THE RELATIONSHIP BETWEEN UNDERGRADUATE AND GRADUATE STUDENTS' STATISTICAL ANXIETY, WORRY LEVELS, AND THEIR COPING SKILLS BASED ON AGE AND GENDER

~ Harry L. Legum, Brian K. Schmitt, Michelle P. Pointer, Rolande Murray, Beverly O'Bryant, Mary Owens-Southall, & Rhonda Jeter-Twilley

Abstract

An empirical study was conducted to determine the existence of a statistically significant relationship to statistical anxiety as measured by student anxiety, worry levels, and coping skills differentiated by age and gender. A correlational research design was implemented to collect data from 46 undergraduate and 38 graduate students using randomly selected cluster groups. Modes of measurement consisted of the Statistical Anxiety Rating Scale, Student Penn State Worry Questionnaire, and the Brief Cope Scale. Quantitative data were coded numerically and analyzed using a Pearson Product Moment Correlational and Regression Analyses, Analysis of Variance, and independent t tests. Results revealed a statistically significant relationship between statistical anxiety and coping skills. Multiple Regression analysis further determined that the strongest predictor of a student's coping skills is his/her statistical anxiety level. A one-way analysis of variance revealed a statistically significant difference in worry levels based on the age of the student. Implications for instructional modality and recommendations for future research are provided.

Key Words: Apprehension, Manage, Math, Pupil, Stress, Statistical Anxiety, Coping Skills

Introduction

Among the more prevalent anxieties gaining nationwide attention is mathematics related statistical anxiety. The phenomena of mathematics and science related anxiety among college students is well documented. Anxiety or apprehension may be defined as excessive persistent daily worry, hyper-vigilance, difficulty sleeping and lack of concentration and coping skills (American Psychiatric Association, 2013).

Cruise, Cash, and Bolton (1985) stated that statistics anxiety is a feeling of anxiety when taking a statistics course or executing a specified statistical analysis. Similarly, statistics anxiety

may be considered the negative feelings and/or thoughts encountered by a student when taking a statistics course (Bandalos, Finney, & Geske, 2003; Onwuegbuzie, 2003; Wei & Tang, 2005). Students may experience excessive worry, tension, and stress when enrolled in these courses (Zeidner, 1991). Lalonde and Gardner (1993) observed an indirect correlation between student anxiety, attitude, and motivation during enrollment in statistics classes. Similar to these perspectives, Onwuegbuzie (2004) reported that students may delay enrollment in statistics classes because of their anxiety and, upon matriculation, tend to procrastinate on completing assignments. Thus, the impact of statistical anxiety may affect many facets of student learning and achievement and include emotional discord brought on by excessive worry and the perceived inability to develop effective coping skills.

Borkovec, Robinson, Pruzinsky, and Dupree (1983) defined worry as a series of unhealthy thoughts that negatively permeate one's mind and can be "relatively uncontrollable". Worry and emotionality are akin to test anxiety (Sarason & Sarason, 1990). Test anxiety has been identified as an experience that impacts performance ability. According to Hembree (1988), students with test anxiety experience increased cognitive interference when learning and are subject to more encoding difficulty. Therefore, both of these psychological concepts (i.e., worry and emotionality) directly interfere with student performance contingent on students' coping skills.

Coping skills are characterized as the ability to strategize and effectively respond to issues that can result in adversity (Johnston, 2010). However, Zeidner and Endler (1996) suggest that some coping strategies are "maladaptive", and may ultimately increase stress levels. Interestingly, Saboonchi and Lundh (1997) linked perfectionism to anxiety/stress levels. According to Rice and Ashby (2007), there are two types of perfectionism: adaptive, which

focuses more on what has been accomplished resulting in a sense of satisfaction; and maladaptive, which focuses more on the failure resulting in ongoing disturbing thoughts. In a study using 329 college students, Gnilka, Ashby, and Noble (2012) examined the relationship between adaptive and maladaptive perfectionism, anxiety, and coping. They found that students with maladaptive perfectionism reported less coping skills. On the other hand, students with adaptive perfectionism had less anxiety, and reported more effective coping skills. Thus, the connection between anxiety and coping skills is re-visited.

Worry, anxiety, and coping are documented issues as it relates to student performance and specifically with taking tests. This study is based on Ozer's and Bandura's notion (1990) that perceived coping self-efficacy and thought control (e.g. worry levels) can either increase or reduce anxiety and avoidant behaviors. However, there is a dearth of empirical investigations about these concepts as it relates to students and statistics. Therefore, the purpose of our study was to determine the relationship between undergraduate and graduate students' statistical anxiety, worry levels, and coping skills based on age and gender. The study also sought to determine whether students possessed the coping skills necessary to handle the challenges of statistics at the university level. Accordingly, our study addressed the following research question: Is there a statistically significant relationship between undergraduate and graduate students' statistical anxiety, worry levels, and their coping skills based on age and gender?

Method

Participants

Eighty-four ($n = 84$) undergraduate and graduate students (46 undergraduate students, 38 graduate students) representing the Department of Applied Psychology and Rehabilitation Counseling from our HBCU (A Regional Historical Black University) partook in the study.

Groups of undergraduate and graduate participants were randomly selected (cluster) from upper division psychology/rehabilitation classes (300, 400, and 500 level classes) during the Fall 2012 semester. The mode of sampling was considered cluster sampling because the population was divided into classes, and then several of these classes were randomly selected with the intent to include all the students from these selected classes (Triola, 2006). The sample consisted of African American, mixed gender (64 females and 20 males), with ages ranging from 21 to 60. Undergraduate participants had successfully met the requirement of a general education mathematics course which included a module of a fundamental statistics.

Instrumentation

Student Worry Levels. The Student Penn State Worry Questionnaire (Meyer, Miller, Metzger, & Borkovec, 1990) was used to measure the students' worry levels. Participants respond to a 16 item inventory using a 5-point Likert scale ranging from "Very Typical of Me" to "Not at all Typical of Me". Prior studies indicate a good internal consistency with samples of older adults (Beck, Stanley, & Zebb, 1995) and strong test-retest reliability with undergraduates (Meyer et al., 1990).

Student Coping Skills/Strategies. The Brief Cope Scale was used to measure the students' coping skills/strategies when challenged with situational scenarios. The Brief Cope Scale provides researchers a way to quickly assess potentially important coping responses. This is a 28 item inventory using a 4-point Likert scale ranging from "I've been doing this a lot" to "I haven't been doing this at all". Carver (1997) has reported Cronbach's alpha reliability coefficients to range from .50 to .90.

Student Statistical Anxiety. The Statistical Anxiety Rating Scale (STARS) was used to measure the students' statistical anxiety. The Statistical Anxiety Rating Scale is a two-part inventory

seeking responses regarding the amount of anxiety experienced in a research/statistics scenario. Such scenarios include worth of statistics, interpretation anxiety, test and class anxiety, computation self-concept, fear of asking for help, and fear of statistics teachers. This instrument is a 51 item inventory using a 5-point Likert scale ranging from "High" to "None" and "Strongly Agree" to "Strongly Disagree". Prior research studies indicate a concurrent validity of .76 and a test-retest reliability ranging from .671 to .833 (Cruise & Wilkens, 1980).

Procedure

Approval to conduct the statistical anxiety study was received per established policy and protocol and included permission by departmental chairperson, school deans, and Institutional Review Board. Undergraduate and graduate student participants were randomly selected as a cluster and required to read and sign an informed consent form. The informed consent form detailed the benefits, mild risks, purpose, confidentiality, and voluntary nature of the study. Further, the informed consent form stated that the participants could withdraw from the study at any time and for any reason. Next, all participants completed the Brief Cope Scale, the Statistical Anxiety Rating Scale, and the Student Penn State Worry Questionnaire during one face-to-face class lecture using a paper-pencil format. These instruments were hand scored, and the data were numerically coded using the Statistical Package for the Social Sciences (SPSS) version 20.0 in order to preserve the participants' confidentiality.

Results

Statistical inferential tests included Pearson Product Moment Correlational Analyses to determine if there is a statistically significant relationship among graduate and undergraduate students' worry and statistical anxiety levels and their coping skills. Data indicate that there is a statistically significant inverse relationship between statistical anxiety and coping skills among

all university students (r = -.247; p = .023) at the .05 level of significance. More specifically, there is a statistically significant inverse relationship between statistical anxiety and coping skills among undergraduate students (r = -.315; p = .033) at the .05 level of significance. There is also a statistically significant inverse relationship between statistical anxiety and coping skills among female (N = 64) university students (r = -.331; p = .008) at the .01 level of significance. In addition, there is a statistically significant inverse relationship between statistical anxiety and coping skills based on age for those less than or equal to age 22 (r = -.523; p = .009) at the .05 level of significance. Although approaching significance (r = .213, p = .052), data revealed that there is not a statistically significant relationship between statistical anxiety and coping skills among the university students. No other statistically significant relationships were noted among the variables.

Extending the procedure one step further, a multiple regression analysis was used to determine if students' statistical anxiety and worry levels can predict their ability to use their coping strategies. Results revealed that the strongest predictor of a student's utilization of coping skills is his/her statistical anxiety level (B = -.232; p = .038). These findings indicate if the student's statistical anxiety level is high, then his/her coping skills would be less effective. Conversely, if the student's statistical anxiety level is low, then his/her coping skills would be more effective.

A one-way analysis of variance was implemented to determine if there is a statistically significant difference among coping skills, and worry and statistical anxiety levels based on the age of the student. Results revealed a statistically significant difference in worry levels based on the university student's age, $F (4, 79) = 5.14$, p = .001. Post-hoc comparisons (Tukey HSD) showed that there were statistically significant differences in worry levels between university

students less than and equal to age 22 and those age 50 or over ($p = .001$) and between university students ages 23 to 29 and those age 50 or over ($p = .029$). A one-way analysis of variance did not reveal statistically significant differences in coping skills and statistical anxiety levels based on the university student's age.

An independent t- test was used to determine if there is a statistically significant difference among coping skills, and worry, and statistical anxiety levels based on the gender of the university student. Results revealed that female university students tend to worry more than male university students, $t(82) = 5.66$, $p = .000$. Conversely, there were no statistically significant differences in statistical anxiety and coping skills based on the university student's gender.

Another independent t-test was used to determine statistically significant differences among coping skills, and worry and statistical anxiety levels based on student status. Results revealed that undergraduate students tend to worry more than graduate students, $t(82) = 3.66$, $p = .000$. However, there were no statistically significant differences in statistical anxiety and coping skills between undergraduate and graduate students.

Discussion

Recommendations for Future Research

This study is germane in addressing underlying factors of statistical anxiety and provides recommendations as to strategies for decreasing anxiety experienced by students in statistics courses. The suggestion is offered that an increase in sample size would increase the power of statistical tests used thereby improving the probability that the results from the sample are representative of the population. Further, a larger pool of students from the two target populations may reveal that more positive experiences in math-related courses is related to less

statistical anxiety over time. The current sample represents a cluster of students pursuing either undergraduate or graduate degrees from one department, Applied Psychology and Rehabilitation Counseling. Math requirements for undergraduate majors include a general education math course and the statistics course. There is no math pre-requisite course for graduate students. A future study should include mathematics and science students where upper level math is required and statistics is a part of the respective academic plans of study.

The relevance of this study in providing a more meaningful academic experience must be explored. Research on the correlation of statistical anxiety and course performance must be expanded to also include other facets of academic instruction. Is it reasonable to expect that mastery of the required statistics course would be enhanced by decreasing subject (statistical) anxiety level? Should students be required to take a pre-requisite statistics course? What is the role of course requirements and expectations when comparing undergraduate and graduate students' responses and level of statistical anxiety? Should a survey be included to determine the most recent exposure to a statistics course and its level? Does exposure to statistics in the workplace or student research play a role in decreasing anxiety? What is the correlation between student statistical anxiety and faculty instructional anxiety in delivering the course? Responses to these research questions should yield stronger results to perhaps lead to a more comprehensive model for decreasing statistical anxiety.

Implications for Educators

While the sample size was somewhat small, there are some significant insights to be gained from the findings of this study for educators. First, many professors are prepared to teach content, but they need to consider adding exercises or conversations that begin to address worry and statistical anxiety. This will be particularly important with the undergraduate population.

Second, universities need to consider adding components in the freshman and graduate orientation classes that look at worry, statistical anxiety, and ways to cope with these concerns. Third, campus counseling centers should offer groups and one-to-one counseling to assist students with worry and statistical anxiety. Any interventions that will increase coping skills will most likely impact students' abilities for managing anxiety and worry in general, but also those related to taking statistical based classes. An immediate recommendation would be to assist students in developing strategies to cope with their particular level of anxiety. There are many ways to address this and may include the following:

*Development of a pre-test to determine analytical skills and statistics readiness;

*Provision of the course syllabus prior to the start of the semester;

*Access to tutorials, sample exercises, and reading lists; and

*Use of instructional technology such as Tegrity (Lecture Capture System) to

record lectures for on-demand viewing.

It is also suggested if educators are going to encourage students to pursue fields that require a strong math or statistics foundation, educators must examine not only at curriculum, but at the corresponding emotional/social barriers that may be keeping students from pursuing or doing well in math-based like statistics.

Conclusion

Various findings that have been cited in the literature have indicated that the academic progress of undergraduate college students may be impeded by the presence of an excessive level of anxiety that may exist for a particular student (Onwuegbuzie, 2004; Saboonchi & Lundh, 1997; Zeidner, 1991). Feeling nervous or worrying may serve to alter the outcome of their performances on assignments, presentations, papers, and examinations in a course. The areas of

mathematics and statistics courses have long been a particular concern among students, in conjunction with the consideration of exactly how does the student cope with their anxiety and successfully get through such courses.

The research in this study has found that the greater the anxiety level for the undergraduate college student, the less coping skills the student will have available to assist him/her in managing their anxiety. The findings as they relate to gender indicate that women had more difficulty in employing coping skills when faced with an increased level of anxiety in a statistics course, than males who were faced with the same coursework and challenges that were presented. Younger aged college students have greater difficulty coping with their anxiety in a statistics course than do their older peers in the class. Overall, it was found that the level of anxiety that was reported by the undergraduate student was relative to the coping skills that are available to the student at the time of their increased anxiety in this area of study.

Younger college students were also found to worry more than their older classmates regarding the subject of statistics. Again, female students expressed more worries than the male students in this study. As a whole, undergraduate students are typically of a younger age than graduate students, and reported to worry more than the graduate students in the study.

The aforementioned results from this study are supportive of the findings of similar studies in the areas of mathematics and statistics and the anxiety that may be associated with such courses (Onwuegbuzie, 2004; Zeidner, 1991). The presence of effective coping skills would seem to indicate that anxiety for the college student in these courses may be less severe than that which is present for the student who does not possess effective coping skills that may be applied at this particular time. Those college students who have good coping skills seem to stand a better

chance to successfully navigate and have a desirable outcome when faced with taking a college

mathematics or statistics class.

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