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Multiple approaches to the validation of the scores from the study anxiety inventory

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Multiple Approaches to the Validation of the Scores From the Study Anxiety Inventory

by

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Abstract

The Study Anxiety Inventory (SAI), consisting of the factors of worry and emotionality, was developed to measure college students' self-reported levels of anxiety while studying for an exam. Data from 2002 undergraduate students from four colleges (Arts and Sciences, Engineering, Business, and Education) at a southeastern state university were used to evaluate the validity of the scores from the 16-item Study Anxiety Inventory.

Results of confirmatory factor analyses for the two factor model, conducted separately for each college, indicated marginally acceptable fit for the data (median fit measures across the four colleges: CFI =.915, SRMR=.049, RMSEA=.098), a pattern that was repeated for both males and females. Multigroup CFA was used to evaluate the factorial invariance of the SAI across gender within each college. Factor loadings (i.e., pattern coefficients) for the SAI items were not found to be significantly different between males and females ($p > .05$). Error variances for four items were found to be significantly different between males and females, indicating that there may be some difference in scale reliability by gender. Factor covariances were invariant for all four colleges ($p > .05$) and factor variances were invariant for all but the worry component for

the College of Arts and Sciences where females had significantly greater variability on the worry factor.

As was hypothesized, the SAI scores were positively correlated with scores on measures of test anxiety (median *r*=.74), trait anxiety (median *r*=.46), active procrastination (median *r*=.23), and passive procrastination (median *r*=.29), but negatively correlated with trait curiosity (median *r*=-.19). Contrary to what was hypothesized, no relationship was demonstrated between study anxiety and study skills and habits (median *r*=-.03). The nomological network was extended in this study by examining relationships between scores obtained from students on the SAI and measures of active and passive procrastination.

This is the first study that systematically examines the factorial invariance of the SAI by gender, which is important because previous research using the SAI has shown men's scores to be consistently lower than women's scores. The results obtained in the current study provide support for gender invariance in a nonclinical population in the situation specific level of anxiety while studying. There is sufficient evidence of validity and reliability (median Cronbach alphas for males and females for the total score were .978 and .980, for worry were .968 and .973, and for emotionality were .947 and .951, respectively) that a researcher should feel confident that the SAI is a psychometrically sound research tool that holds up fairly well across a number of different types of students and that making mean comparisons on the SAI by gender is acceptable.

Chapter 1

Introduction

The construct of test anxiety has been the subject of much research. Sarason and Mandler (1952) are generally credited with establishing test anxiety as an important psychological construct, which they defined as a "drive" with emotional arousal and worry cognitions evoked in examination situations that have a negative effect on performance (S. Sarason, Hill, & Zimbardo, 1964). Spielberger (1980) developed the Test Anxiety Inventory (TAI, 1980) to measure test anxiety as a situation-specific trait. This measure has become one of the most popular for research and has been used in thousands of studies that have examined the effects of anxiety during testing. From this research, techniques have been developed that are widely used in counseling centers across the country to help alleviate this anxiety (see Zeidner, 1998 for a review).

It is interesting that, although the anxiety felt during a test has been researched in depth, there has been very little published research concerning the anxiety that one experiences while studying for a test. Getting information into memory (encoding), retaining that information (storage) and getting that information back out (retrieval) may be influenced by anxiety at these different stages. Cognitive psychology suggests that if a student is unsuccessful in his/her attempt to encode the information due to some interference such as anxiety experienced during studying, then it follows that the retrieval performance of the student would reflect the lack of encoding. Studies have shown that when study skills have been used in conjunction with group counseling techniques to facilitate coping with anxiety during studying, students' grades improved (Gonzalez,

1995). This may be due to improved skills in studying but may also be due to skill in learning to deal with anxiety felt while studying, which may reduce interference with the encoding process. There have been a number of studies that show an interaction effect of study skills and test anxiety on test performance. When students were told that they were going to be evaluated, the high test anxiety/poor study habits group performed more poorly than the high test anxiety/good study habits group and regardless of study habits, the low anxiety students performed better than both of those two groups (I. Sarason & Smith, 1971). On the basis of further research, Naveh-Benjamin (1991) concluded that test performance of test anxious students was influenced by both the interference of retrieval by worry and emotionality during tests, and the organization and encoding of material at the time of studying for a test. He suggested that the performance of students with high test anxiety and good study habits was reduced by the interference in the retrieval from memory during tests, whereas the performance of high test anxious students with poor study habits was poorer because of both interference with retrieval and inability to organize and encode the material.

The view that it would be beneficial to use both test and study anxiety relieving methods and teaching study skills is supported by an intervention study using behavioral modification and study counseling in which Gonzales (1978) demonstrated that grade point average (GPA) improved for high test anxious students who had good study habits but did not improve for high test anxious students with poor study habits. Students who showed a substantial reduction in test anxiety made the greatest improvement in GPA, indicating that reduction of test anxiety in test anxious students with good study habits

contributed to an improved GPA by eliminating the adverse interference effects of worry and emotionality while taking tests. Improvements were also found for students who showed a reduction in anxiety while studying.

These results are consistent with Spielberger's reports, starting as early as 1966, that students complained that "anxiety reduced effectiveness in studying…" (p. 361), singling out study anxiety as an important explanatory variable to understanding students' performances on tests. The importance of study anxiety is suggested by the fact that Spielberger included items that dealt with anxiety felt prior to an exam ("*I worry a great deal before taking an important examination*"), even though the time reference for the items was inconsistent with the definition of test anxiety. In that many studies have shown that anxiety during an exam can interfere with retrieval, it seems reasonable to suggest that those who worry before taking an important exam may have difficulty encoding information for later retrieval. This suggests that another situation-specific construct that may affect the encoding of information prior to taking an exam is study anxiety.

A person suffering from study anxiety would, while studying for exams, experience both worry and emotionality symptoms. The worry symptoms of study anxiety might include: thinking about grades or lack of preparedness in a course so much that it interferes with learning; thoughts freezing up; mind wandering; being easily distracted so that other thoughts interfere with learning; thinking of the consequences of failing that interferes with the learning procedure or concentration; getting a mental block; increasing confusion as effort increases; having a sense of self defeat; an inability

to retain what is studied for long or forgetting it quickly; thoughts of no longer being able to cope with school; wanting to drop classes; worrying about being disorganized physically and mentally; worrying about having to study longer than others to get the same results; and worry thoughts of doing poorly like “I’m not getting this” or “I can’t absorb the material properly.”

The emotionality symptoms of study anxiety may include: getting tense, uneasy, upset feelings; feeling jittery; feeling nervous; feelings of panic; feeling stressed; increased speed or strength of heartbeat; shallow or difficult breathing; feeling hot, cold or breaking out in a sweat; showing signs of stress; having the stomach tighten; feeling physically ill (maybe nauseous); and feeling frustrated to the point of distraction.

The relevance of study anxiety as a factor in test performance is supported by interviews with university students who were plagued with anxiety in their pursuit of their degrees (Spielberger, 1966). The most interesting conversations were held with those who explained that their anxiety did not hinder them during exams as they could reason that once they entered the exam room there was no more they could do to learn the material and hence they became calmer. This suggests that the time factor for this anxiety separates the concept of test anxiety from study anxiety. It is also evident that this construct is different from test anxiety in that the environment of the exam is set by the instructor of the course while the study environment is established by the student. Comments from the students like “I often find that I think I must cook dinner before I can start studying” suggest that procrastination may be a symptom of study anxiety. Finally,

the construct of study anxiety differs from test anxiety in that the interference experienced is for encoding instead of for retrieval.

A search of the literature on study anxiety reveals that there have been several attempts to develop a measure of study anxiety as a scale within inventories measuring various aspects of studying. For example, Welsh, Bachelor, and Wright (1990) developed the Study Anxiety Scale as part of the Study Attitudes and Methods Survey (SAMS). The problem with the Study Anxiety Scale is that is does not follow the theoretical guidelines of the construct of study anxiety in a number of ways. Four of the 16 items reflect test anxiety, as the responses focus on feelings during or just before starting an exam. Four items reflect trait or social anxiety as they indicate situations that are more general or social rather than referring specifically to the time of studying. Three items refer to "not understanding" but they do not identify anxiety as the reason for this lack of understanding and this may simply be assessing a lack of prior preparation as the cause of confusion. One item is clearly a depression item rather than an anxiety item and another item raises two points that are not mutually exclusive "I become so anxious over small points I encounter in studying and reading that I miss the really important points and main trends." It may be that individuals may become anxious over small points while studying but not while reading and they may miss the main trends but not the really important points. Based on the definition of the construct presented by Lunsford (2001), only two items in the SAMS subscale clearly reflect the construct of study anxiety.

Another instrument that includes a measure of anxiety concerning learning designed for college students is called The Learning and Study Skills Inventory (LASSI;

Weinstein & Palmer, 1988). The authors subsequently created a simplified version for high school students called the LASSI-HS (Weinstein & Palmer, 2002). The LASSI is a 76-item cross-curricular self-report measure with an anxiety scale assessing the degree to which students worry about their performance. An example of an item reflecting test anxiety is "While I am taking a test, worry about doing poorly gets in the way of keeping my mind on the test." Both the LASSI and LASSI-HS are 10-scale inventories that are widely used although, in the test manuals, the authors have described these as components of three basic factors of skill, will, and self-regulation. In a confirmatory factor analysis (CFA) of this instrument, however, three other factors were supported relating to effort-related activities, goal orientation, and cognitive activities (Prevatt, Petscher, Proctor, Hurst, & Adams, 2006). This instrument did not fulfill the requirements needed to measure anxiety while studying.

Study anxiety was also investigated in a paper by Owens and Newbegin (1997) where SA was defined as state anxiety and was measured by asking students to indicate how they felt at a particular moment (here, while studying). The measure used in that study was Spielberger's State-Anxiety Scale (which measures current feeling) from the State-Trait Anxiety Inventory with state anxiety items being prefaced with the words "When I am studying…" This definition does not follow the theories presented by Spielberger who clearly states that Test Anxiety is a situation-specific trait anxiety and should be measured by asking how the student generally feels.

These measures of study anxiety clearly do not address study anxiety as defined. The need for an instrument to measure study anxiety is particularly pressing given the

increasing emphasis on the use of tests to make various accountability decisions at all levels of education and the use of test scores to inform accountability decisions. Learning to deal with anxiety during studying and testing is not just important in the high school or college setting. This problem may affect the progress of people in their jobs for the rest of their lives because tests do not finish when formal education ends. Employers are increasing their use of tests given before they take on new employees as they have found that pre-employment tests improve corporate productivity if given under the right conditions (Rudner, 1992).

Based on observations and interviews supporting the distinctiveness of study anxiety from test anxiety and the potentially important role study anxiety may play in students' test performance, Lunsford (2001) developed a paper-and-pencil self-report measure of study anxiety for use as a research tool to examine study anxiety in college students. Because the conceptualization of study anxiety was very similar to test anxiety with the main difference being the time anxiety is felt, study anxiety was posited to be a situation-specific anxiety with the same worry and emotionality components found in test anxiety. A pool of 40 items was created by Lunsford to assess study anxiety and its possible components. To make the reading level of the measure sufficiently low to cover a wide range of students including those whose first language was not English, wording on the survey was established at a sixth grade level using the Flesch-Kincaid Grade Level test. Because the Study Anxiety Inventory items were, in part, modeled after the Test Anxiety Inventory, it was considered that those responding to both sets of items might miss the general instructions to think about their thoughts and feeling at the time of

studying or at the time of a test and hence believe that they were being asked to respond to the same item twice. To avoid this problem, a phrase indicating the specific context was woven into each item. For example, the TAI item read, “While taking examinations I have an uneasy, upset feeling” while the corresponding SAI item read, “While studying for exams, I have an uneasy, upset feeling.”

That 40-item pool was presented to 12 experts in the field of psychology and test development, and items were evaluated for content validity. All items were printed on a form using a 5-point scale with instructions asking for items to be marked that seemed to reflect the construct of study anxiety as operationally defined. Four of the items were eliminated as the experts pointed out that they reflected content different from anxiety (e.g., distractibility) leaving 36 items that received the highest percentage agreement.

Lunsford (2001) conducted a series of studies to evaluate the psychometric properties of these 36 items. Through analysis of the factor loadings (i.e., pattern coefficients) in combination with the conceptual fit with the definition of study anxiety, eight items were selected as indicators of the emotionality aspect and eight items for the worry aspect of study anxiety for the Study Anxiety Inventory (SAI). Each item on this measure enabled the respondent to indicate intensity on a scale from one to four (1=Not at all, 2=Sometimes, 3=Often, 4=Always or almost always). Analysis of the 16-item Study Anxiety Inventory included item analysis, exploratory factor analysis (EFA), and test-retest reliability. Results of the exploratory factor analysis with 536 college students supported the two-factor (emotionality and worry) structure underlying study anxiety and provided evidence of the internal consistency reliability (α=.96 for the overall index, and

.94 and .94 for the worry and emotionality subscales, respectively), and two-week test-retest reliability (r=.84 for the overall scale and .84 and .84 for worry and emotionality subscales, respectively) of the scores from the SAI.

Since the development of Lunsford's Study Anxiety Inventory, several researchers have used the instrument and provided additional evidence of validity. Because it may be argued that study and test anxiety are similar constructs, Kieffer, Reese and Cronin (2005) carried out a study in which they used both Spielberger's Test Anxiety Inventory and Lunsford's Study Anxiety Inventory in one administration. Using exploratory factor analysis with a varimax-rotated solution, all test anxiety items emerged on a single factor with the 16 study anxiety/worry and study anxiety/emotionality items emerging on the remaining two but with two of the worry items loading on the study anxiety/emotionality factor. Keiffer, Reese and Cronin (2004) also conducted confirmatory factor analysis of the 32 items. For the confirmatory factor analysis, five competing, falsifiable models were developed for the 32 items: 1) a single factor, 2) four 8-item factors (test anxiety/worry, test anxiety/emotionality, study anxiety/worry, and study anxiety/emotionality), 3) two 16-item worry and emotionality factors, 4) two 16-item test anxiety and study anxiety factors, and 5) one 16-item test anxiety factor and two study anxiety factors (found in a pilot exploratory factor analysis). Only the second model evidenced an acceptable model-to-data fit as reflected in goodness-of-fit and adjusted goodness-of-fit (both above .83), comparative fit index and Normed Fit Indexes (both above .90) and the Root Mean Square Error of Approximation (RMSEA=.066). The fit of the study anxiety items demonstrated a better fit than the test anxiety items.

The four subscales, Test Anxiety Worry (TA/W), Test Anxiety Emotionality (TA/E), Study Anxiety Worry (SA/W), and Study Anxiety Emotionality (SA/E) had Cronbach alphas of .92, .93, .92 and .94 respectively with item to total correlations all greater than .68. Using 180 students attending an effective study habits course, 10-week test-retest reliability coefficients were .73, .78, .67 and .81 for the same order of subscales mentioned above.

Although these results provided initial validation of the scores from the SAI, validation is an ongoing process that is strengthened through the collection of multiple sources of evidence. Because the CFA was carried out by Keiffer, Reese and Cronin (2004) on the 32 test and study anxiety items combined, their study does not provide an exact test of the measurement model underlying the SAI. Therefore one of the purposes of the current study was to investigate further the latent structure of the 16 SAI items using confirmatory factor analysis. In psychological assessment literature the most popular method for providing empirical support of construct validity is confirmatory factor analysis (AERA, APA, & NCME, 1999; Thompson & Daniel, 1996). When the measure of a construct has been developed using a theory, CFA is used to evaluate the latent structure behind the measure (Byrne, 1998; Hoyle & Panter, 1995). Stevens (1996) explains that exploratory factor analysis is used to identify how many factors underlie a set of observed variables. It is considered to be a method of generating a theory rather than testing a theory-based instrument. While EFA was used in the development stages of the SAI, it was used primarily to enable the elimination of items that obtained poor loadings so that the remaining items would more clearly define the factors already

established by theory. The next logical step in the construct validation process was to evaluate the two-factor structure (worry, emotionality) underlying the SAI using confirmatory factor analysis (CFA).

Research has consistently found that self-report scores of anxiety for females is higher than for males (Hewitt & Norton, 1993; Spielberger, 1975; Spielberger & Wasala, 1995) although there is little research suggesting the reasons for this beyond a biological propensity towards anxiety. General anxiety is suffered by women about twice as much as men (Breslau, Schultz, & Peterson, 1995) which is something that begins to show around puberty (Seeman, 1997) while prior to puberty, males are more susceptible to anxiety. Reproductive hormones and cyclical hormonal patterns are therefore clearly important in the prevalence of anxiety as it relates to gender. There is support of the evolutionary theory that predicts that no differences would exist where the same adaptive problems have been faced but would exist where problems have differed. It would therefore make sense that these differences would appear at the time of puberty if differences in anxiety have to do with sexual selection (changes due to advantage in reproduction). The male pursues higher risk strategies and, because he has a lower level of parental investment, therefore develops a propensity for lower anxiety. This is not to say that social factors like sex roles, differences in economic power, perception of threat, or the impact of sexual selection should be ignored but these would be secondary factors to the biological ones. It has also been documented that there are sex differences in neurotransmitter and neuromodulatory systems that are associated with anxiety (Carlsson & Carlsson, 1988; Wilson & Biscardi, 1994).

Armstrong and Khawaja (2002) compared responses across gender and found that females considered the manifestations of their anxious worries to be more catastrophic and more dangerous. Females also reported more concern about emotional, physical and mental symptoms related to anxiety. Effect sizes, however, are typically moderate to low according to studies reported over the last decade that have compared trait anxiety scores for males and females (Everson, Millsap, & Rodriguez, 1991; Foot & Koszycki, 2004; Marcus, 2001). Mean differences between male and female respondents, then, have been fairly well established, but the factor structure underlying the measures of anxiety have not been compared to determine whether males and females view the meaning of the items in the SAI in a similar manner. Therefore, a second purpose of the study was to determine whether there was factorial invariance of the SAI by gender. Invariance testing involves comparing the factor pattern coefficients (loadings), uniquenesses (error variances), and factor variances and covariances across the male and female groups.

An equally important purpose for this study was to evaluate the validity of the SAI scores using the logic of the nomological network proposed by Cronbach and Meehl (1955). Construct validation using this framework (AERA et al., 1999) involves carrying out tests of the relationship between study anxiety and the related latent variables of test anxiety, trait anxiety, trait curiosity, and procrastination. Because test anxiety has been researched extensively for a number of years, it has a fairly well established nomological network and since the SAI was developed using this construct as a model, it is to be expected that there would be a number of constructs that would also correlate with the

SAI. To continue the ongoing validation process, correlations were investigated using those existing parallels.

The way that test anxiety is similar to study anxiety is that for both: (a) failure on a specific exam is a perceived threat, (b) the threat is perceptual rather than actual, and (c) the nature of the response is worry and emotionality. The similarity of the antecedent suggests that study anxiety will correlate highly with test anxiety. The similarity of perception of threat suggests that study anxiety will correlate highly with trait anxiety. The similarity of worry and emotionality responses suggests that study anxiety will correlate positively with anxiety measures.

The way that test anxiety is dissimilar to study anxiety is that: (a) the time of the perceived threat is while studying instead of while taking the test, (b) the perceived control over what can be done about the unpleasant feelings is located within the individual rather than the test proctor, and (c) the difficulties faced by the individual with high study anxiety are in his/her ability to encode and retain information instead of in his/her ability to retrieve stored information. The dissimilarity of the time of the perceived threat suggests that study anxiety scores will not correlate so highly with test anxiety that it should be considered the same construct. Individuals could have high study anxiety yet become calm as they walk into an exam realizing that there is nothing further they can do, or they may be unaware that the test will be as hard as it turns out to be, or that they are not as prepared as they should be so they could be calm while studying but feel high anxiety at the time of the test.

Curiosity is a motivational instinct described as the tendency to investigate a stimulus. According to the Optimal Stimulation/Dual Process Theory presented by Spielberger and Starr (1994), the level of curiosity a person has will change with the intensity of the stimulus. At low stimulus intensity, curiosity will be at a level that motivates exploration. At moderate stimulus intensity, both curiosity and "mild-to-moderate anxiety" (p. 233) will be the motivating instincts. At high stimulus intensity, high levels of anxiety will cause avoidance behavior and as the intensity increases curiosity will decrease and anxiety will increase (Spielberger & Starr, 1994). Berlyn (1960) posits that the relationship between level of curiosity and level of anxiety is partly due to personality characteristics. Therefore, different personalities will respond differently to different intensities of stimuli. Those with high trait anxiety will more quickly respond to a stimulus with state anxiety and less curiosity while those with low trait anxiety will respond with less state anxiety and more curiosity. Each person will have a different optimal arousal level. Based on this theory, curiosity would be inhibited by anxiety. Thus, curiosity is predicted to correlate negatively with anxiety; this result was found with trait curiosity and study anxiety in a previous study (Lunsford, 2001).

A number of researchers have stated that people may avoid performing a task to avoid uncomfortable feelings of anxiety. Atkinson (1974) suggests that those who avoid failure tend to be more anxious about failing and will hence avoid tasks that will bring on that anxiety. Beswick, Rothblum and Mann (1988) showed that as anxiety and low self-esteem increase, procrastination goes up, and grades go down. However, Ferrari, Johnson and McCown (1995) suggest that this relationship is not so simple. Although Soloman

and Rothblum (1984) defined procrastination as needless delay of tasks “to the point of experiencing subjective discomfort” (p. 503), the measures of procrastination suggest that procrastination is a broader construct than this. Chu and Choi (2005) suggested that there are two major types of procrastination: passive and active. The passive type is procrastination to avoid an unpleasant or anxiety-provoking task. The active type, is procrastination to increase optimum performance by timing the event to cause appropriate pressure for purposeful use of time. They explain that an active procrastinator is more like a non-procrastinator than a passive procrastinator. This would suggest that study anxiety would have a moderate positive correlation with passive procrastination while the relationship would be lower and positive with active procrastination.

Chu and Choi (2005) suggest that active procrastinators are less like passive procrastinators than they are like non-procrastinators in their relationship with anxiety. This rethinking of procrastination as a two-factor construct with opposing relationships with situation-specific anxiety points to a possible reason that past studies that have used one factor measures of procrastination have shown low or no relationships between the constructs of test anxiety and procrastination (Milgram & Tenne, 2000). Ackerman and Gross (2005) found that there was no relationship between procrastination and fear or pressure to meet a deadline. Lee, Kelly and Edwards (2005) only found a moderate correlation in a study looking at the relationship between procrastination and neuroticism. Onwuegbuzie (2000), however, pointed out that among the variables he studied, anxiety was a factor related to students avoiding enrolling in statistics classes as long as possible and tending to procrastinate on their assignments. It is necessary to look at these

relationships as they pertain to study anxiety and to whether the relationships between these types of procrastination differ depending on the type of study anxiety, worry or emotionality.

Purpose

The purpose of this study was to extend research on the construct validity of responses from college students to the Study Anxiety Inventory (SAI). Several approaches were used. Because the SAI was developed using a theory that the construct consisted of two highly correlated factors, support for this two-factor model was needed in establishing factorial validity. Confirmatory factor analysis was used to test the two factor model (worry and emotionality). As part of the CFA, the factorial invariance of the SAI for males and females also was examined.

Additional evidence for construct validity was collected using the nomological network framework. Based on the theoretical framework of study anxiety, it was predicted that there would be a positive relationship between scores on the Study Anxiety Inventory and scores on a measure of passive procrastination and active procrastination. Cronbach and Meehl (1955) argued that to support the validity of a construct, the test developer must show that the responses can be interpreted with specified hypothesized meaning; relationships between the construct and different or similar theoretical constructs or behaviors should be stated (nomological network). Cronbach and Meehl also explained that, although during the early stages of development the network will have few interrelations, more will be learned about a construct by "elaborating the nomological network" (p. 290). Construct validity is supported as the nomological

network is enriched with observable behaviors like responses to related and unrelated measures that appropriately correlate with the construct in question.

In the previous study using these measures (Lunsford, 2001), correlations were computed between study anxiety, test anxiety, trait anxiety, trait depression, trait anger, trait curiosity, and study skills and habits. Given the relationships that were reported between these constructs in earlier studies and using the Optimal Stimulation/Dual Process Theory discussed earlier, it was hypothesized that study anxiety and the two components of study anxiety, worry and emotionality, would have a positive correlation with test anxiety (overall, worry and emotionality) and trait anxiety. A negative relationship was predicted between study anxiety and trait curiosity. A weak positive relationship between study anxiety and study skills and habits was hypothesized.

Based on the findings of Choi and Chu (2005), it was expected that the SAI total, worry, and emotionality scores would correlate positively with the passive procrastination scores and with the active procrastination scores.

In summary, the purpose of this study was to evaluate the construct validity of the scores from the SAI with evidence obtained by:

1. Evaluating the two-factor measurement model underlying the Study Anxiety Inventory in a sample of college students;
2. Evaluating the factorial invariance of the two-factor measurement model underlying the Study Anxiety Inventory across male and female college students;

3. Examining the relationship between the scores on the Study Anxiety Inventory and scores on two measures of procrastination (active procrastination and passive procrastination), a measure of study skills and habits, and two of the four trait personality measures of the State-Trait Personality Inventory, the Trait-Anxiety Scale (T-Anx) and the Trait-Curiosity Scale (T-CY).

Significance

Additional evidence supporting the validation of the responses to the SAI provides the users with greater confidence in employing the SAI for research. Support for the factorial validity of the Study Anxiety Inventory gives confidence to researchers that this measure can be used to continue investigating the construct of study anxiety. Research can then be carried out to determine the effect of study anxiety on encoding information for college students. To establish measurement invariance by gender for the responses to the SAI would give researchers confidence in comparing differences in means between males and females. Findings of relationships of study anxiety with the two types of procrastination will extend the understanding of the construct.

Although at this stage the SAI is intended as a research tool, it is conceivable that treatments might also be developed for study anxiety in the same way that they have been developed for test anxiety, and counselors may start using the measure for assessments that could guide treatment or for making decisions regarding the type of help that might be given to a student.

Limitations

This study was carried out at only one state university in Florida and the sample was not randomly selected but was a sample of convenience made up of students who elected to attend social sciences statistics classes or certain education, business, and engineering classes. The implications of study anxiety may reach outside the population of university students, so using only university students is a limitation of this study which may be dealt with in future studies. A second limitation of this study was that it measured at one point of time students being mostly around the age of 21. Another limitation of this study is the use of paper-and-pencil self-report methods which tend to raise concerns about the validity of any causal conclusions that may be made from their use because of social desirability, response-set bias, or measurement error (Graziano & Raulin, 2007; Razavi, 2001). Although every effort was made to simplify the language of each item, because of the nature of the measure, there is a potential that a participant might not understand the wording of an item and would respond with guesses. Finally, the participant may either be unaware of their anxious responses or deny they had them.

Chapter 2

Review of the Literature

The purpose of this study was to collect various types of evidence to evaluate the validity of the inferences derived from the Study Anxiety Inventory (SAI). Given this focus, the present review begins by overviewing the validation process and the traditional types of evidence that are collected as part of this process. These types of evidence involve an analysis of item content (content validity), internal structure of the responses to the items (exploratory and confirmatory factor analysis), and relationships between the construct and other variables (concurrent, predictive, and construct validity).

Following this overview of the validation process, the theoretical work and research studies focusing on the construct of study anxiety are examined as they relate to the development and validation of the scores from the SAI. Articles that focus on university students, the intended audience of the SAI, are included; articles that focus on other populations are not included unless the information is relevant to the construct validation process.

Overview of the Validation Process

The *Standards for Educational and Psychological Testing* (American Educational Research Association, American Psychological Association, & National Council on Measurement and Education, 1985) emphasizes that validity is "the most fundamental consideration in developing and evaluating tests" (p. 9). According to Messick (1989), validity is the degree to which evidence combined with rationales based in theory "support the adequacy and appropriateness" (p. 13) of inferences made from the scores

obtained from a test. Various types of evidence may be used to support the validity of test scores.

Evidence based on instrument content. After a construct has been conceptualized, a way must be established to measure it. For a construct like study anxiety, a common measurement approach is to present written statements (items) that are indicators of the construct for the respondent to rate him or herself. Items are designed to elicit responses that are theoretically aligned with the conceptualization of the construct. These items and instructions for completing them should then undergo content analysis, which is an examination by experts of both item development and the construct being operationally defined to determine if the sample of items represents the construct of interest (Cronbach, 1949). Completion of the content validation process clears the way for further evaluation of the measure.

The next stage is for the instrument to be completed by a number of participants and a statistical analysis of the responses carried out to determine that the item scores have a reasonable level of reliability. Measures of internal consistency, such as Cronbach's alpha, are frequently used to assess reliability. Reliability may also be viewed in terms of the consistency of scores over time. This type of consistency or stability may be assessed using test-retest reliability.

Once it has been established that the responses to the items on the measure relate to one another sufficiently and that a reasonable degree of stability exists in the responses from one time to another then it is important to establish a level of construct validity. Although construct validity is a unitary concept, it is more difficult to assess the validity

of inferences made from the scores of a measure than to assess its reliability because validity requires that a rational argument be given as to how a construct should be measured and then empirical evidence must be gathered to support that argument. Special types of evidence may be collected including evidence based on the internal structure of item responses and evidence based on relations to other variables.

Evidence based on the internal structure of item responses. Two types of factor analysis are used commonly to evaluate the internal structure of item responses, exploratory (EFA) and confirmatory factor analysis (CFA). Factor analysis identifies the way related items cluster and enables evaluation of the dimensionality underlying a set of scores. Because the SAI was conceived as an instrument with two factors rather than one, the CFA should support the multidimensionality of the responses. The exploratory and confirmatory factor analyses that have been used with the SAI are presented later in this chapter as a rationale for including an examination of factorial invariance between males and females.

Evidence based on relations to other variables. In a landmark paper by Cronbach and Meehl (1955), construct validity was given more clarification and the concept of the nomological net was introduced as a framework for providing evidence of the validity of psychological constructs. Construct validity of the scores is more than one coefficient. It is an ongoing process involving examination of the relationships that should theoretically exist between a scale score and other variables. For the present study, it was hypothesized that the SAI scores should be positively correlated with scores on measures of test and trait anxiety.

Campbell and Fiske (1959), motivated by the fact that, in many areas, there is not a “Gold Standard” criterion with which to compare new measures, introduced the multitrait-multimethod approach which evaluates construct validity of a measure by investigating relationships found through correlations between two or more traits, each assessed by two or more methods. They introduced convergent validity as high correlations between measures of the same construct assessed by different methods and divergent or discriminant validity as low correlations between constructs that should not relate to one another. Even though there have been some objections to this approach, the approach is widely accepted as adding to the empirical evidence of the construct validity of the scores of a measure.

Examination of the scores from the SAI with other theoretically meaningful constructs and observable attributes (e.g., gender) provides deeper insight into the construct validity of this instrument. The following sections deal with the development of the SAI and go through each step in the validation process as it relates to the SAI.

Development and Initial Validation of the Study Anxiety Inventory

Because the first step in the development of an instrument is detailed analysis of the construct being measured, the following sections present the theoretical background of anxiety and study anxiety. This background provides the framework for the creation of the items used to measure the construct of study anxiety and the approaches used in the construct validation process.

It is important to understand the nature of anxiety in order to be able to measure anxiety in a specific and meaningful way. Because the number of articles on this topic is large, this chapter will briefly touch upon the highlights of the general topic of anxiety and situation specific anxiety, but will include appropriate articles on the constructs of trait anxiety, anxiety at the time of studying or testing, study skills, and procrastination.

Conceptualization of Study Anxiety

Anxiety as a typical response to fear is a central problem in our society. Rollo May, in his book, *The Meaning of Anxiety,* described the significant impact of anxiety in the arts, in the social sciences, and in society (May, 1950). Many examples of this impact can be found in popular literature and newspaper articles and include everything from fears of sexual predators (e.g., Hong, 2007) to concern about the amount of coffee being drunk by young people (e.g., Fiely, 2007). There are also many articles about causes of anxiety or how it may be overcome (e.g., Roysdon, 2006). The most common mental health disorders are the anxiety disorders according to Mental Help Net for Anxiety Disorders, accounting for close to half a billion dollars in healthcare costs each year (Anxiety Disorder, 2001).

Darwin (1872) recognized the importance of fear and considered that it had evolved as an adaptive response in both animals and humans with the purpose of arousing the motivation to cope with some danger. He reported those signs of fear (e.g., racing heart, perspiring, etc.) that were fairly easy to observe, whereas other researchers in later years reported less obvious chemical changes (Pitts, 1971). Darwin also suggested that fear is an adaptive signal of danger so the organism may escape or fight the feared stressor. It is interesting that Darwin made the observation that these responses might lead to disaster if too little or too much fear is elicited such that the individual's behavior might attack foolishly or be overcome by excessive fear responses. Creatures with these over- or under-reactions would, according to the theory of evolution, be less likely to survive and be less likely to continue contributing to the gene pool. Those with appropriate reactions would survive to reproduce.

Freud (1936) was more interested in anxiety as experienced feelings – the state characterized by unpleasant feelings of apprehension. Freud's view was that the presence of these feelings served as a warning that action was needed to avoid or eliminate a stressor. He considered that, as well as feelings of apprehension, the experience of anxiety includes tension and thoughts of worry. He also pointed out symptoms of anxiety to be increased heartbeat, increased breathing rate, shaking and possibly nausea or dizziness (Freud, 1936). His work agreed with Darwin's view on anxiety as a response to the presence of real danger but diverged when he introduced the idea of anxiety being a response to danger that was neither present nor imminent.

According to Walter Cannon (1929), during an emergency reaction, blood is redistributed to the body areas that will be active so that the energy supplies will reach the critical muscles and organs while the energy used for digestion can be sacrificed. Thus "fight-or-flight response" is an adaptive response occurring when energy is needed for that purpose. The responses that make up this reaction were considered to be mediated by part of the autonomic nervous system called the sympathetic nervous system (Bernstein, Roy, Srull, & Wickens, 1988). Pavlov also investigated fear and anxiety but studies could only be done on animals and had to be done without a reliable measure of anxiety (Kalechstein, Hocevar, Zimmer, & Klechstein, 1989). Other researchers had differing theories. Heinrich Neumann (1814 - 1884) spoke of unsatisfied drives, as the cause of "anxiety" and Karl Ideler (1795 - 1860) suggested unfulfilled sexual longings as being important in the cause of nervous disorders (Stone, 1996).

Anxiety is complicated because in different contexts it means different things. Many think of it as a mood state, having to do with emotions or physical symptoms, while others discuss its cognitive aspects. The following information is included to clarify the current views on the meaning of anxiety and to examine critically the state of the field.

Types of anxiety. The Diagnostic and Statistical Manual of Mental Disorders - 4th Edition (DSM-IV), a publication primarily dealing with disorders, presents anxiety as being of differing extreme types: Panic Disorder, Agoraphobia, Specific Phobias, Social Phobias, Post-Traumatic Stress Disorder, Obsessive-Compulsive Disorder, and Generalized Anxiety Disorder. Test anxiety is mentioned under the category of Social

Phobia (300.23) as a symptom or associated descriptive feature, and is cited as a reason that sufferers of social phobia may perform poorly in school (American Psychiatric Association, 1994). It is one of the types of anxiety that is more generally accepted to be part of every person rather than a malady that should be considered severe enough to warrant a classification.

The term State Anxiety (S-Anx) is most often used to describe an existing state or feeling of fear of impending danger while the term Trait Anxiety (T-Anx) refers to the overall tendency towards such feelings that remain stable over time and situations (Spielberger, 1975). These two constructs may vary in intensity and often influence individuals differently in their reactions to stress. Those low in T-Anx will experience S-Anx less often than those high in T-Anx.

Test anxiety falls under the umbrella of trait anxiety but is referred to as a situation specific trait anxiety as it occurs at a specific time and has to do with a situation in which the person experiencing it must view the test as a form of evaluation and therefore a threat to some social standing. There would, for example, be no perception of threat by college students if given a test of first grade mathematics because they know that they would not fail to obtain a high evaluation, while threat would be perceived if given a test on college mathematics as they may fail. Situation specific traits are most commonly measured using questionnaires, which have provided evidence in over 2400 studies conducted on test anxiety since 1966 at a rate of 200-400 every five years for 40 years (see Figure 1).

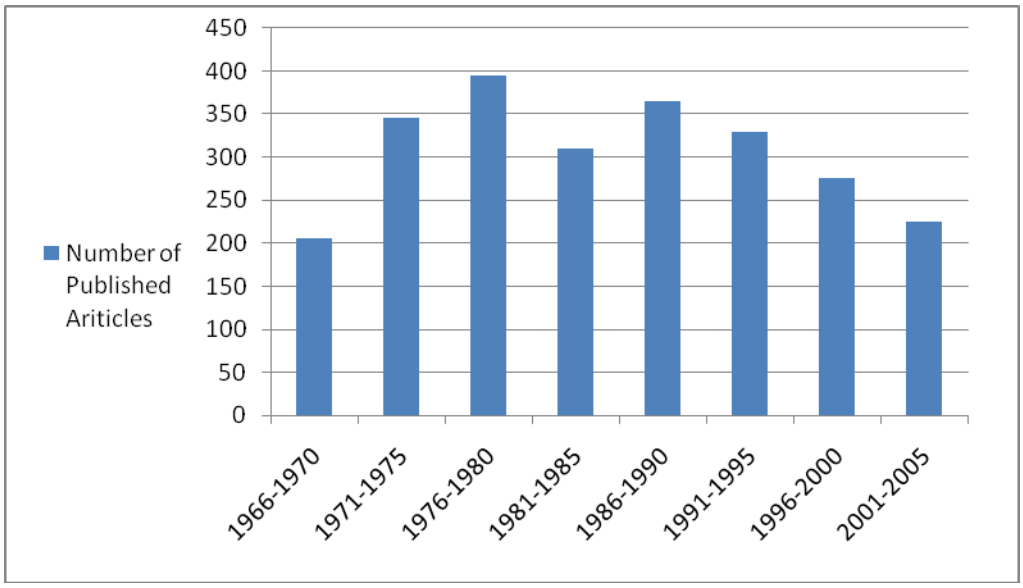

Figure 1. Published Articles Found on PsycInfo Concerning Test Anxiety.

Measures of test anxiety are theory-based with the information processing model (Figure 2) being the most influential in guiding the development of the most popular of these instruments. According to this model, when a student is cued with a question in a test situation, he/she perceives it and makes an appraisal of its threat to his/her position and goes through information processing and retrieval to answer the question.

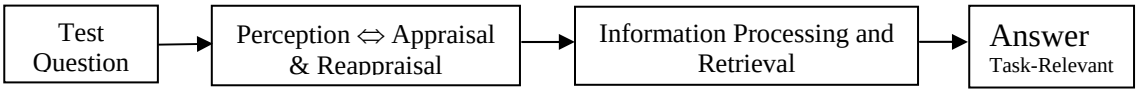

Figure 2. Information Processing Model.

When a person appraises a question as a threat, anxiety in the form of worry and emotionality interferes with information processing and retrieval (see Figure 3).

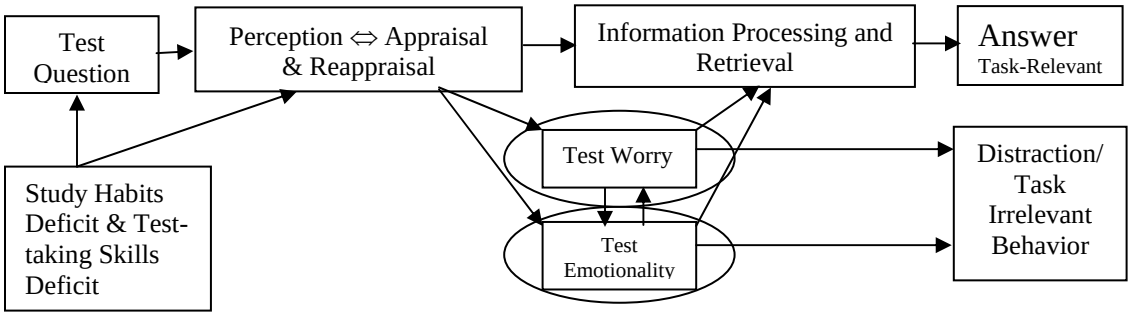

Figure 3. Lazarus's Transactional Process Theory.

The information processing model in Figure 2 and Lazarus's Transactional Process Theory assume encoding but Zeidner (1998) suggests that those suffering from high test anxiousness may have more difficulty encoding information than those low in this trait. This implies that the model needs to be increased in its scope to include encoding of information. If the information to be learned has been presented in an acceptable fashion, it may be anxiety while attempting to learn the information that stops a student from encoding the information in the first place, therefore giving rise to a metacognitive awareness that the material has not been committed to long term memory. It would seem evident that the techniques that should be taught to improve learning would be those that would help someone suffering from anxiety felt when attempting to learn – study anxiety (SA). Figure 4 represents the expanded model that includes study anxiety.

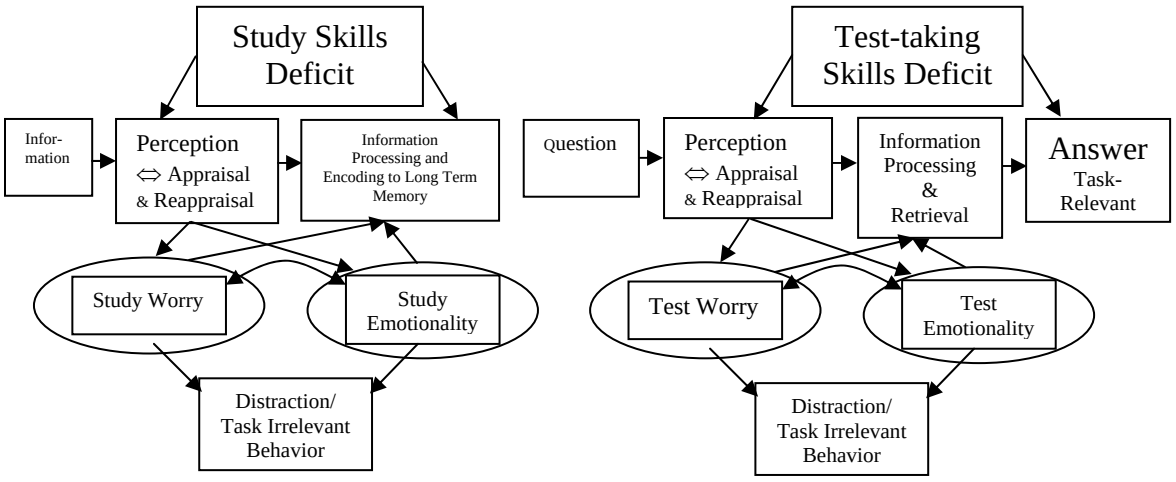

Figure 4. A Suggested Expanded Model Showing Study and Test Worry and Emotionality.

This model distinguishes between test anxiety -- that begins when the student is given a question in a test situation -- and study anxiety -- the anxiety felt during the time that the student is studying for an exam. There may be those who feel anxiety in both situations but some who don't feel anxiety until they enter the exam room. Still there may be others who feel anxiety up to the moment they walk into the room but calm down at that point believing there is nothing more they can do. The model suggests that study skills, worry, and emotionality determine the level of encoding into long term memory (LTM) while a student is studying for a test and that test-taking skills, worry, and emotionality determine the level of interference with retrieval during a test.

The earliest mention of the effects of anxiety during studying was by Spielberger (1966) who discussed research initiated in 1955 on students who complained that their anxiety increased around exam time. Anxiety concerning performance was either the salient symptom or an important background factor. These students indicated that their ability to absorb information was being affected by the anxiety they felt while studying.

When Owens and Newbegin (1997) attempted to examine this concept using Spielberger's State Anxiety Scale from the State Trait Anxiety Inventory they did not use an approach that was in line with the situation-specific basis presented by Spielberger in the development of the Test Anxiety Inventory. They asked participants to complete the State Anxiety Scale while studying when the construct concerns general traits while studying for an exam. Not surprisingly, the relationships found using this approach were in line with those obtained using the State Anxiety Scale without the extra instructions. State Anxiety Scale scores were not significantly correlated with grades of high school students aged 12 to 16 years.

Other cognitive psychologists have examined the mechanism through which anxiety exerts influence on mental functions including attention, memory, levels of processing and retrieval. Tobias (1985) reproduced a research model of the effects of anxiety on learning from instruction, originally presented in *Anxiety, Learning and Instruction,* as early as 1977. He suggested that when cognitive resources are taken by anxiety, the resources to study would be lacking. The concept that anxiety hinders encoding was also introduced by Eysenck (1991) who indicated that a considerable amount of evidence shows that anxiety level and the functioning of the attentional system are related and that the effects of anxiety are an increased susceptibility to distraction (Eysenck, 1979; Wachtel, 1967). Eysenck, MacLeod and Mathews (1987) showed that anxious individuals are more distracted by threatening distracters, which in this context could refer to consequences of failure to learn. Williams, Watts, MacLeod and Mathews

(1988) showed that anxiety affects the passive, automatic aspects of encoding, thus affecting pre-attention and attentional processes more frequently than memory.

Various authors have noted that the anxiety may occur as many as four days before an exam (Bolger, 1990; Lay, Edwards, Parker, & Endler, 1989). Covington and Omelich (1985) suggested that task-irrelevant worry about ability interferes with effective information processing. Their research also suggests that for people who are perfectionistic, anxiety discourages deep-level processing during original learning. Eysenck, MacLeod and Mathews (1987) showed that threat (i.e., appraisal of negative consequences) causes more distraction for high anxious than for low anxious individuals. Williams, Watts, MacLeod and Mathews (1988) showed that, rather than directly affecting memory encoding, anxiety affects the attention and pre-attentive processes that are automatic. One important study on trait anxious students suggested that hypervigilant students responded more to stimuli they perceived as threatening and focused on any task irrelevant stimuli presented (Eysenck & Byrne, 1992). Zeidner (1998) suggested that denial, wishful thinking, and avoidance may disrupt studying. Various authors have noted that the anxiety sometimes occurs days before an exam (Bolger, 1990; Lay, Edwards, Parker, & Endler, 1989).

Naveh-Benjamin (1991) suggested that there are different types of test anxiety sufferers with some having poor study habits and others having good study habits. Naveh-Benjamin also posited that there are some individuals who would benefit most by interventions that help them encode and organize as they study. It has even been shown in studies on rats being trained to run a maze that stress produced by exposure to a cat for 30

minutes each day results in an absence of dendritic spine density that indicates encoding of information into long term memory (LTM). Further results indicated that stress before the training started blocked information from getting into LTM, and stress before the retrieval test blocked access to stored memory (Diamond, Park, Heman, & Rose, 1999).

Since anxiety is the result of appraisal of threat, one might ask what causes that appraisal of threat. One could answer this question from the Cognitive, Rational-Emotive therapy angle by saying that the individual's appraisal is flawed, causing worry. One could ignore the reason for the appraisal and approach a solution from the Systematic Desensitization, Relaxation, or Biofeedback training angle, which attempts to deal with the emotionality of the individual. Better results may come from combining these approaches but, although studies using them have demonstrated a decrease of anxiety during tests, no consistent improvements in performance as measured by GPA have resulted. The general conclusion is that performance on tests is not improved by merely decreasing test anxiety (Vagg & Papsdorf, 1995). A possible reason for this may lie in the metacognition of the individual that he/she has not learned the material. Is this because he/she did not try hard enough? The evidence suggests that there is not a uniform answer to this question. There are, of course, those whose anxiety prior to the exam causes them to accept failure and therefore do not study and as the time of the exam gets closer, the anxiety increases (Covington & Omelich, 1985). There are also those who procrastinate excessively, delaying studying due, in part, to this anxiety (Kalechstein, Hocevar, Zimmer, & Kalechstein, 1989). Anxiety level is not a reflection of intelligence, as anxiety does not discriminate between the more or less intelligent.

Internal Structure: Assessment of State, Trait, and Situation Specific Anxiety

Because autonomic nervous system responses are difficult to control voluntarily, and therefore would not be influenced by faking, defensiveness, and social desirability, the initial way to measure anxiety was with physiological measures. This approach gave way to self-report which is now the more commonly used approach because researchers using respiration, heart rate, galvanic skin response, blood pressure, pulse pressure, and oral and skin temperatures found that results using these physiological measures were disappointing (Hopkins & Chambers, 1966; Levitt, 1967). They concluded that: (a) these physiological measures were unrelated and did not provide a basis for identifying specific anxiety, (b) each person responded differently, and (c) the measures did not relate to test scores obtained under different treatments. Self-report measures, however, did correlate moderately with performance and were able to tap components of anxiety that physiological measures did not assess such as worry or perception of severity of anxiety.

Additionally, self-report inventories have been found to be acceptably reliable while physiological symptoms have been found to be present when a person does not feel anxiety and not to be present when a person does feel anxiety (Spielberger, 1975).

State and Trait Anxiety. The Taylor Manifest Anxiety Scale (MAS), a measure based on the idea that the level of anxiety is an indicator of emotionality and motivation or drive, was the first objective measure of anxiety to be published (Taylor, 1953). Spielberger, using the Liebert and Morris (1967) concept that there are two components of anxiety, worry and emotionality, and realizing that there was also a need to measure anxiety states as well as general tendencies, developed the State-Trait Anxiety Inventory

(STAI; Spielberger, Gorsuch, & Lushene, 1970). In research over the past 50 years the STAI has become one of the most widely used measures for assessing anxiety. Spielberger (1966) introduced the constructs of state and trait anxiety and created the STAI with two self-report 20-item scales intended to provide brief but reliable measures of a person's current and general level of anxiety (Spielberger, Gorsuch, & Lushene, 1970). The best 10 items from each of the scales from this measure have been included in the anxiety scales of Spielberger's State-Trait Personality Inventory (STPI; Spielberger et al., 1979). As was the design of these measures, the state anxiety (S-Anx) scale item responses reflect the feelings of the participant at the time the measure is administered while the trait anxiety (T-Anx) scale items and test-retest reliability show that responses are stable over time and in different administration situations.

Test anxiety. The Test Anxiety Inventory (TAI) (Spielberger, 1980) is the most popular measure of the construct of test anxiety and has been used in thousands of studies published in scholarly articles. In 1990, Ware, Galassi and Dew used the responses from a sample of 752 college students in a confirmatory factor analysis to investigate the factor structure of the TAI. They compared a 2-factor oblique model with a 2-factor orthogonal model, and both a null and single-factor model. The oblique solution gave the best fit, giving support to the theory that the construct contains two correlated factors (worry and emotionality), although the question of the necessity for more than 16 items was raised. Based on these findings and analysis of items by Spielberger, the author of the measure, four items were removed, leaving the 16 best items. The most current version of the TAI uses these 16 items (see the TSAI measure in Appendix B).

Everson, Millsap and Rodriguez (1991) conducted a study using 501 undergraduates to investigate the factor structure and factor invariance across gender of the TAI. Although females generally reported a higher level of test anxiety, factor invariance across gender was supported which suggests that although the meanings of the items are similar for males and females, the level of test anxiety is higher for females.

Study anxiety. The Study Anxiety Inventory (SAI; Lunsford, 2001) was developed as a research tool to examine the construct of study anxiety. The SAI was posited to have two scales reflecting worry and emotionality. Study anxiety is defined as a situation-specific personality trait of anxiety felt while a person is studying for an exam. A sufferer would experience both worry and emotionality while studying for exams. Worry cognitions while studying for an exam would include: not being able to organize material mentally, getting a mental block to absorbing material, worrying to the point of engaging in distracting behaviors, worrying about being capable of learning material, and being unable to keep focused on the subject. Emotionality while studying for an exam would include feeling uneasy, panicky, upset, jittery, or nervous. Theoretically this construct and its components should correlate highly with test anxiety, and less highly with other measures of personality such as anger and curiosity. The information processing model also suggests that study anxiety should have significant relationships with academic achievement.

Prior to 2001, the only measure purporting to measure the construct of study anxiety was a scale in the Study Attitudes and Methods Survey (SAMS) developed by Welsh, Bachelor, and Wright (1990). This scale was limited in that only two items in the

SAMS subscale clearly reflect the construct of study anxiety. Given this limitation, Lunsford developed the Study Anxiety Inventory. Since the Test Anxiety Inventory has a great deal of support for the validity of the scores and has been factor analyzed (Spielberger, 1980) with both exploratory and confirmatory factor analysis, it seemed prudent to start the development of the SAI by considering the items used in the Test Anxiety Inventory (e.g., “During tests I feel very tense”, “During examinations I get so nervous that I forget facts I really know”). There are 20 items on this measure, of which 16 are associated with the subscales of worry and emotionality. Each item included words that approximated “While taking a test.” In developing the initial pool of items for the Study Anxiety Inventory, an effort was made to include an approximately equal number of worry and emotionality items. As both of these factors had been shown to be present in the Test Anxiety Inventory, it was assumed that the same factors would be established in the Study Anxiety Inventory. The items were selected by adapting items from the Test Anxiety Inventory to create new items that were approximately equal in meaning except they specifically targeted the time period of studying rather than the time period during test-taking, and they also specified that the studying was for an upcoming test (e.g., the words "taking a test" being replaced with "studying for a test”). The College Adjustment Scales (Anton, 1991) were also found to have a number of the items that suggested difficulties in studying except they did not specify that the studying should be for an exam. These items from the *College Adjustment Scales* were adapted for use in the SAI by adding that component. This increased the number of items in the SAI to 30. Finally, discussions were held with a person who suffers from the symptoms of anxiety while

studying and an additional 10 items that dealt with specific symptoms like difficulty breathing were developed resulting in a total of 40 items.

Each item on the SAI was worded such that it contained the time element “while studying for an exam” along with a cognitive or emotional symptom. Then, in each item, either the word “feel” was used or strongly implied to tap into the emotionality component or the word “think” was used or strongly implied to tap into the worry component. Using the Flesch-Kincaid Grade Level test, the reading level of the measure was determined to be at a sixth grade level.

In preparation for the items to be rated by a team of experts, all items were printed on a form with a 5-point scale (1=unsuitable to 5=suitable). Instructions asked for items to be marked as suitable that seemed to reflect the construct of study anxiety as defined. A clinical psychology professor, 15 clinical psychology graduate students, and Dr. Spielberger, the author of the Test Anxiety Inventory, completed the form and made comments that suggested that four of the items indicated content different from anxiety (e.g., distractibility) leaving 36 items that were viewed as suitable by the majority of the reviewers.

Once this pool of items had been evaluated and found to be acceptable, the test form was created for completion by participants. A 4-point response scale indicating frequency of experience was used. This was the same response scale used on the Test Anxiety Inventory. The response for each item assesses severity using a 4-point response with 1 = “Almost Never”, 2 = “Sometimes,” 3 = “Often,” and 4 = “Almost Always.” The instructions were worded similarly to the instructions on Spielberger’s Test Anxiety

Inventory (see Appendix B). To evaluate the psychometric properties of the 36-item SAI, 55 undergraduate students attending a large state university were offered the opportunity to take part in a psychometric study in return for extra credit points toward their psychology classes. Eleven participants were lost to attrition by the posttest. The age range was from 18 to 48 in both pretest and posttest. In the pretest, there were 46 (85%) females and 8 (14%) males. One participant did not disclose his/her gender. The ethnic composition of the sample was 22 (46%) Caucasian, 13 (27%) African Americans, 8 (17%) Hispanics, and 1 (2%) other. Seven participants chose not to disclose ethnicity. The inventory was administered and afterwards collected for scoring. Two days later, the same procedure was followed with the only change being the location of the classroom.

The results of a test-retest reliability analysis and an alpha reliability analysis indicated that, from a possible range of scores of 36 to 144, the responses ranged from 38 to 127 on test administration one and 39 to 114 on test administration two. The mean for administration one was 68.72 (*SD*=22.02), with a median score of 70. The mean for the second administration was 64.97 (*SD* =19.9) with a median score of 62. Scores were positively skewed (0.72) with the 25th percentile of the first administration at 48, the 50th percentile at 70 and the 75th percentile score at 81. Any score over 81 fell in the top 25% of these data.

Analysis of data collected on this measure showed an alpha coefficient of .97 for the first administration on the overall scale (.95 for the Worry and .92 for the Emotionality subscales), and .94 for the posttest on the overall scale (.96 for the Worry and .92 for the Emotionality subscales). The test-retest reliability coefficient showing

stability of the overall scale scores on the SAI over time was .79, with the two-day test-retest reliability of the worry and emotionality scales equal to .82 and .71, respectively. Item analyses indicated good item to total correlations so no items were deleted as all items positively influenced scale reliability.

Because the items were constructed to represent the factors of worry and emotionality, principal axis exploratory factor analysis with promax rotation was used to evaluate the internal structure of the SAI (Lunsford, 2001). Evidence of three factors of worry, emotionality and physical responses appeared. Most of the nine items with dominant loadings on factor three referred to physical symptoms (e.g., sweating, upset stomach, heart beating fast, difficulty breathing, etc.), but because the third factor was not part of the theory underlying the development of the SAI, these items were dropped from further analysis. In selecting the items with the best potential for measuring emotionality, the 14 items with consistently high loadings after rotation on factor one for the combined sample, and for both sexes, were retained for further study. Two items were dropped because the loadings for these items were inconsistent for males and females. In selecting the best worry items, the 10 items with dominant salient loadings on factor two after rotation for the combined sample, and for both sexes, were retained for further study. The item with the smallest loading on factor one for the combined sample and with inconsistent loadings on the two factors for males and females was dropped.

Responses to the 24 retained items were further evaluated in a principal axis two-factor analyses with promax rotation, and in separate analyses with promax rotation for males and females. The 10 items with the highest consistent loadings for both males and

females were selected from the pool of emotionality items and all of the 10 worry items were retained for further study. The three items on factor one with the smallest factor loadings (less than .60 for the combined sample and for both males and females after promax rotation) were dropped from further analysis. Two items had dual loadings for males. One of these items was retained because loadings were larger for the principal factor before rotation, and for the combined sample, and for males and females after rotation. All but one of the items in factor two had dominant salient loadings consistently across males and females.

A two-factor principal axis factor analysis was performed on these 20 items. A reexamination of the items showed that one of the items did not refer to the time of studying but asked about worry cognitions after the study period. One of the items designed to measure worry had high loadings on the emotionality scale and one of the items designed to measure emotionality had high loadings on the worry scale. One of the worry items seemed also to be asking about self esteem. This process allowed the number of items to be narrowed down to eight worry items and eight emotionality items for a total of 16 items in the inventory (Lunsford, 2001).

This revised 16-item version of the SAI was used in a multi-site study by Keiffer, Reese and Cronin (2004) consisted of 165 undergraduates. Results of 10-week test-retest reliability supported the stability of the scores. Test-retest reliability was .88 for the total score with .67 and .81 for the Study Worry and Study Emotionality subscales, respectively, indicating a satisfactory level of stability over 10 weeks. Cronbach's alpha

for the overall scale was high at .96 with each subscale at .94 (Keiffer, Reese, & Cronin, 2004).

External Evidence: Nomological Network

Cronbach and Meehl (1955) developed the idea of the nomological network as a framework for evaluating construct validity. They argued that this network would represent a theoretical framework of the construct being measured, a framework of how to measure it, and the relationships between constructs embedded in the framework. The principles that guide establishing construct validity are to make clear what the construct is so that relationships of the construct to other constructs can be established. By increasing the number of variables that relate to the construct of interest, the nomological network increases thus providing additional insight into whether the measures used to represent the construct are operating as theorized.

Using the logic of the nomological network, Lunsford (2001) evaluated the relationships of the Study Anxiety Inventory with the Test Anxiety Inventory, trait anxiety and trait curiosity scales from the State Trait Personality Inventory, and the self-esteem and academic problems scales from the College Adjustment Scale. Data were collected from 536 students. Since the study anxiety scales (worry and emotionality) were developed using the items from the TAI, and the basis of the construct is anxiety, it was predicted that the scores from the SAI would be positively correlated with these other measures. Results from this study supported these predictions with the correlations between scores from the SAI and scores from measures of these constructs being between .39 and .79 (see Table 1).

Table 1

Pearson Product Moment Correlations Between Anxiety Variables (n=536)

	SAI	SA/E	SA/W	TAI	TAE	TAW	TANX	TCY	SH
SA/E	.95								
SA/W	.95	.80							
TAI	.79	.78	.73						
TAE	.75	.74	.68	.96					
TAW	.77	.74	.72	.94	.84				
TANX	.45	.43	.42	.44	.43	.39			
TCY	-.25	-.20	-.29	-.17	-.14	-.16	-.50		
SH	.46	.40	.49	.38	.36	.35	.75	-.49	
AP	.56	.45	.61	.45	.39	.50	.34	-.25	.47

Note: SAI = Study Anxiety Inventory TAI = Test Anxiety Inventory
SA/E = SA Emotionality TA/E = TA Emotionality subscale
SA/W = SA Worry TA/W = TA Worry subscale
TANX = Trait Anxiety TCY = Trait Curiosity
SH = Self for Examinations AP = Academic Problems
N = 536 all correlations were significant at <.0001

The validity of the scores from the SAI as a situation-specific construct was supported by these high correlations and by the high correlations (*r*=.50 to .63) with the academic problems scale (Lunsford, 2001). Given these high correlations, it is important to differentiate between the construct of study anxiety and test anxiety lest the reader conclude they are measures of the same construct. Conceptually there is a clear difference between test anxiety and study anxiety in the situation in which the anxiety is experienced. Test anxiety is experienced during a test and the stress involved is imposed on the student by the instructor, the nature of the test, and the testing environment. Study anxiety on the other hand is experienced prior to the exam and the stress involved is self-imposed; studying is self-arranged; and the environment is self-selected. Another major conceptual difference is that test anxiety is defined as interfering with retrieval of information during a test while study anxiety interferes with the process of encoding information.

Using the same sample of 536 college students, Lunsford (2001) also found relationships between other related constructs. The high correlation with the trait anxiety scores of the State-Trait Personality Inventory (*r*=.43 to .46) gives support to the concurrent validity of the scores as a measure of anxiety. Discriminant validity, the confirmation that this instrument is not measuring other constructs, is supported by lower correlations with trait depression measures (*r*=.32 to .35), decreasing still further with trait anger (*r*=.25 to .28), and trait curiosity (*r*=-.23 to -.30). The correlation between study anxiety and study habits was not significantly different from zero; however there was a moderate and negative correlation between study anxiety and testwiseness.

Extending the Nomological Network in the Present Study

In the following section, a theoretical argument is presented linking study anxiety with procrastination. This section also presents an argument for why study anxiety may be unrelated to study skills and habits. Taken together, the pattern of relationships that is described represents an extension of the nomological network that is used to evaluate further the construct validity of the SAI.

Procrastination. The definition of procrastination is the tendency to put off starting or finishing tasks (Lay, 1986) or the avoidance of unpleasant situations to the point of feeling discomfort (Soloman & Rothblum, 1984). Extension of the nomological network that shows the relationship of study anxiety to other traits like procrastination requires an examination of the theory behind the construct of study anxiety. Because it is a common belief that people avoid what they perceive to be unpleasant, the information processing theory would support that there would be a relationship between scores on the

SAI and scores on measures of procrastination. Figure 4 illustrates how both worry and emotionality lead to task irrelevant behavior which may partly take the form of procrastination. The relationship between the need to avoid failure and anxiety has already been shown to be positive (Atkinson, 1974), as has the relationship between trait anxiety scores and a measure of procrastination (Beswick, Rothblum, & Mann, 1988). This relationship between anxiety and procrastination is not yet fully and clearly established, however, and may be more complicated (Ferrari, Johnson, & McCown, 1995). Although some believe that people delay tasks to avoid experiencing discomfort (Soloman & Rothblum, 1984), Chu and Choi (2005) suggest that there are two major types of procrastination: passive and active. The traditional view of procrastination involving avoidance of discomfort is how these researchers define passive procrastination. They suggest though that another reason for postponing certain activities is to increase motivation and enhance performance achieved when a challenge is presented. Scores from a measure of passive procrastination would theoretically correlate positively with scores from the SAI while scores from a measure of active procrastination would also correlate positively but not as highly with scores from the SAI. Chu and Choi (2005) found that active and passive procrastinators are not much alike but that active procrastinators are more like non-procrastinators in their relationship with anxiety.

In previous studies, the relationship between anxiety and procrastination has been weak (Ackerman 2005; Milgram & Tenne, 2000). Procrastination and neuroticism returned only a moderate correlation in a study to establish a relationship using academically-undecided college students (Lee & Edwards, 2004). It may be that, like

study and test anxiety, procrastination can be factored into two more situation-specific constructs. In a specific situation concerning statistics anxiety, Onwuegbuzie (2000) established that anxiety was a factor related to students' procrastinating as long as possible to enroll into class and procrastinating on assignments. In the present study, additional evidence of construct validity of the scores from the SAI was collected by examining the relationship between scores from the SAI and measures of passive and active procrastination developed by Chu and Choi (2005).

Studying. Research has shown that in college most classes use exams to evaluate the progress of students. These exams are somewhat high-stakes in that there are a number of classes that act as prerequisites for students to be able to get into upper level courses and may, in certain circumstances, be key in judgments as to whether a student gets admitted into a specific program of study (e.g., nursing programs usually require good grades in anatomy). Because of the importance of preparation for exams, researchers have looked at the area of studying and have developed measures of study techniques and habits using items that address exam study habits such as, "I read my notes over several times" and "I do less than one hour's study for an exam" (Brown & Holtzman, 1984). The best predictor of grades according to some researchers is study skills and habits (Gadzella, Goldston, & Zimmerman, 1976; Pace, 1990; Walters & Sherk, 1990). Regular and serious study has been shown to have a positive relationship with academic performance (Fontana, 1986; Howard, 1993; Rau & Durand, 2000; Silverman & Riordan, 1974; Trapey & Harris, 1979).

Anxiety can be due to real or perceived threat. For example, if a person knows that he or she has not studied sufficiently, it would be expected that he or she would fear the outcome of an impending exam. Also, it would seem logical that if a person consistently gets poor results because of low academic ability that he or she would develop a dread of coming exams. This has not been supported by research; however research has shown that anxiety affects the highly intelligent and skillful person as much as and sometimes more than those who logically should feel the anxiety. It has been shown that perfectionists are often filled with anxiety, which interferes with encoding more than for non-perfectionists (Covington & Omelich, 1985). This theory that anxiety affects those regardless of their intelligence and skill sets would suggest that the relationship between the scores on the SAI and scores on a measure of study habits would be small or not significantly different from zero. The fact that scores from the SAI did not correlate with study habits in the 2001 study by Lunsford supports this theory that study anxiety is not affected by knowledge of how to study or with regularity in the use of techniques to study effectively, and that it is a construct independent of study skills and habits. The relationship between study skills and habits and study anxiety is examined in the current study.

Research into coping skills suggests that those who have the ability to respond to test questions correctly, and feel confident in their answers even when they have not studied, will be less anxious during a test. This is supported by the findings of a moderate negative relationship of the SAI scores with test-taking skill scores (r = -.28 to -.30). This suggests that when a student has confidence in his or her knowledge, there is more of an

ability to cope with worry and emotionality even when studying is ineffective, and this perception will lead to decreased anxiety while studying.

Summary

The purpose of this study is to evaluate the validity of the inferences that can be made using scores from the Study Anxiety Inventory. The overview of the validation process has established a basis for collection of further data to continue the validation of the scores from this measure. Analysis of item content (content validity) has been described and some initial findings concerning the internal structure of the responses to the items (exploratory and confirmatory factor analysis) have been described; factorial invariance has been introduced with a focus on gender differences. Relationships between study anxiety and other variables have been discussed and directions for establishing further relationships based on theory have been indicated. A summary of the results of four previous studies that support the reliability and validity of the SAI scores is presented in Appendix A.

Chapter 3

Method

In accordance with the objective to obtain evidence to support the validity of the inferences from the Study Anxiety Inventory (SAI), this chapter describes the procedures used to collect data using the SAI and other theoretically relevant variables that were used in the validation process: test anxiety, trait anxiety, trait curiosity, study skills and habits, and active and passive procrastination. The chapter begins with a review of the purposes of the study, followed by a description of the characteristics of those participating in the validation process, data collection procedures, and statistical analysis of the data.

Purpose

The purpose of this study was to extend research on the construct validity of responses from college students to the Study Anxiety Inventory (SAI). Several approaches were used. Because the SAI was developed using a theory that the construct consisted of two highly correlated factors, support for this two-factor model was needed in establishing factorial validity. Confirmatory factor analysis was used to test the two factor model (worry and emotionality). As part of the CFA, the factorial invariance of the SAI for males and females also was examined. Additional evidence for construct validity was collected by examining the relation between the SAI and other theoretically relevant variables that were part of the nomological network framework. Specific purposes were to:

1. Evaluate the two-factor measurement model underlying the Study Anxiety Inventory in a sample of college students from various disciplines;
2. Evaluate the factorial invariance of the two-factor measurement model underlying the Study Anxiety Inventory across male and female college students;
3. Examine the relationship between the scores on the Study Anxiety Inventory and scores on two measures of procrastination (active procrastination and passive procrastination), a measure of study skills and habits, a measure of test anxiety, and two of the four trait personality measures of the State-Trait Personality Inventory, the Trait-Anxiety Scale (T-Anx) and the Trait Curiosity Scale (T-CY).

Participants

The participants for this first study were 2,002 undergraduate students (939 males and 1,054 females, 9 did not indicate gender). Students were recruited from each of four colleges at a large state university in the southeast: College of Arts and Sciences, College of Business, College of Education, and College of Engineering. These students were recruited by asking for volunteers from classes of professors who agreed to allow data collection in their class. The researcher approached 12 professors teaching in the summer semester and 16 professors teaching in the fall semester, all of whom agreed. It was made optional as to whether the professor offered an extra credit point to those who would be prepared to complete the measures and one psychology professor offered that point. For that professor a sign-up sheet was provided at the table where the completed measures

were returned and this list of names was later given to that professor. Those who allowed data to be collected but did not offer extra credit merely asked if students would volunteer for the study and extra credit was not mentioned. The Arts and Sciences (A & S) students were recruited from social science statistics classes as this class attracts enrollment from most of the different disciplines offered in the College of Arts and Sciences; the social sciences set statistics as part of the graduation requirements. Students from the College of Arts and Sciences were recruited from classes taught by the researcher in the summer and fall semesters during the first week of each class to minimize the influence of social desirability on responses resulting from participants knowing the instructor. The students from the College of Business were obtained by handing out the questionnaire package to two large classes (Ethics and the Law, and Economics), both of which were required course for majors in business. The students from the College of Engineering were obtained by attending and handing out the questionnaire in a number of smaller (11-30 students) classes and also by handing out the questionnaire package in a central meeting area to those who were waiting for classes to start. The students from the College of Education were obtained by handing out questionnaire packages in ESOL (English for Speakers of Other Language) classes, which is a required class for those wishing to obtain teaching certificates in Florida schools and, as such, would have students from many different majors of the college.

Recruitment provided sufficient responses to analyze the 16 SAI items for both males and females based on a recommendation by DiStefano and Hess (2005) that there be no fewer than five responders for each item. Of the 2,002, 1,964 fully completed at

least two measures, indicated gender, and were a part of one of the four colleges under investigation. There were 218 male and 446 female College of Arts and Science students, 261 male and 195 female College of Engineering students, 237 male and 194 female College of Business students, and 210 male and 203 female College of Education students. Obtaining more than 80 of each gender from each college provided more than the expected ratio of between 5 and 17 responders for each item.

The ethnicity of each college was similar in most respects except the College of Engineering which had fewer than half of the African Americans found in the other colleges, and the College of Education which had almost no representation of Asian Americans (2%). The ethnicity percentages for the combined sample was 11% African American, 8% Asian, 12% Hispanic, 54% Caucasian, 1% American Indian/Alaskan Native, 4% more than one race, and 10% not recorded. The design of the study was that students over the age of 64 and under the age of 18 would be excluded to expedite review by the IRB; however no students fell in either category. The students were aged from 18 to 64 years with a mean of 22.16 although the median age of 21 may more accurately reflect the ages of those in this sample.

Table 2

Gender and Ethnicity of 2,002 Participants Across Four Colleges

Variable	Total	Arts & Sciences	Business	Education	Engineering	X^2
Gender	2002	678	439	422	463	
Male	939	225	237	216	261	
Female	1063	453	202	206	202	79.84
Race/ethnicity none	153	25	44	59	25	
Afr. Am./Black	265	96	56	74	39	
Asian Am/	130	37	41	10	42	
Hispanic/Latino	237	106	40	35	56	
White	1050	336	228	227	259	
American Indian	42	20	6	9	7	
Other	66	32	12	3	19	
2 or more	59	26	12	5	16	122.12

Measures

Along with the Study Anxiety Inventory (SAI), the following questionnaires were administered to the participants during the class period: the Test Anxiety Inventory (TAI), the trait anxiety scale (T-Anx) and trait curiosity scale (T-CY) from the State-Trait Personality Inventory (STPI), study for examinations (SH) scale from the Study Habits Evaluation and Instruction Kit (SHEIK), The Passive Procrastination Scale (PPS), and The Active Procrastination Scale (APS).

The Test Anxiety Inventory (TAI), which was developed by Spielberger (1980), is a 16-item self-report measure that was designed to assess individual differences in test anxiety as a situation-specific personality trait. Besides the total scale score, two scales of test anxiety, Test Anxiety Emotionality (TA/E) and Test Anxiety Worry (TA/W), measure the two major components of test anxiety, emotionality and worry, as identified by Liebert and Morris (1967). The TA/E scale was developed from the prototypic item "While taking examinations I have an uneasy, upset feeling" and the TA/W scale was

developed from the prototypical statement “During examinations I get so nervous that I forget facts I really know” (see Appendix B). Relative to Huck and Jacko’s (1974) form and format concerns, all 20 items of the original TAI were administered to the participants using the original multiple-choice format. Frequencies of symptoms are reported on a 4-point scale: 1 = “Almost Never,” 2 = “Sometimes,” 3 = “Often” and 4 = “Almost Always.” Spielberger (1980) reports that this scale exhibits good test-retest reliability ranging from .62 (over 6 months) to .80 (over 1 month). The Cronbach alphas for the TAI total scale are uniformly high at .92 or higher for the total scale score and .94 for each of the two subscales. Exploratory and confirmatory factor analysis has been carried out on this measure using the responses from 752 and 1537 university students, the results from which support the two-factor structure of this measure (Kieffer, Reese, & Cronin, 2004; Ware, Galassi, & Dew, 1990).

The trait anxiety and trait curiosity scales from the State-Trait Personality Inventory (STPI Form Y) (Spielberger, 1995) are from an 80-item measure of four state (S-) and four trait (T-) constructs: curiosity (S-Cy and T-Cy), anxiety (S-Anx and T-Anx), anger (S-Ang and T-Ang), and depression (S-Dep and T-Dep). Responses from only 20 trait (10 T-Anx and 10 T-CY) items were included in the battery of tests and used in the analysis of the data (see Appendix B). These scales use a 4-point response scale indicating frequency of experience (1 = "Almost Never", 2 = "Sometimes", 3 = "Often", 4 = "Almost Always"). Forward and reverse scorings are used in both scales. Spielberger (1980) reports that these scales exhibit good reliability with alpha coefficients of between .80 and .96 for the entire sample and for males and females. Correlations of this scale

with the State Trait Anxiety Inventory, the current gold standard measure of anxiety, were high for both males and females (.95 for both) (Spielberger, 1980). Descriptive statistics, scale intercorrelations and item-remainder correlations are provided in the manual for male and female college students (n = 280) and navy recruits (n = 270).

The study for examinations (SH) scale of Study Habits Evaluation and Instruction Kit (SHEIK) from the New Zealand Council for Educational Research (1979) served as a measure of the degree of knowledge and application concerning a student's study habits (SH) (see Appendix B). The SH consists of 25 self-report items using a 5-point degree of response: 1 = "Never or Almost Never", 2 = "About ¼ of the Time", 3 = "About ½ of the Time", 4 = "About ¾ of the Time", and 5 = "Almost Always". Both forward and reverse scoring is used in the SHEIK. The studying for examinations scale (SH) items address exam study habits (e.g., "I read my notes over several times"). The SHEIK manual reports that reliability of the SH is good with KR20 value of .86, and split half value at .86 (New Zealand Council for Educational Research, 1979). Analysis from a sample of 536 university students indicated that the relationship between this measure and scores from the SAI was not significantly different from zero (Lunsford, 2001). This measure has been used in studies by the New Zealand Council for Educational Research and is being examined for improvement (W. R. Brown, personal communication, May 2, 2000).

The Passive Procrastination Scale (PPS) and The Active Procrastination Scale (APS) measure two types of procrastination (Chu & Choi, 2005). The first (PPS) measures the procrastination construct in the traditional sense in that those with high scores are those who are paralyzed by their indecision and often fail to complete tasks on

time. The second (APS), however, measures a more productive kind of procrastination in that those with high scores are those who make a conscious decision to delay in order to increase pressure as they find that in these circumstances they complete work and perform better. Concerning academic performance, those high in APS are more like non-procrastinators than they are like passive procrastinators. The APS is a 6-item scale with acceptable internal consistency (α=.82) while the coefficient for the 12-item PPS is less acceptable (α=.67). The response format for both of these measures is a 7-point scale ranging from 1 = "Not at all True" to 7 = "Very True" (See Appendix B).

Procedure

The battery of tests printed in light grey was administered to groups of undergraduate students in social science statistics classes in the College of Arts and Sciences, and in various classes in the College of Business, College of Education, and College of Engineering at a state university in the southeast. Undergraduate course instructors were contacted in advance in order to obtain permission to administer all related materials to their students, which took less than 20 minutes of class time in total. To maintain anonymity of the participants, no identifying information was requested.

Participants were tested within their regular classrooms. During the last 30 minutes of class time, the researcher was introduced and participants were informed that the goals of the study were to learn about the feelings and attitudes of students through the use of several questionnaires. The researcher then read the instructions aloud and briefly explained the format of the questionnaires after which the participants filled them out as instructed. Finally, participants were provided with an informational debriefing (in

Appendix A) and were informed that a feedback session would be scheduled at a later time during which any questions could be addressed.

Data Analysis

Analysis of the data using the two statistical computer programs, Statistical Package for the Social Science (SPSS) 16.0 and Mplus 3.0 (Muthén & Muthén, 1998), included calculating the internal consistency coefficient for all measures (Cronbach alpha). This was followed by a confirmatory factor analysis (CFA) to evaluate the fit of the two-factor model (worry and emotionality). For the CFA, Hu and Bentler (1999) recommend using the standardized root mean square residual (SRMR) in conjunction with another fit index like the comparative fit (CFI) or root mean square error of approximation (RMSEA). It is desirable to have the standardized difference between a covariance and a predicted covariance as close to zero as possible (zero indicates perfect fit), but it is typical for the SRMR to range from .05 to .10, although Hu and Bentler (1999) suggest that a cutoff of .08 or below should be used to indicate good model fit. It has been argued that cut offs for CFI should be at least .90, which would indicate that 90% of the covariation in the data set can be reproduced by the model, and, although Bollen (1989) suggests that these cut-offs are arbitrary, Hu and Bentler (1999) suggest that minimum type I and type II errors will occur with a CFI of .95. Good model fit is reflected by an RMSEA of .06 or less (Hu & Bentler, 1999).

To evaluate the equivalence of the two-factor measurement model underlying the SAI, multigroup CFA was used. The data were divided by gender, and variance-covariance matrices were calculated for each group (males, females). The fit of the two-factor model was evaluated separately for males and females followed by the evaluation of the invariance of the model for males and females. Invariance tests were conducted

using a multiple group analysis to test the equality of the factor loadings (i.e., factor patterns), residual variances, factor variances, and the covariance between factors by gender. Equality restrictions were imposed across males and females for tests of invariance. A Chi-square-difference test for relative fit for a nested sequence of models was used for this test. Analyses were conducted separately for each college and and the significance level was set at .01 except in situations where a more stringent significance level was used to take into account multiple statistical tests.

In order to extend the nomological network, Pearson's product moment correlations were calculated between the SAI and the relevant theoretical variables for each of the four colleges.

Chapter 4

Results

In keeping with the purpose of the study to provide evidence to evaluate the validity of the inferences from the Study Anxiety Inventory, data were collected from undergraduate students from four colleges at a southeastern state university: Arts and Sciences, Engineering, Business, and Education. In this chapter, results of the analyses are presented by research question in three sections.

Section one contains the results of the confirmatory factor analyses that were used to evaluate the factorial validity of the SAI scores. These results include fit indices from the CFA two-factor model (worry and emotionality) for each college. In the second section, results from the tests of factorial invariance of the SAI for males and females are reported. Finally, additional evidence for construct validity using relationships between the SAI and other measures (i.e., nomological network framework) is presented.

Research Question 1: Confirmatory Factor Analysis

Confirmatory factor analyses (CFA) were performed using Mplus, version 3.0 (Muthén & Muthén, 1986) to evaluate the two-factor model underlying the Study Anxiety Inventory (see Figure 5). Analyses were based on the variance-covariance matrix of the 16 observed variables and maximum likelihood estimation was used to estimate the model parameters. Fit indices that were used to evaluate the model included the chi-square test (χ^2) test, an indicator of the fit of the responses to the model; the standardized root mean square residual (SRMR), an indicator of the mean of the differences between the predicted variances and covariances and their observed values;

comparative fit index (CFI), an indicator of the percentage of covariation in the data set that can be reproduced in the model; and the root mean square error of approximation (RMSEA), an indicator of the discrepancy per degree of freedom. Listwise deletion was employed in the calculations for the confirmatory factor analysis which had a small influence on the sample sizes reported. Sample size dropped from 2002 to 1867 when using listwise deletion. Tests of statistical significance were conducted at the .01 level given the large sample size. Analyses were conducted separately for each college and are presented in the next section.

College of Arts and Sciences. Table 3 provides descriptive statistics for the 16 observed variables used in the confirmatory factor analysis for responses from students from the College of Arts and Sciences. The responses for each item ranged from one to four and the means for the 16 items ranged from 1.67 to 2.22 (median = 1.93) with standard deviations ranging from 0.78 to 1.08 (median = 0.91).

The normality of the distributions for the 16 items was evaluated using univariate skewness and kurtosis measures for each of these variables. All skewness values were close to zero with the smallest skewness value of 0.37 and the largest skewness value of 1.17 (median = 0.68) which reflects approximate symmetry in each of the items. All kurtosis values were less than 1.0 for each of the items with values ranging from -0.84 to 0.62 (median = -0.31), which suggest that the peak and tails of the distribution were similar to the normal curve. Multivariate normality evaluate using Mardia's test of multinormality was not demonstrated in the College of Arts and Sciences for the total

group or by gender (p<.001 in every case) so the assumption of multivariate normality was not tenable.

Table 3

Descriptive Statistics for the 16 Observed Variables Used in the Two-Factor Confirmatory Factor Analyses of the Study Anxiety Inventory for the College of Arts and Sciences (n=662)

Item #	Mean	*SD*	Skewness	Kurtosis
1e	1.92	0.88	0.78	0.01
2w	2.02	0.78	0.52	0.09
3w	2.21	0.87	0.38	-0.43
4e	1.94	0.93	0.64	-0.52
5e	1.76	0.87	0.96	0.17
6w	2.22	0.89	0.38	-0.44
7w	2.00	0.91	0.60	-0.35
8e	2.02	1.08	0.66	-0.84
9e	1.88	0.96	0.80	-0.37
10w	2.00	0.93	0.58	-0.47
11w	1.99	0.98	0.59	-0.64
12e	1.87	0.91	0.75	-0.25
13e	1.67	0.87	1.17	-0.62
14w	1.92	0.91	0.70	-0.27
15w	1.83	0.84	0.73	-0.09
16e	1.85	0.91	0.78	-0.21

Note: Emotionality (e) items are 1, 4, 5, 8, 9, 12, 13, 16; Worry (w) items are 2, 3, 6, 7, 10, 11, 14, 15

The χ^2 fit statistics for the CFA of the two-factor (worry, emotionality) model for the students from the College of Arts and Sciences indicated that the fit of the model was not acceptable, χ^2 (103, N = 660) = 772.52, $p < .001$. Alternative measures of fit were included because one of the limitations of the χ^2 is that it is sensitive to sample size. The SRMR of .047 indicated acceptable fit while the CFI of .918 and the RMSEA of .099 indicated less than acceptable fit.

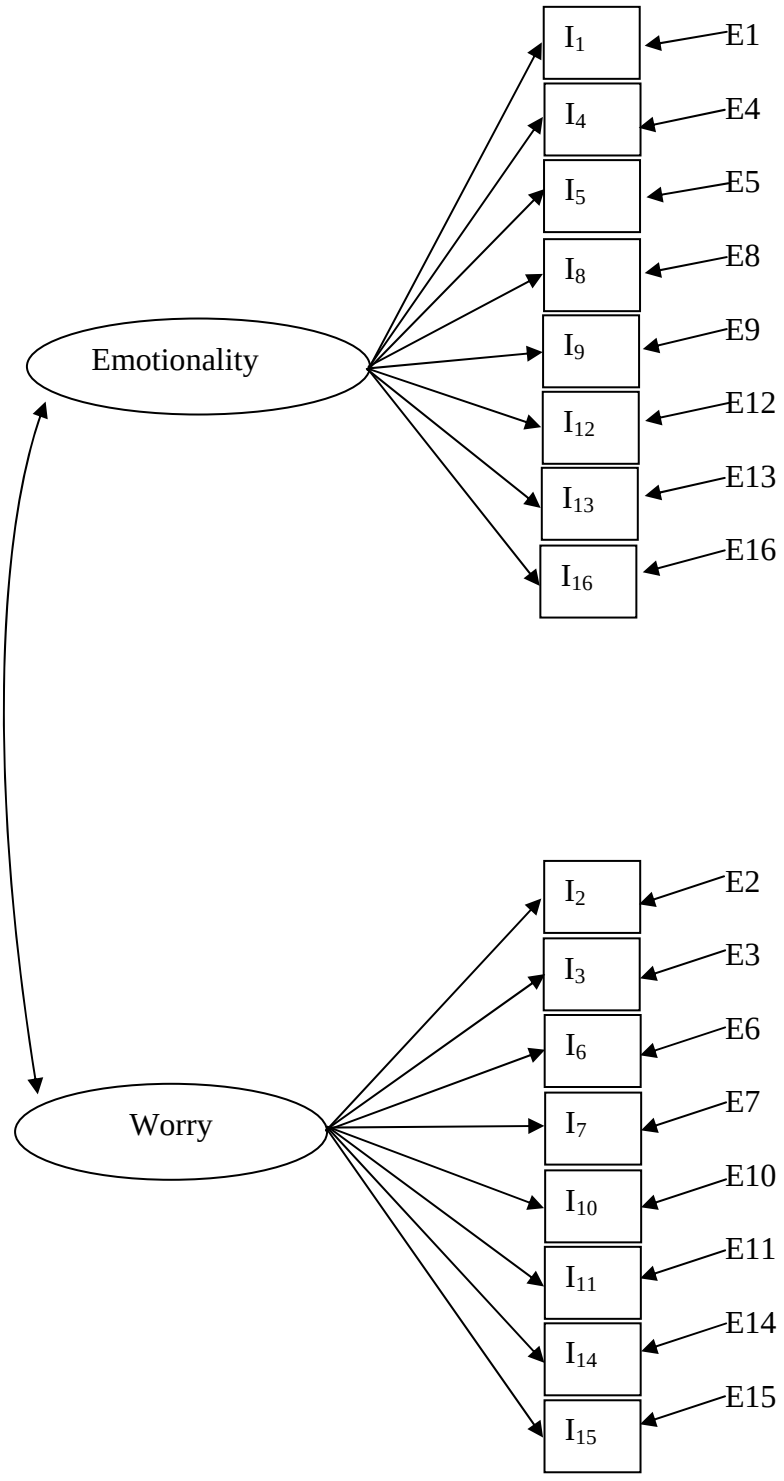

Figure 5. Relationships of Items to Factors in the Two-Factor Model.

The unstandardized factor loadings, excluding the one fixed to 1.0 to identify the model, ranged from 1.18 to 1.39 (median = 1.22) for the factor of emotionality and from 1.01 to 1.45 (median = 1.34) for the factor of worry. All loadings were significantly different from zero ($p < .01$). An examination of the standardized factor loadings showed that the loadings ranged from .69 to .86 for the emotionality items and from .63 to .85 for the worry items. The correlation between emotionality and worry was .87.

Sources of misfit of the model were explored by examining the modification indices that indicated the expected decrease in model fit chi square ($\Delta\chi^2$) that would result when a specific parameter, constrained initially to zero, subsequently was freely estimated. The largest modification indices were for covariances between errors. Because similarities in the item content for pairs of items may result in large error covariances, examination of the modification indices and wording of the pairs with chi-square differences larger than the critical chi-square statistic of 6.64 ($p = .01$) was carried out. Table 4 lists all pairs of items with changes in chi square that were statistically significant and shows details of the six pairs of items with the highest chi-square differences. This value indicates the improvement in model fit if a covariance was posited between the errors of the items.

The largest modification index for the model was for the covariance between the errors for items 6 and 3 ($\Delta\chi^2 = 189.75$). These items were very similar and shared the word “interfere”. Although the change in chi-square was substantially lower for the remaining five pairs of error covariances ($\Delta\chi^2$ ranged from 29.56 to 52.49), examination

of those items revealed similar wording in the pairs of items. Items 4 and 5 were similar because the word “nervous” could be viewed as synonymous with “uneasy” and/or “upset.” Items 9 and 12 used the words “panicky” and “very tense”, which could be viewed as representing the same feeling. Examination of the wording in items 13, 14, and 15 (all worry items) revealed that “freezing up,” “mental block,” and “can’t get my brain to organize” may be sufficiently similar to suggest redundancies in the items. Examination of items 10 and 7 reveal that “can’t absorb the material” and “not being able to learn the material” are sufficiently similar that they may have been viewed by the respondents as nearly identical items. The modification indices for the pairs of items are shown in Table 4.

Table 4

Modification Indices for Error Covariances for the Study Anxiety Inventory for Responses from All Arts and Science Students (n=625)

Items with errors covarying	Chi-Square Difference
Pair 1: 3. I can't keep my mind on the subject when studying for an exam because other thoughts interfere (Worry) 6. While studying for tests, other thoughts interfere with my learning (Worry)	189.75
Pair 2: 4. Even when I have plenty of time, I feel nervous when I try to study for an exam (Emotionality) 5. While studying for exams, I have an uneasy, upset feeling (Emotionality)	48.89
Pair 3: 9. I feel panicky when studying for an important exam (Emotionality) 12. While studying for exams, I feel very tense (Emotionality)	38.65
Pair 4: 13. I freeze up while studying for an important test (Emotionality) 14. When I study for exams, I seem to get a mental block that keeps me from absorbing the material (Worry)	49.85
Pair 5: 14. When I study for exams, I seem to get a mental block that keeps me from absorbing the material (Worry) 15. When I am studying for a test, I can't get my brain to organize the information (Worry)	52.49
Pair 6: 10. While studying for exams, I am stressed with thoughts like "I can't absorb the material properly" (Worry) 7. While studying for a test, I worry about not being able to learn the material (Worry)	29.56

2 with 1	27.05	9 with 3	13.44	5 with 1	10.78
12 with 4	27.04	4 with 3	13.20	7 with 2	10.75
15 with 1	22.58	15 with 10	12.69	9 with 8	9.01
4 with 2	22.02	16 with 11	12.36	12 with 6	8.67
14 with 7	18.58	15 with 13	12.59	9 with 6	8.55
9 with 4	16.51	6 with 4	12.17	16 with 6	8.43
10 with 3	15.72	10 with 9	11.52	12 with 2	7.34
16 with 3	15.15	13 with 12	11.26	5 with 2	6.99
13 with 7	14.33	13 with 8	11.16	14 with 9	6.83

The correlation of .85 between the emotionality and worry factors was statistically significantly different from 0 ($p < .001$). The strength of the correlation between the two factors led the researcher to entertain the possibility of a one-factor model underlying the Study Anxiety Inventory (see Figure 6). Based upon the χ^2, the fit of the one-factor model was also not acceptable with χ^2 (104, $N = 660$) = 1187.42, $p < .001$, which is

larger than the two-factor model. The SRMR for the one-factor model was .06, which indicated poorer fit compared with the two-factor model (SRMR = .047 for the two-factor model). The CFI of .868 for the one-factor model indicated that the fit was not as good as the two-factor model (CFI = .918). The RMSEA of .126 for the one-factor model was larger than the RMSEA for the two-factor model (.099), again suggesting that the one-factor solution provided an even less acceptable fit compared with the two-factor model. The standardized factor loadings for the one-factor model ranged from .56 to .83 and were all significantly different from zero ($p < .01$).

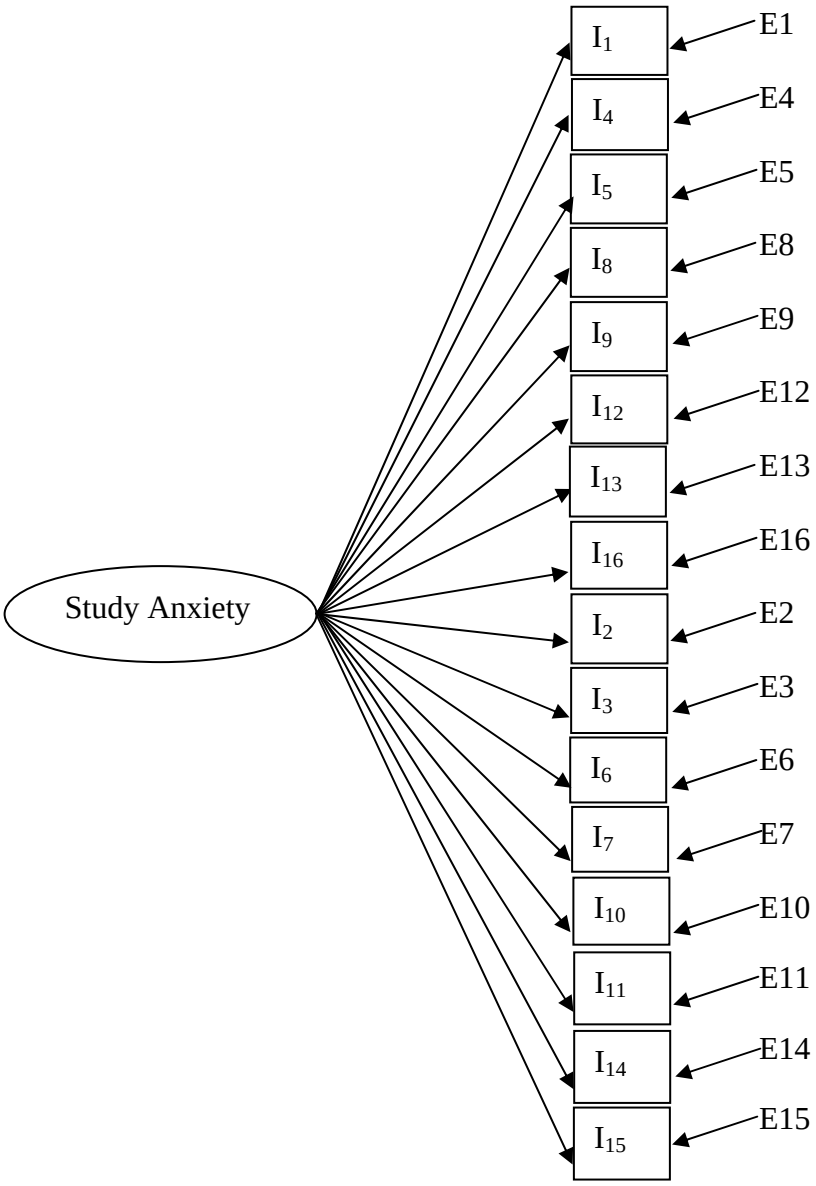

Figure 6. Relationships of Items to Factors in a One-Factor Model.

College of Engineering. Table 5 provides descriptive statistics for the 16 observed variables used in the confirmatory factor analysis for responses from the students in the College of Engineering. The means for the 16 items ranged from 1.59 to 2.08 (median = 1.83) with standard deviations ranging from 0.74 to 1.02 (median = 0.84).

The normality of the distributions for the 16 items was evaluated using univariate skewness and kurtosis measures for each of these variables. All skewness values were close to zero with the smallest skewness value of 0.44 and the largest skewness value of 1.30 (median = 0.81). All kurtosis values were near zero for each of the items with values ranging from -0.30 to 1.21 (median = 0.03), which suggests that the peak and tails of the distribution are similar to the normal curve. Multivariate normality evaluate using Mardia's test of multinormality was not demonstrated in the College of Engineering for the total group or by gender (p<.001 in every case) so the assumption of multivariate normality was not tenable.

Table 5

Descriptive Statistics for the 16 Observed Variables Used in the Two-Factor Confirmatory Factor Analyses of the Study Anxiety Inventory for the College of Engineering (n=433)

Item #	Mean	*SD*	Skewness	Kurtosis
1e	1.88	0.86	0.67	-0.12
2w	1.95	0.74	0.46	0.29
3w	2.06	0.84	0.44	-0.18
4e	1.82	0.83	0.77	0.17
5e	1.62	0.77	1.03	0.65
6w	2.08	0.89	0.50	-0.20
7w	1.84	0.81	0.64	-0.04
8e	1.85	1.02	0.91	-0.30
9e	1.77	0.92	0.92	-0.05
10w	1.86	0.85	0.69	-0.11
11w	1.86	0.92	0.77	-0.22
12e	1.78	0.86	0.86	0.10
13e	1.59	0.81	1.30	1.21
14w	1.73	0.83	0.90	0.31
15w	1.70	0.82	0.97	0.45
16e	1.73	0.84	0.88	0.10

Note: Emotionality (e) items are 1, 4, 5, 8, 9, 12, 13, 16; Worry (w) items are 2, 3, 6, 7, 10, 11, 14, 15

The χ^2 fit statistics for the CFA of the two-factor (worry, emotionality) model for the students from the College of Engineering indicated that the fit of the model was not acceptable, χ^2 (103, N = 428) = 521.82, $p < .001$. Alternative measures of fit were included because one of the limitations of the χ^2 is that it is sensitive to sample size. The SRMR of .050 indicated acceptable fit, while the CFI of .912 and the RMSEA of .097 indicated less than acceptable fit.

The unstandardized factor loadings, excluding the one fixed to 1.0 to identify the model, ranged from 1.20 to 1.51 (median = 1.30) for the factor of emotionality and from 1.08 to 1.38 (median = 1.25) for the factor of worry. All loadings were statistically significantly different from zero ($p < .01$). An examination of the standardized factor loadings showed that the loadings ranged from .61 to .85 for the emotionality items and from .66 to .80 for the worry items. The correlation between emotionality and worry was .89.

Sources of misfit of the model were explored by examining the modification indices that indicated the expected decrease in model fit chi square ($\Delta\chi^2$) that would result when a specific parameter, constrained initially to zero, subsequently was freely estimated. The largest modification indices were for covariances between errors. Because similarities in the item content for pairs of items may result in large error covariances, examination of the modification indices and wording of the pairs of items with chi square differences larger than the critical chi square of 6.64 (p = .01) was carried out. Table 6 lists all pairs of items with changes in chi square that were statistically significant and shows the six pairs of items with the highest chi-square differences ($\Delta\chi^2 > 15$). This value

indicates the improvement in model fit if a covariance was posited between the errors of the items.

The largest modification index for the model was for the covariance between the errors for items 6 and 3 ($\Delta\chi^2 = 123.22$). These items were very similar and shared the word "interfere". Although the change in chi-square was substantially lower for the remaining five pairs of error covariances ($\Delta\chi^2$ ranged from 15.99 to 28.24), examination of those items revealed similar wording in the pairs of items. Items 9 and 10 used the words "panicky" and "stressed", which could be viewed as representing the same feeling. Examination of the wording in items 13, 14 and 15 (all worry items) revealed that "freezing up," "mental block," and "can't get my brain to organize" may be sufficiently similar to suggest redundancies in the items. The modification indices for the pairs of items are shown in Table 6.

Table 6

Modification Indices for Error Covariances for the Study Anxiety Inventory for Responses from All Engineering Students

Items with errors covarying	Chi-Square Difference
Pair 1: 3. I can't keep my mind on the subject when studying for an exam because other thoughts interfere (Worry) 6. While studying for tests, other thoughts interfere with my learning (Worry)	123.22
Pair 5: 14. When I study for exams, I seem to get a mental block that keeps me from absorbing the material (Worry) 15. When I am studying for a test, I can't get my brain to organize the information (Worry)	28.24
Pair 2: 2. While I am studying for an exam I often think "I'm not getting this" (Emotionality) 1. I feel very uneasy just before starting to study for an exam (Emotionality)	27.06
Pair 4: 13. I freeze up while studying for an important test (Emotionality) 14. When I study for exams, I seem to get a mental block that keeps me from absorbing the material (Worry)	19.14
Pair 3: 9. I feel panicky when studying for an important exam (Emotionality) 10. While studying for exams, I am stressed with thoughts like "I can't absorb the material properly" (Worry)	19.01
Pair 6: 4. Even when I have plenty of time, I feel nervous when I try to study for an exam (Emotionality) 1. I feel very uneasy just before starting to study for an exam (Emotionality)	15.99

12 with 11	14.83	14 with 1	11.01	7 with 5	7.66
3 with 2	14.72	4 with 3	10.55	14 with 2	7.53
5 with 4	14.46	15 with 12	10.26	13 with 3	7.39
4 with 2	12.61	12 with 2	9.88	13 with 6	7.22
15 with 1	12.57	12 with 5	9.42	12 with 8	6.96
12 with 9	12.18	13 with 12	8.90	14 with 12	6.82
13 with 1	11.78	9 with 6	8.70	16 with 12	6.79
9 with 3	11.70	12 with 4	7.84	5 with 1	6.67

The correlation of .89 between the emotionality and worry factors was statistically significantly different from 0 ($p < .001$). The strength of the correlation between the two factors led the researcher to entertain the possibility of a one-factor model underlying the Study Anxiety Inventory. Based upon the χ^2, the fit of the one-factor model also was not acceptable with χ^2 (104, $N = 410$) = 613.45, $p < .001$, which is larger than the two-factor model. The SRMR for the one-factor model was .0501, which indicated poorer fit

compared to the two-factor model (SRMR = .050 for the two-factor model). The CFI of .902 for the one-factor model indicated that the fit was not as good as the two-factor model (CFI = .912). The RMSEA of .109 for the one-factor model was larger than the RMSEA for the two-factor model (.097), again suggesting that the one-factor solution provided an even less acceptable fit. The standardized factor loadings for the one-factor model ranged from .59 to .82 and were all statistically significantly different from zero ($p < .01$).

College of Business. Table 7 provides descriptive statistics for the 16 observed variables used in the confirmatory factor analysis for responses from the students from the College of Business. The means for the 16 items ranged from 1.70 to 2.21 (median = 1.93) with standard deviations ranging from 0.74 to 1.04 (median = 0.87).

The normality of the distributions for the 16 items was evaluated using univariate skewness and kurtosis measures for each of these variables. All skewness values were less than 1.0 with the smallest skewness value of 0.25 and the largest skewness value of .97 (median = 0.68), which shows that the symmetry of the items was acceptable. All kurtosis values were less than 1.0 for each of the items with values ranging from -0.62 to 0.22 (median = -0.22), which suggests that the peak and tails of the distribution were similar to the normal curve. Multivariate normality evaluate using Mardia's test of multinormality was not demonstrated in the College of Business for the total group or by gender ($p<.001$ in every case) so the assumption of multivariate normality was not tenable.

Table 7

Descriptive Statistics for the 16 Observed Variables Used in the Two-Factor Confirmatory Factor Analyses of the Study Anxiety Inventory for the College of Business (n=399)

Item #	Mean	*SD*	Skewness	Kurtosis
1e	1.94	0.84	0.63	-0.09
2w	1.98	0.74	0.52	0.22
3w	2.21	0.85	0.25	-0.58
4e	1.90	0.88	0.71	-0.23
5e	1.72	0.82	0.94	0.21
6w	2.18	0.88	0.39	-0.52
7w	1.98	0.87	0.59	-0.24
8e	1.98	1.04	0.75	-0.62
9e	1.91	0.93	0.70	-0.42
10w	1.97	0.90	0.61	-0.38
11w	1.95	0.95	0.66	-0.50
12e	1.83	0.87	0.86	0.12
13e	1.70	0.86	0.97	0.10
14w	1.87	0.85	0.71	-0.06
15w	1.82	0.80	0.65	-0.11
16e	1.85	0.89	0.76	-0.21

Note: Emotionality (e) items are 1, 4, 5, 8, 9, 12, 13, 16; Worry (w) items are 2, 3, 6, 7, 10, 11, 14, 15

The χ^2 fit statistics for the CFA of the two-factor (worry, emotionality) model for the students from the College of Business indicated that the fit of the model was not acceptable, χ^2 (103, N = 399) = 527.43, $p < .001$. Alternative measures of fit were included because one of the limitations of the χ^2 is that it is sensitive to sample size. The SRMR of .05 indicated acceptable fit, while the CFI of .908 and the RMSEA of .102 indicated less than acceptable fit.

The unstandardized factor loadings, excluding the one fixed to 1.0 to identify the model, ranged from 1.15 to 1.41 (median = 1.30) for the factor of emotionality and from 1.07 to 1.49 (median = 1.27) for the factor of worry. All loadings were statistically

significantly different from zero ($p < .01$). An examination of the standardized factor loadings showed that the loadings ranged from .67 to .84 for the emotionality items and from .65 to .82 for the worry items. The correlation between emotionality and worry was .89

Sources of misfit of the model were explored by examining the modification indices that indicated the expected decrease in model fit chi square ($\Delta\chi^2$) that would result when a specific parameter, constrained initially to zero, subsequently was freely estimated. The largest modification indices were for covariances between errors. Because similarities in the item content for pairs of items may result in large error covariances, examination of the modification indices and wording of the pairs with chi square differences larger than the critical chi square of 6.64 ($p = .01$) was carried out. Table 8 lists all pairs of items with changes in chi square that were statistically significant and shows the six pairs of items with the highest chi-square differences ($\Delta\chi^2 > 17$). This value indicates the improvement in model fit if a covariance was posited between the errors of the items.

The largest modification index for the model was for the covariance between the errors for items 6 and 3 ($\Delta\chi^2 = 77.00$). These items were very similar and shared the word “interfere”. Although the change in chi-square was substantially lower for the remaining five pairs of error covariances ($\Delta\chi^2$ ranged from 16.33 to 32.00), examination of those items revealed similar wording in the pairs of items. Item 4 would be responded to in a similar way to items 6 and 3 because the participant may feel that interference is causing their nervousness. Items 9 and 12 used the words “panicky” and “very tense”,

which could be viewed as representing a similar feeling. Examination of the wording in items 14 and 15 (all worry items) revealed that “mental block” and “can’t get my brain to organize” may be sufficiently similar to suggest redundancies in the items. Examination of items 5 and 7 reveal that “uneasy” and “worry about not being able to learn the material” may be identified as having sufficiently similar meaning that they may have been viewed by the respondents as very similar items. Examination of the way item 4 might be related to both items 6 and 3 did not reveal any obvious relationship. The modification indices for the pairs of items are shown in Table 8.

Table 8

Modification Indices for Error Covariances for the Study Anxiety Inventory for Responses from All Business Students (n=399)

Items with errors covarying	Chi-Square difference
Pair 1: 3. I can't keep my mind on the subject when studying for an exam because other thoughts interfere (Worry) 6. While studying for tests, other thoughts interfere with my learning (Worry)	77.00
Pair 2: 4. Even when I have plenty of time, I feel nervous when I try to study for an exam (Emotionality) 6. While studying for tests, other thoughts interfere with my learning (Worry)	32.00
Pair 3: 14. When I study for exams, I seem to get a mental block that keeps me from absorbing the material (Worry) 15. When I am studying for a test, I can't get my brain to organize the information (Worry)	27.90
Pair 4: 5. While studying for exams, I have an uneasy, upset feeling (Emotionality) 7. While studying for a test, I worry about not being able to learn the material (Worry)	22.73
Pair 5: 2. While I am studying for an exam I often think "I'm not getting this"(Worry) 12. While studying for exams, I feel very tense (Emotionality)	21.85
Pair 6: 4. Even when I have plenty of time, I feel nervous when I try to study for an exam (Emotionality) 5. While studying for exams, I have an uneasy, upset feeling (Emotionality)	19.84

4 with 3	18.21	3 with 2	14.50	5 with 1	8.22
13 with 6	17.16	9 with 3	13.34	12 with6	8.20
16 with 12	16.49	9 with 6	12.52	12 with 3	7.80
4 with 1	16.33	10 with 3	11.52	15 with 1	7.70
14 with 13	15.55	9 with 5	10.49	13 with 4	7.25
10 with 9	15.47	6 with 1	9.52	3 with 1	7.10
2 with 1	15.37	16 with 2	9.01	10 with 6	7.07
14 with 7	15.37	15 with 3	8.95	11with 4	6.89
12 with 11	14.87	14 with 8	8.81	5 with 3	6.67
10 with 5	14.67	13 with 1	8.65	4 with 2	6.65

The correlation of .89 between the emotionality and worry factors was statistically significantly different from 0 ($p < .001$). The strength of the correlation between the two factors led the researcher to entertain the possibility of a one-factor model underlying the Study Anxiety Inventory. Based upon the χ^2, the fit of the one-factor model was also not acceptable with χ^2 (104, $N = 399$) = 694.53, $p < .001$, which is larger than the two-factor

model. The SRMR for the one-factor model was .06, which indicated poorer fit compared with the two-factor model (SRMR = .05 for the two-factor model). The CFI of .873 for the one-factor model indicated that the fit was not as good as the two-factor model (CFI = .908). The RMSEA of .119 for the one-factor model was larger than the RMSEA for the two-factor model (.107), again suggesting that the one-factor solution provided an even less acceptable fit. The standardized factor loadings for the one-factor model ranged from .60 to .81 and were all statistically significantly different from zero ($p < .01$).

College of Education. Table 9 provides descriptive statistics for the 16 observed variables used in the confirmatory factor analysis for the responses from students in the College of Education. The means for the 16 items ranged from 1.72 to 2.26 (median = 1.98) with standard deviations ranging from 0.79 to 1.13 (median = 0.89).

The normality of the distributions for the 16 items was evaluated using univariate skewness and kurtosis measures for each of these variables. All skewness values were less than 1.0 with the smallest skewness value of 0.21 and the largest skewness value of 0.90 (median = 0.57), indicating that the items reflected acceptable symmetry. All kurtosis values were near zero for each of the items with values ranging from -1.05 to 0.24 (median = -0.40), which suggests that the peak and tails of the distributions were similar to the normal curve. Multivariate normality evaluate using Mardia's test of multinormality was not demonstrated in the College of Education for the total group or by gender ($p<.001$ in every case) so the assumption of multivariate normality was not tenable.

Table 9

Descriptive Statistics for the 16 Observed Variables Used in the Two-Factor Confirmatory Factor Analyses of the Study Anxiety Inventory for the College of Education (n=410)

Item #	Mean	*SD*	Skewness	Kurtosis
1e	1.93	0.90	0.70	-0.19
2w	2.05	0.79	0.56	0.24
3w	2.26	0.87	0.21	-0.45
4e	1.98	0.94	0.61	-0.55
5e	1.81	0.89	0.90	0.07
6w	2.24	0.90	0.31	-0.55
7w	2.10	0.89	0.44	-0.45
8e	2.08	1.13	0.58	-1.05
9e	1.97	0.97	0.65	-0.57
10w	2.03	0.89	0.54	-0.36
11w	2.01	0.94	0.57	-0.56
12e	1.87	0.90	0.77	-0.20
13e	1.72	0.87	0.90	-0.07
14w	1.98	0.89	0.54	-0.47
15w	1.90	0.81	0.49	-0.23
16e	1.89	0.90	0.74	-0.22

Note: Emotionality (e) items are 1, 4, 5, 8, 9, 12, 13, 16; Worry (w) items are 2, 3, 6, 7, 10, 11, 14, 15

The χ^2 fit statistics for the CFA of the two-factor (worry, emotionality) model for the students from the College of Education indicated that the fit of the model was not acceptable, χ^2 (103, N = 410) = 483.58, $p < .001$. Alternative measures of fit were included because one of the limitations of the χ^2 is that it is sensitive to sample size. The SRMR of .044 indicated acceptable fit, while the CFI of .927 and the RMSEA of .095 indicated less than acceptable fit.

The unstandardized factor loadings, excluding the one fixed to 1.0 to identify the model, ranged from 1.08 to 1.29 (median = 1.11) for the factor of emotionality and from 1.03 to 1.27 (median = 1.22) for the factor of worry. All loadings were statistically

significantly different from zero ($p < .01$). An examination of the standardized factor loadings showed that the loadings ranged from .75 to .85 for the emotionality items and from .69 to .83 for the worry items. The correlation between emotionality and worry was .92.

Sources of misfit of the model were explored by examining the modification indices that indicated the expected decrease in model fit chi square ($\Delta\chi^2$) that would result when a specific parameter, constrained initially to zero, subsequently was freely estimated. The largest modification indices were for covariances between errors. Because similarities in the item content for pairs of items may result in large error covariances, examination of the modification indices and wording of the pairs with chi square differences larger than the critical chi square of 6.64 ($p = .01$) was carried out. Table 10 lists all pairs of items with changes in chi square that were statistically significant and shows the six pairs of items with the highest chi-square differences ($\Delta\chi^2 > 17$). This value indicates the improvement in model fit if a covariance was posited between the errors of the items.

The largest modification index for the model was for the covariance between the errors for items 6 and 3 ($\Delta\chi^2 = 93.34$). These items were very similar and shared the word “interfere”. Although the change in chi-square was substantially lower for the remaining five pairs of error covariances ($\Delta\chi^2$ ranged from 17.9 to 31.39), examination of those items revealed similar wording in the pairs of items. Items 3 and 6 were similar because the word “interfere” is the basis of the item and could therefore be responded to in the same way. Examination of the wording in items 13, 14 and 15 (all worry items)

revealed that “freezing up,” “mental block,” and “can’t get my brain to organize” may be sufficiently similar to suggest redundancies in the items. Examination of items 10 and 7 reveal that “can’t absorb the material” and “not being able to retain the material” are sufficiently similar that they may have been viewed by the respondents as nearly identical items. Item 10 may be related to item 3 because both address the thoughts that interfere with learning. The modification indices for the pairs of items are shown in Table 10.

Table 10

Modification Indices for Error Covariances for the Study Anxiety Inventory for Responses from All Education Students (n=410)

Items with errors covarying					Chi-Square difference
Pair 1: 3. I can't keep my mind on the subject when studying for an exam because other thoughts interfere (Worry) 6. While studying for tests, other thoughts interfere with my learning (Worry)					93.34
Pair 5: 14. When I study for exams, I seem to get a mental block that keeps me from absorbing the material (Worry) 15. When I am studying for a test, I can't get my brain to organize the information (Worry)					31.39
Pair 4: 13. I freeze up while studying for an important test (Emotionality) 14. When I study for exams, I seem to get a mental block that keeps me from absorbing the material (Worry)					30.35
Pair 6: 10. While studying for exams, I am stressed with thoughts like "I can't absorb the material properly" (Worry) 7. While studying for a test, I worry about not being able to learn the material (Worry)					24.62
Pair 3: 10. While studying for exams, I am stressed with thoughts like "I can't absorb the material properly" (Worry) 3. I can't keep my mind on the subject when studying for an exam because other thoughts interfere (Worry)					23.32
Pair 2: 7. While studying for a test, I worry about not being able to learn the material (Worry) 5. While studying for exams, I have an uneasy, upset feeling (Emotionality)					19.64
14 with 7	18.73	15 with 7	12.83	4 with 2	9.11
15 with 13	18.32	10 with 9	11.20	14 with 3	8.60
14 with 5	17.99	7 with 3	10.89	6 with 4	8.19
10 with 6	17.08	9 with 3	10.12	11 with 3	8.09
9 with 6	16.09	2 with 1	9.72	9 with 4	7.62
9 with 8	14.44	4 with 3	9.49	13 with 7	7.56
11 with 2	13.24	9 with7	9.34	9 with 2	7.18
				7 with 2	6.89

The correlation of .92 between the emotionality and worry factors was statistically significantly different from 0 ($p < .001$). The strength of the correlation between the two factors led the researcher to entertain the possibility of a one-factor model underlying the Study Anxiety Inventory (see Figure 6). Based upon the χ^2, the fit of the one-factor model was also not acceptable with χ^2 (104, $N = 428 = 692.48$, $p < .001$, which is larger

than the χ^2 for the two-factor model. The SRMR for the one-factor model was .058, which indicated a poorer fit compared with the two-factor model (SRMR = .044 for the two-factor model). The CFI of .877 for the one-factor model indicated that the fit was not as good as the two-factor model (CFI = .927). The RMSEA of .115 for the one-factor model was larger than the RMSEA for the two-factor model (.095), again suggesting that the one-factor solution provided an even less acceptable fit. The standardized factor loadings for the one-factor model ranged from .64 to .83 and were all statistically significantly different from zero ($p < .01$).

Table 11 presents an overview of the fit indices for the one- and two-factor confirmatory factor analysis of the Study Anxiety Inventory across four colleges and shows that chi-square values for both models indicated less than acceptable fit for each college. The results, however, were consistently poorer for the one-factor model than for the two-factor model. Although the SRMRs for both the hypothesized two-factor and one-factor model for each college were less than .08, indicating acceptable fit, the indices indicated poorer fit for the one-factor model (SRMRs ranged from .050 to .060) for each college than for the two-factor model (SRMRs ranged from .047 to .050). The CFIs for the two-factor model for each of the colleges indicated acceptable fit ranging from .908 to .927 while the one-factor model indicated less than acceptable fit for each of the colleges except the College of Engineering with CFIs ranging from .868 to .902, and even that CFI was lower for the one-factor model than the two-factor model. Although the RMSEA values for both the two-factor (.095 to .092) and one-factor model (.109 to .126) indicated less than acceptable fit for each college, the results were consistently

poorer for the one-factor model than for the two-factor model. So, although for each college the correlation between the two factors of emotionality and worry ranged from .87 to .92 (.87 to .91 for males, and .85 to .92 for females), it still seems more acceptable to consider that the two-factor model is a better fit than the one-factor model. Although multivariate normality was not found to be tenable, rerunning the data using maximum likelihood estimation with standard errors and a mean-adjusted chi-square test statistic (MLM in Mplus), which is robust to this violation, produced results that pointed to the same conclusions.

Table 11

Fit Indices for the Confirmatory Factor Analysis of the Hypothesized Two-Factor and One-Factor Model for the Study Anxiety Inventory Across Four Colleges

	Arts and Sciences		Business		Education		Engineering	
	2-factor	1-factor	2-factor	1-factor	2-factor	1-factor	2-factor	1-factor
χ^2	772.52	1187.42	527.43	694.53	483.58	692.48	521.82	613.45
SRMR	.047	.060	.050	.060	.044	.058	.050	.050
CFI	.918	.868	.908	.873	.927	.877	.912	.902
RMSEA	.099	.126	.102	.119	.095	.115	.097	.109

Research Question 2: Factorial Invariance by Gender

To evaluate the equivalence of the two-factor measurement model underlying the SAI, multigroup CFA was used. The data were divided by gender, and variance-covariance matrices were calculated for each group (males, females). The fit of the two-factor model was evaluated separately for males and females followed by the evaluation of the invariance of the model for males and females. Invariance tests were conducted using a multiple group analysis to test the equality of the factor loadings, residual variances, factor variances, and the covariance between factors by gender. Equality

restrictions were imposed across males and females for tests of invariance. A Chi-square-difference test for relative fit for a nested sequence of models was used for this test. Analyses were conducted separately for each college and are presented in the next section.

College of Arts and Sciences. Table 12 provides descriptive statistics by gender for the 16 observed variables used in the confirmatory factor analysis. The responses for each item ranged from one to four and the means for the 16 items for males ranged from 1.42 to 2.11 (median = 1.72) with standard deviations ranging from 0.73 to 1.93 (median = 0.84), and for females ranged from 1.79 to 2.28 (median = 2.04) with standard deviations ranging from 0.78 to 1.12 (median = 0.92). Examination of the kurtosis and skewness values showed that for each of the items both kurtosis and skewness values were close to zero for both males and female, which suggests that the peak and tails of the distribution were similar to the normal curve and reflected acceptable symmetry.

The mean of every item score for the males was significantly lower than the mean item score for the females. Effect sizes were calculated using:

Effect sizes for the individual items are displayed in Table 12 and ranged from fairly low at -0.13 to moderate at -0.36 with a median effect size of -0.24. The effect size of the overall scale was moderate at 0.32 and the effect sizes of the subscales were moderate at 0.30 for emotionality and 0.29 for worry.

Table 12

Descriptive Statistics for the 16 Observed Variables Used in the Two-Factor Confirmatory Factor Analyses of the Study Anxiety Inventory for the College of Arts and Sciences by Gender (n_M=215, n_F=445)

	Males		Females				Males	Females	Males	Females
	Mean	*SD*	Mean	*SD*	*t*	*es*	Skewness		Kurtosis	
1e	1.76	0.79	2.00	0.92	-3.46**	-0.20	0.86	0.71	0.30	-0.17
2w	1.84	0.76	2.11	0.78	-4.24**	-0.25	0.73	0.44	0.41	0.09
3w	2.09	0.84	2.27	0.88	-2.54*	-0.15	0.49	0.32	-0.26	-0.47
4e	1.76	0.87	2.03	0.95	-3.62**	-0.21	0.91	0.52	0.01	-0.66
5e	1.65	0.83	1.81	0.89	-2.27*	-0.13	1.18	0.87	0.67	0.01
6w	2.11	0.89	2.28	0.89	-2.30*	-0.14	0.52	0.31	-0.38	-0.42
7w	1.71	0.81	2.15	0.92	-6.25**	-0.36	0.96	0.45	-0.31	-0.47
8e	1.73	0.93	2.16	1.12	-5.20**	-0.30	1.02	0.48	-0.05	-1.07
9e	1.61	0.86	2.01	0.99	-5.33**	-0.31	1.25	0.62	0.61	-0.59
10w	1.72	0.86	2.14	0.93	-5.72**	-0.33	1.03	0.41	0.28	-0.54
11w	1.75	0.91	2.10	0.99	-4.50**	-0.26	0.96	0.44	-0.10	-0.73
12e	1.69	0.78	1.96	0.95	-3.87**	-0.22	0.96	0.63	0.36	-0.50
13e	1.42	0.73	1.79	0.91	-5.62**	-0.32	1.76	0.96	2.51	-0.18
14w	1.69	0.84	2.04	0.92	-4.86**	-0.28	1.11	0.54	0.57	-0.41
15w	1.67	0.83	1.91	0.84	-3.47**	-0.27	1.13	0.57	0.62	-0.20
16e	1.66	0.84	1.95	0.92	-4.03**	-0.30	1.09	0.65	0.37	-0.35
SAI	1.74	0.65	2.05	0.71	-5.57**	-0.32	1.03	0.53	0.55	-0.11
SAe	1.66	0.69	1.97	0.79	-5.15**	-0.30	1.11	0.70	0.55	-0.10
SAw	1.83	0.68	2.12	0.71	-5.06**	-0.29	.912	0.47	0.50	-0.05

Note: *es* = effect size, *p <.05, ** p < .01. Emotionality (e) items are 1, 4, 5, 8, 9, 12, 13, 16; Worry (w) items are 2, 3, 6, 7, 10, 11, 14, 15; SAI = Study Anxiety Inventory Index Score, SAe=Study Anxiety Emotionality subscale score, SAw=Study Anxiety Inventory Worry subscale score.

The χ^2 fit statistics for the CFA of the two-factor (worry, emotionality) model for male and female students from the College of Arts and Sciences indicated that the fit of the model was not acceptable, χ^2 (103, N_M=215) = 337.64 and χ^2 (103, N_F=445) = 617.76, respectively. The same alternative measures of fit were included because the χ^2 is sensitive to sample size. The SRMRs for the male and female groups of .050 and .053 respectively indicated similar and acceptable fit, while the CFIs of .915 and .904 respectively, and the RMSEAs of .103 and .106 both indicated less than acceptable fit.

The unstandardized factor loadings for the responses, excluding the one fixed to 1.0, ranged from 1.07 to 1.40 with a mean of 1.30 (*SD* = 0.12) for the males and from 1.17 to 1.38 with a mean of 1.27 (*SD* = 0.09) for the females for the factor of emotionality. Loadings ranged from 0.82 to 1.33 with a mean of 1.16 (*SD* = 0.17) for the males and from 1.14 to 1.50 with a mean of 1.37 (*SD* = 0.13) for the females for the factor of worry.

An examination of the standardized factor loadings showed that the loadings of all items on the emotionality and worry scale were statistically significant as hypothesized (>.68 for males and >.54 for females). The correlation between emotionality and worry was .90 for males and .85 for females.

Sources of misfit of the models for males and females were further explored by comparing the modification indices that indicated the expected decrease in model fit chi square ($\Delta\chi^2$) that would result when a specific parameter, constrained initially to zero, subsequently was freely estimated. As with the combined sample of Arts and Sciences students, the largest expected chi square change was between covariances of the errors for items 3 and 6 ($\Delta\chi^2$=70.96 for males and 116.67 for females). Of the eight pairs of items with the highest chi-square change for the females, three of the error covariances were also found in the list of the highest eight for males (6 and 3, 14 and 13, and 15 and 14).

Table 13

Modification Indices for Error Covariances for the Study Anxiety Inventory for Responses from Male Arts and Science Students (n = 225)

Items with errors covarying	Chi-Square Difference
Pair 1: 3. I can't keep my mind on the subject when studying for an exam because other thoughts interfere (Worry) 6. While studying for tests, other thoughts interfere with my learning (Worry)	116.67
Pair 2: 13. I freeze up while studying for an important test (Emotionality) 14. When I study for exams, I seem to get a mental block that keeps me from absorbing the material (Worry)	38.42
Pair 3: 9. I feel panicky when studying for an important exam (Emotionality) 12. While studying for exams, I feel very tense (Emotionality)	38.23
Pair 4: 14. When I study for exams, I seem to get a mental block that keeps me from absorbing the material (Worry) 15. When I am studying for a test, I can't get my brain to organize the information (Worry)	33.21
Pair 5: 1. I feel very uneasy just before starting to study for an exam (Emotionality) 2. While I am studying for an exam I often think "I'm not getting this" (Worry)	26.77
Pair 6: 4. Even when I have plenty of time, I feel nervous when I try to study for an exam (Emotionality) 2. While I am studying for an exam I often think "I'm not getting this" (Worry)	23.25
Pair 7: 4. Even when I have plenty of time, I feel nervous when I try to study for an exam (Emotionality) 2. While studying for exams, I feel very tense (Emotionality)	23.37
Pair 8: 10. While studying for exams, I am stressed with thoughts like "I can't absorb the material properly" (Worry) 7. While studying for a test, I worry about not being able to learn the material (Worry)	22.72

15 with 13	21.31	10 with 6	12.96	12 with 3	8.90
10 with 9	19.66	13 with 7	12.85	5 with 1	8.80
15 with 1	18.51	10 with 3	11.95	11 with 5	8.64
4 with 3	16.20	9 with 3	11.69	5 with 2	8.41
14 with 7	16.14	12 with 6	11.29	15 with 10	7.49
6 with 4	14.43	7 with 2	10.30	13 with 12	7.42
9 with 4	14.25	11 with 9	9.32	15 with 9	7.18
				13 with 6	6.70

Table 14

Modification Indices for Error Covariances for the Study Anxiety Inventory for Responses from Female Arts and Science Students (n = 410)

Items with errors covarying	Chi-Square Difference
Pair 1: 3. I can't keep my mind on the subject when studying for an exam because other thoughts interfere (Worry) 6. While studying for tests, other thoughts interfere with my learning (Worry)	70.96
Pair 2: 14. When I study for exams, I seem to get a mental block that keeps me from absorbing the material (Worry) 15. When I am studying for a test, I can't get my brain to organize the information (Worry)	18.69
Pair 3: 9. I feel panicky when studying for an important exam (Emotionality) 8. I wish studying for tests did not upset me so much (Emotionality)	17.21
Pair 4: 12. While studying for exams, I feel very tense (Emotionality) 5. While studying for exams, I have an uneasy, upset feeling (Emotionality)	16.90
Pair 5: 3. I can't keep my mind on the subject when studying for an exam because other thoughts interfere (Worry) 6. I feel jittery while studying for important exams (Emotionality)	14.69
Pair 6: 7. While studying for a test, I worry about not being able to learn the material (Worry) 8. I wish studying for tests did not upset me so much (Emotionality)	12.17
Pair 7: 13. I freeze up while studying for an important test (Emotionality) 14. When I study for exams, I seem to get a mental block that keeps me from absorbing the material (Worry)	12.00
Pair 8: 13. I freeze up while studying for an important test (Emotionality) 8. I wish studying for tests did not upset me so much (Emotionality)	11.91

15 with 9	9.92	11 with 1	8.78	16 with 11	7.08
5 with 4	9.27	16 with 4	8.45	16 with 7	6.70

After looking at the CFA model separately for males and females, multigroup CFA was conducted to compare the parameter estimates (factor loadings, residual variances, covariance between factors, and factor variances) for males and females. Models were tested sequentially beginning with the least restrictive model and continuing with the addition of specific constraints. Table 15 contains the fit indices corresponding to each of the models that were tested in the confirmatory factor analysis to evaluate

factorial invariance of the scores on the Study Anxiety Inventory by gender. Model 1 was the baseline model in which there were no equality constraints across the male and female groups. For this model, factor loadings, residual variances (i.e., uniquenesses), and factor variances and covariance were freely estimated in each group (males and females). Model 2 is a more restrictive model that imposes equality constraints on the loadings by gender. Because two factors were hypothesized, one loading from each factor was fixed to 1.0 to identify the model. This left 14 pairs of loadings free to vary, seven from each factor. This results in an increase in the degrees of freedom for Model 2 of 14 and a critical value of chi square of 29.121 (p = .01). Model 3 adds additional restrictions by imposing equality constraints on the item residual variances for males and females. Model 4 adds an additional equality constraint, restricting the factor covariance to be equal across gender and Model 5 imposes equality constraints on the factor variances across males and females.

Table 15 shows the different models tested to determine invariance. To test the hypothesis of equal loadings across gender, the more restrictive Model 2 is compared with Model 1 (loadings freely estimated in each group). The change in the chi square value of 30.74 relative to the change in degrees of freedom ($\Delta df = 14$) suggested that invariance of the factor loadings may be untenable (critical value of chi square for 14 degrees of freedom at p = .01 is 29.12).

Table 15

Goodness-of-Fit Indices for Models Tested for Invariance of Scores on the Study Anxiety Inventory by Gender (n = 660 A & S Students, n_M=215, n_F=445)

Model	*Model #*	χ^2	df	$\Delta\chi^2$	Δdf	*p*
1. Baseline	1	955.39	206			
2. Equal Loadings	2	986.13	220	30.74	14	<.01
3. Equal Residual Variances	3	1082.78	236	96.65	16	<.01
3a. Equal Residual Variance for all but 4 items	3a	1031.19	232	45.06	12	<.01
4. Equal Factor Covariances	4	1032.35	233	1.16	1	>.01
5. Equal Factor Variances	5	1044.90	235	12.55	2	<.01

Table 16

Goodness-of-Fit Indices for Invariance of Loadings on the Study Anxiety Inventory by Gender (n = 660 A & S Students, n_M=215, n_F=445)

Item #	χ^2	$\Delta\chi^2$	*p*
3w	960.47	5.08	.0224
4e	958.26	2.87	.0902
5e	957.32	1.93	.1648
6w	957.24	1.85	.1738
7w	958.40	3.01	.0828
8e	955.42	0.03	.8625
9e	955.40	0.01	.9203
10w	956.81	1.42	.2334
11w	956.71	1.32	.2506
12e	956.14	0.75	.3865
13e	956.74	1.35	.2453
14w	957.94	2.55	.1103
15w	956.22	0.83	.3623
16e	956.72	1.33	.2488

Note: degrees of freedom (df) = 207; change in df = 1; *p*-value shows 4 decimal places to compare with .05/14=.0035; χ^2 for the baseline model was 955.39, df =206.

Because the overall hypothesis of equal loadings was rejected ($p < .01$), follow-up testing of each item loading was done to identify the source of the difference. A .0035 (05/14 = .0035) level of statistical significance was used to control the type I error rate. Results are displayed in Table 16. These results indicated that no item loading was significantly different across gender. The *p*-value closest to being statistically significant was .0224 and was for item 3 ("I can't keep my mind on the subject when studying for an exam because other thoughts interfere").

The next model that was tested (Model 3) imposed equality constraints on the error variances. The $\Delta\chi^2$ was 96.65 relative to a change in degrees of freedom of 16 indicating that invariance of errors was not tenable.

Table 17

Goodness-of-Fit Indices for Invariance of Error Variances on the Study Anxiety Inventory by Gender (n = 660 A & S Students, n_M=215, n_F=445)

Item #	χ^2	$\Delta \chi^2$	*p*
1e	993.99	7.86	.0051
2w	992.25	6.12	.0134
3w	987.07	0.94	.3323
4e	1000.85	14.72	.0001
5e	990.51	4.38	.0364
6w	987.58	1.45	.2285
7w	995.24	9.11	.0025
8e	1000.80	14.67	.0001
9e	989.86	3.73	.0534
10w	991.32	5.19	.0227
11w	990.17	4.04	.0444
12e	987.52	1.39	.2384
13e	990.12	3.99	.0458
14w	989.90	3.77	.0522
15w	986.46	0.33	.5657
16e	997.50	11.37	.0007

Note: degrees of freedom (df) = 221; the change in df = 1; *p*-value shows 4 decimal places to compare with .05/16 = .0031; χ^2 for Model 2 was 986.13, df =220.

Because the overall hypothesis of equal error variances was rejected ($p < .01$), follow-up testing of each item error variance was done to identify the source of the difference. A .0031 (.05/16 = .0031) level of statistical significance was used to control the type I error rate. Results are displayed in Table 17. These results indicated that item error variance was statistically significantly different across gender for items 7, a worry item, and items 4, 8, and 16, three emotionality items. Model 3a removes the restrictions on the four items that demonstrated an inequality of residual variance. Model 4 and Model 5 were then run disallowing the restrictions on the four residual variances.

When the covariance between the worry and emotionality factors was set equal, the resulting chi square was 1032.35, which represented a change of 1.16 from Model 3a.

The change in chi square was not statistically significant at the .01 level indicating that invariance of the covariance between the two factors was tenable. When the factor variances of emotionality and worry were set equal across the male and female groups, the resulting chi square was 1044.90 representing a change of 12.55, which was statistically significant at the .01 level indicating that invariance of this parameter was not tenable.

Because the overall hypothesis of equal factor variances was rejected ($p < .01$), follow-up testing of each variance was done to identify the source of the difference. A .025 (05/2 = .025) level of statistical significance was used to control the type I error rate. When the factor variance of emotionality was allowed to vary across gender, the resulting chi square was 1032.37, a chi square change of 0.05, which was not statistically significant at the .01 level indicating that invariance of emotionality was tenable. When the factor variance of worry was allowed to vary across, the resulting chi square was 1039.02, a chi square change of 6.67, which was statistically significant at the .01 level indicating that invariance of worry was not tenable.

College of Engineering. Table 18 provides descriptive statistics by gender for the 16 observed variables used in the confirmatory factor analysis. The responses for each item ranged from one to four and the means for the 16 items for males ranged from 1.50 to 2.05 (median = 1.72) with standard deviations ranging from 0.72 to 0.94 (median = 0.83), and for females the means ranged from 1.70 to 2.15 (median = 1.98) with standard deviations ranging from 0.73 to 1.09 (median = 0.84). For the emotionality scale, the

means for every item were significantly lower for males vs. females. For the worry scale, the means for five of the eight items were significantly lower for males vs. females.

Effect sizes for the individual items are displayed in Table 18 and ranged from fairly low at -0.04 to moderate at -0.39 with low median effect size of -0.18. The effect size of the overall scale was low at -0.11 and the effect sizes of the subscales were moderate at -0.12 for emotionality and low at -0.07 for worry.

Table 18

Descriptive Statistics for the 16 Observed Variables Used in the Two-Factor Confirmatory Factor Analyses of the Study Anxiety Inventory for the College of Engineering by Gender (n_M=243, n_F=192)

	Males		Females				Males	Females	Males	Females
	Mean	*SD*	Mean	*SD*	*t*	*es*	Skewness		Kurtosis	
1e	1.79	0.84	1.99	0.88	-2.40**	-0.20	0.85	0.48	0.47	-0.60
2w	1.89	0.75	2.02	0.73	-1.82*	-0.13	0.48	0.46	0.42	0.20
3w	2.00	0.88	2.15	0.78	-1.88*	-0.15	0.49	0.46	-0.27	0.02
4e	1.71	0.80	1.96	0.84	-3.15**	-0.25	0.97	0.57	0.81	-0.29
5e	1.57	0.72	1.70	0.83	-1.72*	-0.13	0.94	1.06	0.52	0.52
6w	2.05	0.93	2.11	0.84	-0.71	-0.06	0.50	0.54	-0.25	-0.14
7w	1.75	0.80	1.96	0.81	-2.70**	-0.21	0.68	0.61	-0.01	-0.01
8e	1.73	0.94	2.01	1.09	-2.82**	-0.28	1.07	0.71	0.32	-0.84
9e	1.60	0.83	1.99	0.98	-4.41**	-0.39	1.19	0.62	0.87	-0.69
10w	1.73	0.85	2.02	0.83	-3.58**	-0.29	0.88	0.53	0.20	-0.21
11w	1.74	0.89	2.02	0.95	-3.14**	-0.28	0.96	0.57	0.33	-0.64
12e	1.66	0.82	1.93	0.89	-3.25**	-0.27	1.02	0.68	0.68	-0.35
13e	1.50	0.76	1.70	0.86	-2.53**	-0.20	1.37	1.21	1.49	0.86
14w	1.71	0.85	1.76	0.79	-0.63	-0.05	0.96	0.84	0.38	0.23
15w	1.68	0.85	1.72	0.77	-0.51	-0.04	1.08	0.80	0.69	0.03
16e	1.62	0.79	1.86	0.88	-2.95**	-0.24	0.99	0.75	0.48	-0.25
SAI	1.74	0.63	1.94	0.64	-3.26**	-0.20	0.82	0.71	1.04	0.22
SAe	1.65	0.66	1.89	0.72	-3.58**	-0.24	0.95	0.74	1.05	-0.05
SAw	1.83	0.66	1.98	0.64	-2.39**	-0.15	0.71	0.69	0.75	0.22

Note: *p <.05, ** p < .01. *es* = effect size. Emotionality (e) items are 1, 4, 5, 8, 9, 12, 13, 16; Worry (w) items are 2, 3, 6, 7, 10, 11, 14, 15

Kurtosis and skewness values for each of the items were close to zero for both males and females, which suggests that the peak and tails of the distribution were similar to the normal curve and reflected acceptable symmetry.

The χ^2 fit statistics for the CFA of the two-factor (worry, emotionality) model for male and female students from the College of Engineering indicated that the fit of the model was not acceptable, χ^2 (103, N_M=240) = 359.11 and χ^2 (103, N_F=188) = 345.52. respectively. The same alternative measures of fit were included because the χ^2 is sensitive to sample size. The SRMRs for the male and female groups of .053 and .060,

respectively, indicated similar and acceptable fit, while the CFI of .907 for males and .882 for females, and the RMSEAs of .102 for males and .112 for females indicated less than acceptable fit.

The unstandardized factor loadings for the items, excluding the one fixed to 1.0, ranged from 1.12 to 1.36 with a mean of 1.26 (*SD* = 0.10) for the males and from 1.28 to 1.65 with a mean of 1.44 (*SD* = 0.15) for the females for the factor of emotionality. These loadings ranged from 1.14 to 1.39 with a mean of 1.26 (*SD* = 0.09) for the males and from 0.99 to 1.38 with a mean of 1.18 (*SD* = 0.13) for the females for the factor of worry.

Standardized factor loadings of all items on the emotionality and worry scale were statistically significant as hypothesized (>.62 for males and >.58 for females). The correlation between emotionality and worry was .90 for males and .88 for females.

Sources of misfit of the models for males and females were further explored by comparing the modification indices that indicated the expected decrease in model fit chi square ($\Delta\chi^2$) that would result when a specific parameter, constrained initially to zero, subsequently was freely estimated. As with the combined sample of engineering students, the largest expected chi square change was between covariances of the errors for items 3 and 6 ($\Delta\chi^2$=59.99 for males and 67.08 for females). Of the eight pairs of items with the highest chi-square change for the females, two of the correlated errors were also found in the list of the highest eight for males (6 and 3, and 15 and 14).

Table 19

Modification Indices for Error Covariances for the Study Anxiety Inventory for Responses from Male Engineering Students (n = 240)

Items with errors covarying	Chi-Square Difference
Pair 1: 3. I can't keep my mind on the subject when studying for an exam because other thoughts interfere (Worry) 6. While studying for tests, other thoughts interfere with my learning (Worry)	59.99
Pair 2: 1. I feel very uneasy just before starting to study for an exam (Emotionality) 2. While I am studying for an exam I often think "I'm not getting this" (Worry)	25.67
Pair 3: 4. Even when I have plenty of time, I feel nervous when I try to study for an exam (Emotionality) 1. I feel very uneasy just before starting to study for an exam (Emotionality)	16.44
Pair 4: 12. While studying for exams, I feel very tense (Emotionality) 15. When I am studying for a test, I can't get my brain to organize the information (Worry)	14.86
Pair 5: 11. I worry so much when I study for a test that I do things that distract me (Worry) 2. While studying for exams, I feel very tense (Emotionality)	12.10
Pair 6: 3. I can't keep my mind on the subject when studying for an exam because other thoughts interfere (Worry) 2. While I am studying for an exam I often think "I'm not getting this" (Worry)	11.41
Pair 7: 14. When I study for exams, I seem to get a mental block that keeps me from absorbing the material (Worry) 1. I feel very uneasy just before starting to study for an exam (Emotionality)	10.88
Pair 8: 14. When I study for exams, I seem to get a mental block that keeps me from absorbing the material (Worry) 15. When I am studying for a test, I can't get my brain to organize the information (Worry)	9.69

14 with 10	8.45	11 with 10	8.10	13 with 10	6.99
14 with 13	8.27	9 with 6	7.69	14 with 7	6.87
4 with 3	8.11	16 with 15	7.40	9 with 7	6.69

Table 20

Modification Indices for Error Covariances for the Study Anxiety Inventory for Responses from Female Engineering Students (n = 188)

Items with errors covarying	Chi-Square Diff
Pair 1: 3. I can't keep my mind on the subject when studying for an exam because other thoughts interfere (Worry) 6. While studying for tests, other thoughts interfere with my learning (Worry)	67.08
Pair 2: 5. While studying for exams, I have an uneasy, upset feeling (Emotionality) 4. Even when I have plenty of time, I feel nervous when I try to study for an exam (Emotionality)	23.42
Pair 3: 15. When I am studying for a test, I can't get my brain to organize the information (Worry) 14. When I study for exams, I seem to get a mental block that keeps me from absorbing the material (Worry)	15.63
Pair 4: 12. While studying for exams, I feel very tense (Emotionality) 9. I feel panicky when studying for an important exam (Emotionality)	13.56
Pair 5: 12. While studying for exams, I feel very tense (Emotionality) 5. While studying for exams, I have an uneasy, upset feeling (Emotionality)	13.32
Pair 6: 14. When I study for exams, I seem to get a mental block that keeps me from absorbing the material (Worry) 12. While studying for exams, I feel very tense (Emotionality)	12.72
Pair 7: 13. I freeze up while studying for an important test (Emotionality) 14. When I study for exams, I seem to get a mental block that keeps me from absorbing the material (Worry)	10.34
Pair 8: 9. I feel panicky when studying for an important exam (Emotionality) 10. While studying for exams, I am stressed with thoughts like "I can't absorb the material properly" (Worry)	9.52

15 with 2	8.76	9 with 5	7.74	4 with 2	7.10
12 with 7	8.33	11 with 6	7.68	5 with 2	6.76
9 with 3	8.13	13 with 1	7.49	16 with 8	6.71

After looking at the CFA model separately for males and females, multigroup CFA was conducted to compare the parameter estimates (factor loadings, residual variances, covariance between factors, and factor variances) for males and females. Models were tested sequentially beginning with the least restrictive model and continuing with the addition of specific constraints.

Table 21 shows the different models tested to evaluate invariance. The constraint of equal loadings by gender is the more restrictive Model 2. The change in the chi square value of 6.38 relative to the change in degrees of freedom ($\Delta df = 14$) suggested that invariance of the factor loadings is tenable.

Table 21

Goodness-of-Fit Indices for Models Tested for Invariance of Scores on the Study Anxiety Inventory by Gender (n = 428 Engineering Students, n_M=240, n_F=188)

Model	*Model #*	χ^2	df	$\Delta\chi^2$	Δdf	*p*
1. Baseline	1	704.62	206			
2. Equal Loadings	2	710.93	220	6.38	14	>.01
3. Equal Residual Variances	3	759.34	236	48.41	16	<.01
3a. Equal Residual Variance for all but 2 items	3a	736.87	234	25.94	14	>.01
4. Equal Factor Covariances	4	736.88	235	0.01	1	>.01
5. Equal Factor Variances	5	744.61	237	7.73	2	>.01

The next model that was tested (Model 3) imposed equality constraints on the error variances. The $\Delta\chi^2$ was 48.41 relative to a change in degrees of freedom of 16 indicating that invariance of errors was not tenable.

Table 22

Goodness-of-Fit Indices for Invariance of Error Variances on the Study Anxiety Inventory by Gender (n = 428 Engineering Students, n_M=240, n_F=188)

Item #	χ^2	$\Delta \chi^2$	*p*
1e	712.10	1.17	.2794
2w	711.37	0.44	.5071
3w	714.26	3.33	.0680
4e	710.97	0.04	.8415
5e	713.79	2.86	.0908
6w	711.38	0.45	.5023
7w	711.37	0.44	.5071
8e	716.45	5.52	.0188
9e	719.76	8.83	.0030
10w	711.16	0.23	.6315
11w	713.53	2.60	.1069
12e	711.56	0.63	.4274
13e	722.83	11.9	.0006
14w	710.95	0.02	.8875
15w	716.30	5.37	.0205
16e	713.41	2.48	.1153

Note: degrees of freedom (df) = 221; change in df = 1; *p*-value shows 4 decimal places to compare with .05/14=.0035; χ^2 for model 2 was 710.93, df =220; Emotionality (e) items are 1, 4, 5, 8, 9, 12, 13, 16; Worry (w) items are 2, 3, 6, 7, 10, 11, 14, 15

Because the overall hypothesis of equal error variances was rejected ($p < .01$), follow-up testing of each item error variance was done to identify the source of the difference. A .0031 (.05/16 = .0031) level of statistical significance was used to control the type I error rate. Results are displayed in Table 22. These results indicated that item error variance was statistically significantly different across gender for items 9 and 13, two emotionality items. Model 3a removes the restrictions on the two items that demonstrated an inequality of residual variance. Models 4 and 5 were then run and compared with Model 3a which constrained the factor loadings and 14 out of the 16 residual variances to be equal across gender.

When the covariance between the two factors was set equal, the resulting chi square was 736.88, which represented a change of 0.01 from Model 3a. The change in chi square was not statistically significant at the .01 level indicating that invariance of the covariance between the two factors was tenable. When the factor variances of emotionality and worry were set equal across the male and female groups, the resulting chi square was 744.61 representing a change of 7.73, which was not statistically significant at the .01 level indicating that invariance of these parameters was tenable.

College of Business. Table 23 provides descriptive statistics by gender for the 16 observed variables used in the confirmatory factor analysis. The responses for each item ranged from one to four and the means for the 16 items for males ranged from 1.64 to 2.20 (median = 1.87) with standard deviations ranging from 0.70 to 0.98 (median = 0.83), and for females ranged from 1.77 to 2.23 (median = 1.98) with standard deviations ranging from 0.77 to 1.11 (median = 0.90). For the emotionality scale, the means for four of the eight items were significantly lower for males vs. females. For the worry scale, the means for two of the eight items were significantly lower for males vs. females.

Effect sizes for the individual items were low and (see Table 23) and ranged from -0.17 to -0.21 with a low median effect size of -0.18. There was no significant difference between males and females for the overall scale or the worry subscale and the effect size for the emotionality scale was low at -0.18.

Table 23

Descriptive Statistics for the 16 Observed Variables Used in the Two-Factor Confirmatory Factor Analyses of the Study Anxiety Inventory for the College of Business by Gender (n_M=216, n_F=193)

	Males		Females				Males	Females	Males	Females
	Mean	*SD*	Mean	*SD*	*t*	*es*	Skewness		Kurtosis	
1e	1.95	0.87	1.93	0.82	0.24	0.02	0.52	0.77	-0.35	0.30
2w	1.93	0.70	2.03	0.77	-1.37	-0.10	0.43	0.57	0.10	0.24
3w	2.20	0.84	2.23	0.87	-0.35	-0.02	0.20	0.30	0.61	-0.56
4e	1.82	0.80	2.00	0.95	-2.06*	-0.14	0.72	0.63	-0.04	-0.53
5e	1.65	0.76	1.79	0.87	-1.72*	-0.12	0.94	0.90	0.18	0.09
6w	2.18	0.87	2.19	0.90	-0.11	-0.01	0.43	0.36	-0.41	-0.61
7w	1.90	0.87	2.06	0.86	-1.87*	-0.13	0.67	0.53	-0.13	-0.30
8e	1.88	0.98	2.08	1.11	-1.92*	-0.14	0.84	0.62	-0.36	-0.89
9e	1.86	0.87	1.97	0.99	-1.19	-0.08	0.68	0.67	-0.43	-0.54
10w	1.89	0.83	2.05	0.98	-1.77*	-0.12	0.65	0.52	-0.17	-0.65
11w	1.92	0.92	1.99	0.98	-0.74	-0.05	0.74	0.58	-0.33	-0.64
12e	1.75	0.79	1.91	0.95	-1.84*	-0.13	0.87	0.78	0.28	-0.19
13e	1.64	0.80	1.77	0.91	-1.53	-0.11	1.08	0.85	0.40	-0.19
14w	1.85	0.83	1.91	0.86	-0.72	-0.05	0.84	0.58	0.23	-0.28
15w	1.79	0.77	1.87	0.83	-1.01	-0.13	0.76	0.53	0.21	-0.38
16e	1.80	0.85	1.91	0.93	-1.24	-0.09	0.81	0.69	-0.11	-0.33
SAI	1.89	0.63	1.99	0.71	-1.50	-0.11	0.48	0.63	-0.39	-0.22
SAe	1.80	0.69	1.93	0.78	-1.78*	-0.12	0.61	0.68	-0.30	-0.42
SAw	1.97	0.64	2.04	0.71	-1.04	-0.07	0.34	0.57	-0.56	-0.16

Note: *p <.05, ** p < .01. *es* = effect size, Emotionality (e) items are 1, 4, 5, 8, 9, 12, 13, 16; Worry (w) items are 2, 3, 6, 7, 10, 11, 14, 15

Examination of the kurtosis and skewness values showed that the value of each of the items was close to zero for both males and females, which suggests that the peak and tails of the distribution are similar to the normal curve and reflected acceptable symmetry.

The χ^2 fit statistics for the CFA of the two-factor (worry, emotionality) model for male and female students from the College of Business indicated that the fit of the model was not acceptable, χ^2 (103, N_M=210) = 273.61 and χ^2 (103, N_F=189) = 434.36, respectively. The same alternative measures of fit were included because the χ^2 is

sensitive to sample size. The SRMRs for the male and female groups of .052 and .059 respectively, each indicated similar and acceptable fit. The CFI of .921 for the males and .869 for the females indicated less than acceptable fit. The RMSEAs of .089 and .089 for both indicated less than acceptable fit.

The unstandardized factor loadings for the responses, excluding the one fixed to 1.0, ranged from 1.04 to 1.32 with a mean of 1.18 (*SD* = 0.10) for the males and from 1.23 to 1.47 with a mean of 1.36 (*SD* = 0.08) for the females for the factor of emotionality. These loadings ranged from 1.09 to 1.56 with a mean of 1.29 (*SD* = 0.16) for the males and from 1.05 to 1.44 with a mean of 1.26 (*SD* = 0.14) for the females for the factor of worry.

An examination of the standardized factor loadings showed that the loadings of all items on the worry scale were statistically significant as hypothesized (>.60 for males and >.67 for females). The correlation between emotionality and worry was .87 for males and .85 for females.

Sources of misfit of the models for males and females were further explored by comparing the modification indices that indicated the expected decrease in model fit chi square ($\Delta\chi^2$) that would result when a specific parameter, constrained initially to zero, subsequently was freely estimated. As with the combined sample of business students, the largest expected chi square change was between covariances of the errors for items 3 and 6 ($\Delta\chi^2$=45.95 for males and 31.13 for females). Of the eight pairs of items with the highest chi-square change for the females, two of the correlated errors were also found in the list of the highest eight for males (6 and 3, and 15 and 14).

Table 24

Modification Indices for Error Covariances for the Study Anxiety Inventory for Responses from Male Business Students (n = 210)

Items with errors covarying	Chi-Square Difference
Pair 1: 3. I can't keep my mind on the subject when studying for an exam because other thoughts interfere (Worry) 6. While studying for tests, other thoughts interfere with my learning (Worry)	45.95
Pair 2: 13. I freeze up while studying for an important test (Emotionality) 6. While studying for tests, other thoughts interfere with my learning (Worry)	15.45
Pair 3: 14. When I study for exams, I seem to get a mental block that keeps me from absorbing the material (Worry) 7. While studying for a test, I worry about not being able to learn the material (Worry)	13.76
Pair 4: 12. While studying for exams, I feel very tense (Emotionality) 2. While I am studying for an exam I often think "I'm not getting this" (Worry)	12.37
Pair 5: 1. I feel very uneasy just before starting to study for an exam (Emotionality) 2. While I am studying for an exam I often think "I'm not getting this" (Worry)	10.38
Pair 6: 10. While studying for exams, I am stressed with thoughts like "I can't absorb the material properly (Worry) 6. While studying for tests, other thoughts interfere with my learning (Worry)	8.19
Pair 7: 15. When I am studying for a test, I can't get my brain to organize the information (Worry) 14. When I study for exams, I seem to get a mental block that keeps me from absorbing the material (Worry)	9.91
Pair 8: 10. While studying for exams, I am stressed with thoughts like "I can't absorb the material properly" (Worry) 5. While studying for exams, I have an uneasy, upset feeling (Emotionality)	8.19

Table 25

Modification Indices for Error Covariances for the Study Anxiety Inventory for Responses from Female Business Students (n = 189)

Items with errors covarying	Chi-Square Difference
Pair 1: 4. Even when I have plenty of time, I feel nervous when I try to study for an exam (Emotionality) 6. While studying for tests, other thoughts interfere with my learning (Worry)	32.83
Pair 2: 3. I can't keep my mind on the subject when studying for an exam because other thoughts interfere (Worry) 6. While studying for tests, other thoughts interfere with my learning (Worry)	31.13
Pair 3: 1. I feel very uneasy just before starting to study for an exam (Emotionality) 6. While studying for tests, other thoughts interfere with my learning (Worry)	21.81
Pair 4: 4. Even when I have plenty of time, I feel nervous when I try to study for an exam (Emotionality) 3. I can't keep my mind on the subject when studying for an exam because other thoughts interfere (Worry)	20.45
Pair 5: 5. While studying for exams, I have an uneasy, upset feeling (Emotionality) 7. While studying for a test, I worry about not being able to learn the material (Worry)	20.43
Pair 6: 4. Even when I have plenty of time, I feel nervous when I try to study for an exam (Emotionality) 1. I feel very uneasy just before starting to study for an exam (Emotionality)	20.36
Pair 7: 14. When I study for exams, I seem to get a mental block that keeps me from absorbing the material (Worry) 15. When I am studying for a test, I can't get my brain to organize the information (Worry)	19.92
Pair 8: 12. While studying for exams, I feel very tense (Emotionality) 6. While studying for tests, other thoughts interfere with my learning (Worry)	18.21

10 with 9	17.67	9 with 6	12.82	10 with 3	8.24
5 with 4	15.71	16 with 12	12.12	16 with 11	7.93
12 with 11	15.50	15 with 3	10.48	5 with 1	7.44
12 with 4	13.52	11 with 7	9.95	16 with 7	7.39
14 with 13	13.13	3 with 2	9.80	15 with 1	7.36
9 with 3	13.01	12 with 2	9.54	10 with 5	7.28
9 with 8	12.87	9 with 5	9.04	9 with 4	7.05

After looking at the CFA model separately for males and females, multigroup CFA was conducted to compare the parameter estimates (factor loadings, residual variances, covariance between factors, and factor variances) for males and females.

Models were tested sequentially beginning with the least restrictive model and continuing with the addition of specific constraints. Table 26 contains the fit indices corresponding to each of the models that were tested in the confirmatory factor analysis to evaluate factorial invariance of the scores on the Study Anxiety Inventory by gender. Model 1 is the baseline model in which there are no equality constraints across the male and female groups. For this model, factor loadings, residual variances (i.e., uniquenesses), and factor variances and covariance are freely estimated in each group (males and females). Model 2 is a more restrictive model that imposes equality constraints on the loadings by gender. Because two factors were hypothesized, one loading from each factor was fixed to 1.0 to identify the model. This left 14 pairs (seven from each factor) of loadings free to vary. This establishes an increase in the degrees of freedom for Model 2 by 14 which increases the change in the critical value of chi square by 29.121 (p = .01). Model 3 adds additional restrictions by imposing equality constraints on the residual variances for males and females. Model 4 adds an additional equality constraint, restricting the factor covariance to be equal across gender, and Model 5 imposes equality constraints on the factor variances across males and females.

Table 26 shows the different models tested to determine invariance. The constraint of equal loadings by gender is the more restrictive Model 2 compared with Model 1 (loadings freely estimated in each group). The change in the chi square value of 7.51 relative to the change in degrees of freedom ($\Delta df = 14$) suggested that invariance of the factor loadings was tenable.

Table 26

Goodness-of-Fit Indices for Models Tested for Invariance of Scores on the Study Anxiety Inventory by Gender (n = 399 Business Students, n_M=210, n_F=189)

Model	*Model #*	χ^2	df	$\Delta\chi^2$	Δdf	*p*
1. Baseline	1	707.97	206			
2. Equal Loadings	2	715.48	220	7.51	14	>.01
3. Equal Residual Variances	3	761.74	236	46.26	16	<.01
3a. Equal Residual Variance for all but 4 & 9	3a	736.27	234	20.79	13	>.01
4. Equal Factor Covariances	4	741.41	235	5.14	1	>.01
5. Equal Factor Variances	5	741.85	237	0.44	2	>.01

The next model that was tested (Model 3) imposed equality constraints on the error variances. The $\Delta\chi^2$ was 42.16 relative to a change in degrees of freedom of 16 indicating that invariance of errors was not tenable.

Table 27

Goodness-of-Fit Indices for Invariance of Error Variances on the Study Anxiety Inventory by Gender (n = 399 Business Students, n_M=210, n_F=189)

Item #	χ^2	$\Delta \chi^2$	*p*
1e	717.72	2.24	.1345
2w	715.72	0.24	.6242
3w	715.48	0.00	.9999
4e	730.7	15.22	.0001
5e	715.7	0.22	.6390
6w	719.48	4.00	.0455
7w	716.61	1.13	.2878
8e	717.16	1.68	.1949
9e	724.59	9.11	.0025
10w	718.89	3.41	.0648
11w	715.54	0.06	.8065
12e	718.67	3.19	.0741
13e	715.54	0.06	.8065
14w	718.19	2.71	.0997
15w	715.86	0.38	.5376
16e	715.92	0.44	.5071

Note: degrees of freedom (df) = 235; the change in df = 1; *p*-value shows 4 decimal places to compare with .05/16 = .0031; χ^2 for the baseline model was 761.74, df =206. Emotionality (e) items are 1, 4, 5, 8, 9, 12, 13, 16; Worry (w) items are 2, 3, 6, 7, 10, 11, 14, 15

Because the overall hypothesis of equal error variances was rejected ($p < .01$), follow-up testing of each item error variance was done to identify the source of the difference. A .0031 (.05/16 = .0031) level of statistical significance was used to control the type I error rate. Results are displayed in Table 27. These results indicated that item error variance was statistically significantly different across gender for items 4 and 9, both emotionality items. Model 3a removes the restrictions on the two items that demonstrated an inequality of residual variance. Models 4 and 5 were then run while still disallowing the restrictions on the three residual variances.

When the covariance between the emotionality and worry factors was set equal, the resulting chi square was 741.41, which represented a change of 5.14 from Model 3a. The change in chi square was not statistically significant at the .01 level indicating that invariance of the covariance between the two factors was tenable. When the factor variances of emotionality and worry were set equal across the male and female groups, the resulting chi square was 741.85 representing a change of 0.44, which was not statistically significant at the .01 level indicating that invariance of these parameters was tenable.

College of Education. Table 28 provides descriptive statistics by gender for the 16 observed variables used in the confirmatory factor analysis. The responses for each item ranged from one to four and the means for the 16 items for males ranged from 1.63 to 2.12 (median = 1.82) with standard deviations ranging from 0.68 to 1.06 (median = 0.83), and for females ranged from 1.81 to 2.41 (median = 2.15) with standard deviations ranging from 0.84 to 1.18 (median = 0.94). Kurtosis and skewness values for each of the items were close to zero for both males and female, which suggest that the peak and tails of the distribution were similar to the normal curve and reflected acceptable symmetry.

The mean of every item score for the males was statistically significantly lower than the mean item score for the females. Effect sizes for the individual items are displayed in Table 28 and ranged from fairly low at -0.15 to moderate at -0.34 with a low median effect size of -0.24. The effect size of the overall scale was low at -0.29 and the effect sizes of the subscales were low at -0.24 for emotionality and low at 0.31 for worry.

Table 28

Descriptive Statistics for the 16 Observed Variables Used in the Two-Factor Confirmatory Factor Analyses of the Study Anxiety Inventory for the College of Education by Gender (n_M=210, n_F=203)

	Males		Females				Males	Females	Males	Females
	Mean	*SD*	Mean	*SD*	*t*	*es*	Skewness		Kurtosis	
1e	1.79	0.81	2.08	0.95	-3.33**	-0.23	0.72	0.61	0.03	-0.50
2w	1.87	0.68	2.24	0.86	-4.84**	-0.34	0.35	0.47	0.47	-0.29
3w	2.12	0.83	2.41	0.89	-3.42**	-0.24	0.18	0.19	-0.26	-0.68
4e	1.80	0.85	2.15	1.01	-3.80**	-0.27	0.72	0.43	-0.14	-0.91
5e	1.67	0.81	1.96	0.95	-3.33**	-0.23	1.00	0.75	0.51	-0.35
6w	2.11	0.83	2.37	0.94	-2.98**	-0.21	0.38	0.19	-0.15	-0.84
7w	1.92	0.82	2.29	0.92	-4.31**	-0.30	0.51	0.32	-0.19	-0.69
8e	1.96	1.06	2.21	1.18	-2.26*	-0.16	0.70	0.45	-0.74	-1.31
9e	1.80	0.90	2.15	1.00	-3.73**	-0.26	0.78	0.50	-0.30	-0.81
10w	1.84	0.79	2.23	0.94	-4.56**	-0.32	0.52	0.43	-0.28	-0.65
11w	1.87	0.87	2.15	0.99	-3.05**	-0.21	0.65	0.44	-0.26	-0.84
12e	1.71	0.82	2.03	0.95	-3.66**	-0.25	0.90	0.60	0.27	-0.59
13e	1.63	0.80	1.81	0.92	-2.12*	-0.15	0.94	0.81	0.01	-0.26
14w	1.83	0.86	2.13	0.90	-3.46**	-0.24	0.71	0.39	-0.17	-0.62
15w	1.78	0.76	2.02	0.84	-3.04**	-0.21	0.53	0.42	0.06	-0.49
16e	1.81	0.87	1.97	0.92	-1.81*	-0.13	0.89	0.59	0.27	-0.58
SAI	1.86	0.61	2.14	0.77	-4.09**	-0.29	0.59	0.56	-0.27	-0.49
SAe	1.79	0.71	2.05	0.84	-3.39**	-0.24	0.74	0.59	-0.24	-0.53
SAw	1.93	0.59	2.23	0.76	-4.47**	-0.31	0.44	0.46	-0.50	-0.42

Note: *p <.05, ** p < .01. *es* = effect size, Emotionality (e) items are 1, 4, 5, 8, 9, 12, 13, 16; Worry (w) items are 2, 3, 6, 7, 10, 11, 14, 15

The χ^2 fit statistics for the CFA of the two-factor (worry, emotionality) model for male and female students from the College of Education indicated that the fit of the model was not acceptable, χ^2 (103, N_M=208) = 283.07 and χ^2 (103, N_F=202) = 388.97 respectively. The same alternative measures of fit were included because the χ^2 is sensitive to sample size. The SRMRs for the male and female groups of .053 and .046 respectively, indicated similar and acceptable fit, while the CFIs of .916 and .905 respectively, and the RMSEAs of .092 and .117 respectively, indicated less than acceptable fit.

The unstandardized factor loadings for the responses, excluding the one fixed to 1.0, ranged from 1.08 to 1.32 with a mean of 1.21 (*SD* = 0.08) for the males and from 1.03 to 1.23 with a mean of 1.10 (*SD* = 0.09) for the females for the factor of emotionality. These loadings ranged from 1.04 to 1.57 with a mean of 1.33 (*SD* = 0.21) for the males and from 1.03 to 1.23 with a mean of 1.12 (*SD* = 0.07) for the females for the factor of worry.

Standardized factor loadings of all items on the emotionality and worry scales were statistically significant as hypothesized (>.54 for males and >.77 for females). The correlation between emotionality and worry was .91 for males and .92 for females.

Sources of misfit of the models for males and females were further explored by comparing the modification indices that indicated the expected decrease in model fit chi square ($\Delta\chi^2$) that would result when a specific parameter, constrained initially to zero, subsequently was freely estimated. As with the combined sample of education students, the largest expected chi square change was between covariances of the errors for items 3 and 6 ($\Delta\chi^2$=35.08 for males and 63.59 for females). Of the eight pairs of items with the highest chi-square change for the females, three of the covariances between errors were also found in the list of the highest eight for males (6 and 3, 14 and 13, and 15 and 14).

Table 29

Modification Indices for Error Covariances for the Study Anxiety Inventory for Responses from Male Education Students (n = 208)

Items with errors covarying	Chi-Square Difference
Pair 1: 3. I can't keep my mind on the subject when studying for an exam because other thoughts interfere (Worry) 6. While studying for tests, other thoughts interfere with my learning (Worry)	35.08
Pair 2: 10. While studying for exams, I am stressed with thoughts like "I can't absorb the material properly"(Worry) 3. I can't keep my mind on the subject when studying for an exam because other thoughts interfere(Worry)	14.21
Pair 3: 13. I freeze up while studying for an important test (Emotionality) 14. When I study for exams, I seem to get a mental block that keeps me from absorbing the material (Worry)	13.90
Pair 4: 9. I feel panicky when studying for an important exam (Emotionality) 5. While studying for exams, I have an uneasy, upset feeling (Emotionality)	11.98
Pair 5: 9. I feel panicky when studying for an important exam (Emotionality) 7. While studying for a test, I worry about not being able to learn the material (Worry)	11.92
Pair 6: 14. When I study for exams, I seem to get a mental block that keeps me from absorbing the material (Worry) 5. While studying for exams, I have an uneasy, upset feeling (Emotionality)	11.26
Pair 7: 14. When I study for exams, I seem to get a mental block that keeps me from absorbing the material (Worry) 3. I can't keep my mind on the subject when studying for an exam because other thoughts interfere (Worry)	10.76
Pair 8: 14. When I study for exams, I seem to get a mental block that keeps me from absorbing the material (Worry) 15. When I am studying for a test, I can't get my brain to organize the information (Worry)	9.94

12 with 7	9.17	10 with 7	8.26	12 with 10	7.02
7 with 5	8.82	7 with 3	7.96	7 with 1	6.95
10 with 9	8.49	4 with 3	7.26	9 with 3	6.82
				11 with 9	6.71

Table 30

Modification Indices for Error Covariances for the Study Anxiety Inventory for Responses from Female Education Students (n = 202)

Items with errors covarying	Chi-Square Difference
Pair 1: 3. I can't keep my mind on the subject when studying for an exam because other thoughts interfere (Worry) 6. While studying for tests, other thoughts interfere with my learning (Worry)	63.59
Pair 3: 9. I feel panicky when studying for an important exam (Emotionality) 8. I wish studying for tests did not upset me so much (Emotionality)	23.32
Pair 2: 14. When I study for exams, I seem to get a mental block that keeps me from absorbing the material (Worry) 15. When I am studying for a test, I can't get my brain to organize the information (Worry)	20.75
Pair 2: 10. While studying for exams, I am stressed with thoughts like "I can't absorb the material properly"(Worry) 7. While studying for a test, I worry about not being able to learn the material (Worry)	17.78
Pair 2: 14. When I study for exams, I seem to get a mental block that keeps me from absorbing the material (Worry) 7. While studying for a test, I worry about not being able to learn the material (Worry)	16.70
Pair 5: 13. I freeze up while studying for an important test (Emotionality) 7. While studying for a test, I worry about not being able to learn the material (Worry)	16.02
Pair 7: 13. I freeze up while studying for an important test (Emotionality) 14. When I study for exams, I seem to get a mental block that keeps me from absorbing the material (Worry)	15.70
Pair 8: 4. Even when I have plenty of time, I feel nervous when I try to study for an exam (Emotionality) 2. While I am studying for an exam I often think "I'm not getting this" (Worry)	14.72

10 with 6	14.37	7 with 5	11.15	5 with 4	9.61
9 with 6	13.41	10 with 3	11.13	13 with 4	9.42
11 with 2	12.88	2 with 1	11.12	15 with 7	8.67
15 with 13	11.83	11 with 9	9.95	5 with 3	7.06

After looking at the CFA model separately for males and females, multigroup CFA was conducted to compare the parameter estimates (factor loadings, residual variances, covariance between factors, and factor variances) for males and females. Models were tested sequentially beginning with the least restrictive model and continuing

with the addition of specific constraints. Table 31 contains the fit indices corresponding to each of the models that were tested in the confirmatory factor analysis to evaluate factorial invariance of the scores on the Study Anxiety Inventory by gender.

The constraint of equal loadings by gender is the more restrictive Model 2 compared with Model 1 (loadings freely estimated in each group). The change in the chi square value of 24.68 relative to the change in degrees of freedom ($\Delta df = 14$) suggested that invariance of the factor loadings was tenable.

Table 31

Goodness-of-Fit Indices for Models Tested for Invariance of Scores on the Study Anxiety Inventory by Gender (n = 410 Education Students, n_M=208, n_F=202)

Model	*Model #*	χ^2	df	$\Delta\chi^2$	Δdf	*p*
1. Baseline	1	672.04	206			
2. Equal Loadings	2	696.72	220	24.68	14	>.01
3. Equal Residual Variances	3	735.59	236	38.87	16	<.01
3a. Equal Residual Variance for all except 3	3a	726.05	235	29.33	15	>.01
4. Equal Factor Covariances	4	735.12	236	9.07	1	<.01
5. Equal Factor Variances with Covariances and Residual Variance for item 3 free to vary	5	737.24	237	2.12	2	>.01

The next model that was tested (Model 3) imposed equality constraints on the error variances. The $\Delta\chi^2$ was 38.87 relative to a change in degrees of freedom of 16 indicating that invariance of errors was not tenable. Because the overall hypothesis of equal error variances was rejected ($p < .01$) follow-up testing of each item error variance was done to identify the source of the difference. A .0031 (.05/16 = .0031) level of statistical significance was used to control the type I error rate. Results are displayed in Table 32. These results indicated that item error variance was statistically significantly different across gender for item 3, a worry item.

Model 3a removed the equality restrictions on this one item that demonstrated an inequality of residual variance. Model 4 was then run while still disallowing the restriction on the residual variance of item 3. The $\Delta\chi^2$ was 9.07 relative to a change in degrees of freedom of 1 indicating that invariance of covariances was not tenable. Model

5 was then run while still disallowing the restriction on the residual variance of item 3 and disallowing the restriction on the covariance between worry and emotionality. The $\Delta\chi^2$ was 2.12 relative to a change in degrees of freedom of 2 indicating that invariance of the factor variances was tenable.

Table 32

Goodness-of-Fit Indices for Invariance of Error Variances on the Study Anxiety Inventory by Gender (n = 410 Education Students, n_M=208, n_F=202)

Item #	χ^2	$\Delta\chi^2$	*p*
1e	696.73	0.01	.9203
2w	697.63	0.91	.3401
3w	706.27	9.55	.0020
4e	702.67	5.95	.0147
5e	698.91	2.19	.1389
6w	700.97	4.25	.0393
7w	698.56	1.84	.1750
8e	698.8	2.08	.1492
9e	697.25	0.53	.4666
10w	698.07	1.35	.2453
11w	697.86	1.14	.2857
12e	702.03	5.31	.0212
13e	698.57	1.85	.1738
14w	696.89	0.17	.6801
15w	696.99	0.27	.6033
16e	697.4	0.68	.4096

Note: degrees of freedom (df) = 221; change in df = 1; *p*-value shows 4 decimal places to compare with .05/16=.0031; χ^2 for the Equal Loadings model was 696.72, df =220. Emotionality (e) items are 1, 4, 5, 8, 9, 12, 13, 16; Worry (w) items are 2, 3, 6, 7, 10, 11, 14, 15

Summary of Results for Research Question 2

Table 33 presents fit indices for the confirmatory factor analysis for the two-factor model for both males and females for each college. Although for each college, chi square values for males and females indicated less than acceptable fit, the SRMRs indicated acceptable fit for both in each college with SRMRs ranging from .050 to 053 for males

and from .046 to .060 for females. Both males and females for all four colleges had CFIs that indicated less than acceptable fit for the two-factor model (CFIs for males ranged from .907 to .921 and for females from .869 to .921). Both males and females for each college had RMSEAs that indicated less than acceptable fit for the two-factor model ranging from .089 to .103 for males and from .089 to .112 for females.

Table 33

Fit Indices for the Confirmatory Factor Analysis of the Hypothesized Two-Factor Model by Gender for the Study Anxiety Inventory Across Four Colleges

	Arts and Sciences		Business		Education		Engineering	
	Males	Females	Males	Females	Males	Females	Males	Females
χ^2	337.64	617.76	273.61	434.36	283.07	388.97	359.11	345.52
SRMR	.050	.053	.052	.059	.053	.046	.053	.060
CFI	.915	.904	.921	.869	.916	.905	.907	.882
RMSEA	.103	.106	.089	.089	.092	.117	.102	.112

Standardized loadings of the items for the emotionality and worry factors were consistent across the four colleges and were for both males and females above .60 on emotionality and above .62 on worry. The standardized loadings were above .54 for males and females on both factors for each college.

Correlated errors for item pairs 6 and 3 and 15 and 14 were significant sources of misfit indices for all four colleges and for both males and females. The pair 14 and 13 also had a significant modification index for all four colleges and for each college sample of females (exception was for the sample of males in business). Item pairs 10 and 9, 9 and 6 and 9 and 3 also had significant modification indices for all four colleges but when checked for males and females within the colleges produced inconsistent results.

Correlated errors for pairs 4 and 3, 4 and 2 and 2 and 1 were also significant for all four colleges. Although there were a number of other pairs of items that showed modification indices that were significant, none was significant for all four colleges. Table 34 presents a list of the pairs that showed significant sources of misfit for three or four colleges.

Table 34

Item Pairs that Showed Significant Chi Squares for Modification Indices on the Study Anxiety Inventory by Gender Across Four Colleges

Item Pair	Colleges	Males	Females
15 with 14	4	4	4
14 with 13	4	3	4
10 with 9	4	2	2
9 with 6	4	1	2
9 with 3	4	2	2
6 with 3	4	4	4
4 with 3	4	3	1
4 with 2	4	1	2
2 with 1	4	3	1
15 with 1	3	1	1
14 with 7	3	3	1
12 with 2	3	1	1
10 with 3	3	2	2
7 with 5	3	1	2
6 with 4	3	1	1
5 with 4	3	0	4
5 with 1	3	1	1

Note: Numbers in table represent the number of times out of four that the correlated error for the pair of items was a significant source of misfit.

Invariance testing by gender indicated that loadings were equal for each of the four colleges; however some differences in item residual variances identified in the four colleges (see Table 35). Factor covariances were invariant across all four colleges and factor variances were equal for all except the College of Arts and Sciences where the factor of worry was shown to vary by gender with females having more varied responses.

Table 35

Summary of Results for Models for the Study Anxiety Inventory Tested for Invariance by Gender by Colleges

	Arts and Sciences	Engineering	Business	Education
Equal Loadings	>.01	>.01	>.01	>.01
Equal Residual Variances	<.01	<.01	<.01	<.01
Equal Residual Variance with corrections	>.01 when 4,7,8 &16 were freed	>.01 when 9 & 13 were freed	>.01 when 4 & 9 were freed	>.01 when 3 was freed
Equal Factor Covariances	>.01	>.01	>.01	<.01
Equal Factor Variances	>.01 for emotionality but <.01 for worry	>.01	>.01	>.01

Research Question 3: Relationships between SAI and Related Measures

Because the Study Anxiety Inventory (SAI) and the two components of worry and emotionality are based on items from gold standard anxiety measures, it was predicted that scores from the SAI (overall, worry and emotionality) would have a strong positive correlation with scores from the Test Anxiety Inventory (overall, worry and emotionality) and scores from the Trait Anxiety scale. Based on the Optimal Stimulation Dual Process Theory, a moderate to low negative relationship was predicted between the SAI, Study Anxiety/Emotionality (SA/e) and Study Anxiety/Worry (SA/w) with scores from the Trait Curiosity scale. Based on previous findings, it was predicted that the SAI and the subscales (SA/e and SA/w) would show a weak relationship with the measure of study skills and habits. As a part of the construct validation process, the nomological network was extended by examining the relationship between study anxiety and passive and active procrastination. Because the procrastination measures and the study skills and habits

measure are fairly new, prior to presenting the correlational results as part of the construct validation process, a table of Cronbach's alphas for all measures is presented.

Reliability of Scores

Internal consistency reliability for the scales was computed for each college (see Table 36). Cronbach alphas for the Study Anxiety Inventory and the Test Anxiety Inventory for the four colleges ranged from .91 to .96. Cronbach alphas for Spielberger's trait anxiety and trait curiosity measures for the four colleges ranged from .77 to .85. For the study skills and habits measure (Study for Examinations), Cronbach's alphas were .78 for each college except for Arts and Sciences which was .79. For the passive procrastination scale, Cronbach alphas for the four colleges ranged from .81 to .85, and for the active procrastination scale from .64 to .66. All of the scales and subscales demonstrate that responses to the items of each scale are highly related. The lowest internal consistency index at .66 for the Active Procrastination scale was not so low that the scale was not useful for the purposes of this study. It was concluded that scores obtained from these measures were sufficiently reliable to be used in the construct validation process.

Table 36

Cronbach's Alpha for Internal Consistency for Constructs of Interest for Four Colleges

Constructs of Interest	# items	Arts & Sciences	Engineering	Business	Education
Study Anxiety Overall Scale	16	.95	.95	.95	.96
Study Anxiety/Worry	8	.92	.91	.91	.92
Study Anxiety/Emotionality	8	.94	.93	.93	.94
Test Anxiety Overall Scale	16	.96	.95	.96	.96
Test Anxiety/Worry	8	.93	.91	.92	.92
Test Anxiety/Emotionality	8	.94	.92	.93	.93
Trait Anxiety	10	.85	.83	.84	.85
Trait Curiosity	10	.80	.77	.78	.82
Study for Examinations	25	.79	.78	.78	.78
Passive Procrastination Scale	6	.85	.81	.82	.82
Active Procrastination Scale	12	.66	.64	.66	.66

Correlational Results for SAI and Constructs of Interest

Findings for the correlations between the Study Anxiety Inventory (SAI) scale and the emotionality (SA/e) and worry (SA/w) subscale scores and other anxiety measures are presented in Table 37. These other anxiety measures include test anxiety (TAI) with subscale scores reflecting emotionality (TA/e) and worry (TA/w), and trait anxiety (T-Anx). Table 38 contains the correlations between the SAI (SA/e and SA/w) with two measures reflecting constructs that are commonly related to academic performance, curiosity (T-Cy) and study skills and habits (SH). Finally, Table 39 provides two measures of different types of procrastination, active (AP) and passive (PP).

Anxiety Measures. Although there is no overlap between the content of the emotionality and worry subscales of the SAI and the Test Anxiety Inventory (TAI), because the items of the SAI are based largely on the TAI, the correlations between the

two measures were expected to be large and statistically significant. As expected, there was a strong correlation between the SAI scale and subscale scores with the Test Anxiety Inventory (TAI) scale and subscale scores for all four colleges. These correlations ranged from .64 to .83 (median *r*=.74).

As hypothesized, the correlations were moderate to high for the SAI and scores from the trait anxiety (T-ANX) scale. Correlations for the four colleges for these scores ranged from .40 to .48 (median *r*=.46).

Table 37

Pearson Product Moment Correlations Between the SAI, SA/e and SA/w with Anxiety Constructs of Interest for Students from Four Colleges

	SAI	SA/E	SA/W
A & S (*n*= 662)			
TAI	.78**	.79**	.74**
TA/E	.76**	.78**	.72**
TA/W	.76**	.77**	.73**
T-Anx	.42**	.42**	.41**
Engineering (*n* = 434)			
TAI	.79**	.80**	.76**
TAI/W	.78**	.78**	.76**
TAI/E	.77**	.79**	.73**
T-Anx	.48**	.48**	.47**
Business (*n* = 434)			
TAI	.80**	.81**	.77**
TAI/W	.77**	.77**	.74**
TAI/E	.80**	.81**	.76**
T-Anx	.45**	.45**	.44**
Education (*n* = 409)			
TAI	.79**	.80**	.76**
TAI/W	.78**	.78**	.75**
TAI/E	.77**	.79**	.74**
T-Anx	.61**	.63**	.58**

SAI=Study Anxiety Overall Scale SA/W=Study Anxiety/Worry SA/E=Study Anxiety/Emotionality
TAI=Test Anxiety Overall Scale TA/W=Test Anxiety/Worry TA/E=Test Anxiety/Emotionality
T-Anx=Trait Anxiety *<.05, **<.01

Curiosity and Study Skills and Habits. As hypothesized, the correlations were negative between the SAI, and both the SA/e and SA/w subscales, with trait curiosity (T-CY). The strength of the relationships was moderate for Arts and Sciences, Engineering and Business students (*r*s ranged from -.13 to -.22) and strong for Education students (*rs*=-.39, -.41, and -.42, respectively). For these students, higher scores on curiosity were related to lower scores on anxiety while studying.

There was no statistically significant relationship between the study skills and habits (SH) scale and the SAI or the SA/e and SA/w subscales except in the responses

from the students from the College of Business who showed a small relationship between the emotionality and worry subscales with SH ($r_{SA/e\ to\ SH}$=.-.12 and $r_{SA/w\ to\ SH}$=.-10).

Table 38

Pearson Product Moment Correlation for Other Constructs of Interest for Students from Four Colleges

	SAI	SA/E	SA/W
A & S (*n* = 662)			
T-CY	-.14**	-.12**	-.15**
SH	.04	.07	.02
Engineering (*n*=434)			
T-CY	-.22**	-.23**	-.21**
SH	-.07	-.05	-.09
Business (*n* = 409)			
T-CY	-.16**	-.15**	-.16**
SH	-.09	-.06	-.12*
Education (*n* = 413)			
T-CY	-.38**	-.38**	-.38**
SH	.01	-.02	.03

SAI=Study Anxiety Overall Scale SA/W=Study Anxiety/Worry SA/E=Study Anxiety/Emotionality
T-CY = Trait Curiosity SH=Study for Examinations *<.05, **<.01

Procrastination. A positive correlation was predicted between scores from the SAI, SA/e and SA/w with scores from the measures of active and passive procrastination. The correlations of the SAI, SA/e and SA/w scales with each procrastination scale for each college are reported in Table 37. The relationships between the SAI total score and Active Procrastination Scale scores were positive and moderate and ranged between .22 and .30 (median = .23). For the Passive Procrastination Scale scores, correlations were positive and moderate and ranged from .26 to .32 (median = .28). Except for the College of Engineering, the picture is different for the subscale scores of Emotionality and Worry with correlations ranging between .21 and .29 for active procrastination (median = .24) and .23 and .36 for passive procrastination (median = .26). Correlations for passive

procrastination and SAI (Worry and Emotionality) were generally higher than the correlations for active procrastination and SAI (Worry and Emotionality). It is, perhaps, worth noting, in case the reader should believe that these two procrastination measures are merely the same, that Chu and Choi (2005) posited that the constructs of active and passive procrastination as measured with these two scales were not related. This was supported by the findings in this study in which the correlations between active and passive procrastination ranged from -.15 to -.01.

Table 39

Pearson Product Moment Correlations Between Each Study Anxiety Variable and Each Procrastination Scale for Arts and Sciences, Engineering, Business and Education Students

	SAI	SA/E	SA/W
Arts & Sciences (n = 500)			
APS	.23**	.25**	.21**
PPS	.29**	.25**	.32**
Engineering (n = 386)			
APS	.30**	.29**	.30**
PPS	.26**	.23**	.27**
Business (n = 362)			
APS	.23**	.21**	.24**
PPS	.32**	.30**	.32**
Education (n = 212)			
APS	.22**	.23**	.21**
PPS	.28**	.27**	.28**

Note: SAI = Study Anxiety Inventory SA/E = SA - Emotionality
SA/W = SA Worry APS=Active Procrastination Scale PPS=Passive Procrastination Scale
*p<.05 **p<.01

Summary of Results for Research Question 2

As was expected, for all four colleges, the relationships between the SAI and its two factors with the Test Anxiety Inventory and its two factors were high while the relationships between the SAI and its two factors with trait anxiety were lower. For each of the colleges, the relationships between SAI and its two factors with trait curiosity were moderate and negative. For all four colleges, the relationships between the SAI and its two factors with the measure of study skill were, with two exceptions, not significantly different from zero. For three of the colleges (exception was Engineering), correlations for passive procrastination and SAI (Worry and Emotionality) were generally higher than the correlations for active procrastination and SAI (Worry and Emotionality).

Chapter 5

Discussion

The purpose of this study was to collect various types of evidence to evaluate the construct validity of the inferences derived from the Study Anxiety Inventory (SAI; Lunsford, 2001) from students from four colleges (Arts and Sciences, Engineering, Business, and Education) at a large southeastern state university. This chapter contains six sections. The first section discusses the construct of study anxiety and the development and validation process used for the Study Anxiety Inventory. The second section discusses the results related to the first research question, which focused on the factor structure of the SAI. The third and fourth sections discuss the results related to research questions two and three (invariance of the SAI by gender and relations of the SAI to other variables respectively). The fifth section presents the significance of the study with conclusions concerning the CFA and the relationship discovered between study anxiety and two measures of procrastination. The sixth section identifies limitations of the study and provides recommendations for future research.

Background

Study anxiety was conceptualized as a situation-specific anxiety with the same worry and emotionality components found in test anxiety. Lunsford (2001) used an expansion of Lazarus's Transactional Process Theory discussed in Chapter 2 as the basis for the development of items for the Study Anxiety Inventory. Lunsford (2001) provided several types of evidence to support the validity of the inferences from the SAI including an analysis of item content (content validity), internal structure of the responses to the

items (exploratory factor analysis), and relationships between the construct and other variables (concurrent, predictive, and construct validity).

The purpose of the current study was to collect further evidence of the validity and reliability of the scores from the SAI. More specifically this study had three purposes: (a) evaluate the two-factor model underlying the Study Anxiety Inventory, (b) evaluate the factorial equivalence by gender of the two-factor measurement model underlying the SAI, and (c) examine the construct validity of the SAI by examining its relationship to test anxiety, trait anxiety, trait curiosity, study habits and skills, and passive and active procrastination.

To address these purposes, data were collected from 2,002 undergraduates at one southeastern state research university. Participants included 664 students from the College of Arts and Sciences, 456 from the College of Engineering, 431 from the College of Business, and 413 from the College of Education. Paper and pencil measures were handed out to 2,002 undergraduate university students during normal class periods. The measures included the Study Anxiety Inventory, the Test Anxiety Inventory, the Trait Anxiety scale and the Trait Curiosity scale from the State Trait Personality Inventory, the Study for Exam (SH) scale from the Study Habits Evaluation and Instruction Kit (SHEIK), the Active Procrastination Scale, and the Passive Procrastination Scale.

Research Question One: Evidence of Two-Factor Structure

The Study Anxiety Inventory was hypothesized to consist of two underlying factors or dimensions: worry and emotionality. Confirmatory factor analysis (CFA) was used to evaluate the two-factor model (worry and emotionality). Results of these analyses

indicated that the fit of the two-factor model was marginally acceptable with most of the measures of fit below the guidelines for acceptable fit proposed by Hu and Bentler (1999). The SRMR was the only measure of fit that suggested an acceptable level of fit. These results, along with the strong correlation between emotionality and worry (ranging from .87 to .92 across the four colleges), led to the consideration of an alternative model that consisted of one-factor. Fit of the one-factor model, evaluated using chi-square, SRMR, CFI, and RMSEA, indicated that the one-factor model for all four colleges was less acceptable than the two-factor model. These results provide some support for the two-factor model and the underlying theory that guided the development of the instrument.

Although the fit of the two-factor model was statistically better than the one-factor model, support for the two-factor model was not overwhelming. The finding of strong correlations between worry and emotionality makes it reasonable to question whether viewing study anxiety as having two factors might be unnecessary and that one overall score would give as much information as two. Correlation coefficients between worry and emotionality ranged from .87 to .92 indicating that from 76% to 85% of the variance in one factor can be explained by the other factor. Although there is some unique variance that is captured by the two factors, some researchers may decide that there is not enough unique variance and therefore choose to use an overall score for research purposes. Further investigation is needed to determine if these high correlations replicate in other settings and if the factors of worry and emotionality differentially relate to student outcomes (e.g., GPA).

Examination of the modification indices (i.e., indicators of where there is misfit in the model) from the confirmatory factor analyses showed that there may be a degree of redundancy in the items. Modification indices that were significant and large involved correlated errors between two worry items. Item 3 ("I can't keep my mind on the subject when studying for an exam because other thoughts interfere") and item 6 ("While studying for tests, other thoughts interfere with my learning") both seem to be focusing on the inability to keep thoughts from interfering with learning. Two other worry items, item 14 ("When I study for exams, I seem to get a mental block that keeps me from absorbing the material") and item 15 ("When I am studying for a test, I can't get my brain to organize the information"), also showed consistently large correlated errors across all four colleges possibly because the phrases "mental block" and "can't get my brain to organize" could be viewed as the same by many people. These same pairs of items had modification indices that were significant and large across all four colleges for both males and females except for the item pair 14 and 13, which was only significant for three of the colleges for males. Because the essential idea of including items on a questionnaire is to learn more about the construct rather than having items that are merely repetitions of the same question, this might indicate that certain items could be removed without decreasing the information obtained by the measure. Further research would be needed to establish this as the best course of action.

Research Question Two: Evidence of Invariance by Gender

Research has consistently found that self-report scores of anxiety for females are higher than for males (Hewitt & Norton, 1993; Spielberger, 1975; Spielberger & Wasala,

1995). Females have also reported more concern about emotional, physical and mental symptoms related to anxiety. Mean differences between male and female respondents, then, have been fairly well established, but the factor structure underlying the measures of anxiety have not been compared to determine whether males and females view the meaning of the items in the SAI in a similar manner.

Therefore, a second purpose of the study was to determine whether there was factorial invariance of the SAI by gender. Invariance testing involved carrying out comparisons of the factor pattern coefficients (loadings), uniquenesses (error variances), and factor variances and covariances across the male and female groups. Factorial invariance of the SAI for males and females was examined using multigroup confirmatory factor analysis.

The key element in invariance testing is in establishing that the same items load on the same factor to the same degree across groups. Factor loadings are similar to regression coefficients. They reflect the strength of the relationships between each item and its underlying construct and represent the change in observed scores that occurs for every unit change on the latent construct (Vandenberg, 2002). If these loadings are statistically different between groups, it indicates that the responders in the different groups view the items as having different meanings. The construct is defined by how the items load and if they do not load on the same factor for males and females then the invariance of the residuals, factor variances and the covariance between the factors (worry and emotionality) is irrelevant. As Vandenberg and Lance (2000) stated, if there is a difference between groups in the relations of items to the latent variable, then

comparing scores between those groups "may be tantamount to comparing apples and sparkplugs" (p. 9). Because gender differences are often referred to in reports about different types of anxiety, findings of invariance across gender is an important part of the construct validation process for study anxiety, as findings of invariance may indicate that mean differences found could be spurious.

At first look, the factor loadings for the College of Arts and Sciences did not appear to be invariant across gender, but further analysis showed that no item loading was significantly different across gender. Factor loadings by gender for the Engineering, Education, and Business students' responses were not found to be significantly different. These findings indicate that there was no evidence that males and females in each of the colleges view the meaning of the items in the SAI in a different manner. Any differences in observed mean scores between males and females on identical items or scales are not due to measurement bias but, rather, are due to true differences on the factor mean. It is therefore reasonable for a researcher to feel comfortable making mean comparisons between males and females for this measure.

Further investigation showed that invariance of the residuals for the observed variables was not supported. If invariance of the factor loadings is established, invariance in residuals can be considered a test of the invariance of scale reliability by gender (Schmitt & Kuljanin, 2008; Steenkamp & Baumgartner, 1998). This is the most stringent of the invariance tests and non-significance is not necessary in order to be able to make meaningful cross-group interpretations of mean differences. These findings state that the items carry an unequal amount of error which suggests that there is a difference between

the reliability of the scales for males vs. females. The lack of invariance for the item residuals is a common finding with psychological measures (Steenkamp & Baumgartner, 1998).

The covariance between the factors of worry and emotionality was not significantly different between males and females for three of the colleges (Education was the exception), which indicated that the two subscales were related in the same way for males and females. Invariance of the factor variances by gender was also supported for all except the variance for worry for the College of Arts and Sciences where that factor was shown to differ by gender. Females used a wider range of responses than the males on the factor of worry which suggests that they have a wider range of worry cognitions than males. This suggests that, should means be compared between males and females for these students, it would be prudent to precede that test with a comparison of the variances to determine whether or not it would be appropriate to carry out an independent *t*-test (i.e., one assumption underlying an independent *t*-test is homogeneity of variance).

Research Question Three: Validity Evidence Based on Relations to Other Variables

Evidence of the validity of the psychological construct of study anxiety was provided by expanding the framework of the nomological net (Cronbach & Meehl, 1955). Deeper insight into the construct validity of the scores from the SAI was provided by examining the scores from the instrument with other theoretically meaningful constructs. Construct validation using this framework (AERA et al., 1999) involved carrying out tests of the relationship between study anxiety and the related latent variables of test

anxiety, trait anxiety, trait curiosity, study skills and habits, active procrastination, and passive procrastination.

The Test Anxiety Inventory (TAI) is based on Lazarus's Transaction Process Theory and measures situation-specific anxiety that occurs during an exam. The Study Anxiety Inventory is also based on an extension of this same theory and measures situation-specific anxiety that occurs while studying for that exam. Based on these similarities, it was predicted that a moderate positive correlation would be found between scores from the SAI and the TAI.

Because situation-specific anxiety falls under the umbrella of trait anxiety, it was also predicted that the correlation between scores from the SAI with scores from the trait anxiety measure would be moderate but lower than the correlation with test anxiety. As in a previous study (Lunsford, 2001), findings in the current study showed a positive relationship between study anxiety and test anxiety (median r = .76), and, as expected, a weaker relationship between study anxiety and trait anxiety (median r = .44). As scores on the SAI increase, so do scores on the TAI and the trait anxiety measure. This supports previous findings and provides evidence to support the extended theory upon which the items of the SAI were created.

The correlation between test and study anxiety is high enough that one might question whether they are separate constructs. As presented in the first chapter, the two constructs are similar in that the student is responding to the same perceived threat in similar ways (worry and emotionality), but study anxiety and test anxiety are separated by a number of conceptual issues. The anxious thoughts and feelings occur in different

situations (while studying vs. while taking an exam) and have different effects (hinders pre-attention and attentional processes vs. hinders memory retrieval). The environment for studying is set by the student while the environment of an exam is set by the instructor or proctor. The measures specify these different times, situations and effects and, while the correlations indicate that when one experiences one construct, one also experiences the other, there will be those who feel anxiety while studying but calm down when they start the exam or those who feel calm until the exam starts and then feel the anxiety symptoms.

Based on the Optimal Stimulation/Dual Process Theory presented by Spielberger and Starr (1994), curiosity would be inhibited by anxiety and this, combined with previous findings that SAI scores correlated negatively with trait curiosity scores (Lunsford, 2001), prompted the prediction that the same negative correlation would be found in this study. As in the previous study, findings in this study showed a negative relationship between study anxiety and the construct of trait curiosity (median r = -.19), which supports the validity of the construct and adds evidence to the theory upon which the items were based.

Lazarus's Transaction Process Theory suggests that deficits in study skills and habits will influence a student to believe that failure on an exam is imminent which would lead to test anxiety. The expanded theory suggests that deficits in study skills and habits will lead directly to worry and emotionality while studying. This theory led to the hypothesis that scores on the SAI would correlate negatively with scores from the study skills and habits measure. Contrary to what was hypothesized, study anxiety showed no

significant relationship with study skills and habits across all four colleges (median *r* = -.04). This suggests that people with or without good study skills and habits will experience symptoms of study anxiety. These results were determined using a correlational design and therefore future research may examine if an experimental intervention designed to impact students' knowledge and practice of study techniques would impact their study anxiety.

Chu and Choi (2005) have suggested that there are two major types of procrastination: passive (a response to stressors) and active (a planned behavior to improve performance). Atkinson (1974) proposed that those who tend to be more anxious about failing will avoid tasks that will bring on that anxiety. McCown and Johnson (1991) stated that anxiety is a motivating factor in dilatory behavior. This implies that study anxiety would correlate positively with passive procrastination. Chu and Choi (2005) further suggested that active procrastinators are less like passive procrastinators than they are like non-procrastinators in terms of anxiety which suggests that the relationship of scores from the SAI would not be as strongly positive with active procrastination. This study found that the measures of passive and active procrastination showed a positive relationship (median *r* = of .28 and .23, respectively) with the scores from the SAI, which indicates that those who experience study anxiety may also experience either passive or active procrastination. Those who put off studying because they find the task stressful, or because they believe they work better under stress and so put off tasks until the last minute, may also experience some degree of anxiety while studying. Not much variance in the scores of the SAI can be accounted for by the scores

from the passive or active procrastination measure. Because people passively respond to situations considerably more than they actively plan behaviors, a higher positive correlation should appear with passive procrastination than with active procrastination. Although the difference was not statistically significant, the difference was in the direction one would expect for the students from the College of Arts and Sciences ($r_{SA\ to\ PP}$=.29, $r_{SA\ to\ AP}$=.23), the College of Business ($r_{SA\ to\ PP}$=.32, $r_{SA\ to\ AP}$=.23), College of Education ($r_{SA\ to\ PP}$=.28, $r_{SA\ to\ AP}$=.22) but in the opposite direction for the College of Engineering ($r_{SA\ to\ PP}$=.26, $r_{SA\ to\ AP}$=.30).

In summary, as was hypothesized, the SAI scores were positively correlated with scores on measures of test anxiety, trait anxiety, active procrastination and passive procrastination but negatively correlated with trait curiosity. Contrary to what was hypothesized, no relationship was demonstrated between study anxiety and study skills and habits. The nomological network was extended in this study by examining relationships between scores obtained from students on the SAI and measures of active and passive procrastination. It should be kept in mind that the participants completed these measures at the same sitting (common time) and that these measures were all of the same type (paper and pencil) with a similar response format (common method), which could possibly account, in part, for the observed relationships.

Significance of the Study

This study was designed to examine systematically the two-factor model underlying the SAI. Part of this objective was achieved by testing the two-factor model of the SAI by college and then separately by gender. The current study has provided some

support for the factorial validity of the Study Anxiety Inventory, so that, at least for research purposes, this measure can be used to continue investigating the construct of study anxiety. The correlations between the two factors ranged from .85 to .92 within each college and for males and females, which led the researcher to consider an alternative one-factor model. The one-factor model of the SAI provided an inadequate fit to the data, and while the two-factor model is not ideal, it appears that the SAI is better represented by a two-factor model. Further research evaluating the factor structure of the SAI is warranted.

Another part of the objective was achieved by addressing potential gender differences in the factorial structure of the SAI. This is the first study that has systematically examined the factorial invariance of the SAI by gender, which is important because previous research using the SAI has shown men's mean scores to be consistently lower than women's scores. This difference could have been due to noninvariance in SAI items rather than gender differences in level of reported study anxiety. Unless the factor loadings are invariant, it is not meaningful to make mean comparisons.

The results obtained in the current study provide support for gender invariance in a nonclinical population in the situation-specific level of anxiety while studying. The factor structure for both males and females was not significantly different, providing further evidence that men and women are interpreting the items in a similar way but endorsing them differently. Females may have elevated anxiety but the relationships that the items have with the construct are similar. Given this invariance, it is appropriate to examine mean differences by gender. This applies to a non-clinical population only,

however, as this research was carried out on a non-clinical population. Until research is carried out on a clinical population, this measure should be used for researching the construct of study anxiety and not for individual diagnosis or clinical purposes such as deciding treatment for those suffering from anxiety.

Comparisons of means in the present study indicated that there were statistically significant gender differences in self-report of anxiety by males and females while studying, although the effect sizes were moderate to low. These effect sizes are similar to those reported in studies over the last decade that have compared trait anxiety scores for males and females (Everson, Millsap, & Rodriguez, 1991; Foot & Koszycki, 2004; Marcus, 2001). These results are consistent with theory relating gender to anxiety and with findings from other research, thus providing support that the SAI measure is performing as expected.

The results of the CFA lead to these conclusions and the correlational analyses:

1. The fit of the two-factor model is marginal but the model would be acceptable to use in research to investigate further the relationships between each factor and other variables. Further research might also address the issue of items being somewhat redundant.
2. The two-factor structure of study anxiety was invariant by gender, but gender differences were detected in the means indicating that females reported higher levels of anxiety with low to moderate effect sizes. This supports the theory discussed in Chapter 1 which led to the prediction that there would be differences in the means but that the factor structure would be invariant. This allows

researchers who want to make gender comparisons to be more comfortable that their findings are due to real differences and not a measurement artifact.

3. The finding that there is a relationship between anxiety while studying and different types of procrastination is a new addition to the literature.
4. Overall, there is sufficient evidence of validity and reliability that a researcher should feel confident that the SAI is a reasonable research tool that holds up fairly well across a number of different types of students.

Limitations

Although the sample size of undergraduate students was approximately equal by gender and the sample was heterogeneous from four different colleges with many majors, one limitation of this study was that the students were not selected randomly. Instead, convenience sampling was used to recruit the participants from one southeastern university and hence the sample may not represent students from other types of universities (e.g., private, on-line, "Ivy League," etc.). A second limitation of this study was that it measured students at one time only with the students being mostly around the age of 21. Also, the sampling was cluster sampling (i.e., classes) so there may be some violation of the independence of the data which can lead to inflated Type I error.

A third limitation of this study was that all data were collected utilizing a survey-type methodology. The advantage of a self-report measure of anxiety is that it enables the efficient assessment of the frequency of behaviors, thoughts and feelings across time of a large number of participants. Disadvantages of a self-report measure include: (a) inability of the items to encompass the entire range of anxious symptoms of the responders, (b) the

avoidance or denial of the anxiety experienced by the responders, (c) responders' difficulty in revealing weakness (social desirability) or secret feelings of anxiety (self-serving bias), (d) misinterpretation of items by those with low reading ability or low comprehension, (e) non-compliance due to lack of interest or retaliation, (f) forced-choice categories may not fit the experience of the responder, (g) response bias due to inaccurate recall of experience (Sallis & Owen, 1999), and (h) the responders' lack of awareness of their thoughts, feelings, and behaviors. It may also be that the observed similarities between the measures are due to the similarity of the items and response constraints rather than the perceptions or constructs themselves.

An attempt was made to address some of the disadvantages connected with self-report measures. To make the reading level of the measure sufficiently low to cover even students whose first language was not English, wording on the survey was established at a sixth grade level using the Flesch-Kincaid Grade Level test. In order to avoid social desirability, emphasis was placed on the fact that no names were recorded on the measure thus providing complete anonymity. To address self-serving bias, it was pointed out that the information obtained from the measures would be reported as group data; to deal with non-compliance due to lack of interest or retaliation, it was announced that that they could opt out of filling in the items at any time.

As previously mentioned, researchers have suggested that test anxiety in the form of emotionality and worry is a stable phenomenon (Spielberger, 1980). Because of the correlation found between study and test anxiety and in view of the theory upon which the measure is based, this statement could be extended to suggest that study anxiety is

also stable in this way. Because the relationship between rumination and mood in both cross-sectional and longitudinal designs have been examined using survey studies (Brinker & Dozois, 2009), it is reasonable to suggest similar studies for future research on study anxiety.

A fourth limitation of this study was that none of these students was screened as needing help due to situation-specific anxiety (e.g., test anxiety) even though these are the types of students that this measure may eventually be used to assess.

Recommendations for Future Research

With regard to the first limitation, future studies should expand the sample to include students from different parts of the country and of different ages including graduate students and pre-college students. This would help to determine how well the SAI works with different types of students.

Concerning the second limitation, future studies should include both younger and older age groups and investigate whether study anxiety changes with age and influences learning for both younger and older students. Also, further research is needed to determine whether differences in study anxiety between males and females change with age.

If it is demonstrated that study anxiety is stable over specific situations and time, this could show that this type of anxiety may be a contributing factor in school- and work-related learning problems. Future research, then, could investigate study anxiety over time by following participants over a period of years. In addition to using the SAI to examine anxiety over time, daily diary logs over that same time would extend the validity

of the construct of study anxiety and the inferences made based on the responses to the SAI.

The third limitation could be addressed by using the diary entry approach. The method used by the Study Anxiety Inventory of asking individuals, in a retrospective way, whether they experience anxiety while studying, is only one way to obtain this information. An alternative approach to measuring study anxiety that could be used in a multitrait-multimethod design to provide construct validity evidence of the SAI would involve using a diary method during a period in which students had important exams. For example, if students were asked to record on a provided paper or electric diary what they felt at the time they approached the time of studying, or were studying for exams, this information could then be examined and compared with responses to the scores from the Study Anxiety Inventory. Requiring an individual to self-observe and systematically record his or her anxiety at the time it occurs would be an effective way to collect evidence concerning the frequency of study anxiety as well as its consequences (Shiffman, Stone, & Hufford, 2008). With a diary approach to examine study anxiety, other disadvantages of self-report measures are addressed. The range of anxious symptoms experienced by the responder could be reported as the technique would not restrict the person to a preset list of symptoms. This approach would also have the responses at the time of studying so an examination of current feelings would help the responder from denying his or her experience of anxiety. This technique of data collection would not be so reliant on memory, would not rely on the participant understanding the language of the items, and, with appropriate cues, would cause the

responder to increase his or her awareness of thoughts, feelings and behaviors. If the reliability and validity of the scores obtained from the diary method were demonstrated, this method in conjunction with the SAI could increase our understanding of study anxiety. Diaries have been demonstrated to be an effective assessment tool with externalizing behavior disorders (Nelson, Hay, Devany, & Koslow-Green, 1980), although it is not an approach frequently used to assess anxiety. This addition to the literature would establish a different method to approach the validity of the inferences from the scores from the study anxiety measure.

The fourth limitation could be addressed in future studies by including students who had applied to the university counseling center for help with problems related to anxiety. Although important similarities on responses to the SAI may exist between students who have and who have not been assessed for clinical levels of anxiety, there have not been any studies that have examined invariance across gender among those who experience anxiety at this higher level, and so conclusions concerning these types of students are premature. It is important therefore to replicate the research in other settings with non-clinical and clinical samples.

Future studies need to be carried out using methods that are similar to those used here to assess gender invariance. A possible starting point would be to use a group being treated for test anxiety in university counseling centers to assess the fit of the two-factor model for males and females and the invariance across gender in a clinical sample. A study of this kind would add to the construct validity of this instrument. Assuming results were similar among groups that were obtaining treatment, a potential use of this measure

would be for screening and treatment evaluation of those who suffer from anxiety while studying. Also, classes designed to encourage appropriate behaviors and attitudes towards college (University Experience, Learn to Learn, etc.) would be another way to find students who had high worry and high emotionality, low worry and low emotionality, or who were high in one factor but low in another to determine the characteristics of these different types of characters.

Once studies like these have been carried out, the potential uses of this measure are as varied as those for test anxiety in terms of research (e.g., techniques to alleviate anxiety) although ultimately use of the measure in a clinical setting would be most useful. Those students who are suffering from study anxiety can become aware of the fact that study anxiety is affecting their learning and deal with it using methods researched using this measure.

The mean item and scale scores for the engineering students were statistically significantly lower than the other three colleges. Invariance testing across colleges also is needed to determine whether the lower scores of the students in the College of Engineering were due to variation in the way students from that college interpreted the items rather than an actual difference in their level of anxiety.

Although construct validity requires evidence from different sources, similar studies to this one could be carried out and examination of the item order effect could be carried out by introducing the pairs of items showing significant correlated error in different places on the questionnaire. Further expansion of the nomological network by including measures relating to facilitative and debilitative anxiety, individual coping

styles, social desirability, and life-styles may introduce further explanations for the worry and emotionality differences observed in the current research.

In conclusion, the current study provides evidence that the two-factor solution using the 16 items of the SAI is an acceptable conceptualization of this scale for both men and women. Tests of invariance revealed that the factorial structure of the SAI was invariant across gender, thus providing good support for the validity of inferences made from responses to this instrument. As predicted, scores from the Study Anxiety Inventory were related to measures of test anxiety, trait anxiety, curiosity, passive procrastination and active procrastination. The SAI was not shown to be related to scores from the study skills and habits measure. Overall, the results from this study provide support for the use of the SAI as a research tool for examining study anxiety in male and female undergraduate college students.

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Appendix A: *Summary of findings from studies using the SAI*

Appendix A: *Summary of findings from studies using the SAI*

Authors	Alphas	Retest Reliabilities	Other	Statistically Significant Correlates
Lunsford (2001) Study using students from two colleges in a Florida state university	.96 overall .94 for each subscale	For 2 days 81, .82 and .82 For 2 months .84, .82, & .83 for the Overall, Worry and Emotionality scales, respectively	EFA using n=536 Showed 2 factors	Test Anxiety TA-Worry TA-Emotionality Trait Anxiety Trait Depression Trait Curiosity Trait Anger Testwiseness Academic Problems Self-Esteem Intelligence
Kieffer, Reese, & Cronin (2004) Study using students from three university locations	.976 overall and .92-.94 for subscales	For 10 weeks .88 overall and .67-.81 for subscales	Corrected item to total corr .56-.84 EFA using n=512 Showed 2 factors CFA using n=1025 Showed 2 factors	
Kieffer, Cronin & Gawet, (2006)	Overall not reported .83-.87 for subscales		Examined the relationship between SAI, TAI and Reasons for Drinking for 365 students.	Social Camaraderie Mood enhancement Tension reduction
Draper (2001) Study using student from a dorm in a Florida state university	Examined the relationship between SAI, TAI and GPA for 200 college students living on campus.			Test Anxiety TA-Worry TA-Emotionality Trait Anxiety ACT SAT

Note: GPA = Grade Point Average SAT = Scholastic Aptitude Test ACT = American College Test
TAI = Test Anxiety Inventory SAI = Study Anxiety Inventory TA = Test Anxiety

Appendix B: *Preamble to data collection*

Explanation of the study and what the consent form says

Educational Debriefing

Explanation of the study and what the consent form says.

Hello. My name is Douglas Lunsford and I am a graduate student in the Research and Measurement Department. I am here to ask you to fill out a questionnaire designed to find out how you describe yourself regarding your behavior, thoughts and sensations. You will find that some of the questions ask you to consider these while studying and very similar questions will ask for these while taking tests. Please keep these in mind while answering questions about your view of yourself generally. Analysis of your answers will help to find the relationship between these different items and will help education majors and psychologists develop better programs for understanding them.

You do not need to complete any consent forms as your name will not be taken so there are no risks associated with participation in this study. If you are in any way concerned and do not wish to participate, merely turn the blank form back in. No record will be kept to show that you did not participate. On the questionnaire, which is set up like a scantron, blacken in the circles in the column that most applies to you.

(For participating, you will receive one extra credit point that can be put toward your grade in this class.) Remember this is entirely voluntary so you may withdraw at any time without fear of reprisal. (There is no other compensation than the extra credit point for completing the whole measure.) Afterwards you will be given a sheet explaining the items that we expect are associated and how you can contact me to find what the overall results of the study show us. Both my telephone number and the number of the Division of Compliance Services are on your copy of the consent form.

If you have any questions, I will be here to answer them

Appendix B Continued

EFFECT OF STUDY ANXIETY ON ACADEMIC ACHIEVEMENT

Educational Debriefing

The goals of this research are to evaluate the responses of the Study Anxiety Inventory and to relate those responses to the responses to other measures. The other anxiety measures that have been used in this study are the Test Anxiety Inventory (TAI) and the trait anxiety scale of the State-Trait Personality Inventory (STPI). Study habits were assessed by the Study for Exam (SH) scale from the Study Habits Evaluation and Instruction Kit (SHEIK). Procrastination was measured by the Active Procrastination Scale and the Passive Procrastination Scale. We expect to find that anxiety during studying and during test taking is negatively correlated with active procrastination and positively correlated with passive procrastination. If you would like to find out what the results are for this study, you may call Douglas Lunsford at _____or attend our debriefing meeting which will be held at the offices of Dr. Dedrick on Monday, August 8, 2007 at 4 p.m. If you would like to read more about this subject, you will find that the below references are exceptional works which give a very in-depth background. Thank you for participating in this study.

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Appendix C: Experimental Measures

This Appendix includes the Study Anxiety Inventory, Test Anxiety Inventory, the trait anxiety and trait curiosity scales from the State-Trait Anxiety Inventory Form Y-2, the Study Habits and Test-Taking Skills scales from the Study Habits Evaluation and Instruction Kit, the Active Procrastination Scale and the Passive Procrastination Scale. A scoring guide for these measures is also provided in this appendix.

Appendix C Continued

Code number: __ __ __ __ __ Age: ____ Sex: __M, ___F, Today's Date _____

Ethnic Code: ①African American or Black, ②Asian American/Asian/Pacific Islander, ③Hispanic or Latino, ④ White, ⑤ American Indian/Alaska Native ⑥ Two or More Races ⑦ Other _____

College_____ Department _____ Major_____

Have you attended either the University Experience or the Counseling center to gain learning or studying skills? _____

Directions: The Study Attitudes Inventory (SAI) presents a number of statements which people have used to describe themselves while studying for tests are given below. Read each statement and then blacken the appropriate circle to the right of the statement to indicate how often it **generally** applies to you ***"while you are studying for an exam."*** There are no right or wrong answers. Do not spend too much time on any one item. Give the answer which seems best to describe your thoughts and feelings ***while studying for an exam.***

		Almost Never	**Sometimes**	**Often**	**Almost Always**
1.	I feel very uneasy just before starting to study for an exam	①	②	③	④
2.	While I am studying for an exam I often think "I'm not getting this"	①	②	③	④
3.	I can't keep my mind on the subject when studying for an exam because other thoughts interfere	①	②	③	④
4.	Even when I have plenty of time, I feel nervous when I try to study for an exam	①	②	③	④
5.	While studying for exams, I have an uneasy, upset feeling	①	②	③	④
6.	While studying for tests, other thoughts interfere with my learning	①	②	③	④
7.	While studying for a test, I worry about not being able to learn the material	①	②	③	④
8.	I wish studying for tests did not upset me so much	①	②	③	④
9.	I feel panicky when studying for an important exam	①	②	③	④
10.	While studying for exams, I am stressed with thoughts like "I can't absorb the material properly"	①	②	③	④
11.	I worry so much when I study for a test that I do things that distract me	①	②	③	④
12.	While studying for exams, I feel very tense	①	②	③	④
13.	I freeze up while studying for an important test	①	②	③	④
14.	When I study for exams, I seem to get a mental block that keeps me from absorbing the material	①	②	③	④
15.	When I am studying for a test, I can't get my brain to organize the information	①	②	③	④
16.	I feel jittery while studying for important exams	①	②	③	④

The Test Attitudes Inventory (TAI) evaluates thoughts and feelings that are experienced by students when taking or studying for examinations. A number of statements which people have used to describe themselves while taking tests are given below. Read each statement and then blacken the appropriate circle to the right of the statement to indicate how often it **generally** applies to you ***"while you are taking an exam."*** There are no right or wrong answers. Do not spend too much time on any one item. Give the answer which seems best to describe your thoughts and feeling **while taking an exam.**

	Almost Never	**Sometimes**	**Often**	**Almost Always**
1. While taking examinations I have an uneasy, upset feeling	①	②	③	④
2. Thinking about my grade in a course interferes with my work on tests	①	②	③	④
3. I worry and freeze up on important exams	①	②	③	④
4. During exam, I find myself thinking about whether I'll get through school	①	②	③	④
5. The harder I work at taking a test, the more confused I get	①	②	③	④
6. Thoughts of doing poorly interfere with my concentration on tests	①	②	③	④
7. I feel jittery when taking an important test	①	②	③	④
8. Even when I'm well prepared for a test, I feel very nervous about it	①	②	③	④
9. During an exam, I start feeling uneasy about not doing well	①	②	③	④
10. During tests I feel very tense	①	②	③	④
11. I wish examinations did not upset me so much	①	②	③	④
12. I seem to defeat myself while working on important tests	①	②	③	④
13. I feel very panicky when I take an important test	①	②	③	④
14. During test, I find myself thinking about the consequences of failing	①	②	③	④
15. I feel my heart beating very fast during important tests	①	②	③	④
16. During examinations, I get so nervous that I forget facts I really know	①	②	③	④

A number of statements that people have used to describe themselves are given below. Read each statement and then darken the appropriate value to the right of the statement to indicate ***how you generally feel***. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe how you ***generally*** feel.

		Almost Never	Sometimes	Often	Almost Always
1.	I am a steady person	①	②	③	④
2.	I feel like exploring my environment	①	②	③	④
3.	I feel satisfied with myself	①	②	③	④
4.	I am curious	①	②	③	④
5.	I get in a state of tension or turmoil as I think over my recent concerns and interests	①	②	③	④
6.	I feel interested	①	②	③	④
7.	I wish I could be as happy as others seem to be	①	②	③	④
8.	I feel inquisitive	①	②	③	④
9.	I feel like a failure	①	②	③	④
10.	I feel eager	①	②	③	④
11.	I feel nervous and restless	①	②	③	④
12.	I am in a questioning mood	①	②	③	④
13.	I feel secure	①	②	③	④
14.	I feel stimulated	①	②	③	④
15.	I lack self-confidence	①	②	③	④
16.	I feel disinterested	①	②	③	④
17.	I feel inadequate	①	②	③	④
18.	I feel mentally active	①	②	③	④
19.	I worry too much over something that really does not matter	①	②	③	④
20.	I feel bored	①	②	③	④

The following statements refer to how you study for an examination such as a midterm or final exams. In these statements, the term 'multiple-choice exam' includes exams with true-false or multiple choice questions, which require picking the correct answer out of four or five alternatives. The term 'essay exam' refers to exams where you have to write an extended answer, e.g., an essay or paragraph. If the statement does not specify an essay or multiple-choice exam, then consider it to be about both types. There are no right or wrong responses for the statements in this inventory. Please read each statement and indicate how often these statements ***generally*** apply to by blackening in the circle that most applies to you.

Darken ① for NEVER or ALMOST NEVER. Darken ② for about ¼ of the time.
Darken ③ for about ½ of the time. Darken ④ for about ¾ of the time
Darken ⑤ for ALWAYS or ALMOST ALWAYS

	Almost Never	About ¼ of the time	About ½ of the time	About ¾ of the time	Almost Always
1. When an exam is near I spend more time doing homework and studying than I do normally	①	②	③	④	⑤
2. I start to study for the exam at least two days before it…..…	①	②	③	④	⑤
3. I do not read my notes over at all……	①	②	③	④	⑤
4. When preparing for an exam I study for it on at least two separate occasions…..……	①	②	③	④	⑤
5. I think up questions which might be asked in the exam and see if I can answer them..……	①	②	③	④	⑤
6. I rewrite at least part of my notes……	①	②	③	④	⑤
7. I do not study for an exam at all……..……	①	②	③	④	⑤
8. I use memory aids such as rhymes and mnemonics to help me remember things	①	②	③	④	⑤
9. I try to find out as much as I can beforehand about the exam	①	②	③	④	⑤
10. If I do any study for an exam it is only on the day of the exam	①	②	③	④	⑤
11. Before an exam I try to find out how many questions will be asked, what kinds they will be, etc.	①	②	③	④	⑤
12. I study by asking questions of other students and by answering their questions……..……	①	②	③	④	⑤
13. If appropriate old exam papers are available, then I look to see if I can answer the questions	①	②	③	④	⑤
14. I do the same amount of study for a multiple-choice exam as I would for an essay exam	①	②	③	④	⑤
15. If I read over my notes at all, I do it only once……	①	②	③	④	⑤
16. I memorize rules, definitions and formulae……	①	②	③	④	⑤
17. I concentrate on specific tasks rather than main ideas…….	①	②	③	④	⑤

18.	I read over my notes several times……	①	②	③	④	⑤
19.	I do less than one hour's study for an exam……	①	②	③	④	⑤
20.	I rewrite my notes in the form of a summary……	①	②	③	④	⑤
21.	I skim read the parts of the textbooks which cover what the exam will be on…..……..	①	②	③	④	⑤
22.	When I am studying for an exam I concentrate on those parts I already know…..……...	①	②	③	④	⑤
23.	I try to guess what questions are likely to be asked……	①	②	③	④	⑤
24.	I read through the important facts more than once……..	①	②	③	④	⑤
25.	I make sure I know what topics the exam will be on….....	①	②	③	④	⑤

Instructions: A number of statements are listed below which people have used to describe themselves. Read each statement and then blacken the appropriate circle to the right of the statement to indicate how true you **generally** feel or react in the manner described. There are no right or wrong answers. Do not spend too much time one any one statement but give the answer that seems best to describe how you **generally feel or react.**

		s	Not at all true					Very true
1	I tend to work better under pressure	+	①	②	③	④	⑤	⑥ ⑦
2	Even though I tend to work on papers or study for exams at the last moment, I am still motivated to do my best	-	①	②	③	④	⑤	⑥ ⑦
3	Since I often start working on things at the last moment, I have trouble finishing assigned tasks most of the time	+	①	②	③	④	⑤	⑥ ⑦
4	It is hard to keep myself motivated while working against impending deadline.	+	①	②	③	④	⑤	⑥ ⑦
5	I feel like giving up the task when I know there is no way that I can finish it on time	+	①	②	③	④	⑤	⑥ ⑦
6	I intentionally put off work to maximize my motivation	-	①	②	③	④	⑤	⑥ ⑦
7	To use my time more efficiently, I deliberately postpone some tasks	-	①	②	③	④	⑤	⑥ ⑦
8	I am unsatisfied with the outcome of my work when I put it off until the last moment	+	①	②	③	④	⑤	⑥ ⑦
9	I am more focused and motivated while I am working against the impending deadline	-	①	②	③	④	⑤	⑥ ⑦
10	I find the return for working under deadline is great	-	①	②	③	④	⑤	⑥ ⑦
11	I tend to do things at the last minute and often find it difficult to complete them on time	+	①	②	③	④	⑤	⑥ ⑦
12	I feel that putting work off until the last minute does not do me any good	+	①	②	③	④	⑤	⑥ ⑦
13	I tend to finish tasks well ahead of deadlines	-	①	②	③	④	⑤	⑥ ⑦
14	Even after I make a decision I delay acting upon it	+	①	②	③	④	⑤	⑥ ⑦
15	I prepare to study at some point of time but don't get any further	+	①	②	③	④	⑤	⑥ ⑦
16	I tend to leave things until the last minute	+	①	②	③	④	⑤	⑥ ⑦
17	I often find myself performing tasks I intended to do days earlier	+	①	②	③	④	⑤	⑥ ⑦
18	I generally delay before starting on work I have to do	+	①	②	③	④	⑤	⑥ ⑦

Scoring for the measures

Measure	Positively Scored Items	Negatively Scored Items
SAI Emotionality	1,4,5,8,9,12,13,16	
SAI Worry	2,3,6,7,10,11,14,15	
TAI Emotionality	1,7,8,9,10,11,13,15	
TAI Worry	2,3,4,5,6,12,14,16	
T-Anx	5+,7+,9+,11+,15+,17+,19+	1-,3-,13-,
T-CY	2+,4+,6+,8+,10+,12+,14+,18+,	16-,20-
Study for Examinations	1+,2+,4+,5+,6+,8+,9+,11+,12+, 13+,16+,18+,20+,21+,23+,24+,25+	3-,7-,10-,14-,15-,17-,19-,22-
Active Procrastination	3,4,5,8,11,12	1-,2-,6-,7-,9-,10-
Passive Procrastination	14,15,16,17,18	13-

About the Author

George Douglas Lunsford returned to university after a 35 year break to receive a B.A. in Psychology from the University of South Florida in 1997 and an M.A. in Clinical Psychology from the same university with faithful support from his wife, Nancy. While working for his master's degree, he worked as both a research and teaching assistant after which he became an adjunct professor of psychology, social science statistics, and research methods and entered USF's College of Education to obtain his Ph.D. in Educational Measurement and Research from the Measurement and Evaluation Department. My education was enriched by Major Professor, Robert F. Dedrick, and committee members Bruce W. Hall, Jeffrey D. Kromrey, and James A. Eison.