APPLIED COGNITIVE PSYCHOLOGY
Appl. Cognit. Psychol. **18**: 311–325 (2004)
Published online in Wiley InterScience
(www.interscience.wiley.com) DOI: 10.1002/acp.968

The Impact of Cognitive Test Anxiety on Text Comprehension and Recall in the Absence of External Evaluative Pressure

JERRELL C. CASSADY*

Ball State University, USA

SUMMARY

Two studies examined the effects of cognitive test anxiety on students' memory, comprehension, and understanding of expository text passages in situations without externally-imposed evaluative pressure. The results gathered through structural equations modelling demonstrated a significant impact of cognitive test anxiety on performance in conditions with and without external evaluative pressure. The impact of cognitive test anxiety was stronger in those conditions with external evaluative pressure. The results are interpreted to support processing models of test anxiety that propose test anxiety interferes with learning through deficiencies in encoding, organization, and storage in addition to the classic interpretation of retrieval failures. In addition, the data provide support for additive models of test anxiety that address both stable and situational factors in the overall impact of cognitive test anxiety on performance. Copyright © 2004 John Wiley & Sons, Ltd.

Research on the role of test anxiety on performance has repeatedly demonstrated that high levels of cognitive test anxiety promote the probability of notable declines in exam performance. The classic interpretation of this relationship was that irrelevant thinking and heightened worry intrude upon conscious thought during the test session itself, inhibiting performance through a retrieval-blocking process (Morris, Davis, & Hutchings, 1981; Sarason, 1986; Sarason, Pierce, & Sarason, 1996; Zohar, 1998). However, this view of test anxiety has been demonstrated to be overly limited in scope, and contemporary conceptualizations of cognitive test anxiety have focused on processing deficiencies that appear to accompany anxiousness over tests at various phases in the learning-testing cycle (Cassady, in press; Cassady & Johnson, 2002; Covington, 1985; Schwarzer & Jerusalem, 1992).

Models of test anxiety that focus on deficits in basic information processing have been supported by data demonstrating that test anxious students have difficulty with cognitive processes beyond the classic view of retrieval failure. That is, students with high levels of test anxiety experience problems with encoding and storage processes as well, commonly leading to inadequate conceptual representations of the content (Benjamin, McKeachie, Lin, & Holinger, 1981; McKeachie, 1984; Mueller, 1980; Naveh-Benjamin, 1991).

*Correspondence to: Dr Jerrell C. Cassady, Department of Educational Psychology, Ball State University, Muncie, Indiana 47306, USA. E-mail: jccassady@bsu.edu

The first phase of information processing that has been proposed as a significant challenge for students with high levels of test anxiety is attention. A classic study by Easterbrook (1959) demonstrated that heightened emotional responses led to a restricted range of retrieval cues available to learners during a recall task. This becomes a central concern for students with high-test anxiety, as emotionality tends to be heightened when preparing for or taking examinations (Hembree, 1988). These physiologically aroused states experienced by students with test anxiety have been proposed to cause inward-focused attention, or distraction from testing materials, which has an end result of reduced performance (Geen, 1980; Wine, 1980).

Working memory is a primary stage in the information processing model where students with test anxiety demonstrate significant difficulty in effective cognitive functioning. Beyond the classic interpretation of test anxiety as students experiencing retrieval blockage or 'going blank' once entering the testing room, research has demonstrated students with high test anxiety have difficulty encoding, organizing, and storing information effectively (Benjamin et al., 1981). Students with high anxiety have been shown to develop and maintain less complete conceptual representations for course content (Naveh-Benjamin, McKeachie, & Lin, 1987), which may explain why students with high test anxiety are even outperformed on open-book take home examinations (Benjamin et al., 1981).

The negative effects of test anxiety are often exacerbated by poor metacognitive skills. Specifically, students with high-test anxiety generally select and employ less effective study strategies and skills. In a study examining the effects of both evaluative pressure and study skills, Naveh-Benjamin et al. (1987) demonstrated that all students with high-test anxiety performed below non-anxious students in evaluative situations. However only students with high-test anxiety and poor study skills performed more poorly on learning tasks that were not pressured evaluative situations (practice tests). The metacognitive failures illustrated by these students support research demonstrating high-anxious students' difficulties in directing and maintaining focus on relevant content and using methods that promote long-term learning benefits. Students with high levels of test anxiety often report they are more likely to procrastinate (Cassady & Johnson, 2002; Kalechstein, Hocevar, Zimmer, & Kalechstein, 1989), select surface-level processing strategies (Benjamin et al., 1981; Mueller, 1980), and engage in repetitive memorization strategies (Naveh-Benjamin et al., 1987). Oddly enough, there is evidence that test-anxious students actually spend more time preparing for tests than those with low levels of test anxiety (Culler & Hollohan, 1980).

The final point of potential failure on a test is the inability to retrieve information from long-term memory on demand. Many times, students report they 'knew it cold' before the exam, but the information just escaped them once they got the test (Covington & Omelich, 1987). A test of this 'anxiety blockage' hypothesis was provided by giving students a test under normal conditions, then having students take the test items again after being told that the test score had no impact on their course grades. In this study, the assertion was that if anxiety blockage was a significant determinant of test-anxious students' performance deficiencies, the no-external evaluative pressure setting would lead to significant gains for the test anxious students, and no similar gains would be expected for the low-anxiety students. The results demonstrated that students with high anxiety and good study skills performed better in the no-external evaluative pressure condition, but only on easy test items that addressed basic content knowledge. Interestingly, students with low levels of test anxiety and poor study skills were the ones who benefited the most from the removal of external evaluative pressure during testing tasks (Covington & Omelich, 1987).

The overwhelming evidence that students encounter processing deficiencies that affect encoding, organization, storage, and retrieval efforts has guided the development of process-oriented models of test anxiety that focus on the behaviours and perceptions of individuals with anxiety outside the period of time devoted to exam completion (Cassady, in press). These models generally propose three basic phases in the learning-testing cycle: test preparation, test performance, and test reflection (Covington, 1985; Schutz & Davis, 2000; Zeidner, 1998). In these models, the students' behaviours (e.g. study habits, procrastination, text comprehension) and perceptions (e.g. tests as threatening, learned helplessness, self-efficacy) at all three phases can have eventual detrimental impact on test performance levels (Covington, 1985; McKeachie, 1984; Schwarzer & Jerusalem, 1992). The primary advantage of process models of test anxiety is the ability to explain performance deficits for students with high-test anxiety in the absence of evaluative pressure (Covington & Omelich, 1987; Tobias, 1986).

PRESENT INVESTIGATION

The cognitive processing tasks undertaken by most undergraduate students in preparation for tests in traditional courses include reading expository text materials (i.e. textbooks), attempting to draw meaning from those readings, organizing and storing the content, and subsequently retrieving the information when needed. To examine the hypothesis that fundamental processing errors underlie the performance deficits observed for students with high levels of test anxiety, this study has targeted three primary performance measures related to typical learning and testing processes: tests of recognition, comprehension, and recall.

The two studies reported here specifically tested the hypothesis that high levels of cognitive test anxiety would be associated with inferior performance on all measures of learning and memory. The unique contribution of these studies was that there was no external evaluative pressure imposed in the testing events associated with the expository text materials. The limitation or outright removal of evaluative stress arose from three conditions: the learning and memory data were gathered in laboratory sessions that were unrelated to the participants' course work, data were gathered anonymously, and students were aware before participating that there was no way for them to discover their performance level on any task. Given the nature of test anxiety as a stable construct, there is no assurance that the students in this study experienced a complete absence of evaluative stress. That is, students with test anxiety tend to view events as threatening or stressful, suggesting that internal evaluative pressure could still be present in any situation, regardless of the benign nature of the event.

In addition to low performance on learning and memory tasks, cognitive test anxiety was also expected to be associated with lower self-reported performance levels on the Scholastic Aptitude Test (SAT) (high external evaluative pressure) and general study skills and habits. These data were investigated to test the pervasiveness of negative effects potentially stemming from high levels of cognitive test anxiety.

STUDY 1

Study 1 examined the influence of cognitive test anxiety on self-reported study skills, standardized tests of achievement, and a laboratory-based learning and memory test for

expository text information. The expectation was that the use of Structural Equation Modelling (SEM) would support the model predicting that cognitive test anxiety had a significant, negative effect on performance measures from high- and no-evaluative pressure situations. In addition, the relationship between cognitive test anxiety and study skills was explored to investigate the interactive role of those two variables.

Method

Participants

Two hundred and seventy-seven undergraduate students participated in the first study, (females = 177, males = 98, not reported = 2). The students were recruited from a psychology student research participation pool at a large midwestern university, and participation in this experiment was one of many options for satisfying a course requirement. The participants ranged in age from 18 to 36 years ($M = 20.20$, $SD = 2.18$). Consistent with the population, the majority of participants $n = 224$ identified themselves as white (composing 81% of the sample). Twenty-two participants identified themselves as black, with the remaining students reporting race as Asian or Asian-American ($n = 18$), American Indian ($n = 2$), Hispanic ($n = 6$), or reported that race was 'not applicable' ($n = 5$). The reported majors and minors of the students revealed they represented a full range of undergraduate bachelors students, with no single major representing more than 10% of the sample.

Materials

The materials used in this study were self-report measures, constructed expository text passages, and tests of the content represented in the text passages. The self-report measures included a demographics sheet soliciting age, gender, race, college major, and SAT performance level. Although the SAT performance level was gathered through only self-report, recent research has validated this approach as a viable means of gathering reliable and valid estimates of these standardized college entrance exam scores from a similar sample (Cassady, 2001a).

Students completed the Cognitive Test Anxiety scale (see Cassady & Johnson, 2002 for all items), a 27-item instrument examining only the cognitive domain of test anxiety, which includes tendencies to (a) engage in task-irrelevant thinking during test taking and preparation periods, (b) draw comparisons to others during test taking and preparation periods, (c) have either intruding thoughts during exams and study sessions, and/or (d) have relevant cues escape the learner's attention during testing. Reliability analyses with this instrument have demonstrated high levels of internal consistency and construct stability, suggesting the measurement of a trait component of test anxiety (Cassady, 2001b). The possible range of scores on this measure runs from 27 to 108. In this sample, the Cognitive Test Anxiety scale was again shown to have a high degree of internal reliability (alpha = 0.93).

The 20-item study skills and habits survey (see Appendix A) was created for the purposes of this investigation. The survey addresses a wide variety of common study activities, as well as other positive test-preparation behaviours. The 20-item survey has a potential range from 20 to 80. Examination of responses from participants yielded an acceptably high value for internal consistency, $\alpha = 0.82$.

The expository text materials used in this study were created for this and later studies of learning and memory for prose materials with and without examples embedded in the text.

The passages used for this experiment addressed two content areas: *Experimental Designs* and *Simple Machines*. Both passages were adapted from basic textbook treatments of their content area, and there was a foundation-only version as well as an example-rich version of each text. The example-rich version merely includes an illustrative example after each main point in the foundation-only version (see Appendix B for excerpt). The foundation only versions of the two passages were approximately 400 words long, while the example-rich versions were roughly twice that length. Despite the variations in length for the texts, preliminary analyses revealed that textual version was not a significant factor in determining group differences on any of the reported outcome measures. Therefore, for the purposes of this investigation on cognitive test anxiety, passage format was not included in the reported analyses.

For each passage, a series of questions taken directly from the content in the passages was created. The final test included 15 items taken from the foundational text versions; so all subjects were exposed to the tested content, regardless of passage format. Again, preliminary analyses on the two content passages revealed no differences in performance levels. Hence, all analyses were conducted on a combined multiple-choice test performance score.

Procedures

Participants attended one data collection session that lasted 90 min. After providing informed consent, all participants read one of the expository text passages (either *Simple Machines* or *Experimental Designs*) twice. At the conclusion of reading the first passage, the participants were asked to complete the Cognitive Test Anxiety scale. The students all completed the instrument during a 12-min time period, after which they were directed to answer the multiple-choice items related to the passage they had just read.

The second phase of the data collection session consisted of the participants reading the second text passage twice. After reading the second passage, the students completed the study skills and habits survey and the demographic information sheet during a 12-min time period (to match the delay from the first phase). The participants then answered the multiple-choice items related to the second passage.

Results

Due to a history of varied gender effects in test anxiety research (Arch, 1987; Bandalos, Yates, & Thorndike-Christ, 1995; Cassady & Johnson, 2002; Hembree, 1988; Volkmer & Feather, 1991; Zeidner, 1990), the first analysis was an examination of gender differences on the Cognitive Test Anxiety scale. The univariate analysis of variance was statistically significant, $F(1, 273) = 27.55$, $p < 0.001$, $\eta^2 = 0.09$. Examination of the means confirmed previous studies (e.g. Arch, 1987; Hembree, 1988) that identified heightened levels of test anxiety for females ($M = 68.09$, $SD = 15.01$) compared to males ($M = 58.41$, $SD = 13.97$). To examine gender differences in the structural equation models, independent models were tested for males and females (see Ullman & Bentler, 2003). The results demonstrated that the fit indices were similar, and comparison of each gender-specific model to subsequent models that combined the male and female data resulted in no observed differences. That is, although there were gender differences in reported cognitive test anxiety, the relationship between test anxiety, performance, and study skills was not influenced significantly. Thus, for simplicity only the combined gender models are presented.

Table 1. Zero-order and partial correlation coefficients matrix: Study 1

	1	2	3	4	5
1. Cognitive test anxiety	64.70 (15.36)	−0.66*	−0.47*	−0.32*	−0.37*
2. Study skills and habits	—	52.45 (8.71)	0.41*	0.28*	0.29*
3. Test performance (no external evaluative pressure)	—	0.16	10.48 (2.88)	0.26*	0.34*
4. SAT-verbal	—	0.10	0.14	532.74 (82.15)	0.31*
5. SAT-math	—	0.06	0.21*	0.22*	542.70 (100.07)

Note: Values above the diagonal are zero-order correlations, values below the diagonal are partial coefficients controlling for cognitive test anxiety, and values along the diagonal report sample means and standard deviations (in parentheses).
*$p < 0.003$; the p-value was set to this level based on the Bonferonni adjustment to create a family-wise alpha level of $p < 0.05$.

Correlations among the study variables were also examined, using zero-order and partial correlation coefficients controlling for cognitive test anxiety. Data from 216 participants were available for all target measures, and are displayed in Table 1. As the correlation matrix reveals, cognitive test anxiety shared a moderate to strong negative correlation with each of the target variables. Furthermore, controlling for the effects of cognitive test anxiety in the partial correlations drastically reduced the strength of correlations observed among the remaining variables. The effect is most dramatic when examining the study skills factor results. Given earlier research documenting the differential patterns of performance for students as a joint function of test anxiety and study skills, this study was originally planned to test that phenomenon.

Following the theoretical model discussed earlier, SEM was used to test the fit of the data to two derivations of the proposed model, using maximum likelihood estimations with AMOS 4.0 software (see Kline, 1998 for review and comparison with similar programs). Figure 1 demonstrates the first model, in which 'performance' is a latent variable derived from SAT-verbal, SAT-math, and multiple choice test-item performance. This factor seems to be a reasonable representation of broad performance given the relatively equal distribution of the path weights for the three contributing observed variables. Two observed variables, study skills and cognitive test anxiety, were both tested for direct effects on performance, after controlling for the correlation between those two variables. As demonstrated in Figure 1, cognitive test anxiety had a meaningful impact (30% of variance) on general performance while study skills did not (5% of variance). Modifications of this model to test the potential of one of these variables serving as a mediating variable in the model did not produce a significantly better fit for the data. Following the convention called upon by experts on the use of SEM, multiple fit indices have been reported (Gridley, 2002; Ullman & Bentler, 2003). All indications of goodness of fit indicate that the model provides a valid explanation for the data.

To more directly assess the role of cognitive test anxiety on different testing situations (high-external pressure vs no-external pressure), a second model was also tested. As illustrated in Figure 2, the no-external pressure variable was students' performances on the short test completed in the testing session while the high-external pressure factor comprised the SAT math and verbal subtests. This model was developed with the

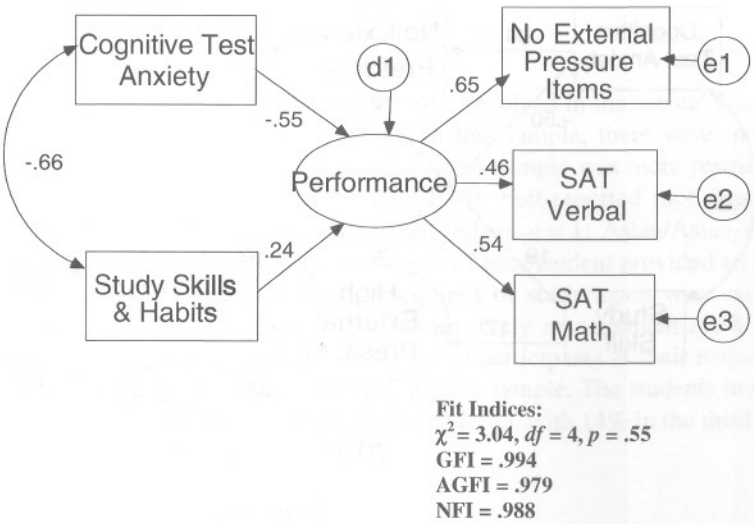

Figure 1. Cognitive test anxiety and study skills predicting general performance

expectation that external evaluative pressure would be high in the SAT condition, as it is primarily used for access to higher education as well as a means to be competitive for honours and scholarships.

The data demonstrate that performance for both types of evaluative presure conditions were meaningfully predicted by cognitive test anxiety, but not by study skills. Therefore, the data support the proposition that cognitive test anxiety operates on testing performance, despite the removal of external evaluative pressure. However, it is informative that the level of influence is dramatically different between the two testing conditions. In a high-external evaluation pressure situation, cognitive test anxiety accounted for 25% of the variance in reported performance while in the no-external evaluation pressure condition, cognitive test anxiety accounted for 12%. Once again, multiple fit indices are reported in Figure 2. The goodness of fit was not as strong as the model displayed in Figure 1, but still within suggested parameters (Schumaker & Lomax, 1996). The only troubling value was the χ^2 value, which produced a significant p value, indicating a poor fit. However, it is well documented that this measure is a poor indicator with larger sample sizes such as this (see Gridley, 2002 for review).

Discussion

The results from Study 1 confirmed the expectations that high levels of cognitive test anxiety would lead to deficient performance in varied test-related performance measures. Furthermore, the results demonstrated a strong correlation between self-reported study skills and habits and cognitive test anxiety. Directionality in that relationship cannot be meaningfully determined with these data, as comparison of modified models demonstrated no meaningful change to the overall model based on manipulation of the cognitive test anxiety and study skills relationship. Therefore, the correlational model has been maintained rather than a mediating pathway through these two variables.

The results support process-oriented models of test anxiety, such as the information processing perspective proposed by Naveh-Benjamin (1991). In concordance with this

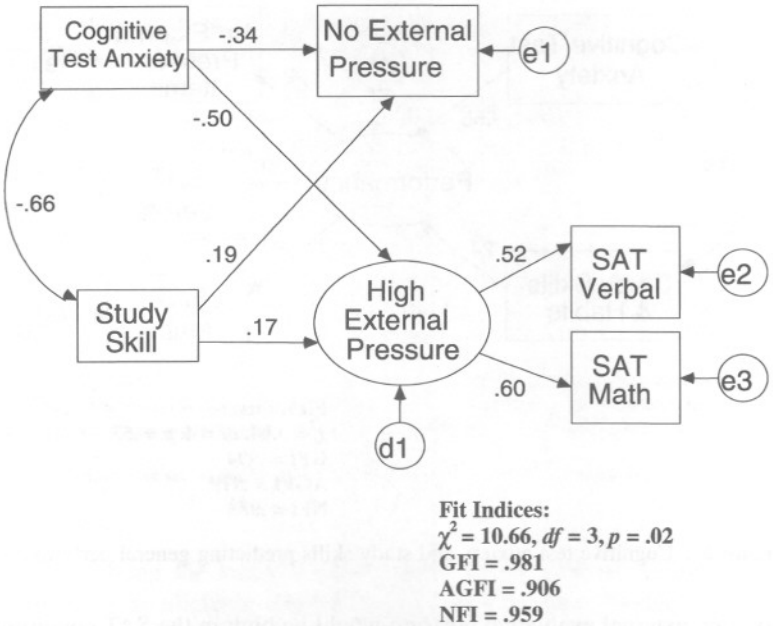

Figure 2. Cognitive test anxiety and study skills predicting performance on high- and no-external evaluative pressure tasks

theory, these data reveal that students with high levels of cognitive test anxiety experience difficulties in a broad range of performance tasks, and the removal of external evaluative pressure (as occurred in the experimental testing situation) does not eliminate this deficiency. Further, the relationships among test anxiety, study skills, and performance on the SAT further indicates that cognitive test anxiety is predominately a trait construct, that is manifest in nearly all aspects related to the learning-testing cycle.

The model illustrated in Figure 2 demonstrated that cognitive test anxiety is a contributor to overall level of performance regardless of level of external evaluative pressure. However, the finding that the predictive power of cognitive test anxiety is higher in conditions of high external evaluative pressure also supports an additive model of test anxiety, where a certain level of anxiety is always present but certain situational variables activate greater levels of effect from the anxiety construct (Zohar, 1998).

STUDY 2

The primary purpose of the second study was to explore the impact of cognitive test anxiety on two additional no-external evaluation performance tasks: free recall and inferential reasoning-based multiple-choice questions. The passages used in this experiment were modified to provide greater similarity among the text versions in length and number of foundational units (to facilitate comparisons on the free-recall task). Inferential reasoning was assessed by creating a new set of items for the learning and memory test. Thus, the outcome measures in this study included: performance on knowledge-based test items (as in Study 1), performance on inferential reasoning test items, and free recall.

Method

Participants

A substantially smaller number of participants were involved in the second study, with a total of 88 participants completing all phases. In this sample, there were more males ($n = 65$) than females ($n = 23$). The age range for this sample was more restricted, with ages ranging from 18 to 26 ($M = 19.22$, $SD = 1.48$). Self-reported race demonstrated similar distributions to the first study: American Indian, $n = 1$; Asian/Asian-American, $n = 5$; black, $n = 2$; Hispanic, $n = 2$; and white, $n = 77$ (one student provided an irrelevant response to the prompt). Students' major disciplines of study again were widespread, representing the primary undergraduate disciplines. Only management (13%) and undecided (11%) were reported by more than 5% of the participants as their major. Data on number of years in college were also available for this sample. The students in this study were primarily in their first two years of college (79.10%), with 14% in the third year, and 6% reporting four years of college experience.

Materials

The participants completed the Cognitive Test Anxiety scale and the demographics questionnaire described earlier. The passages used in this experiment were identical in foundational content to the passages in the first experiment. The only differences were structural changes to the texts, and the elimination of an introductory paragraph in the *Simple Machines* text that did not contain target content.

To test recall levels for the text passages, the process of foundational unit identification was employed. The foundational units were established through pausal unit analyses (see Johnson, 1973, 1982) and examination of the core, superordinate textual units. These foundational units were considered represented when the gist of the foundational unit was present in the participant's free recall response to the direction to recall 'as much of the text' as they could, with 'no information being unimportant.' All foundational units were validated through ratings provided by graduate students and faculty experts in fields from which the passages were drawn. As the content differences were not important to the study of cognitive test anxiety, and there were no significant differences in patterns of group recall levels, each participant's recall performance for the two passages were condensed into a single recall score.

Two types of multiple-choice items were used in this investigation. Knowledge-based items were test questions ($k = 17$) that drew the answer directly from the presented foundational units of the passages. Correctly answering these items merely required recognizing the content prompt and identifying the similarity in content presented in text and the response options in the test. The inferential reasoning items ($k = 27$) could not be answered through simple recognition. Accurate response to inferential reasoning items required combining textual units to create a new thought, applying text information to a novel situation, or inferring meaning that was not explicitly presented.

Procedures

The procedures from the first experiment were primarily replicated. However, in this experimental setting, directly after completing the multiple-choice items, the participants were asked to 'recall as much of the passage you just read as possible.' The participants were instructed to recall *any* content that came to mind, and that no portion of the text was unimportant.

Table 2. Intercorrelation matrix: Study 2

	1	2	3	4
1. Cognitive test anxiety	63.34 (12.42)	−0.29*	−0.27*	−0.28*
2. Knowledge-based items		9.65 (2.28)	0.65*	0.57*
3. Inferential reasoning items			15.95 (3.40)	0.58*
4. Free recall				20.39 (8.58)

Note: Values along the diagonal report sample means and standard deviations (in parentheses).
*$p < 0.01$.

Results

As in the first study, a preliminary analysis of gender differences on the Cognitive Test Anxiety scale was conducted. The univariate analysis of variance was not statistically significant, $F(1, 85) = 1.83$, $p = 0.18$, $\eta^2 = 0.01$. Thus, all analyses for this experiment were conducted without including the gender factor.

Correlational analyses were conducted using the Pearson Product-Moment correlational coefficient. Results demonstrated that cognitive test anxiety had a weak to moderate, negative correlation with the outcome measures (Table 2). The correlational matrix also demonstrated that the three outcome variables were strongly related with one another.

Once again, SEM was used to test the proposed model asserting that cognitive test anxiety was a significant determinant in student performance. In this study, there was only one model tested (see Figure 3). The latent variable 'No External Pressure' was composed of three observed measures: passage recall, performance on knowledge-based items, and performance on inferential reasoning items. Each of the three observed variables contributed significantly to the performance factor. Cognitive test anxiety once again was a significant predictor of performance, in this instance accounting for 13% of the variance in the performance estimate.

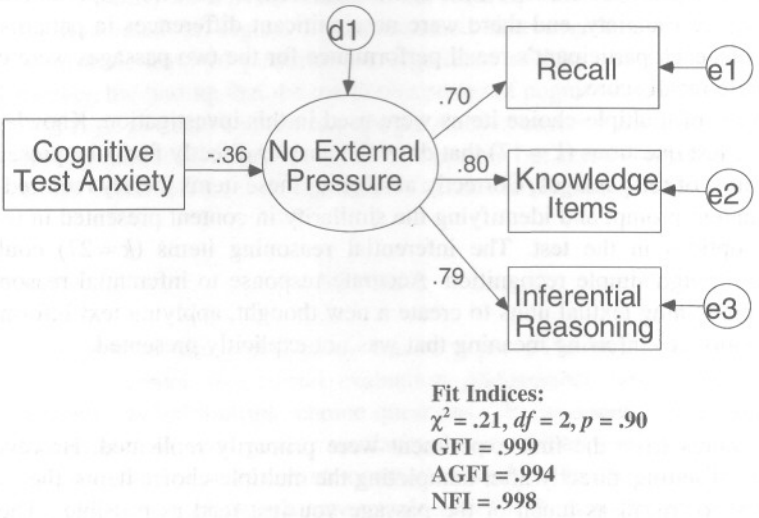

Figure 3. Cognitive test anxiety predicting performance on three no-external evaluative pressure tasks

Discussion

This study confirmed the findings from Study 1 related to no-evaluative pressure situations. Specifically, high levels of test anxiety were found to have a meaningful negative impact on overall performance for tasks that were designed to eliminate overt external evaluative pressure. Again, the data support the view of cognitive test anxiety proposed earlier, that cognitive test anxiety is an indicator of basic processing deficiencies or errors that permeate all phases of the learning-testing cycle, and theoretical explanations of the impact of test anxiety that showcase retrieval failure are likely missing a fundamental aspect of the role of cognitive test anxiety.

GENERAL DISCUSSION

The results from these two experiments provide supportive evidence for models that assert students with test anxiety have difficulties with fundamental cognitive processing during the encoding, storage and retrieval phases that impair eventual performance (Naveh-Benjamin, 1991; Naveh-Benjamin et al., 1987; McKeachie, 1984). The results have extended the understanding of these cognitive processing deficiencies by demonstrating that high levels of cognitive test anxiety lead to poor performance on a wide variety of tasks, even those delivered in the absence of external evaluative stress. Therefore, the data do not support views of test anxiety that focus simply on cognitive interference during a stressful retrieval event. Processing models of test anxiety that acknowledge the challenges faced while attempting to encode and store content during the test preparation phase in addition to accessing content during the test performance phase appear to provide a better explanation for the broad performance deficiencies observed in this study (Cassady, in press; Schutz & Davis, 2000; Zeidner, 1998). Failure to succeed in recall tasks, basic knowledge-level questions, and more taxing inferential reasoning items suggests that the content presented in the expository text passages was simply not fully available to those with high levels of cognitive test anxiety.

The widespread impact of cognitive test anxiety in the learning-testing cycle is further supported by the strong correlation between cognitive test anxiety and study skills, as well as the significant overlap in shared correlations with performance variables noted in Study 1 (see Table 1). Examination of the items in Appendix A allows the reader to recognize that the study skills items were not focused on paying attention to study materials, or setting aside time to study before tests as is often expected with study skill instruments. Rather, the items also assess self-perceived reading comprehension, organization, and metacognitive skills. These data suggest that not only do students with high levels of cognitive test anxiety have inferior content-acquisition and organization skills (as demonstrated by their poor performance in no-external evaluative pressure conditions), they are also aware of their inabilities.

Self-awareness of an inability to adequately prepare has been proposed to activate debilitative test perceptions and behaviours such as task avoidance, perceived test threat, emotionality, and learned helplessness, that further impair students' abilities to effectively cope with the testing event (Bandalos et al., 1995; Cassady & Johnson, 2002; Lay, Edwards, Parker, & Endler, 1989; Schwarzer & Jerusalem, 1992). The data in Figure 2 provide new evidence for this relationship, demonstrating that cognitive test anxiety predicts performance difficulties in all situations, but the effect is magnified under situations where

external evaluative pressure is salient. It is possible that cognitive test anxiety may be conceptualized as a generalized manifestation of an individual's self-efficacy for succeeding on tests, derived from an appraisal of her or his available cognitive resources. In this conceptualization, the fundamental cognitive processing deficiencies (ability to organize, synthesize, or comprehend textual content) would be the primary causal factor underlying performance deficits, with cognitive test anxiety mediating that effect.

FUTURE DIRECTIONS

As a condition of establishing the no-external evaluative pressure condition, these data were collected under controlled conditions. One natural extension of this study is to conduct similar tests of the role of cognitive test anxiety on performance in realistic testing situations, manipulating the level of induced external evaluative pressure. For instance, the level of impact of cognitive test anxiety on three course examinations of varied 'weight' in overall grade determination may allow for a more ecologically valid test of evaluative pressure. Furthermore, assessing the individual's perceived level of stress or test threat (see Cassady, in press for example) could serve as a test of the role of evaluative pressure by including that variable in the models.

Finally, the most pressing extension to be applied to this research paradigm appears to be the inclusion of tests of basic information processing skills in a model similar to those in Study 1. These basic operations or skills (e.g. organization, reading comprehension, selective attention) would enable a strong test of the proposition that cognitive test anxiety is a manifestation of self-awareness of basic processing deficiencies, and operates as a mediating variable through which basic processing skills influence performance on high- and low-evaluative pressure tasks.

ACKNOWLEDGEMENTS

I would like to thank Ronald E. Johnson and Betty E. Gridley for their supportive guidance on aspects of this investigation.

REFERENCES

Arch, E. (1987). Differential responses of females and males to evaluative stress: anxiety, self-esteem, efficacy and willingness to participate. In R. Schwarzer, H. M. van der Ploeg, & C. D. Spielberger (Eds.), *Advances in test anxiety research* (Vol. 5, pp. 97–106). Lisse, The Netherlands: Swets & Zeitlinger.

Bandalos, D. L., Yates, K., & Thorndike-Christ, T. (1995). Effects of math self-concept, perceived self-efficacy, and attributions for failure and success on test anxiety. *Journal of Educational Psychology, 87*, 611–623.

Benjamin, M., McKeachie, W. J., Lin, Y., & Holinger, D. P. (1981). Test anxiety: deficits in information processing. *Journal of Educational Psychology, 73*, 816–824.

Cassady, J. C. (in press). The influence of cognitive test anxiety across the learning-testing cycle. *Learning & Instruction*.

Cassady, J. C. (2001a). Self-Reported GPA and SAT: a Methodological Note. *Practical Assessment, Research, and Evaluation 7(12)*, [online]. Available: http://ericae.net/pare/getvn.asp?v = 7&n = 12 [2002 May 28].

Cassady, J. C. (2001b). The stability of undergraduate students' cognitive test anxiety levels. *Practical Assessment, Research & Evaluation, 7(20)*, [online]. Available: http://ericae.net/pare/getvn.asp?v = 7&n = 20 [2002 May 28].

Cassady, J. C., & Johnson, R. E. (2002). Cognitive test anxiety and academic performance. *Contemporary Educational Psychology, 27*, 270–295.

Covington, M. V. (1985). Test anxiety: causes and effects over time. In H. M. van der Ploeg, R. Schwarzer, & C. D. Spielberger (Eds.), *Advances in test anxiety research* (Vol. 4, pp. 55–68). Lisse, The Netherlands: Swets & Zeitlinger.

Covington, M. V., & Omelich, C. L. (1987). 'I knew it cold before the exam': a test of the anxiety-blockage hypothesis. *Journal of Educational Psychology, 79*, 393–400.

Culler, R. E., & Holohan, C. J. (1980). Test anxiety and academic performance: the effects of study-related behaviors. *Journal of Educational Psychology, 72*, 16–26.

Easterbrook, J. A. (1959). The effect of emotion on cue utilization and the organization of behavior. *Psychological Review, 66*, 183–201.

Geen, R. G. (1980). Test anxiety and cue utilization. In I. G. Sarason (Ed.), *Test anxiety: Theory, research, and applications* (pp. 43–61). Hillsdale, NJ: Lawrence Erlbaum.

Gridley, B. E. (2002). In search of an elegant solution: reanalysis of Plucker, Callahan, and Tomchin, with respects to Pyryt and Plucker. *Gifted Child Quarterly, 46*, 224–234.

Hembree, R. (1988). Correlates, causes, and treatment of test anxiety. *Review of Educational Research, 58*, 47–77.

Johnson, R. E. (1973). Meaningfulness and the recall of textual prose. *American Educational Research Journal, 10*, 49–58.

Johnson, R. E. (1982). Retrieval cues and remembering of prose: a review. In A. Flammer, & W. Kintsch (Eds.), *Advances in psychology: Discourse processing* (Vol. 8, pp. 219–238). New York, NY: New Holland Publishing.

Kalechstein, P., Hocevar, D., Zimmer, J. W., & Kalechstein, M. (1989). Procrastination over test preparation and test anxiety. In R. Schwarzer, H. M. van der Ploeg, & G. D. Spielberger (Eds.), *Advances in test anxiety research* (Vol. 6, pp. 63–76). Lisse, The Netherlands: Swets & Zeitlinger.

Kline, R. B. (1998). Software programs for structural equations modeling: AMOS, EQS, and LISREL. *Journal of Psychoeducational Assessment, 16*, 343–364.

Lay, C. H., Edwards, J. M., Parker, J. D. A., & Endler, N. A. (1989). An assessment of appraisal, anxiety, coping, and procrastination during an examination period. *European Journal of Personality, 3*, 195–208.

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.

Morris, L. W., Davis, M. A., & Hutchings, C. H. (1981). Cognitive and emotional components of anxiety: literature review and a revised worry-emotionality scale. *Journal of Educational Psychology, 73*, 541–555.

Mueller, J. H. (1980). Test anxiety and the encoding and retrieval of information. In I. G. Sarason (Ed.), *Test anxiety: Theory, research, and applications* (pp. 63–86). Hillsdale, NJ: Erlbaum.

Naveh-Benjamin, M. (1991). A comparison of training programs intended for different types 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. (1987). Two types of test-anxious students: support for an information processing model. *Journal of Educational Psychology, 79*, 131–136.

Sarason, I. G. (1986). Test anxiety, worry, and cognitive interference. In R. Schwarzer (Ed.), *Self-related cognitions in anxiety and motivation* (pp. 19–34). Hillsdale, NJ: LEA.

Sarason, I. G., Pierce, G. R., & Sarason, B. R. (1996). Domains of cognitive interference. In I. G. Sarason, G. R. Pierce, & B. R. Sarason (Eds.), *Cognitive interference: Theories, methods, and findings* (pp. 139–152). Mahwah, NJ: Erlbaum.

Schumacker, R. E., & Lomax, R. G. (1996). *A beginner's guide to structural equation modeling.* Mahwah, NJ: Erlbaum.

Schutz, P. A., & Davis, H. A. (2000). Emotions and self-regulation during test taking. *Educational Psychologist, 35*, 243–256.

Schwarzer, R., & Jerusalem, M. (1992). Advances in anxiety theory: a cognitive process approach. In K. A. Hagtvet, & T. B. Johnsen (Eds.), *Advances in test anxiety research* (Vol. 7, pp. 2–31). Lisse, The Netherlands: Swetts & Zeitlinger.

Tobias, S. (1986). Anxiety and cognitive processing of instruction. In R. Schwarzer (Ed.), *Self-related cognitions in anxiety and motivation* (pp. 35–54). Hillsdale, NJ: Erlbaum.

