "if it is assumed that people have a finite capacity for processing information...then the cognitive representation of test anxiety must absorb some processing capacity, leaving a reduced portion for task solution" (p.138). This limited capacity notion suggests that tasks demanding greater allocations of cognitive processing ability, like the comprehension tasks in the Assumption subscale, are more susceptible to interference from test anxiety. The analyses presented here support this cognitive capacity formulation.

As noted earlier, with the exception of the work done recently by Naveh-Benjamin (1991) and Tobias (1992), the deficit and interference models of test anxiety have been conceptualized (Kirkland and Hollandsworth, 1980) as mutually exclusive. The exploratory analyses presented in this paper suggest that a more thorough understanding of the interplay of both the affective and cognitive constructs associated with learning from text, in this case test anxiety and metacognitive skill deficits, are essential for a complete understanding of academic performance. In general,

metacognitive skills and test anxiety contribute independently; however, on more challenging reading tasks they interact to influence performance in the domain of reading comprehension. Turning our attention to performance on the subscale measuring the ability to understand the writer's tone, assumptions and implications--clearly the most difficult of the three subscales (see Everson et al., 1992 for subscale difficulty estimates)-- we find evidence of an interaction between anxious worrying and metacognitive skill level. The highly anxious examinee, even if more metacognitively able, performed less well on the relatively difficult tasks in this subscale. Thus, anxious worrying in the extreme apparently interferes with metacognitive skill deployment when the cognitive demands of the task are high.

For the most part, tests of reading achievement are based on the use of cognitive skills to identify facts, main ideas, and inferences. Yet durable, transferable learning in these areas requires students to use metacognitive skills-- to plan their approach to reading, to construct and refine meanings, to monitor their understanding, and to resolve comprehension problems. With the development of the metacognitive word knowledge task in this study, it becomes more likely that systematic research in this domain will progress. Moreover, the strategy of using component measures of reading comprehension that differ in difficulty holds promise for disentangling the interfering effects anxious worrying from metacognitive skill deficits.

REFERENCES

Aiken, L.S. and West, S.G. (1991). Multiple regression: Testing and interpreting interactions. CA: Sage Publications.

Baker, L. & Brown, A.L. (1984). Metacognitive skills and reading. In P. D. Pearson, R. Barr, J.L. Kamil, & P. Rosenthal (Eds.), Handbook of reading research. NY: Longman Press.

Brown, A.L. (1975). The development of memory: Knowing, knowing about knowing, and knowing how to know. In H.W. Reese (Ed.), Advnaces in child development and behavior (Vol. 10). NY: Academic Press.

Brown, A.L., & Smiley, S.S. (1977). Rating the importance of strucutral units of prose passages: A problem of metacognitive development. Child Development, 48, 1-8.

Brown, A.L. (1980). Metacognitive development and reading. In R.J. Spiro, B.C. Bruce, & W.F. Brewer (Eds.), Theoretical issues in reading comprehension. Hillsdale, NJ: Erlbaum.

College Board (1978). Descriptive Tests of Language Skills. NJ: Educational Testing Service.

College Board (1989). Descriptive Tests of Language Skills, NJ: Educational Testing Service.

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. Psychometrika, 16, 297-334.

Culler, R.E., & Holahan, C. (1980). Test taking and academic performance: The effects of study-related behaviors. Journal of Educational Psychology, 72, 16-20.

Everson, H.T., Gourgey, A., & Rodriguez, C. (1992). A new yardstick for measuring reading comprehension: A field test report for CUNY. NY: City University of New York.

Everson, H.T., Hartman, H., Tobias, S., & Gourgey, A. (June, 1991). A metacognitive reading strategies scale: Preliminary validation evidence. Paper presented at the annual meeting of the American Psychological Society, Washington, DC.

Flavell, J.H. (1976). Metacognitive aspects of problem solving. In L.B. Resnick (Ed.), The nature of intelligence. Hillsdale, NJ: Erlbaum.

Garner, R. (1987). Metacognition and reading comprehension. NJ: Ablex.

Garner, R. (1991). When children and adults do not use learning strategies: Toward a theory of settings. Review of Educational Research, 60 (4), 517-529.

Green, D.M., & Swets, J.A. (1966). Signal detection theory and psychophysics. NY: Wiley.

Grier, J.B. (1971). Nonparametric indexes for sensitivity and bias: Computing formulas. Psychological Bulletin, 75(6), 424-429.

Hembree, R. (1988). Correlates, causes, effects, and treatments of test anxiety. Review of Educational Research, 58, 47-77.

Kirkland, K., & Hollandsworth, J. (1979). Test anxiety, study skills, and academic performance. Journal of College Personnel, 20, 431-435.

Kirkland, K., & Hollandsworth, J. (1980). Effective test taking: Skills-acquisition versus anxiety-reduction techniques. Journal of Counseling and Clinical Psychology, 48, 431-439.

Lachman, J.L., Lachman, R., & Thronesbery, C. (1979). Metamemory through the adult life span. Developmental Psychology, 15, 543-551.

Marzano, R.J. (1987). Practicing theory. Cogitare, 2(1).

McKeachie, W.J. (1984). Does anxiety disrupt information processing or does poor information processing lead to anxiety? International Review of Applied Psychology, 33, 187-203.

McLain, K.V.M., Gridley, B.E., & McIntosh, D. (1991). Metacognitive reading awareness. Journal of Educational Research, 84(6).

Mislevy, R.J., & Bock, R.D. (1989). PC-BILOG 3: Item analysis and test scoring with binary logistic models. Mooresville, IN: Scientific Software.

Naveh-Benjamin, M. (1991). A comparison of training programs intended for differnt tyes of test-anxious students: Further support for an information processing model. Journal of Educational Psychology, 83, 134-139.

Naveh-Benjamin, M., McKeachie, W.J., & Lin, Y.G. (1987). Two types of test anxious students: Support for the information processing model. Journal of Educational Psychology, 79, 131-136.

Paris, S.G., & Cross, D. (1983). Ordinary learning: Pragmatic connections among children's beliefs, motives, and actions. In J. Bisanz, G.Bisanz, & R. Kail (Eds.), Learning in Children. NY: Springer-Verlag.

Paris, S.G. Lipson, M.Y., & WIxson, K.K. (1983). Becoming a strategic reader. Contemporary Educational Psychology, 8, 293-316.

Pastore, R.E., & Scheirer, C.J. (1974). Signal detection theory: Considerations for general application. Psychological Bulletin, 81, 945-958.

Paulman, R.G., & Kennelly, K.J. (1984). Test anxiety and ineffective test taking: Different names, same construct. Journal of Educational Psychology, 76, 279-288.

Pressley, M., Borkowski, J.G., & O'Sullivan, J.T. (1984). Children's metamemory and the teaching of memory strategies. In D.L. Forrest-Pressley, G.E. MacKinnon, & T.G. Waller (Eds.), Metacognition, Cognition, and Human Performance. NY: Academic Press.

Sarason, I.G. (1972). Experimental approaches to test anxiety: Attention and the uses of information. In C.D. Spielberger (Ed.), Anxiety: Current trends in theory and research (Vol.2, pp. 381-403). New York: Academic Press.

Sarason, I.G. (1980). Test anxiety, theory, research, and applications. Hillsdale, NJ: Erlbaum.

Sarason, I.G. (1984). Stress, anxiety, and cognitive interference: Reactions to tests. Journal of Personality and Social Psychology, 46, 929-938.

Sieber, J.F., O'Neil, H.F., & Tobias, S. (1977). Anxiety, learning and instruction. Hillsdale, NJ: Erlbaum.

Slife, B.D., Weiss, J., & Bell, T. (1985). Separability of metacognition and cognition: Problem solving in learning disabled and regular students. Journal of Educational Psychology, 77(4), 437-445.

Spielberger, C.D., Gonzalez, H.P., Taylor, C.J., Anton, W.D., Algaze, B., Ross, G.R., & Westberry, L.G. (1980). Preliminary Professional Manual for the Test Anxiety Inventory. Palo Alto, CA: Consulting Psychologists Press.

Tobias, S. (1991). The impact of test anxiety on cognition in school learning. In K. Hagtvet (Ed.), Advances in test anxiety research. (Vol. 8, pp. 17-30). Hillsdale, NJ: Erlbaum.

Tobias, S. (1985). Test anxiety: Cognitive interference, defective skills, and cognitive capacity. Educational Psychologist, 2 (3), 135-142.

Tobias, S., Hartman, H., Everson, H., & Gourgey, A. (August, 1991). Development of a group administered, objectively scored metacognitive evaluation procedure. Paper presented at the annual meeting of the American Psychological Association, San Francisco, CA.

Wine, J. D.(1971). Test anxiety and direction of attention. Psychological Bulletin, 76, 92-104.

Wine, J.D. (1980). Cognitive-attentional theory of test anxiety. In I.G. Sarason (Ed.),Test anxiety: Theory, research, and application. Hillsdale, NJ: Erlbaum.

Wong, B.Y.L. (1985). Self-questioning instructional research: A review. Review of Educational Research, 55(2), 227-268.

Worden, P.E., & Sladewski-Awig, L.J. (1982). Children's awareness of memorability. Journal of Educational Psychology, 74, 341-350.

APPENDIX A

WORD LIST TASK

(Sample)

PART I.

Directions: For each of the words listed below, please indicate whether you know or do not know its meaning by checking the appropriate choice.

Abuse	_____Know	_____Do not know
Attributed	_____Know	_____Do not know
Benign	_____Know	_____Do not know
Diagnosis	_____Know	_____Do not know
Entity	_____Know	_____Do not know
Gradation	_____Know	_____Do not know
Implicated	_____Know	_____Do not know
Inferred	_____Know	_____Do not know
Optimal	_____Know	_____Do not know
Originate	_____Know	_____Do not know
Pamphlet	_____Know	_____Do not know
Presumed	_____Know	_____Do not know
Prevalent	_____Know	_____Do not know
Prognosis	_____Know	_____Do not know
Residual	_____Know	_____Do not know
Reversible	_____Know	_____Do not know
Severity	_____Know	_____Do not know
Significant	_____Know	_____Do not know
Transitory	_____Know	_____Do not know

TABLE 1. Means and Standard Deviations of the Metacognitive Word Knowledge Subscores by Level of Anxious Worry.

		Worry Subscale Scores	
		Low	High
Hits (++)			
	Mean	19.27	15.06
	SD	3.6	5.7
Correct Rejections (--)			
	Mean	1.38	4.63
	SD	1.7	6.9
False Alarms (+-)			
	Mean	6.40	7.16
	SD	1.9	3.7
Misses (-+)			
	Mean	1.95	2.16
	SD	1.7	1.9

TABLE 2. Means and Standard Deviations of Metacognitive Word Knowledge Task, Prior Reading Ability, Anxious Worry and the Reading Comprehension Scores.

Variable	Mean	SD
Metacognition	.96	.59
Prior ReadingAbility	17.93	3.88
AnxiousWorry	14.61	5.94
Reading Comp.*	16.6	5.47
Context	9.28	2.04
Literal	13.9	3.51
Assumptions	10.93	2.97

*Note: The Reading Comprehension score is reported as a scaled score, while all three subscores are reported as raw scores.

TABLE 3. Zero-Order Correlations Among Metacognitive Word Knowledge, Prior Reading Ability, Anxious Worry and the Reading Comprehension Scores.

	1	2	3	4	5	6	7
Metacognition	1.00						
Prior Reading Ability	.34	1.00					
Anxious Worry	-.29	-.34	1.00				
Reading Comprehension	.39	.52	-.49	1.00			
Context	.32	.37	-.38	.83	1.00		
Literal	.43	.44	-.47	.94	.73	1.00	
Assumptions	.26	.51	-.43	.88	.67	.72	1.00

TABLE 4. Regression Analysis with the Meaning in Context Subscale as the Dependent Variable.

Independent Variables	ß	t	p
Test Anxiety	-.25	-2.83	.006
Metacognition	.17	1.89	.061
Reading Ability	.23	2.52	.013

R^2= .24, $F(3,113)=11.65$, p=.0000

TABLE 5. Regression Analysis with the Literal Subscale as the Dependent Variable.

Independent Variables	ß	t	p
Test Anxiety	-.31	-3.87	.000
Metacognition	.25	3.07	.003
Reading Ability	.25	3.03	.003

R^2= .37, $F(3,113)=21.93$, p=.0000

TABLE 6. Regression Analysis with the Assumption Subscale as the Dependent Variable.

Independent Variables	ß	t	p
Test Anxiety	-.27	-3.36	.001
Metacognition	.05	.55	.583
Reading Ability	.40	4.70	.000

R^2= .33, $F(3,113)=19.06$, p=.0000

FIGURE 1. A Plot of the Interaction of Metacognitive Word Knowledge and Anxious Worry on Performance on the Assumption Subscale of the Reading Comprehension Test