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Training Coping Techniques to Reduce Statistics Anxiety

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Training Coping Techniques to Reduce Statistics Anxiety

By

Brittany Prothe

A Thesis Submitted in Partial Fulfillment of the

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Training Coping Techniques to Reduce Statistics Anxiety

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Training Coping Techniques to Reduce Statistics Anxiety

By: Brittany Prothe

Minnesota State University, Mankato

Abstract

Undergraduate students in introduction to statistics courses have been shown to have difficulties and anxiety related to the course. This study examines how coping training might reduce the statistics anxiety associated with these courses using a sample of students currently enrolled in the course. Results indicate that individual differences such as negative affect, trait anxiety, disengaged coping strategies and cognitive ability are related to statistics anxiety. The specific coping training used in this study was unable to reduce statistics anxiety; however, other methods for reducing statistics anxiety are suggested and directions for future research are provided.

Training Coping Techniques to Improve Statistics Self-Efficacy

Many undergraduate psychology programs across the country have recognized statistics as one of the essential aspects of the psychology degree, with most schools requiring at least an introductory to statistics course as part of the core curriculum. A 1981 study by Bartz found 72% of psychology majors at four-year universities requiring one course in statistics. Even as curricula changed, it was still reported years later that most psychology programs valued statistics as a requirement (Zanakis & Valenzi, 1997). However, many students have anxiety tied to taking a statistics course, even going as far as to report statistics as the most challenging and least pleasant of the courses that they have to take (Berk & Nanda, 1998). The purpose of this research is to examine whether a training intervention can make this core course less stressful for undergraduate psychology students.

Instructors need to know how to help students reduce negative attitudes and alleviate anxiety they experience when taking a statistics course. Providing students with strategies to handle these stressors can increase their performance and retention of this valuable course. Previous research has focused on finding the variables that have a relationship with statistics anxiety (Gal & Ginsburg, 1994: Zanakis & Valenzi, 1997). Because of the relatively new nature of this area of research, there has not been a significant amount of research in resolving the issues associated with statistics anxiety. The purpose of the present study is to support the previous research by examining relationships between statistics anxiety and statistics self-efficacy, as well as exploring some trait-based individual differences that may influence statistics anxiety. In addition, the study is hoping to find that training will moderate the effect of trait-based individual

differences on statistics anxiety, thus leading to better statistics self-efficacy. Specifically, it is believed that training on coping skills and the resources available to the students will lead to more engaged coping that allows students to become more active in resolving the stressors associated with a statistics course.

General Anxiety and Statistics Anxiety

All students enter school with a personal level of trait anxiety. Trait anxiety is the amount of anxiety that a person experiences on a day to day basis. Anxiety is an abstract concept that has not been exactly defined by the scientific community. One definition involves a reaction to a perception of threat and diffusion of the arousal that is associated with that threat (Epstein, 1972). Individuals with high levels of trait anxiety tend to perform the same on low-difficulty tasks but have a hard time handling the stress of a high-difficulty task as related to their less anxious peers (Fitzgerald, 1997). Therefore, when related to school, students who have higher trait anxiety have significantly different levels of learning in high-difficulty situations as compared to their peers. Those with high anxiety experience difficulties in all stages of processing problems (Tobias, 1979).

As stated before, students often report that statistics is one of the most difficult and the least enjoyable of the courses they are required to take (Berk & Nanda, 1998). In part because of these student perceptions, and perhaps because of its challenging nature, statistics courses are high-difficulty tasks for some psychology undergraduates. This can contribute to the reduction of processing ability. Statistics anxiety is a state form of anxiety defined as the “feeling of anxiety encountered when taking a statistics course, or doing statistical analyses: that is, gathering, processing, and interpreting" (Crusie, Cash & Bolton, 1985). A large number of students report that they experience statistics anxiety,

with 30% of students reporting that they had a large amount of statistics anxiety and 41% of students reporting they had at least some degree of statistics anxiety (Zeidner, 1991).

There are many aspects of statistics anxiety, but the six main components as defined by Cruise et al. (1985) are: worth of statistics, interpretation anxiety, test and course anxiety, computational self-concept, fear of asking for help, and statistics teachers. Worth of statistics is when the student thinks what they are learning will not have any relevance to their life and, therefore, is worthless to them. Interpretation anxiety is the stress associated with being given results to a statistics analysis and being required to explain or make decisions based on the results. Test and course anxiety is the stress associated with the homework and exams in a statistics course. Computational self-concept is when a student doubts their ability to do statistics because they believe it is too math-focused, or that they do not possess the skills required to learn statistics. Fear of asking for help is the fear of going to others when the student does not understand the material. The fear of statistics teachers is the anxiety associated with going to the teacher when they have a question or need assistance because they think the teacher will judge them or that the teacher cannot relate to the struggles they are having in the course. One or more of these components can lead to high levels of statistics anxiety and the negative outcomes associated with it.

These negative outcomes from statistics anxiety have been shown to be correlated with higher drop rates for statistics and lower exam scores in the course (Zanakis & Valenzi, 1997). However, these issues may not be caused by the lack of ability to learn statistics, but rather the combination of multiple factors. The attitudinal factors of negative emotions related to statistics and trait anxiety have also been shown to be

connected to lower performance in statistics-related courses (Gal & Ginsburg, 1994). Therefore, solutions for reducing statistics anxiety have to include these attitudinal factors. Reducing these statistics anxieties has been seen as a possible first goal of teaching statistics effectively (Blalock, 1987).

Statistics Self-Efficacy

Statistics anxiety relates to how the students perceive they will do in the course. This self-efficacy can influence their performance in a course (Finney, 2003). Self-efficacy was defined by Bandura in 1977 as a person's judgment of their abilities to complete an action that gets a desired amount of performance. Self-efficacy is different from the actual skills the person possesses; it is more so their perception of their ability to do a given task (Bandura, 1997).

There are four ways a student can change their self-efficacy (Bandura, 1997). The experience of completing the task is the strongest influence. Students can also improve their self-efficacy by watching others either succeed or fail, with others' success increasing the amount of self-efficacy. Others can also influence a student's self-efficacy by giving them encouragement, which will increase the student's perceptions of their ability. Finally, physiological and affective states can change the way they perceive their ability. Therefore, the physical responses to stress and anxiety may cause lower self-efficacy.

Self-efficacy is important because it can affect the choices people make and how much effort they put forth in a given skill (Bandura, 1986). That is why self-efficacy has been researched as it relates to academic motivation and how a student's self-efficacy influences how they approach skill-based courses (Pintrinch & Snkunk, 1995). People

who have higher self-efficacy are more likely to put more effort into completing the skill. However, students who have lower self-efficacy are more likely to dwell on the problems and imagine they are bigger than they are (Beck, 1979). These students also tend to avoid engaging in the skills they perceive themselves to be bad at, and will give up sooner than their peers that have higher self-efficacy (Bandura, 1986).

Studying self-efficacy is important because it has been found to be a strong predictor of both past and future performance (Lazarus & Launier, 1978). A study by Finney (2003) looked at comparing a self-efficacy scale for statistics and a math problem test to predict performance in the class. Self-efficacy was found to be significantly related to class performance, with a correlation of $r = 0.4–0.5$. More importantly, the self-efficacy scale was found to be more related to class performance than the math problems. Therefore, this study will be using self-efficacy as a proxy for student performance.

Negative Affect

Students commonly enter a course with an opinion of the course before the teacher even starts the first lecture. If this opinion is negative, it can be hard to change, and can affect their performance. Research has shown that students who have negative emotions towards school have a tendency to exhibit lower performance in school (Gumora & Arsenio, 2002). Thus, with a high negative affect in a course, students can exhibit low levels of motivation, which further leads to lower performance. Lower performance in school can include having a lower GPA, being perceived by peers and teachers as less academically competent, and having a more general negative mood (Gumora & Arsenio, 2002).

If students enter a course with negative emotions, then it will affect how they choose to deal with stress in the course. There is a correlation between negative emotions about school and the coping strategy that the students use to handle the school anxiety (Arsenio & Loria, 2011). More specifically, research found a relationship between negative emotions and disengaged coping. If a student has higher negative affect in a course, it may contribute to using non-productive methods of coping in response to its stressors.

Coping Techniques

When students face the anxiety and stressors related to mathematically-centered courses, there are multiple ways to handle them. The most popular definition of coping was offered by Lazarus and Folkman (1984), who defined coping as cognitive and behavioral efforts to manage demands that the subject has determined to be stressful. There are two main types of coping: disengaged and engaged coping.

Disengaged coping (also known as blunting, avoidant, and non-productive coping) consists of behaviors like ignoring and denying the stressor instead of addressing it. An example of disengaged coping would be procrastination. A student who uses disengaged coping methods will commonly allow themselves to get distracted and find ways to avoid working on the assignment in order to avoid the stress that comes along with the work. Unfortunately, such strategies are not very helpful, as students are either left with less time to complete the assignment, or end up with an incomplete assignment. Therefore, they have to face the consequences of incomplete or incorrect work. It is these higher stress levels associated with disengaged coping that lead to stronger negative health effects such as depression (Ebata & Moos, 1991; Cunningham & Walker, 1999).

Engaged coping (also known as monitoring, and active or productive coping) consists of strategies that actively work to resolve the stressor. Active engagement of coping strategies can improve performance in a course because of the nature of the various strategies. Cognitive decision-making is one of the engaged coping strategies where the person thinks about the stressor and comes up with choices for how the problem may be solved (Compas et al., 2001). In the classroom environment, this would consist of setting aside extra time to do homework, study, or find what learning strategies would be best for them to help study. Another engaged coping strategy is direct problem solving which consists of changing the person or their surroundings to help resolve the stressors. Problem-focused support is another engaged strategy which consists of using other people for help in finding solutions to the problem. In a statistics course, this would be going to the professor, classmates, or tutors to get assistance with stressors. These strategies are associated with positive health outcomes (Frydenberg & Lewis, 1999).

The choice of coping strategies has been shown to relate directly to classroom performance. Disengaged coping consists mostly of ignoring and denying the problem, and those behaviors lead to procrastination and incomplete assignments. With these behaviors, the students who choose to use disengaged coping have been shown to have a lower GPA (Arsenio & Loria, 2011). Students who use engaged coping, and have much more effective solutions to their stressors, make active plans and get help from others when they need it. Students who choose to use this constructive coping have been shown to have a higher GPA (Arsenio & Loria, 2011). It can be speculated that teachers should be able to influence the type of coping method that the students use, which may improve students' grades in the course.

Training To Reduce Statistics Anxiety

Because of the relatively recent nature of statistics-related anxiety research, very few studies have examined factors that may moderate the effect of individual differences on statistics anxiety. However, there has been research on integrating coping training into the curriculum as a way to prevent the negative effect of stressors on other courses (Elias, 1991). Integrating engaged coping provides a way to reduce the overall risk of anxiety in the population of students (Rosenman, 1998). Integrating the training into the course is more effective than pulling out high-risk students and training them, because it helps all students to some extent, and identifying and training high-risk students can be difficult in the college setting. Therefore, an effective method of training might be to incorporate coping resources into the existing structure of the course (Reiss & Price, 1996).

For the content of such training, teachers have used The Best of Coping: Developing Coping Skills Program (BOC) (Frydenberg & Brandon, 2002). This program is made up of ten parts, each intended on being a separate session for the students to attend. The first part identifies what coping is and how other people respond to it. This relates to the research on statistics anxiety which suggests that one way of reducing anxiety is acknowledging that statistics can be stressful and that the students are not the only ones who experience this anxiety (Tobias, 1991).

The second part of the training program introduces the connection between how we evaluate a situation and the feelings we have about the situation. The third part identifies what ways would not be effective in dealing with the stressors they are experiencing. Portions four and five relate to how to work with others and how to listen to the advice of others, as well as who and where to ask for help. The sixth and seventh

portions emphasize problem-solving and making decisions. Portions eight and nine are referring to setting goals, and finding ways to achieve those goals. The final portion examines how students can effectively manage their time to find opportunities to execute the strategies learned in the previous parts.

The current study will be taking the different pieces of BOC training and incorporating them into one training module. This training will be presented to students through their learning management system to integrate the training into the course.

Current Study and Hypotheses

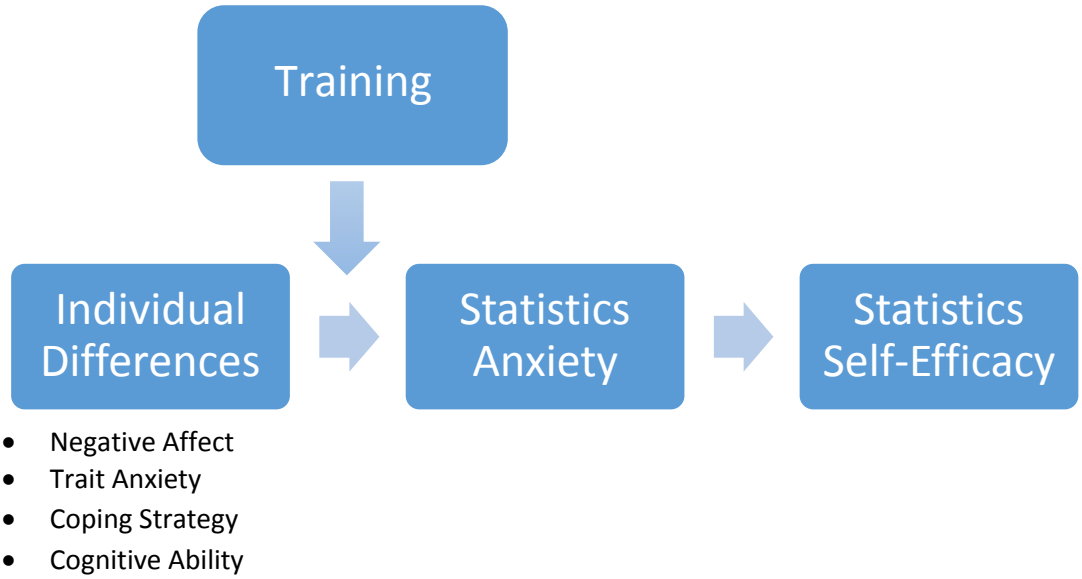

Figure 1: Proposed Model of Training of Coping on Statistics Self-Efficacy

The current study will examine the influence of individual differences on statistics anxiety that were discovered in previous research. The individual difference variables that the study is interested in are: negative affect, trait anxiety, coping strategies, and cognitive ability. In addition, the study will explore training coping strategies as a method for weakening the effect of these individual differences on statistics anxiety (see Figure 1).

Hypothesis

The hypotheses drawn from the proposed model that will be tested in this study are as follows:

H1: Individual difference variables will be related to the amount of statistics anxiety reported by the student.

H1a – Negative affect will be positively related to statistics anxiety.

H1b – Trait anxiety will be positively related to statistics anxiety.

H1c – Disengaged coping strategies will be positively related to statistics anxiety.

H1d - Cognitive ability will be negatively related to statistics anxiety.

H2: Statistics anxiety will be negatively related to self-efficacy on a pre- and post-test.

H3: Training will reduce the statistics anxiety reported by the student.

H4: Training will weaken the relationship between the relevant individual differences and statistics anxiety.

Methodology

Participants

145 participants were recruited from students enrolled in the fall and spring semesters of an introduction to statistics course in a Midwestern public university. Students' ages ranged from 18 to 35 (M_{age} = 20.37) with students from all years of college; 26 freshmen (17.9%), 51 sophomores (35.2%), 51 juniors (35.2%), and 17 seniors (11.7%). Students received extra credit for their participation in the study in the class from which they were recruited. The amount of extra credit was determined by the instructor of the course, based on guidelines provided by the researcher.

Procedure

At the beginning of the study, both the course instructor and researcher informed students about the opportunity to be involved in the study. For the fall semester, students were recruited at the midterm of the semester and completed the study during the last week of classes. The students in the spring semester were recruited at the beginning of the semester and completed the study at the midterm of the semester.

Immediately after recruitment, students were provided a link to the first part of the study; the pretest measures. The pretest was presented to the participants using the Qualtrics platform, which was provided to the students using a link in the course's learning management system (LMS). The survey contained measures of demographic information, cognitive ability, statistics self-efficacy, negative affect, general and statistics anxiety, and a coping inventory. More detailed descriptions of these measures are included in the following section. Students were given two weeks to complete the pretest survey.

Following the pretest, the students were provided the coping training intervention. This training was developed using an online learning software and distributed through the courses' LMS. The training was developed using the BOC program (Frydenberg & Brandon, 2002) and modified for online facilitation. After the training, participants answered questions to see if the students completed the training, as a manipulation check. A modification was made for the spring semester that combined the pretest and the coping training, so they were completed at the same time to reduce attrition.

After six weeks, participants were notified and given access to the posttest. Similar to the pretest, the survey was also presented using the Qualtrics platform and

delivered through the courses' LMS. The survey contained measures of statistics self-efficacy, statistics anxiety, and a coping inventory.

Measures

Demographic Information. Participants were asked to provide demographic information such as age, ethnicity and academic year. Students were also asked to provide the number of college-level math courses they had taken prior to the statistics course. Additionally, to match the participant's data throughout the different portions of the study, the student's university ID was collected.

Cognitive Ability. To determine whether a change in statistics self-efficacy is related to the independent variable of the coping training, a proxy measure of cognitive ability was used. To measure cognitive ability, GPA was collected by self-report. GPA has been shown in previous studies to be a predictor of success in an introductory statistics course (Benson, 1989).

Statistics Self-Efficacy. Self-efficacy in the statistics class was measured with a self-reported level of confidence using the *Current Statistics Self-Efficacy* (CSSE) measure developed by Finney and Schraw (2003). This scale was presented in both the pre- and posttests to determine the relative change in self-efficacy between the two periods of testing. The measure consists of 14 items with responses on a 6 point Likert scale (1 = No confidence at all, 6 = Complete confidence) in which participants report the amount of confidence that they have in completing specific statistics-related tasks. Previous research has found the internal consistency reliability of the CSSE to be $\alpha = 0.91$ (Finney & Schraw, 2003).

Negative Affect. Negative affect was measured using portions of the Positive Affect and Negative Affect Schedule (PANAS) as developed by Watson and Clark (1998). It was developed to explore individual differences in emotional states and traits across years and cultures. It consists of 20 words relating to feelings and emotions: 10 for positive affect and 10 for negative affect. Participants respond on a 5-point Likert scale (1 = very slightly or not at all, 2 = a little, 3 = moderately, 4 = quite a bit, 5 = extremely) indicating the extent they had felt the emotion in a period determined by the researcher. For this study, only the ten items related to negative affect were used. This measure also framed the questions using a present moment mindset, asking the participants "the extent you feel this way right now, that is, at the present moment" to get a state-based measure of negative affect. Previous research has found the moment negative affect scale to have an internal consistency reliability of $\alpha = .85$. (Watson & Clark, 1998)

Trait Anxiety. Trait anxiety was measured using the State Trait Anxiety Inventory (STAI) developed by Spielberger (1983). The test was developed as a 40-item test with 20 for both the state and trait anxiety scales. For this study, only the 20 questions that relate to trait anxiety were used. The STAI is presented as a 4-point Likert scale (1 = not at all, 2 = somewhat, 3 = moderately so, 4 = very much so) that asks the participant to indicate how they generally feel. Previous research has found the internal consistency reliability of the STAI to be $\alpha = 0.86$ in students (Spielberger, 1983).

Statistics Anxiety. To test student anxiety as it relates to working on statistics, the Statistical Anxiety Scale (SAS) was used as developed by Vigil-Colet et al. (2008). It was based on the longer Statistical Anxiety Rating Scale (STARS), created by Cruise and Wilkens (1980), but was created to be a statistics-related anxiety test that was short

enough to be used easily in a classroom setting. Although the test was developed in Spain, a study by Chiesi et al. (2011) has shown that the measure has cross-country validity. Previous research has found the internal consistency reliability of the SAS to be α= 0.91 (Vigil-Colet et al., 2008). The scale consists of 24 items divided into three subscales of examination anxiety (α=0.87), asking for help anxiety (α=0.92) and interpretation anxiety (α=0.82).

Coping Strategies. The effect of coping will be measured by the COPE developed by Carver et al. (1989). For this study, the shortened version of this measure will be used, as modified by Carver (1997). The brief COPE has 14 subscales included, with two questions on each scale. The religion and substance use scales were removed because of their irrelevance to the current topic. In previous research by Carver (1997), the internal reliability of most subscales was over an alpha of 0.6 with the scales of venting (α=0.50) and denial (α=0.54) being below the threshold. The items are presented on a 4-point Likert scale (1=I haven't been doing this at all to 4= I've been doing this a lot) (Carter, 1989).

Results

Data Cleanup

Before analyzing the results of the hypotheses, some issues with the data should be discussed. Although 145 participants were involved with at least one portion of the study only 80 participants completed all three parts of the study (i.e., pretest, training, and posttest). In order to have the proper statistical power and a large enough sample size, analyses used pairwise deletion. Therefore, when the participants had all responses relevant to the analysis, they were included. Also, to account for the students completing

the survey in different semesters and different times in the semester a variable was created to covary the effect of the semester. Scales were created by averaging the items on the scales and subscales; refer to Table 1 for scale internal reliabilities. In addition, the internal reliabilities for the statistics anxiety subscales were: α=0.90 for examination anxiety, α=0.94 for asking for help anxiety, and α=0.86 for interpretation anxiety. Nine items in the STAI were written in a positive tone; these items were reverse-coded to match the other items.

Individual Differences

Means, standard deviations, and correlations among the individual differences variables are included in Table 1. The first hypothesis and the sub-hypotheses that follow were associated with the relationship between the relevant individual differences and statistics anxiety. For the analysis of this hypothesis, data from the pretest was used. The use of the pretest data is to see how these individual differences relate to statistics anxiety without an intervention.

Table 1

Means, Standard Deviations, and Correlations Between Individual Difference Variables

Variable	N	Mean	SD	1	2	3	4	5
1. Negative Affect	144	2.07	0.63	(0.82)				
2. Trait Anxiety	140	2.35	0.55	0.60**	(0.92)			
3. Disengaged Coping Strategies	141	1.98	0.55	0.56**	0.49**	(0.86)		
4. Cognitive Ability	141	3.21	0.51	-0.17	-0.11	-0.12	--	
5. Statistics Anxiety (pre)	143	2.72	0.73	.49**	0.55**	0.47**	-0.20*	(0.94)

*Significant at $p < 0.05$ level **Significant at $p < 0.01$ level

Hypothesis 1a stated that negative affect should have a positive relationship with statistics anxiety, where higher levels of negative affect are associated with higher levels

of statistics anxiety. As shown in Table 1, there is a positive correlation that is significant between the two variables, $r(140) = 0.49$, $p < 0.01$. When analyzing the correlations with the subscales of statistics anxiety, negative affect was found to be significantly related to all subscales. Results indicate a correlation of $r(141) = 0.39$, $p < 0.01$ with exam anxiety, $r(142) = 0.35$, $p < 0.01$ with asking for help anxiety, and $r(141) = 0.46$, $p < 0.01$ with interpretation anxiety. Hypothesis 1a was supported.

Hypothesis 1b stated that trait anxiety was expected to have a positive relationship with statistics anxiety. As shown in Table 1, there is a positive correlation that is statistically significant between the two variables; $r(137) = 0.55$, $p < 0.01$. When analyzing the correlations with the subscales of statistics anxiety, trait anxiety was found to be significantly related to all subscales. There was a correlation of $r(137) = 0.46$, $p < 0.01$ with exam anxiety, $r(138) = 0.43$, $p < 0.01$ with asking for help anxiety, and $r(138) = 0.46$, $p < 0.01$ with interpretation anxiety. Hypothesis 1b was supported.

Hypothesis 1c stated that disengaged coping strategies were expected to have a positive relationship with statistics anxiety. As shown in Table 1, there is a positive correlation that is significant between disengaged coping and statistics anxiety; $r(137) = 0.47$, $p < 0.01$. When analyzing the correlations with the subscales of statistics anxiety, disengaged coping strategies were found to be significantly related to all subscales. There was a correlation of $r(138) = 0.34$, $p < 0.01$ with exam anxiety, $r(139) = 0.36$, $p < 0.01$ with asking for help anxiety, and $r(138) = 0.47$, $p < 0.01$ with interpretation anxiety. Hypothesis 1c was supported.

Hypothesis 1d stated that cognitive ability, measured with GPA, would have a negative relationship with statistics anxiety. As shown in Table 1, there is a negative

correlation that is significant between the two variables; $r(137) = -0.20$, $p < 0.05$, such that lower GPA is associated with higher statistics anxiety. When analyzing the correlations with the subscales of statistics anxiety, cognitive ability was found to be significantly related to only the subscale of asking for help anxiety; $r(139) = -0.26$, $p < 0.01$. Hypothesis 1d was partially supported.

To determine how much of the variance in statistics anxiety is accounted for by these individual differences, a multiple regression was conducted. It was found that the model significantly predicted the outcome of statistics anxiety ($F(4,127) = 19.32$, $p < .001$, $R^2 = 0.38$). The analysis shows that the traits that significantly predicted were trait anxiety (Beta = 0.345, $t(130) = 3.81$, $p < .01$) and disengaged coping strategies (Beta=0.190, $t(130) = 2.21$, $p < .05$). The individual differences of negative affect (Beta = 0.158, $t(130) = 1.64$, ns) and GPA (Beta = -0.124, $t(130) = -1.75$, ns) were not significant predictors of statistics anxiety.

Table 2
Results of a Multiple Regression of Individual Differences on Statistics Anxiety

Variable	*t*	*p*	β	F	df	*p*	R^2
Individual Differences on Statistics Anxiety				19.32	4, 127	0.00	0.38
Negative Affect	1.64	0.104	0.158				
Trait Anxiety	3.81	0.000	0.345				
Disengaged Coping Strategies	2.21	0.029	0.190				
Cognitive Ability	-1.75	0.083	-0.124				

Self-Efficacy

The second hypothesis pertained to whether statistics anxiety is negatively related to students' self-efficacy. Based on the results from the pretest of the study, statistics anxiety was not statistically significantly related to self-efficacy; $r(143) = -0.14$, $p > 0.05$. The hypothesis was not supported.

Training Effectiveness

The third hypothesis tested whether a training intervention would be related to a reduction in statistics anxiety. A paired-samples t-test was conducted to see whether there was a change in statistics anxiety from pretest to posttest. There was a not a statistically significant difference in statistics anxiety from the pretest (M = 2.72, SD = 0.73) to the posttest (M = 2.86, SD = 0.80) conditions; $t(75) = -1.76$, ns. This hypothesis was not supported.

The fourth hypothesis sought to examine whether training weakens the relationship between the individual difference variables described above and statistics anxiety. The results from Hypothesis 1 indicate the individual difference variables are all significantly related to statistics anxiety prior to the training intervention. To test if the training was effective at weakening the influence of the individual differences, correlations were conducted at the posttest, after the completion of the training.

Negative affect was still related to statistics anxiety; $r(75) = 0.32$, $p < 0.01$, and all of the statistics anxiety subscales, as shown in Table 3. Trait anxiety was still positively related to statistics anxiety; $r(72) = 0.321$, $p < 0.01$. In addition, it was still correlated to all of the statistics anxiety subscales. Disengaged coping strategies were still positively related to statistics anxiety; $r(76) = 0.472$, $p < 0.01$, and were still correlated to all the

subscales. Cognitive ability was no longer related to statistics anxiety, $r(73) = -0.194$, $p < 0.05$, however, it was still correlated with asking for help anxiety; $r(34) = -0.258$, $p < 0.05$. The hypothesis was partially supported.

Table 3
Correlations Between Individual Difference Variables and Posttest Statistics Anxiety

Variable	Statistics Anxiety	Exam Anxiety	Asking for Help Anxiety	Interpretation Anxiety
Negative Affect	0.320**	0.255*	0.241*	0.317**
Trait Anxiety	0.321**	0.248*	0.315**	0.229*
Disengaged Coping Strategies	0.472**	0.369*	0.381**	0.446**
Cognitive Ability	-0.194	0.002	-0.258*	-0.197

*Significant at $p < 0.05$ level **Significant at $p < 0.01$ level

Discussion

The purpose of this study was to investigate the effectiveness of a training on reducing students' statistics anxiety. In addition, the study examined the influences of certain individual differences on students' statistics anxiety and if the training would reduce the influence of those individual differences. The current study provides a foundation for future research to support an intervention to address the issue of statistics anxiety. This will be important for helping prevent the negative health and academic outcomes that may result from those anxieties.

As hypothesized, the key individual differences in this study had the predicted relationships with statistics anxiety. Negative affect was found to be positively related to statistics anxiety. This supports previous research conducted by Arsenio and Loria (2014) which found that higher levels of negative attitudes about a course lead the student to be more likely to have anxiety. The current research extended the previous finding that was

previously found with academic stress and showing that it extends to the specific concept of statistics anxiety. Because of the lack of research on interventions in this area, future research on how to effect students' perceptions of a course would be beneficial to help guide professors to make necessary changes.

Findings indicated a positive relationship between trait anxiety and statistics anxiety. Students who have higher trait anxiety are predisposed to have larger stress responses to general stressors. Therefore, when the students who have an elevated general stress response are confronted with the stress associated with a statistics course, they are more likely to have a higher stress response compared to their peers with lower trait anxiety. The results indicated by the current research supports previous research conducted by Baloglu (2001) that found that trait anxiety was related to all aspects of statistics anxiety, excluding interpretation anxiety. The current study found both the correlation with statistics anxiety in general but also all of the subscales of this form of anxiety. While trait anxiety and statistics anxiety are separate concepts, it is informative to understand their correlation. The knowledge of the correlation can be used as a way to help students identify if they are at risk for developing statistics anxiety and get access to resources before it even develops.

Previous research by Arsenio and Loria (2011) and Compas et al. (2001) had found that disengaged coping strategies were associated with academic anxiety. The current study supported the previous research and extended this relationship to the specific form of anxiety related to statistics. The study did not, however, find a relationship between engaged coping strategies and a reduction of statistics anxiety. This could be due to the students not effectively using the engaged coping strategies without

training. Given the relationship between disengaged coping strategies and statistics anxiety, it would be beneficial to teach strategies to reduce the frequency with which students use these strategies to handle their stressors.

Contrary to previous research by Arsenio and Loria (2014), the current study found that cognitive ability was negatively related to statistics anxiety. Arsenio and Loria had hypothesized this relationship, but did not find it with their study. Students who have higher cognitive ability are less likely to develop or have severe levels of statistics anxiety. The cause of this relationship could be due to having previously developed engaged coping strategies that also contribute to a higher GPA.

An additional aim of the current research was to connect statistics anxiety to a performance outcome and to determine whether reducing this anxiety would lead to an increase in performance. The present study used statistics self-efficacy as a proxy for performance because previous research has shown it is more effective at predicting course performance than a mathematical problem quiz (Finney, 2003). The results showed that there was not a statistically significant relationship between the two variables. These results do not support previous research that statistics anxiety is related to performance (Gal & Ginsburg, 1994; Zanakis & Valenzi, 1997). A potential reason for this lack of relationship could be due to self-efficacy not being the proper proxy for performance when evaluating the relationship with statistics anxiety.

The main purpose of this study was determine whether a training intervention would lead to a reduction in statistics anxiety. There was no change in statistics anxiety from the pretest to the posttest. This could be due to the posttest being conducted during exam weeks; finals in the fall and midterms in the spring, thus leading student's exam

anxiety to be higher than it would be on a non-exam week. The study was conducted only during half of the semester; therefore, a larger change may have been possible if the study had extended to the entirety of the semester. Future research that uses a longer period for change and takes posttest measures on a non-exam week should be conducted to potentially find a statistically significant change in statistics anxiety.

The current study was interested in evaluating the effectiveness of the coping training used as an intervention of statistics anxiety. The training used was developed using the BOC training, which has been shown to be effective in academic settings (Frydenberg & Brandon, 2002). The training was adapted to be used in an online college setting. The study found that a change in statistics anxiety occurred from time one to time two. In addition, the correlation between negative affect and cognitive ability was no longer present after the training. Unfortunately, because of a lack of control group, any changes from pretest to the posttest cannot be fully attributed to the training.

Professors have multiple options for helping to assist with students' anxieties in statistics courses. Previous research has shown that just making students aware that statistics anxiety is common in students might be a first step to reducing it (Tobias, 1991). Because of the relationship between students' statistics anxiety and individual differences, interventions can be put in place to reduce these effects. For example, professors may benefit from monitoring classroom negative affect in students and changing teaching strategies to ones who have been shown to improve impressions about a course. A training similar to the one presented in the current study may be provided to help reduce the frequency with which students use disengaged coping methods. In addition, using cognitive ability as a predictor for students who might be at risk of high

levels of statistics anxiety will allow the instructor to identify students who might need additional help.

A weakness in the design of the study is the absence of a control group. It was not practical to add a randomly-assigned control group using the methodology we used to recruit participants and collect data. Due to the presentation of the training materials integrated into the course LMS, it was not possible to randomly assign the training intervention to individual students in each course. One consideration was to apply the control to different classrooms and have different course sections act as the control and intervention conditions. Therefore, a student would be assigned to one of the conditions based on the course section they enrolled in. However, any change in statistics anxiety between the groups may be due to teaching differences, rather than the training intervention provided. Due to this lack of a control group, it was not possible to test a moderation effect of the training on the individual differences. Future research should work to examine similar training interventions conducted with a control group in order to determine whether anxiety can be reduced with a training intervention.

Another limitation of this study is the small sample size. This was due to multiple factors, including attrition across the portions of the study and the population of potential subjects during the time period, consisting of only nine medium-sized classes. Only 80 participants completed all three portions of the study. If a larger sample size was obtained, it is possible that the effects of the training would be statistically significant.

Despite its limitations, this study is important for setting a foundation for finding solutions to a prominent problem in the undergraduate psychology coursework. One of its strengths is that it presents evidence that providing a coping training intervention has the

potential to reduce the effect of the individual differences on statistics anxiety. In addition, the study found that the correlation between certain individual factors and academic anxiety, negative affect, and trait anxiety, extend to statistics anxiety.

Future research can expand on this foundation by using larger sample sizes and a control group for comparison to establish a causal relationship In addition, future research can further validate the coping training intervention and also find additional methods of reducing statistics anxiety. All of this information will provide instructors with tools to help students cope with statistics anxiety.

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Appendix A -Demographics

Will only be used to assign extra credit and match scores: Student ID _____

Section ID _____

Age _____

Year in College

- Freshman
- Sophomore
- Junior
- Senior

GPA _____

Ethnicity

- White
- Hispanic or Latino
- Black or African American
- Native American or American Indian
- Asian/Pacific Islander
- Other

Number of college math classes taken previously _____

How would you rate your comfort with stats

- Poor
- Fair
- Good
- Very Good
  Excellent

Appendix B - PANAS

This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you feel in general, that is, on the average. Use the following scale to record your answers.

	Very slightly or not at all	*A little*	*Moderately*	*Quite a bit*	*Extremely*
Distressed	1	2	3	4	5
Afraid	1	2	3	4	5
Irritable	1	2	3	4	5
Ashamed	1	2	3	4	5
Nervous	1	2	3	4	5
Upset	1	2	3	4	5
Strong	1	2	3	4	5
Guilty	1	2	3	4	5
Scared	1	2	3	4	5
Hostile	1	2	3	4	5

Appendix C - SAS

Please rate the following activities in terms of how anxious they make you feel.

	No Anxiety				*Considerable anxiety*
Studying for an exam in a statistics course	1	2	3	4	5
Interpreting the meaning of a table in a journal article	1	2	3	4	5
Going to ask my statistics teacher for individual help with material I am having difficulty understanding	1	2	3	4	5
Realizing the day before an exam that I cannot do some problems that I thought were going to be easy.	1	2	3	4	5
Asking a tutor to explain a topic that I have not understood at all.	1	2	3	4	5
Reading a journal article that includes some statistical analyses	1	2	3	4	5
Asking a teacher how to use a probability table	1	2	3	4	5
Trying to understand a mathematical demonstration	1	2	3	4	5
Doing the final exam for a statistics course	1	2	3	4	5
Reading an advertisement for an automobile which includes figures on gas mileages, compliances with populations regulations, etc.	1	2	3	4	5
Walking into the classroom to take a statistics test	1	2	3	4	5
Asking the teacher about how to do an exercise	1	2	3	4	5
Getting to the day before an exam without having time to study	1	2	3	4	5
Waking up in the morning the day of a statistics test	1	2	3	4	5
Realizing, just before you go into the exam, that you have not prepared for a particular exercise.	1	2	3	4	5
Copying a mathematical problem from the board while the teacher is explaining it.	1	2	3	4	5

Asking your teacher for help in understanding an assignment.	1	2	3	4	5
Trying to understand the odds in a lottery.	1	2	3	4	5
Seeing a classmate carefully studying the results table of a problem he has solved.	1	2	3	4	5
Going to a statistics exam without having had enough time to study.	1	2	3	4	5
Asking a teacher for help when trying to interpret a results table	1	2	3	4	5
Trying to understand the statistical analyses described in the abstract of a journal article.	1	2	3	4	5
Going to office hours to ask questions	1	2	3	4	5
Asking a tutor to tell me how to do an exercise.	1	2	3	4	5

Appendix D - Brief COPE

Each item says something about a particular way of coping. I want to know to what extent you've been doing what the item says. How much or how frequently. Don't answer on the basis of whether it seems to be working or not—just whether or not you're doing it. Use these response choices. Try to rate each item separately in your mind from the others. Make your answers as true FOR YOU as you can.

	I haven't been doing this at all	*I've been doing this a little bit*	*I've been doing this a medium amount*	*I've been doing this a lot*
I've been turning to work or other activities to take my mind off things.	1	2	3	4
I've been concentrating my efforts on doing something about the situation I'm in.	1	2	3	4
I've been saying to myself "this isn't real".	1	2	3	4
I've been getting emotional support from others.	1	2	3	4
I've been giving up trying to deal with it.	1	2	3	4
I've been taking action to try to make the situation better.	1	2	3	4
I've been refusing to believe that it has happened	1	2	3	4
I've been saying things to let my unpleasant feelings escape.	1	2	3	4
I've been getting help and advice from other people.	1	2	3	4
I've been trying to see it in a different light, to make it seem more positive.	1	2	3	4
I've been criticizing myself.	1	2	3	4
I've been trying to come up with a strategy about what to do.	1	2	3	4
I've been getting comfort and understanding from someone.	1	2	3	4

I've been giving up the attempt to cope.	1	2	3	4
I've been looking for something good in what is happening.	1	2	3	4
I've been making jokes about it.	1	2	3	4
I've been doing something to think about it less, such as going to movies, watching TV, reading, daydreaming, sleeping, or shopping.	1	2	3	4
I've been accepting the reality of the fact that it has happened.	1	2	3	4
I've been expressing my negative feelings.	1	2	3	4
I've been learning to live with it.	1	2	3	4
I've been thinking hard about what steps to take.	1	2	3	4
I’ve been blaming myself for things that happened.	1	2	3	4
I've been making fun of the situation.	1	2	3	4

Appendix E - STAI

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

	Almost Never	*Sometimes*	*Often*	*Almost Always*
I feel pleasant	1	2	3	4
I feel nervous and restless	1	2	3	4
I feel satisfied with myself	1	2	3	4
I wish I could be as happy as others seem to be	1	2	3	4
I feel like a failure	1	2	3	4
I feel rested	1	2	3	4
I am “calm, cool and collected”	1	2	3	4
I feel that difficulties are piling up so that I cannot overcome them	1	2	3	4
I worry too much over something that really doesn’t matter	1	2	3	4
I am happy	1	2	3	4
I have disturbing thoughts	1	2	3	4
I lack self-confidence	1	2	3	4
I feel secure	1	2	3	4
I make decisions easily	1	2	3	4
I feel inadequate	1	2	3	4
I am content	1	2	3	4
Some unimportant thought runs through my mind and bothers me	1	2	3	4

I take disappoints so keenly that I can't put them out of my mind	1	2	3	4
I am a steady person	1	2	3	4
I get in a state of tension or turmoil as I think over my recent concerns and interests	1	2	3	4

Appendix F - CSSE

Please rate your confidence in your current ability to successfully complete the following tasks. The item scale has 6 possible responses: (1) = no confidence at all, (2) = a little confidence, (3) = a fair amount of confidence, (4) = much confidence, (5) = very much confidence, (6) = complete confidence. For each task, please mark the one response that represents your confidence in your current ability to successfully complete each task.

	No confidence at all	***A little confidence***	***A fair amount of confidence***	***Much confidence***	***Very much confidence***	***Complete confidence***
Identify the scale of measurement for a variable.	1	2	3	4	5	6
Interpret the probability value (p-value) from a statistical procedure.	1	2	3	4	5	6
Identify if a distribution is skewed when given the values of three measures of central tendency.	1	2	3	4	5	6
Select the correct statistical procedure to be used to answer a research question.	1	2	3	4	5	6
Interpret the results of a statistical procedure in terms of the research question.	1	2	3	4	5	6
Identify the factors that influence power.	1	2	3	4	5	6
Explain what the value of the standard deviation means in terms of the	1	2	3	4	5	6

variable being measured.						
Distinguish between a Type I error and a Type II error in hypothesis testing	1	2	3	4	5	6
Explain what the numeric value of the standard error is measuring.	1	2	3	4	5	6
Distinguish between the objectives of descriptive versus inferential statistical procedures.	1	2	3	4	5	6
Distinguish between the information given by the three measures of central tendency.	1	2	3	4	5	6
Distinguish between a population parameter and a sample statistic.	1	2	3	4	5	6
Identify when the mean, median and mode should be used as a measure of central tendency.	1	2	3	4	5	6
Explain the difference between a sampling distribution and a population distribution.	1	2	3	4	5	6