

Gender, Age Differences, And Statistical Anxiety: A Study Using Canonical Correlation Analysis

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Abstract

The aim of the present study was to examine the gender and age differences in the statistical anxiety scores in a sample drawn from students in the Kuwaiti College of Social Sciences. Using descriptive discriminant canonical correlation analysis and Welch two-sample t-tests on the six original subscales were undertaken to examine differences between male and female students in social statistics courses. There were statistically significant anxiety score differences between both gender and age. Females had more statistics anxiety (i.e., about the value of statistics, anxiety about interpreting statistics, about tests, class, computation self-concept ; they had fears about asking for help and

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fear of statistics teachers) than males. Nontraditional students (25 or older) had greater statistics anxiety than did traditional students (ages 18-24). Additional research needs to be conducted among other levels of students, from high school students to graduate students, in order to create strategies that will reduce anxiety and encourage more students to feel comfortable entering the field of statistics.

Introduction

Statistical Anxiety

Most students in the social sciences are required to take at least one statistics course as part of their program of study. Some students even choose a particular major in an attempt to avoid these courses, saying that they “do not want to have to take more math.” Students often dread their statistics courses and put them off until the end of their undergraduate careers (Onwuegbuzie and Wilson 2003; Roberts and Bilderback 1980; Zeidner 1991). Recent studies have shown that there is a need for effective ways to help college students overcome their fears about learning statistics (Bi, Duan and Liu 2005; Jiang and Mei 2003; Li and Wu 2004; Zhang 2010).

Statistics anxiety is defined as “the feelings of anxiety encountered when taking a statistics course or doing statistics analyses; that is, gathering, processing, and interpreting” (Cruise, Cash and Bolton 1985). Such anxiety matters beyond the student’s emotional state: studies examining statistics anxiety have shown that students’ competence and success in statistics courses are influenced by their attitudes toward the course (Kottke 2000).

Theoretical Perspective

Social and Educational Theories

Social and Educational Theories are being comprised of a numbers of theories, rather than a single explanation of how we learn, and how we should teach. Rather, it is affected by several factors, including theoretical perspective and epistemological position (Bowen, 1990). One of these theories is the constructivist perspectives on learning have contributed to the teaching of statistics in the classroom, as the importance of teaching statistics has been part of the educational reform within mathematics education, which was established by the NCTM (Garfield & Chance, 2000). As part of the reform in teaching, a constructivist perspective of pedagogy has replaced the traditional behaviorist teaching method, where the teacher was the sole information-giver to passive students. In this setting, teachers lecture and students listen as teachers transfer their thoughts and meanings to the passive students. These classes relied heavily on

textbooks that promote the idea that there is a fixed world of knowledge that the student must come to know (Hanley, 1994). Differently, in the constructivist classroom, the instructor's role is to "facilitate and negotiate meaning-making with the learner" (Merriam et al., 2007), with the purpose of learning being to construct knowledge. Sometimes these are manifested in adult learning through experimental learning, transformative learning, or situated learning (Merriam, et al, 2007).

Further, Hanley explains: The role of the teacher is to organize information around conceptual clusters of problems, questions and discrepant situations in order to engage the student's interest. Teachers assist the students in developing new insights and connecting them with their previous learning...activities are student centered and students are encourage to ask their own questions, carry out their own experiments, make their own analogies and come to their own conclusions. For the learners, their role is to become actively engaged in their own learning, through willing participation in hands-on activities, and to share thoughts in dialogues in order to pursue topics in depth (Mvududu, 2005). Most important is how this variety of constructivist thought, cognitive, sociocultural and radical, along with the underlying tenets of constructivism, has impacted the teaching of statistics for adults, as each one has some relevance to the teaching of statistics today.

In the approach-avoidance theory of affect, people tend to approach things that give them pleasure and avoid things that elicit pain or fear. The more pleasurable a situation, person, or thing, the more it will be favored by others. Non-verbal behaviors can signal the promise of pleasure (or displeasure), and, in turn, approachability (or avoidance), to others within interpersonal relationships. This holds true for various social relationships and for the instructor-student relationship as well. Certain teaching styles are easily recognized as being more welcoming and causing less anxiety in the instructor-student relationship. One characteristic of such teaching is immediacy.

When instructors practice immediacy, students regard them as being available and welcoming (Mehrabian 1969). Andersen (1979), the first to investigate immediacy in the classroom context, described an "immediate instructor" as one who "is more likely to communicate at a close distance, smile, engage in eye contact, use direct body orientation, use overall body movement and gestures, touch others, relax, and be vocally expressive."

Literature Review

Until recent years, canonical correlation analysis was a relatively unknown statistical technique. As with almost all of the multivariate techniques, the availability of computer

programs has facilitated its increased application to research problems. It is particularly useful in situations in which multiple output measures, such as satisfaction, purchase, or sales volume, are available. If the independent variables were only categorical, multivariate analysis of variance could be used. But if the independent variables are metric, canonical correlation is the answer, allowing for the assessment of the relationship between metric independent variables and multiple dependent measures (Cruise, Cash, and Bolton 1985).

Canonical correlation is considered to be the general model on which many other multivariate techniques are based because it can use both metric and non-metric data for either the dependent or independent variables.

We express the general form of canonical analysis as:

$$Y_1 + Y_2 + Y_3 + \dots + Y_n = X_1 + X_2 + X_3 + \dots + X_n$$

(metric, nonmetric) (metric, nonmetric).

Canonical correlation analysis is the most generalized member of the family of multivariate statistical techniques. It is directly related to several dependence methods. Similar to regression, canonical correlation's goal is to quantify the strength of the relationship—in this case between the two sets of variables (independent and dependent). It corresponds to factor analysis in the creation of composites of variables. It also resembles discriminant analysis in its ability to determine independent dimensions (similar to discriminant functions) for each variable set in this situation with the objective of producing the maximum correlation between the dimensions (Cruz et al. 2004).

Thus, canonical correlation identifies the optimum structure or dimensionality of each variable set that maximizes the relationship between independent and dependent variable sets. Sherry and Henson (2005) argued that canonical correlation analysis deals with the association between composites of sets of multiple dependent and independent variables. In doing so, it develops a number of independent canonical functions that maximize the correlation between the linear composites, which are also known as canonical variates, sets of dependent and independent variables.

Each canonical function is actually based on the correlation between two canonical variates—one variate for the dependent variables and one for the independent variables. Another unique feature of canonical correlation is that the variates are derived to maximize their correlation.

Anxiety's Effect on Grades

In an academic setting, anxiety produced the same curvilinear relationship in performance as measured by students' grades (Sarid et al. 2004). Anxiety seems to have the

same effect on test performance (Bodas and Ollendick 2005). Therefore, we expect that statistics anxiety will follow a curvilinear relationship with performance on statistics exams. This notion has been explored before (Onwuegbuzie and Wilson 2003). Several studies have reported a negative relationship between statistics anxiety and course performance (Fitzgerald, Jurs, and Hudson 1996; Onwuegbuzie and Seaman 1995; Zanakis and Valenzi 1997; Zeidner 1991). Onwuegbuzie and Wilson (2003) hypothesized that statistics anxiety may impair performance by interfering with students' ability to receive, concentrate on, and encode the terms and concepts presented in class. However, the authors also noted that a certain level of statistics anxiety may actually be beneficial if such anxiety motivates adequate preparation. The negative effects of statistics anxiety have also been documented. In an in-depth qualitative study of statistics anxiety, Onwuegbuzie, Daros, and Ryan (1997) engaged 21 graduate students in interviews, focus groups, and journal writing as a method to explore their attitudes and perceived experiences in an intermediate statistics class in a department of education.

The authors found that students were reporting psychological symptoms such as depression, frustration, panic, and worry, as well as physiological signs of headaches, muscle tension, perspiration, and "feeling sick." Observation by one of the researchers as a participant-observer revealed students' anxious behaviors, such as nail-biting, anger, and tears. Onwuegbuzie (1997) suggests many students delay enrolling in statistics classes because of their anxiety, and once enrolled, tend to procrastinate on their assignments (Onwuegbuzie 2004). In his 2004 study, Onwuegbuzie surveyed 135 education graduate students concerning statistics anxiety and academic procrastination. He found that as many as 45 percent of the students reported procrastination problems in areas such as reading assignments, studying for tests, and writing papers.

Additionally, the author found procrastination was significantly related to four dimensions of statistics anxiety, though no causal relationship was implied. Other researchers have found that statistics anxiety can affect students' performance in both statistics and research classes (Lalonde and Gardner 1993; Onwuegbuzie 2000; Onwuegbuzie and Seaman 1995; Zanakis and Valenza 1997). Lalonde and Gardner (1993) found that students' learning in statistics classes was indirectly affected by their anxiety because of the impact that anxiety had on students' attitudes toward statistics and their motivation.

Similarly, Onwuegbuzie and Seaman (1995) found that students who were given statistics tests under timed conditions showed significantly lower levels of performance than students who were tested under untimed conditions. In subsequent studies On-

wuegbuzie (1995; 1997) determined that statistics anxiety affects students' ability to understand research articles, data analysis, and interpretation of analyses. Research has shown that statistics anxiety is a multidimensional construct. For example, a study conducted by Cruise et al. (1985) led to the identification of the following six components of statistics anxiety: worth of statistics, interpretation anxiety, test and class anxiety, computational self-concept, fear of asking for help, and fear of statistics teachers.

Components of Statistical Anxiety

The authors explain that worth of statistics refers to a student's perception of the relevance of statistics. Interpretation anxiety refers to the anxiety experienced when a student is faced with making a decision based on statistical data. Test and class anxiety refers to the anxiety involved when taking a statistics class or test. Computational self-concept refers to the anxiety experienced when attempting to solve mathematical problems, as well as the student's perception of her/his ability to do mathematics. Fear of asking for help is defined as the anxiety experienced when asking a fellow student or professor for help in understanding the material covered in class, or with any type of statistical data, such as that contained in an article. Finally, fear of statistics teachers concerns the student's perception of the statistics instructor.

Relationship of Anxiety to Student Age and Gender

A variety of student characteristics, such as age and gender of the student, have been examined in relation to statistics anxiety. For example, nontraditional students (aged 25 years or older) were found to have greater statistics anxiety related to taking tests and being in the class (Bell 2003).

Additionally, traditional students had higher final statistics course grades compared to their nontraditional counterparts. Bell (2003) suggests that the lower grades of the nontraditional students can be partially explained by statistics anxiety, but they could also be due to nontraditional students' longer absence from math courses prior to enrolling in their current statistics course.

Baloglu (2003) found that, in general, older students were more able to recognize the value of statistics, but had more anxiety about doing statistics than younger students. Mji (2009) examined whether the student characteristics of gender and college major were related to statistics anxiety. Using the Statistical Anxiety Ratings Scale (STARS; Cruise and Wilkins, 1980), Mji (2009) found that statistics anxiety was high among all 226 South African technical college students sampled.

Furthermore, Rodarte-Luna and Shelley (2008) studied 323 undergraduates and found some small and weak gender differences in statistics anxiety; however, these dif-

ferences were more defined when they examined the cognitive strategies that students used to learn, such as procrastination and seeking help from peers. Males were more likely to use procrastination as a strategy and were also more likely to have anxiety related to test and class, interpretation of statistics, and anxiety about asking for statistics help.

Females used many other strategies to learn, and these other strategies were related to lower statistics anxiety. However, for women who used procrastination, statistics anxiety was also higher overall. Some limitations to Rodarte-Luna and Shelley's study (2008) were that they administered their measures online and used only the criterion of whether the student was taking or ever had taken a statistics course. In general, studies supported the notion that women report more test anxiety than men (Bradley and Wygant 1998; Demaria-Mitton 1987; Fulk 1998; Hembree 1988; Hojat 1999; Rozendaal, Minnaert, and Boekaerts 2003; Williams 1996).

Objectives of the Study

The aims of the present study were to examine gender and age differences of the statistical anxiety STARS subscales in a sample of Kuwaiti social science college students who are studying a social statistics course. We are considering the following questions: Are there any statistically significant score differences on anxiety between male and female students who are taking a social statistics course? Are there any statistically significant score differences on anxiety between traditional (aged 18-24) and nontraditional (aged 25 or older) students who are taking a social statistics course?

The STARS bridges a communication gap in the classroom, providing students with a tool for identifying triggers of their statistics anxiety and allowing them to explore and express attitudes towards statistics and determine which ones affect their performance. STARS also provides professors with a diagnosis of their greatest obstacles to decreasing the students' statistical anxiety. Teachers are able to understand which activities students are most anxious about and which are most likely to elicit poor performance. An understanding of student attitudes towards the class reminds teachers of the importance of demonstrating the value of statistics and their role in daily life.

Few studies in Kuwait address the problem of helping college students overcome their fears to learn statistics, especially those students whose majors are in the social sciences. This research helps statistics teachers identify their students' anxiety and monitor their progress in statistics. Understanding students' anxieties should help instructors design ways to build students' self-confidence while creating classroom activities that will encourage them to work on problems effectively.

Hypotheses

H1: Females will have more statistics anxiety (i.e., questioning the worth of statistics, interpretation anxiety, test and class anxiety, computation self-concept, fear of asking for help, and fear of statistics teachers) than males will.

H2: Nontraditional students (25 or older) will have greater statistics anxiety (i.e., worth of statistics, interpretation anxiety, test and class anxiety, computation self-concept, fear of asking for help, and fear of statistics teachers) than traditionally aged students will (18-24 years old).

Methods

Canonical correlation is defined as the measure of the strength of the overall relationships between the linear composites (canonical variates) for the independent and dependent variables (Cruz, Regazzi, and Carneiro 2004). In effect, it represents the bivariate correlation between the two canonical variates.

Canonical correlation analysis is a multivariate statistical model that facilitates the study of interrelationships among sets of multiple dependent variables and multiple independent variables; where multiple regression predicts a single dependent variable from a set of multiple independent variables, canonical correlation simultaneously predicts multiple dependent variables from multiple independent variables.

Canonical correlation places the fewest restrictions on the types of data on which it operates. Because the other techniques impose more rigid restrictions, it is generally believed that the information obtained from them is of higher quality and may be presented in a manner that lends itself to more accurate interpretation. For this reason, many researchers view canonical correlation as a last-ditch effort, to be used when all other higher-level techniques have been exhausted. But in situations with multiple dependent and independent variables, canonical correlation is the most appropriate and powerful multivariate technique. It has gained acceptance in many fields and represents a useful tool for multivariate analysis, particularly as interest has spread to considering multiple dependent variables.

Measures

Descriptive discriminant analysis (DDA), canonical correlation and Welch two-sample t-test were conducted comparing males and females on the six statistics anxiety subscales. DDA is a multivariate technique that is superior to other group comparison methods, such as MANOVA in that it minimizes Type I, or experiment wise error, by simultaneously identifying whether the groups differ, and if so how, without having to conduct a series of post hoc univariate analyses like ANOVA (Sherry 2006). DDA was conducted in order to preserve the theoretical groupings of the one variable of interest,

statistics anxiety. In this analysis, gender was coded as a dichotomous variable where 1 = male and 2 = female.

The measures used in this study included demographic information about the students, such as age and gender. Also, the Statistical Anxiety Rating Scale (STARS—Cruise and Wilkins 1980) was translated into Arabic by the author and a colleague, and the translation was further presented to members of the faculties at the Departments of Sociology, Statistics, and English in the Social Science College. They were asked to evaluate the clarity of the subscale items and their suitability for measuring the concepts within the Kuwaiti culture. STARS is a 51-item scale developed by Cruise and Wilkins (1980) to assess statistics anxiety.

STARS consists of 51 items measured on a 5-point Likert-scale. The instrument includes six sub-scales, or factors, designed to assess anxiety in the areas of the worth of statistics, interpretation anxiety, test and class anxiety, computation self-concept, fear of asking for help, and fear of statistics teachers. Worth of statistics refers to students' perceptions of the usefulness of statistics either in their personal, academic, or future professional lives. Sample items include "I wonder why I have to do all these things in statistics when in actual life I'll never use them" and "I don't understand why someone in my field needs statistics." These are scored along the continuum from 1 (strongly disagree) to 5 (strongly agree).

Interpretation anxiety refers to how much anxiety students may feel when having to interpret statistical data or make a decision about an analysis outcome, and are scored from 1 (no anxiety) to 5 (high anxiety). Sample items reflecting this type of anxiety include "Interpreting the meaning of a table in a journal article" and "Interpreting the meaning of a probability value once I have found it."

Test and class anxiety are measured on the same scale, with items such as "studying for an examination in a statistics course" and "enrolling in a statistics course."

Computation self-concept is intended to represent students' anxiety concerning working math problems as well as their self-perceptions of their own mathematical ability (rather than their actual mathematical ability). Sample items from this subscale, measured on a 5-point Likert scale from strongly disagree to strongly agree include "Since I've never enjoyed math, I don't see how I can enjoy statistics" and "I'm too slow in my thinking to get through statistics."

The final two subscales, fear of asking for help and fear of statistics teachers, are also measured on a 5-point Likert scale with 1 indicating no anxiety and 5 indicating high anxiety. These subscales are designed to assess students' anxiety over asking for help in

understanding statistics material and their perceptions of statistics teachers. Sample items include “asking one of your professors for help in understanding a printout” and “statistics teachers talk so fast you cannot logically follow them.” Higher scores on each of the subscales indicate higher anxiety levels for that area.

Reliability

The Cronbach's alpha reliability coefficients for the six subscales were .82 (worry of statistics); .70 (interpretation anxiety); .64 (test and class anxiety); .90 (computation self-concept); .84 (fear of asking for help); and .73 (fear of statistics teachers). Thus, the Cronbach's alpha for the overall scale was 0.83. Of all the various measures of statistics anxiety in the literature, STARS are the most frequently used and most empirically investigated (Onwuegbuzie and Wilson 2003). Higher scores indicate greater statistics anxiety in each of the factors. Internal consistency and the reliability to predict statistics anxiety have been demonstrated for the STARS (Hanna, Shevlin, and Dempster 2008; Mji and Onwuegbuzie 2004).

Research Society and Sample Procedures

Participants

Participants (464) were recruited from the Social Science College in Kuwait from four different social statistics courses. Students were required to take a social statistics course. Thus, the sample was one of convenience. Most students (65.9 percent) were female and (34.1 percent) were male. The majority of students were seniors. This sample consisted of 240 women and 124 men. The mean age of the sample was 23.32 years (SD = 5.46).

Procedure

With the permission of the statistics instructors, in the first week of the semester we asked students from social science statistics courses in the sociology department at the Faculty of Social Science to participate in the research study. Participants read and signed a consent form detailing their rights as participants, and the researchers told them the information collected would be kept confidential.

The experimenters stated that students would be asked to complete a short questionnaire during the first lab meeting and after every test. In compensation, students would be given extra course credit for every time they participated; they were told that other opportunities for extra credit would be available over the course of the semester. To ensure confidentiality, students identified themselves on the questionnaires through use of a code name known only to them and the teaching assistants. After all was explained, students were asked to sign a consent form indicating their permission for the

experimenters to use their data as given on the surveys and their corresponding test scores. Consent levels were greater than 95 percent for all classrooms. Interested social statistics teachers volunteered their classrooms for inclusion in the study. Each of the participating classrooms was a required class (i.e., not an elective), in order to reduce the likelihood of self-selection bias. Each participant completed an anonymous survey that gathered descriptive data about the students. The classroom statistical teachers were trained to administer the surveys, which were completed during one class period.

Statistical Results and Tables

Testing the First Hypothesis: Differences between Males and Females on Statistical Anxiety

Descriptive discriminant analysis investigated differences between males and females on the six statistical anxiety subscales. Table 1 lists the means and standard deviations for each group on the variables of interest. The data were analyzed using SPSS Version 20.

The assumption of multivariate normality was evaluated by plotting the Mahalanobis distances and paired X^2 values in a scattergram, and the plots were evaluated. Because the plots formed a straight, diagonal line, the data were considered to have met the assumption of multivariate normality. The homogeneity of variance assumption was evaluated using Box's M. A non-significant Box's M is desired in order to determine that variances are equal across the two groups. However, because Box's M is an overly sensitive test of homogeneity, more stringent levels can be determined, such as .001 or greater in some cases (Sherry 2006).

It was determined that the homogeneity of variance assumption was met for the analysis as noted by Box's M, $F(23,758421) = 1.821$, $p = .004$, indicating that covariance matrices can be pooled for this analysis. In examining the canonical discriminant functions, there was a moderate canonical correlation (.285) on function 1 with an effect size of $R^2c = 8.12$ percent.

The full model test of function 1 was statistically significant at $p < .001$. Table 2 represents these findings.

Standardized discriminant function coefficients and structure coefficients were examined in order to investigate what variables contributed to group separation. Table 3 reports these values. Fear of statistics teacher, test and class anxiety, interpretation anxiety, and worth of statistics were primarily responsible for group differences, with females being significantly more anxious in these four areas than males were. Feeling that statis-

tics had little worth made a slight additional contribution, with females believing this more than males did. This is supported by both the standardized discriminant function coefficients and the structure coefficients, with the slight exception of fear of asking for help and computation self concept, which had low function coefficients but high structure coefficients. This suggests the variance being explained by these two subscales is in part being explained by its correlation with the other variables in the variable set. (Bradley and Wygant, 1998; Demaria-Mitton, 1987; Fulk, 1998; Hembree, 1988; Hojat, 1999; Rozendaal, Minnaert, and Boekaerts, 2003; Williams, 1996).

The means and standard deviations on the students' STARS by gender are shown in Table 1, which presents the means and standard deviations for the variables used in this study. Among the most interesting mean differences are the women's having higher mean scores (4.104 worth of statistics; 3.983, interpretation anxiety; 3.63, test and class anxiety; 3.66, computation self-concept; 3.09, fear of asking for help; and 4.73, fear of statistics teacher) than men did.

A Welch two-sample t-test is used to determine whether the unknown of two populations differs from each other based on independent samples from each population. If the two-sample means are sufficiently different from each other, then the population means are declared to be different. Table 4 presents the differences on mean scores between males and females for the six subscales of statistics anxiety rating scales (Cruise and Wilkins, 1980).

First, Levene's test for the worth of statistics scale indicated that the variances cannot be assumed to be equal ($F=17.504$, $p < .001$). A Welch two-sample t-test indicated a statistically significant difference between males and females on the worth of statistics anxiety scale ($t = -2.243$, $p = .025$). Thus, the women have a higher mean score of worth of statistics scale than the men did (Table 4).

Second, Levene's test for the interpretation anxiety scale indicated that the variances cannot be assumed to be equal ($F=20.980$, $p < .001$). A Welch two-sample t-test indicated a statistically significant difference between males and females on the interpretation anxiety scale ($t = -9.288$, $p = .001$). In other words, females have a statistically significantly higher mean score on the interpretation anxiety scale than males (see Table 4).

In addition, Levene's test for the test and class anxiety scale indicated that the variances cannot be assumed to be equal ($F=8.436$, $p < .004$). A Welch two-sample t-test indicated a statistically significant difference between males and females on the test and class anxiety scale ($t = -2.833$, $p = .05$). Thus, women have a higher mean score of test

and class anxiety scale than men do (Table 4).

Moreover, Levene's test for the computation self-concept scale indicated that the variances cannot be assumed to be equal ($F=28.960, p < .001$). A Welch two-sample t-test indicated a statistically significant difference between males and females on the computation self-concept scale ($t = -6.655, p = .001$). As a result, women have a higher mean score of computation self-concept scale than men (Table 4).

Furthermore, Levene's test for the fear of asking help scale indicated that the variances are assumed to be equal ($F=2.702, p > .101$). A Welch two-sample t-test indicated a statistically significant difference between males and females on the fear of asking help scale ($t = -1.755, p = .001$). Thus, women have a higher mean score of fear of asking help scale than men (Table 4).

Also, Levene's test for the fear of statistics teacher scale indicated that the variances cannot be assumed to be equal ($F=18.002, p < .001$). A Welch two-sample t-test indicated a statistically significant difference between males and females on the fear of statistics teacher scale ($t = -8.738, p = .001$) (Table 4).

In conclusion, females will have more statistics anxiety (i.e., worth of statistics, interpretation anxiety, test and class anxiety, computation self-concept, fear of asking help, and fear of statistics teachers) than males will.

Testing the Second Hypothesis: Anxiety of Older Students

The means and standard deviations on the students' STARS by age are shown in Table 5, which presents the means and standard deviations for the variables used in this study. Among the most interesting mean difference is the age (i.e., 25 years or older) of the respondent. Nontraditional students (aged 25 or older) have higher mean scores (3.935, worth of statistics; 4.36, interpretation anxiety; 3.45, test and class anxiety; 4.36, computation self-concept; 3.76, fear of asking for help; and 4.72, fear of statistics teacher) than traditional-aged students (age 18-24).

Welch Two-sample t-test for Age 25 or Older and for 18-24:

A Welch two-sample t-test is used to determine whether the unknown of two populations differs from each other based on independent samples from each population. If the two-sample means are sufficiently different from each other, then the population means are declared to be different. Table 5 shows the differences in mean scores between the group aged 25 years and older, and those in the group aged 18 to 24 years for the six subscales of STARS (Cruise and Wilkins, 1980).

Levene's test for the worth of statistics, interpretation anxiety scale, test and class anxiety, computation self-concept, fear of asking help, and fear of statistics teacher

scales indicated that the variances cannot be assumed to be equal (see Table 6). A Welch two-sample t-test indicated a statistically significant difference between the non-traditional students (25 or older) and the traditional ones (18-24) on the total subscales of statistics anxiety. To clarify this point, the results of the older students have statistical significance on the worth of statistics ($t=.026$); interpretation anxiety ($t=3.940$); computation self-concept ($t=5.078$); fear of asking help ($t=3.341$); fear of statistics teacher ($t=4.279$) than (18-24) age groups. However, those in the younger group, have statistically significant on ($t= -1.463$ test and class anxiety) than (25 or older) age groups. In conclusion, older, nontraditional students will have greater statistics anxiety (i.e., doubt about the worth of statistics, interpretation anxiety, computation self-concept, fear of asking help, and fear of statistics teachers) than traditional aged students (age 18-24), who had test and class anxiety.

Discussion

The present study examined the gender and age differences of the statistical anxiety scores in a sample of Kuwaiti social science college students studying in social statistics courses. Using descriptive discriminant, Canonical Correlation Analysis and Welch two-sample t-test on the six original subscales were undertaken between male and female students, particularly in social statistics courses. The Statistical Anxiety Rating Scale was administered to 364 college students taking a social statistics course. The current study was designed to evaluate the STARS, a 51-item scale developed by Cruise and Wilkins (1980). There were statistically significant anxiety score differences between gender and age.

All of the STARS subscales were significant and related to the findings of our proposed hypotheses. To clarify this point, we studied the first hypothesis and it was consistent with the previous research literature.

We used the canonical correlation analysis which is the most generalized member of the family of multivariate statistical techniques. It is directly related to several dependence methods. Similar to regression, canonical correlation's goal is to quantify the strength of the relationship, in this case between the two sets of variables (independent and dependent). It corresponds to factor analysis in the creation of composites of variables. (Bradley and Wygant, 1998; Demaria-Mitton, 1987; Fulk, 1998; Hembree, 1988; Hojat, 1999; Rozendaal, Minnaert, and Boekaerts, 2003; Williams, 1996).

The second hypothesis was supported and it is consistent with the previous researches (Baloglu, 2003; Bell, 2003). Thus, nontraditional students (age 25 or older) had greater scores statistics anxiety than traditional-aged students (age 18-24).

Older students' anxiety about poor performances on class tests could lead to their increasing the level of concentration for exams. Therefore, we expect that statistics anxiety will follow a curvilinear relationship with performance on statistics exams. This notion has been expressed from the previous literature (Onwuegbuzie and Wilson 2003). When comparing individual and classroom level data, professors can gain insight using the statistical anxiety subscale. The statistics anxiety subscale can be used as a tool for anticipating the activities in the course that are likely to increase anxiety levels in individuals/classes. For example, the instructor can use subscales information to allocate more time and thus attention to the calculation of probabilities, which hopefully in turn will reduce students' anxiety. The performance factor provides insight as to how to best assess student achievement across individuals, different departments, and course levels. For example, some students/classes may specify that they expect to perform better on class projects and quizzes than exams. In this case a professor might want to consider administering multiple quizzes and requiring a final project as opposed to exams. This method can be applied as an either/or option at the student level or as an overall change in assessment practice at the classroom level or even the departmental level. The STARS is not expected to be used as a tool for individualizing instruction, although it could be; the STARS is intended to be used as a tool for instructors to re evaluate their teaching and assessment methods in given populations of students (i.e. graduate versus undergraduate students, sociology versus psychology students, etc.).

Teachers can use to determine how to structure their class, academic counselors can use to determine which style of instruction will best fit their student, and researchers can use when further exploring relationships with and within statistics anxiety. Thus, the results of this study is based on the social and educational theories (Merriam et al., 2007; Mvududu, 2005; and Hanley, 1994).

There were limitations to this study. The students recruited for the study were all drawn from the social sciences college, particularly from the classes in social statistics. The generalization from the sample is limited, since the sample was a convenient one, chosen from the particular field of social statistics students and within the limited area of the social science college, rather than representative of the entire population. Nor was a diverse sample from ethnic groups was obtained. Also, there were six scales for participants to answer in that study, putting a burden in terms of time on students who wanted to finish the instruments. Finally, the instruments were self-reporting, which can promote bias in how the students answered (Gall et al. 2007).

Further research is needed to explore what instructors can do to help alleviate anxiety in their students. For example, Pan and Tang (2005) found that students believed

that fear of math, the lack of connection between statistics and daily life, the pace of instruction, and the instructors' attitudes about teaching all contributed to students' statistics anxiety. Additional research and strategies are needed for reducing this anxiety. For example, research should be conducted in terms of multidimensional teaching approach, applying statistics information in real-world way, and having the instructors aware of and attentive to students' anxiety. Experimental designs to assess classroom and counseling-based intervention effectiveness in reducing anxiety and improving attitudes should be conducted to decrease the likelihood of students experiencing this anxiety in statistics.

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Table 1
Comparison of Male and Female Students' STARS by Gender

Type of Behavior	Males	Standard Deviation	Females	Standard Deviation	Significance
Worth of statistics	2.8790	1.600	4.1042	1.31	.01*
Interpretation anxiety	2.3145	1.17	3.9833	1.41	.001*
Test and class anxiety	2.4677	.841	3.6375	.966	.001*
Computation self-concept	3.4435	1.55	3.6625	1.75	.01*
Fear of asking for help	2.2984	1.43	3.9042	3.69	.001*
Fear of statistics teachers	1.6774	1.33	4.7375	.824	.002**
N	124		240		

** $p < .05$.

* $p < .001$.

Table 2 Wilk's χ^2 and canonical correlation for gender

Function	Wilk's χ^2	χ^2	df	p	R_c	R^2_c
Statistic Anxiety Findings	.969	23.470	6	.001	.285	.08122

Table 3 Standardized discriminant function and structure coefficient for gender

Scale	Coefficient	rs	rs ² (%)
Worth of statistics	.366	.380	.145
Interpretation anxiety	.474	.509	.259
Test and class anxiety	.476	.515	.265
Computation self-concept	.083	.062	.004
Fear of asking for help	.364	.238	.057
Fear of statistics teacher	.809	.817	.667

Table 4 Independent-Sample Test of Male and Female Students and Statistics Anxiety Rating Scale

Type of Behavior	Levene's Test for Equality of Variances				
	F	Sig.	T	Df	Sig. (2-tailed)
Worth of statistics Equal variances assumed	17.504	.000	-2.243	362	.025
Equal variances not assumed			-2.397	2.977E2	.017
Interpretation Anxiety Equal variances assumed	20.980	.000	-9.288	362	.000
Equal variances not assumed			-10.167	3.162E2	.000
Test and Class Anxiety Equal variances assumed	8.436	.004	-2.833	362	.005
Equal variances not assumed			-2.989	2.881E2	.003
Computation Self-Concept Equal variances assumed	28.960	.000	-6.655	362	.000
Equal variances not assumed			-7.028	2.888E2	.000
Fear of Asking for Help Equal variances assumed	2.702	.101	-1.755	362	.001
Equal variances not assume			-2.223	3.449E2	.027
Fear of Statistics Teachers Equal variances assumed	18.002	.000	-8.738	362	.000
Equal variances not assume					
			-11.050	3.460E2	.000

Table 5: Comparison of Age Groups (age 25 or older and 1824-) and Statistics Anxiety Rating Scale

Type of Behavior	Age 25 or Older	Standard Deviation	Age from 18- 24	Standard Deviation	Significance
Worth of statistics	3.9355	1.52	3.5583	1.53	.001*
Interpretation anxiety	4.3629	1.51	2.9250	1.53	.01*
Test and class anxiety	3.4597	1.045	3.1250	1.10	.001*
Computation self-concept	4.3629	1.56	3.1875	1.70	.001*
Fear of asking for help	3.7661	4.11	3.1458	1.78	.001*
Fear of statistics teachers	4.7258	1.57	3.1625	1.87	.004**
N	124		240		

**p < .05.

*p < .001.

Table 6: Comparison of age groups (25 or older and 1824-) and Statistics Anxiety Rating Scale

Type of Behavior		Levens Test for Equality of Variances		t-Test for Equality of Means		
		F	Sig.	t	Df	Sig. (two-tailed)
Worth of statistics	Equal variances assumed	4.044	.005	.026	362	.010
	Equal variances not assumed			.026	361.916	.980
Interpretation anxiety	Equal variances assumed	5.021	.022	3.940	362	.001
	Equal variances not assumed			3.941	361.992	.000
Test and class anxiety	Equal variances assumed	1.688	.040	-1.463-	362	.014
	Equal variances not assumed			-1.463-	361.564	.144
Computation self-concept	Equal variances assumed	6.641	.010	5.078	362	.001
	Equal variances not assumed			5.083	360.532	.000
Fear of asking for help	Equal variances assumed	3.966	.012	3.341	362	.001
	Equal variances not assumed			3.316	243.029	.001
Fear of statistics teachers	Equal variances assumed	4.841	.000	4.279	362	.001
	Equal variances not assumed			4.287	354.076	.000

القلق الإحصائي والفوارق العمرية والجنس باستخدام قانون معامل الارتباط المقتن.

د. عامر علي الصالح

الملخص

ان الهدف من الدراسة الحالية هي اختبار الفروق في القلق الإحصائي والفوارق العمرية بالإضافة الي الجنس من عينة مختارة من طلاب وطالبات مقرر احصاء اجتماعي المطروح في كلية العلوم الاجتماعية. تم استخدام قانون تحليل معامل الارتباط المقتن بالإضافة الي اختبار (ت) المستقل للمجموعتين للفروق الفردية بين الذكور والإناث في المتوسطات بين افراد العينة المختارة والمتعلقة بالقلق الاحصائي وهي عددها ستة اختبارات وذلك بهدف معرفة الفروق بين الذكور والإناث بالنسبة للقلق الاحصائي في مقررات الإحصاء الاجتماعي. أشارت نتائج الدراسة بأنه توجد هناك فروقات جوهريّة ذات دلالات إحصائية بين كل من معدلات القلق الاحصائي وبين متغيرات الجنس والعمر. كذلك أشارت نتائج الدراسة بأن معدلات فئة الإناث في اختبارات القلق الاحصائي تتسم بصورة مرتفعة من فئة الذكور مثل (خوفهن من القلق حول التفسير الإحصائي وخوفهن حول الاختبارات التطبيقية وحساب مفاهيم المعادلات الاحصائية بالكمبيوتر، وكذلك خوفهن من طلب المساعدة وخوفهن من معلمين مادة الاحصاء وطرح الاسئلة). كذلك أشارت نتائج الدراسة أيضا بأن الطلاب غير التقليديين (25 سنة في العمر فما فوق) يتسمون بمعدلات مرتفعة في اختبارات القلق الاحصائي عن معدلات الطلاب التقليديين والتي تتراوح أعمارهم بين (18-24 سنة). أشارت توصيات الدراسة في النهاية الي المزيد من البحث العلمي بأن تتم دراسة معدلات القلق الاحصائي بين مستويات تعليمية لمراحل أخرى من طلاب المدارس بدا من مرحلة الثانوية وصولا الي الدراسات العليا وذلك بهدف وضع استراتيجيات من شأنها أن تقلل من معدلات القلق الاحصائي بين الطلاب وتشجيع المزيد منهم بالشعور بالراحة أو الاستقرار وذلك بانخراطهم بدراسة حقل الإحصاء.