

ELEMENTARY SCIENCE ANXIETY:
IMPACT OF EXPERIENCE AND GENDER

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Abstract

Our country has some of the finest educational institutions that produce some of the world's most innovative thinkers. However, our K-12 public school system science achievement levels are far behind many of the other leading industrialized countries. While mathematics education studies have found links between teacher math anxiety, teacher gender, and student learning by gender, few such studies have been done in the context of science education. In this study, we analyze pre-service and practicing teachers' responses to the State-Trait Anxiety Inventory (STAI) to determine their levels of general anxiety and their level of anxiety specifically about teaching science. The goal of this project was to see if pre-service and in-service teachers are experiencing anxiety about teaching science. We hypothesized that both populations would present higher levels of science anxiety than general populations. The participants in the pre-service STAI overwhelmingly presented as science anxious. There were not enough participants in the in-service teacher study to generate an interpretation representative of the population. The pre-service teacher data contributes to the body of research addressing the concern of how science anxiety, like math anxiety, is perpetuated possibly as early as elementary schools, and the in-service teacher data lays the ground work for future research.

Elementary Teacher Science Anxiety

Theoretical Framework

For the past couple of decades, school aged children and students in higher education have been evaluated on their abilities and beliefs in science. Currently, it has been shown that by eighth grade, boys begin to outperform girls in science with a significant margin (Martin, Mullis, & Chrostowski 2004). These margins continue to increase as students matriculate through high school and enroll in higher educational institutions. Before research studies were aimed at uncovering these performance rates, there had been many stereotypes that suggested that men were biologically more cognitively able to understand science and advance into science-based careers. When under-represented groups, such as women, are made aware of these stereotypes, and their gender is highlighted, it can result in lower performance within science or other STEM content areas (Bell, Spencer, Iserman, & Logel, 2003). In the 1980s, it was uncovered that science anxiety had become an obstacle for women, and that it started becoming prevalent in young girls as early as age nine (Chiarelott & Czerniak, 1985). When students feel overwhelmed or anxious about a subject, they tend to close down, lose interest, and can underperform in that subject, which in turn causes negative experiences. These experiences in science can lead to science avoidance, which can produce underrepresentation of females in science and non-science fields (Udo, Ramsay, & Mallow, 2004). Currently, over 90% of elementary teachers are female (Beilock 2010.) Elementary teachers are exposed to limited amounts of collegiate level science courses. Looking at the teachers' level of science content knowledge raises the question of how prepared these teachers are when teaching science to our young students, especially

female students who look towards their female teachers as mentors. If females are less likely to take science intensive courses, have internalized feelings of gender stereotypes, possible unengaging lab experiences in secondary education, and have high levels of science anxiety, then our science gender gaps within the public educational system will continue to be a revolving cycle with widening margins. Something must be done to transform this anxiety into efficacy.

Previously, there has been ample evidence to correlate that math anxiety affects both teachers and students (Beilock, 2010). Such was the case in a study done by Sian L Beilock (2010), at the University of Chicago, who studied the correlation between teachers' math anxiety and their students' math achievement. She stated that "math anxiety is not simply a proxy for poor math ability. Rather, the fears that math-anxious individuals experience when they are called on to do math... [prevent] them from using the math knowledge they possess to show what they know." She suggested that students may major in elementary education so that they avoid the more rigorous university mathematics courses, which in turn fuels their math anxiety. We seek to find out if science anxiety has the same effects on pre-service teachers and practicing teachers who choose education as their major.

What is Science Anxiety?

In the 1950s, research on anxiety was first recognized and started to become a household term. Sigmund Freud was the first to grapple with the concept of anxiety. He speculated that anxiety was a psychosomatic disorder that was "something felt" (Freud, 1936). Since Freud, there have been numerous studies done across universities

throughout the world and within psychological clinics that look at human anxiety daily. Currently, anxiety is a term that is used to designate an “unpleasant emotional state” or can describe an individual’s personality trait (Spielberger, 1983). Psychologists have moved beyond simply defining anxiety to identifying many different forms of anxiety including but not limited to, anxiety disorders, phobias, panic disorders, post-traumatic stress disorders, obsessive-compulsive disorder, and situational or state anxieties. In the educational community, two psychological terms that have gained wide spread interest are math anxiety and science anxiety. Mallow (1981) first defined science anxiety as “feelings of tension and stress that interfere with the construction of science knowledge, the development of science skills and abilities, and the use of science knowledge, skills, and abilities in life and in academic situations.” (Mallow, 1981). In later research, Mallow, along with his colleagues Udo and Ramsey concluded that science anxiety was developed through many factors which included stereotyping of scientists in popular media, bad experiences in science classes in both elementary and secondary schools, racial and gender stereotyping, and contact with teachers whom themselves were science anxious (Udo, Ramsay, & Mallow, 2004). This raises concerns for females, especially in elementary school, because studies have shown that children are more likely to imitate adults of the same gender than adults of the opposite sex (Perry & Bussey, 1979). Therefore, young girls may be adopting these science anxieties without even being consciously aware of the situation.

Causes of Science Anxiety in Pre-Service Teachers

It is not uncommon for a female pre-service teacher who is attending a university, to have had prior negative experience in science, such as recurring tedious lectures or monotonous amounts of book work. These negative experiences leave her feeling completely science illiterate. In an effort to assist non-science majors to have a greater understanding of science concepts and feel comfortable with science curriculum, many universities have adopted core curriculum courses that cater to and are designed for non-science students, such as business, education, humanities, and social science majors. However, when studying whether or not these courses helped lower the science anxiety level of these students, researchers have found that there were still drastic levels of science anxiety, especially within the female populations, and that education majors had the highest overall general anxiety (Udo, Ramsey, & Mallow, 2004).

So what may be the causes of continuing science anxiety of future teachers, or pre-service teachers, who are studying to become educators? One possible source of anxiety may be that pre-service teachers do not feel prepared to take science courses at the collegiate level. To graduate high school in the state of Texas, currently, one only needs a minimum of two science credits: biology, and integrated physics and chemistry (Texas Education Agency, 2014). It is recommended that students take an additional chemistry and/or physics course, but it is not required by the state for graduation. Most students who are admitted into college take three or four science courses, but many times the courses only include the biological sciences and not the physical sciences. Another reason why pre-service teachers in Texas may be science anxious could be due to being overwhelmed with having to be proficient in all science related Texas Essential

Knowledge and Skills or TEKS. The TEKS are the state standards that must be students must demonstrate that they have mastered by the end of the year in the state of Texas. In 2001, the No Child Left Behind Act (NCLB) was passed, requiring standardized testing on state standards (U.S. Department of Education, 2002). Most elementary teachers in Texas are certified as generalists. This means they are required to pass a certification test that will assess if they have the basic skills and educational attainment needed for teaching language arts, mathematics, science, social studies, health, physical education, art, music, and theater to children within the grades they aim to teach (Texas Education Agency, 2014). This means that pre-service teachers are responsible for mastering over 300 TEKS in science alone (Texas Education Agency 2014.) The certification test is theoretical and does not assess efficacy in teaching. Each state has differences, but twenty-six states use the Next Generation Science Standards, and most of the other states align their standards to match (Next Generation Science Standards, 2015). Currently, there is research that demonstrates that teachers beliefs cause them to resist reform (Czerniak, & Lumpe, 1996) and that the institutionalization of practice hinders teachers to change (Bridwell-Mitchell, 2015). Meaning, that many teachers teach as they were taught which is why it can be difficult and puzzling to implement change when educators only know what they have experienced.

Causes of Science Anxiety in Practicing Teachers

One possible source is that the teacher may not have a completely proficient grasp of the content that they are teaching. It has been shown that many elementary teachers do

not understand the science that they are teaching until after teaching the content for several years (Carin, Bass & Contant, 2008). Anxiety can stem from not continuing science professional development throughout one's years of teaching. In the state of Texas, practicing educators are required to obtain 150 continuing professional education or CPE hours every five years which works out to 30 CPE hours a year to maintain their certification (Texas Education Agency, 2014). However, they are able to choose what areas they would like to further in their education, as long as it pertains to their content area. Elementary teachers should associate themselves with all content areas, but most of the time they do not. If teachers are avoiding science because of science anxiety, then they may be less likely to choose science or related content areas to supplement their understandings.

Another possible source of anxiety comes from the management of inquiry based learning, which is a widely used approach for teaching science. Inquiry based learning is a method of teaching that allows students to observe and experiment, collect and organize data, construct models and theories, and formulate explanations and conclusions through independent and small group based work, much like an actual scientist would work. What can make this difficult for a teacher, is assessing if each student is obtaining the knowledge necessary for mastery on their end of year standardized assessment, and also keeping younger students on track academically. In a study done by Czerniak and Chiarelott in 1990, teachers admitted to being flustered easily "by hands-on instruction, open-ended instruction, or other less rigid teaching strategies" and felt a higher self-efficacy in science when they had control over their classrooms and used more lecture and book based whole class instruction (Czerniak & Chiarelott, 1990). Ironically, that is

what can lead to student disengagement and create uninteresting experiences for students learning the science.

Student- Teacher Relationship

It is no question that many young students look up to their teachers as mentors. It has been shown that children are more likely to imitate the actions of same-gender than contrasting-gendered adults (Bussey & Bandura, 1984). Knowing that over 90% of elementary teachers are female, one can suggest that young females are looking to see how their teachers act during science instruction. Are the teachers bored? Are they anxious? How do they manage their science classroom? In a study looking at community-oriented classrooms, researchers found that positive student-teacher relationships inspired risk-taking performances essential for learning (Baker, Dilley, & Lacey, 2003). If a teacher is going to use inquiry-based learning when teaching science, which requires students to plan and conduct experiments and to formulate their own opinions, the teacher must first model positive risk-taking performances, and have efficacy in the subject that they are teaching. This will allow students who are looking up to teachers as mentors to have a more positive science classroom experience.

Motivation for Research

The main question that we wanted to ask was, where does science anxiety or efficacy originate in pre-service elementary teachers, and have those feelings changed

since becoming practicing teachers? We wanted to first assess if current pre-service teachers are presently still exhibiting anxiety about teaching science. Next, we wondered if those pre-service teachers associate themselves with one main subject content area, even though they are supposed to be generalists. Lastly, we wanted to examine if practicing teachers are exhibiting anxiety about teaching science.

Based on the literature reviewed for this research study, we hypothesized that pre-service teachers would still be science anxious and would identify themselves with teaching language arts or related (humanities) subjects. We also hypothesized that currently practicing elementary teachers would also identify as science anxious.

Research Methodologies

Pre-Service Teachers Population

We gathered data from pre-service teachers for this research from a large public university in Texas. This university's ethnicity is diverse with African-American students accounting for 9%, Hispanic students accounting for 31%, White students accounting for 52%, and all other ethnicities accounting for 2% or less. The College of Education accounts for 16.2% of the university's total enrollment. All study participants were Interdisciplinary Studies majors seeking certification to teach early childhood through sixth grade. In this degree seeking and certification process, students must complete a minimum of two elementary physics courses, an elementary physics lab, one biology course, two general science courses, and a science methods course that focuses on constructivist methods of science teaching. In this course, instructors model constructivist science lessons for students and students teach two middle school lessons using the 5E model (Baybee et al., 2006) before taking their last science pedagogy course which focuses on science methods in elementary education. The students in the science methods course are primarily seniors with a few juniors, and are majority female. It is here, in the science methods course, that we gathered our pre-service teacher data.

In-Service Teacher Population

We chose second and fifth grade teachers to be in our in-service teacher population. We decided to choose these two grade levels to determine if state testing had an effect on anxiety levels: state-mandated standardized testing begins in third grade, and

the first state science test is given in fifth grade. We solicited responses from all teachers at these grade levels in a medium-sized Central Texas school district (approximately 7500 k-12 students). In total, responses were requested from forty-three practicing elementary teachers.

Data Collection

The State-Trait Anxiety Inventory (STAI) will be used to determine if a participant has science anxiety. This instrument allows the researcher to gauge the participants' level of general anxiety and also an anxiety that is brought on by certain stimuli (Spielberger, 1983) which in this case study will be teaching science. The developer of this proprietary instrument, Charles D. Spielberger, has broken the instrument into forty questions. Twenty questions measure trait anxiety (T-anxiety) which refers to general anxiety proneness or the tendency to perceive a stressful situation as intimidating or hazardous (Spielberger, 1983). State anxiety (S-anxiety), on the other hand, accounts for the other twenty questions, and refers to the individuals' reaction to a particular situation at a given place and/or time (Spielberger, 1983). The STAI has been used in numerous research studies since its development in 1979. It can be administered to anyone with at least a sixth grade reading level, and has been adapted to be administered in more than thirty languages (Spielberger, 1983). Therefore, using this inventory allows for measurement of participants' levels of anxiety through a well-developed and validated test.

Since there is no standard inventory used to determine anxiety about teaching science, we modified the STAI from its original version to specify science teaching as the particular situation for which the S-anxiety scale measured participants' anxiety levels. This has been done previously, in a study that looked at science anxiety by Westerback in 1981. In Westerback's study, the questions of the STAI that gauged the participants levels of anxiety were not altered, only the headings of the T-anxiety scale, and S-anxiety scale. The T-anxiety scale was kept from the original inventory and it read, "How Do You Feel in General?" and the S-anxiety scale was adapted from, "How do you feel right now, that is, at this moment?" to read, "How Do You Feel About Teaching Science?" (Westerback, M. E., 1981).

This study used that adaption, along with several other demographic questions. There was also written reflections collected from the pre-service teachers, followed up with one student interview. Examples of some of the written questions for pre-service teachers included: (a.) After taking the survey reflect on your level of anxiety about teaching science to children. What experiences have fostered confidence or anxiety in your teaching of science? (b.) After your teaching experience at Taylor (pseudonym) Middle School, have your feelings about teaching science changed? If so, in what way, and why? If not, why not? (c.) When you think of your future self in your own elementary classroom, do you identify most with one subject area (math, science, reading/writing, social studies)? Why or why not? Pre-service teachers also had the option to discuss further science anxiety concerns in a follow up interview.

Next, twenty-nine pre-service teachers' reflections about teaching science for the first time were analyzed to identify patterns of anxiety. All of the students were in the

same science methods course. As part of their course, and during the duration of the study, this particular group of students engaged in a micro-teaching field experience where they taught a science lesson to sixth graders. This survey was distributed to these students a week before their field experience and they were asked to respond to a written reflection before and after this experience.

When this project was first established the goal was to have three different study groups. One pre-service teacher study group and two different in-service teacher study groups. The in-service teachers would be second and fifth grade teachers from a school district in central Texas. Originally, the project was given IRB exemption, but because the teachers worked for a school district there would have to be a second IRB approval process from the district itself.

This consisted of gaining letters of support from principals at each school along with completing Collaborative Institutional Training (CITI.) Once the project received support from five out of the six elementary school principals, and CITI training was completed, IRB was filed with the district. The original response took three weeks to come in and it stated, “The project as described, did not sufficiently add value for requests that would be made on our teachers.” Therefore, it was not approved.

We decided to file again, however, this time there would be an incentive for the district. Trying to appeal to the district administrators, we articulated that, “The researchers will share this information with the district’s instructional leadership in whatever form is most useful to them: a presentation describing and explaining the study results and sharing relevant prior research, a brief report, and/or a copy of the Honors

Senior Thesis based on this study... so that professional development and support for teachers can be designed to be maximally effective.” After another week, the IRB was approved, and the project was given support to start surveying the teachers right after the district’s spring break.

The next obstacle that required to be overcome was getting the teachers contact information, i.e. email addresses for each teacher. It was not until right before surveys needed to be administered that we realized that the staff directory was not current or accurate. Fortunately, after about a week, a science instructional leader was able to supply a list a names for each of the second and fifth grade teachers. In the list it was communicated that each teacher’s name was their email address. She explained that all you needed to do was you firstname.lastname@domiannname, and so the names were put into the system.

Two weeks went by and no teachers were responding to the surveys. Principals were encouraged to ask teachers to participate and incentives were given to boost responses. Still no responses were coming into the system. One of the instructional leaders informed the project team that it seemed as if none of the surveys were making it into the teachers’ email inboxes. The next step was to try and troubleshoot the problem. Maybe the district email system was rejecting a bulk email; maybe Mind Garden was not set up correctly? It was opted to try and use the instructional leader’s email to see if she would get the survey. To the surprise and frustration of the team, the problem was identified that all of the email addresses had been put into the system as name@domain.com instead of name@domain.net.

With one week left to gain responses the issue was quickly resolved and email solicitations went out each day for the remainder of the week. Of the forty-three solicited teachers, only eight responded. Three were fifth grade teachers, and five were second grade teachers. Since there were so few participants it is important to note that the results may not be representative of the whole group, and also that the data has been merged from two separate in-service groups to one main in-service group.

Data Analysis

Data for the STAI surveys were collected through the online tool Mind Garden and analyzed through Mind Garden's data analysis tool, Transform, to show participants' average general anxiety and anxiety about teaching science. The data were compared to the mean and standard deviation of the STAI developers' norm groups to determine whether the participant fell within various standard deviations of the mean scores reported. The pre-service teacher reflections were also analyzed to find patterns and outliers. This was done through reviewing written reflections and a follow-up interview of one participant.

Research Results

Pre-service STAI Results

Twenty-nine students were solicited to take the STAI from the science methods course. Of the twenty-nine students, twenty participated in the research. The STAI, when it was designed, discouraged “black and white” labelling of a respondent as anxious or not anxious. Spielberger (1983) encouraged administrators to identify a respondent or group of respondents as “more anxious than the norm” or “less anxious than the norm”. Within these categories the administrator can create categories that are more anxious or less anxious (Spielberger, C. D., 1983). For this research, we identify participants as: without the presence of anxiety, with the presence of anxiety, and with heightened anxiety. The results established that almost all participants sampled had some anxiety. There were only two participants that communicated an absence of both general anxiety and science anxiety. Twelve of the participants fell into a category that flagged them for having the presence of general anxiety. Within those students nine of them demonstrated heightened general anxiety, or anxiety levels more than one full standard deviation above the population mean. When it came to science anxiety the participants overall demonstrated higher levels of anxiety. Seventeen students, or 85% of the participants, scored above the mean and we identified them for having the presence of science anxiety. Of those students, twelve also demonstrated heightened general anxiety, scoring a standard deviation or more above the mean. There was only one student that had general anxiety without demonstrating science anxiety. (See Figure 1)

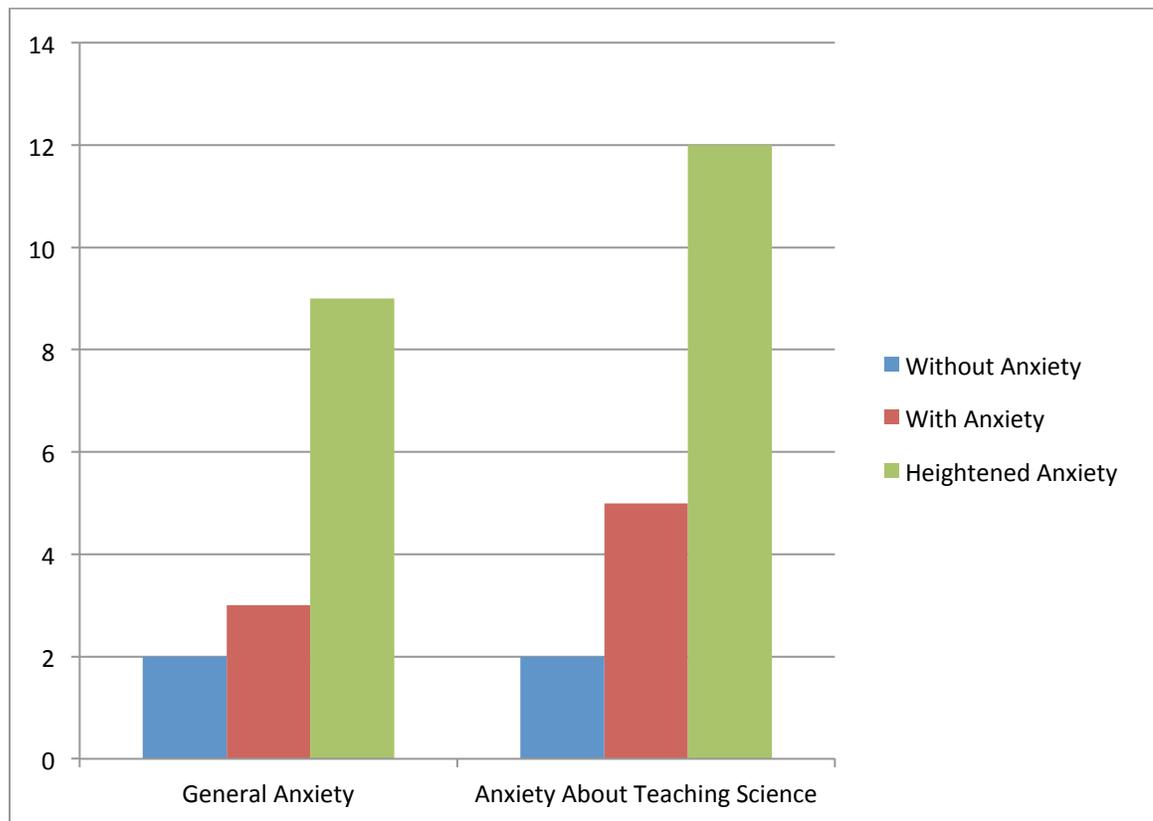
Figure 1. Anxiety Among the Sample Pre-service Population (N = 20)

S-anxiety raw score ranges

(20-39 – without anxiety), (40- 52 – with anxiety), (53-80 – heightened anxiety)

T-anxiety raw score ranges

(20-40 – without anxiety), (41-51 – with anxiety), (52-80 – heightened anxiety)



The presence of anxiety was determined by looking at the developer's norm group of 531 female college students. Their mean for trait anxiety was 40.40 with a standard deviation of 10.15. The participants in this study had a mean of 43.35 and a standard deviation of 9.99 for their trait, or general, anxiety. This demonstrated that the participant group fell within the normal general anxiety range for this population.

When looking at state anxiety, the norm group had a mean of 38.76 with a standard deviation of 11.95. The pre-service participants presented with a mean of 51.65 and a standard deviation of 12.19. This demonstrated that the participants in this group were significantly anxious about teaching science. (See Figures 2-5)

Figure 2. Trait anxiety distribution among the norm sample. (normal curve showing mean and standard deviation of norm group).

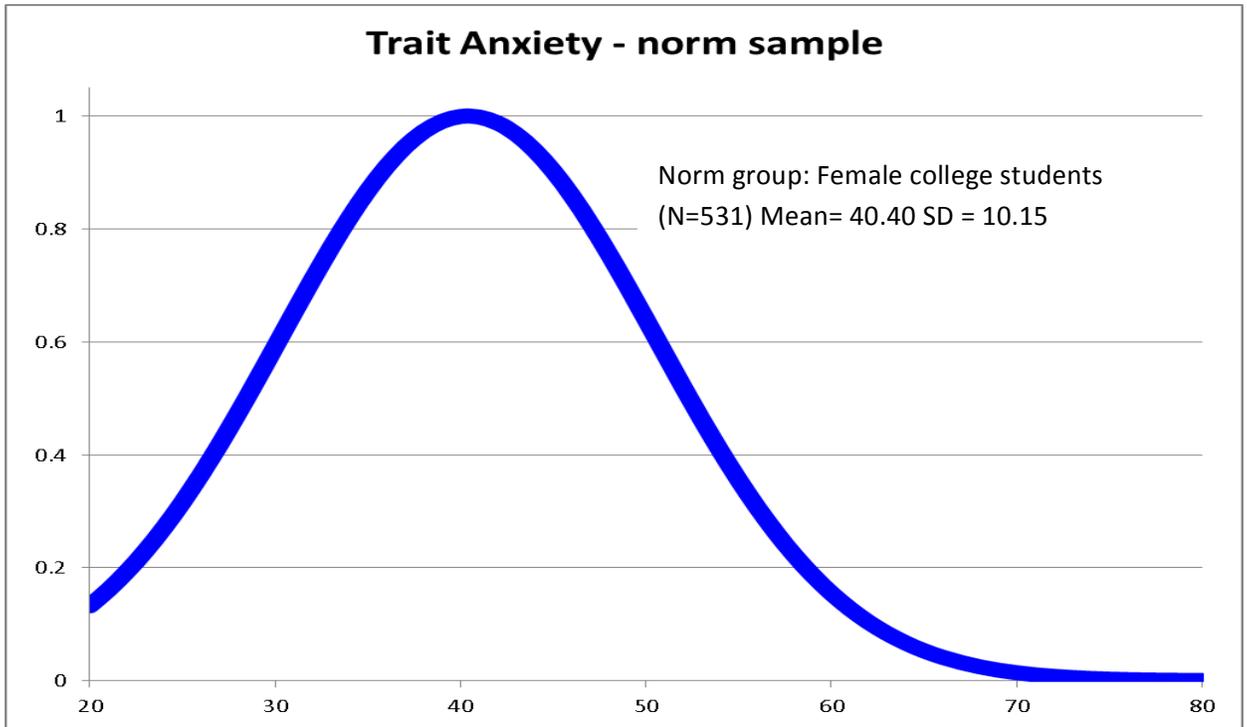


Figure 3. Trait anxiety distribution among the sample population. (N=20)

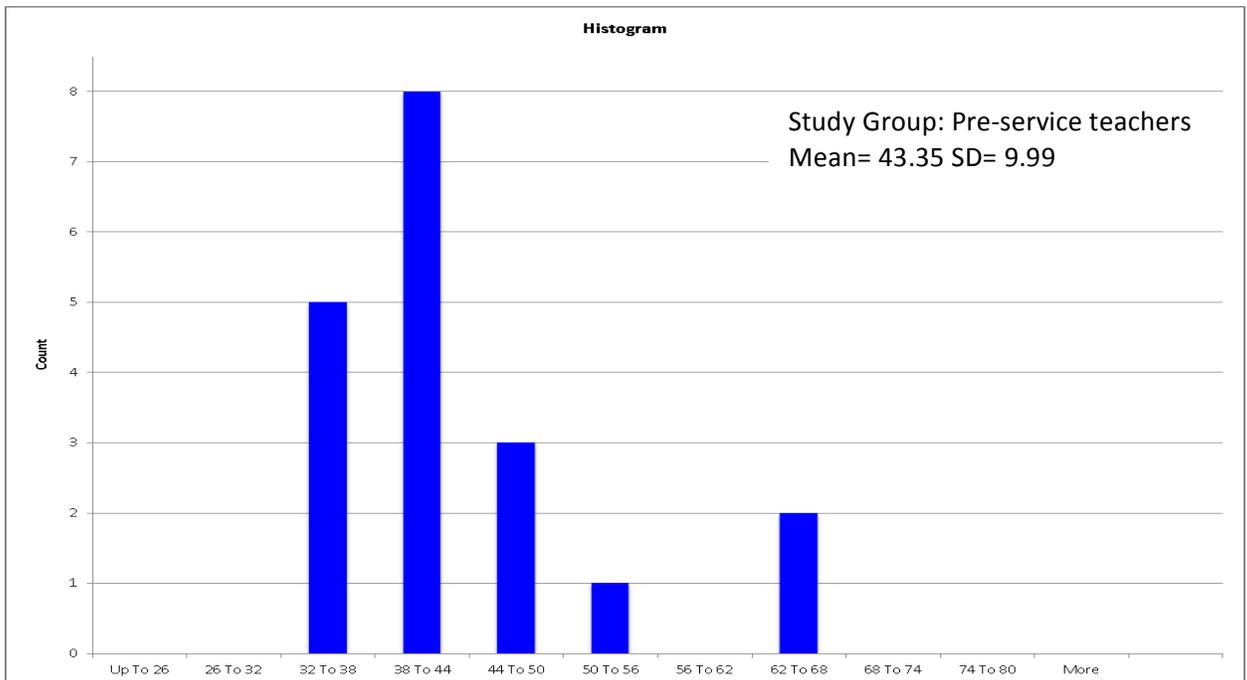


Figure 4. State anxiety distribution among the sample population. (normal curve showing mean and standard deviation of norm group).

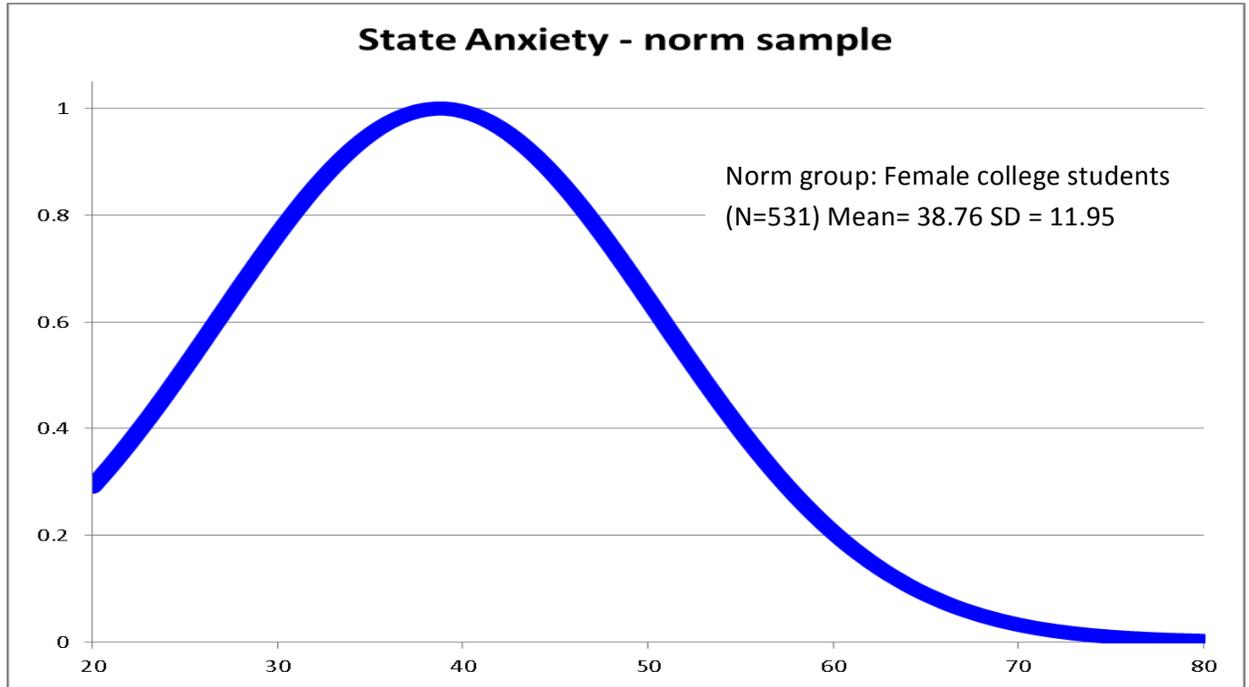
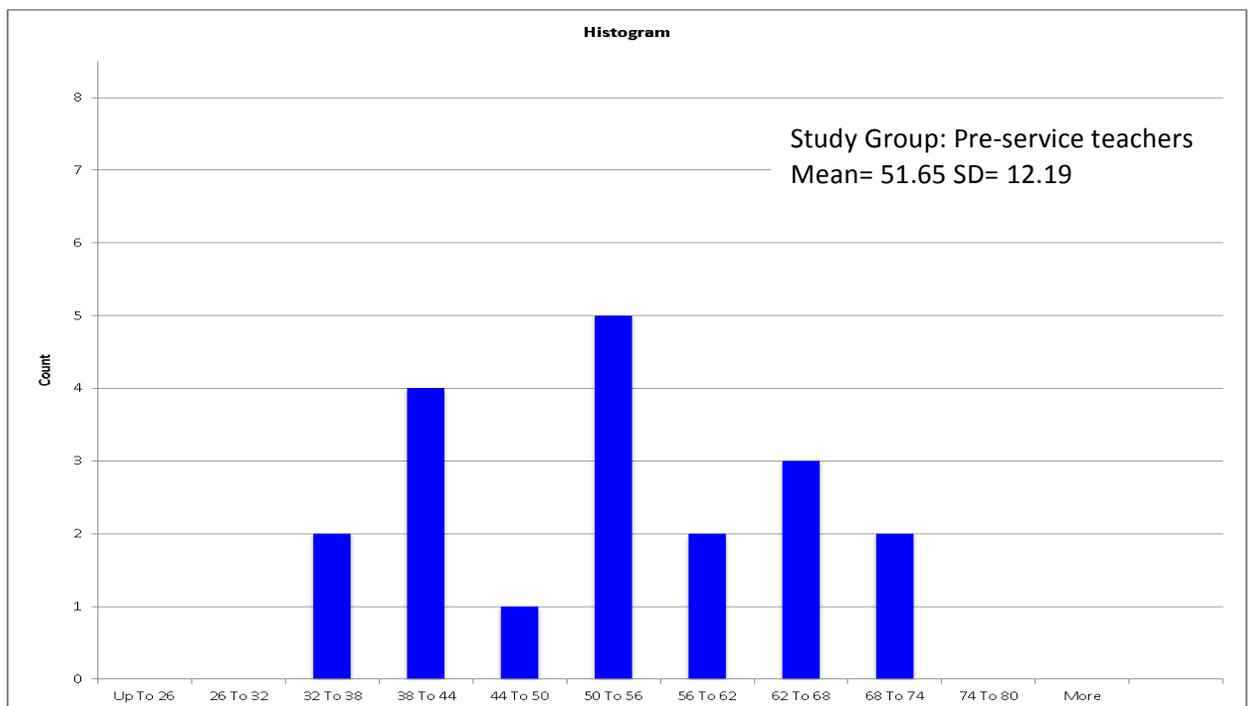


Figure 5. State anxiety distribution among the sample population. (N=20)



Pre-Service Reflections

As part of their regular science methods course, students were asked to reflect before and after their teaching experience. Twenty-two participants gave responses that were collected on various questions. The first reflection question, administered before the micro-teaching experience, pertained to participants that volunteered to take the STAI. It asked, “After taking the survey reflect on your level of anxiety about teaching science to children. What experiences have fostered confidence or anxiety in your teaching of science?” Eighteen participants responded. There was an overarching theme of anxiety throughout the responses. Several of the participants stated that they were scared of science. Many expressed concern that they were underprepared to teach, and were worried that the students that they would end up teaching would have greater science knowledge base than they themselves had. One-third of the participant pool expressed that science was their worst subject, with two participants saying that they “hated” science.

To gauge their levels of anxiety after their micro-teaching experience, a second reflection question was administered. It asked, “After your teaching experience at [Named] Middle School, have your feelings about teaching science changed? If so, in what way, and why? If not, why not?” Fourteen participants responded. The predominant theme expressed in these responses was a greater sense of confidence, with one contributor stating she felt “joy”, though most articulated some remaining level of anxiety. Three participants voiced no change in feelings and conveyed still having a heightened level of anxiety towards teaching science.

The last question, aimed at seeing how many of the participants would identify themselves as a generalist, with not being partial to one academic discipline, and how many, if any, would identify mostly with science. The reflection question was, “When you think of your future self in your own elementary classroom, do you identify most with one subject area (math, science, reading/writing, social studies)? Why or why not?” Fourteen participants responded. Six of the students claimed to identify with math, six identified with reading/writing, one with social studies, and one with science.

Pre-service Interviews

After the written reflections were collected and analyzed, six respondents were asked to participate in an interview to gain further insight into why they were anxious about teaching science. Only one student opted to do an interview. The first question asked was, “Is there a particular grade that you want to teach?” Her response was second grade. The question that followed was, “Do you feel anxious about teaching second grade science?” She expressed that she did not feel anxious about teaching science at that grade level. This prompted the next question, “At which grade level would you feel that you would have anxiety about teaching science?” Her response was fourth grade. She explained that she “didn’t understand science” very well and that she felt that she would “need more experience” before teaching science at that grade level or any grade higher.

The course of questioning that followed these first few questions was chosen to find out if the participant really wanted more experience so that she would feel less anxious in teaching science, or if she, as research before had suggested, would avoid

teaching science because she was anxious. The next question prompted was, “You recently went into a middle school and taught a science lesson to sixth graders. Did you feel that this experience helped you become less anxious about teaching science?” She explained that she was still very anxious but “liked teaching the lesson.” The next question inquired, “Did you know that the particular section of science methods, in which you are enrolled, is the only section that does a classroom teaching experience?” She seemed to almost be flustered and upset, and responded, “No, but I wish I did know that before I enrolled.” I questioned further, “So, if you had the chance to re-enroll into another section, and not gain the experience of teaching science, you would have switched?” She answered, “I would have switched. I liked teaching the science, but I don’t want to teach it, if I don’t have to.”

This demonstrates that even though the student benefitted from the teaching experience, she would have avoided the subject if given the choice, which suggests that later in her career she might also avoid science-related professional development if she had a choice in the matter. This also demonstrates that anxiety about teaching science can lead to science avoidance.

Practicing Teachers STAI Results

Forty-three participants were solicited to take the STAI from the central Texas school district. Eight teachers submitted completed surveys. The results established that half or four of the participants sampled had some presence of anxiety. There were four participants that communicated an absence of both general anxiety and science anxiety. Of the eight participants, one was male and he presented with a heightened level of

general anxiety. Within the other three teachers that had the presence of general anxiety, all of them demonstrated heightened general anxiety. When it came to anxiety about teaching science, all the participants who had general anxiety also demonstrated anxiety about teaching science. Of those teachers, two of them demonstrated heightened anxiety about teaching science. (See Figure 6)

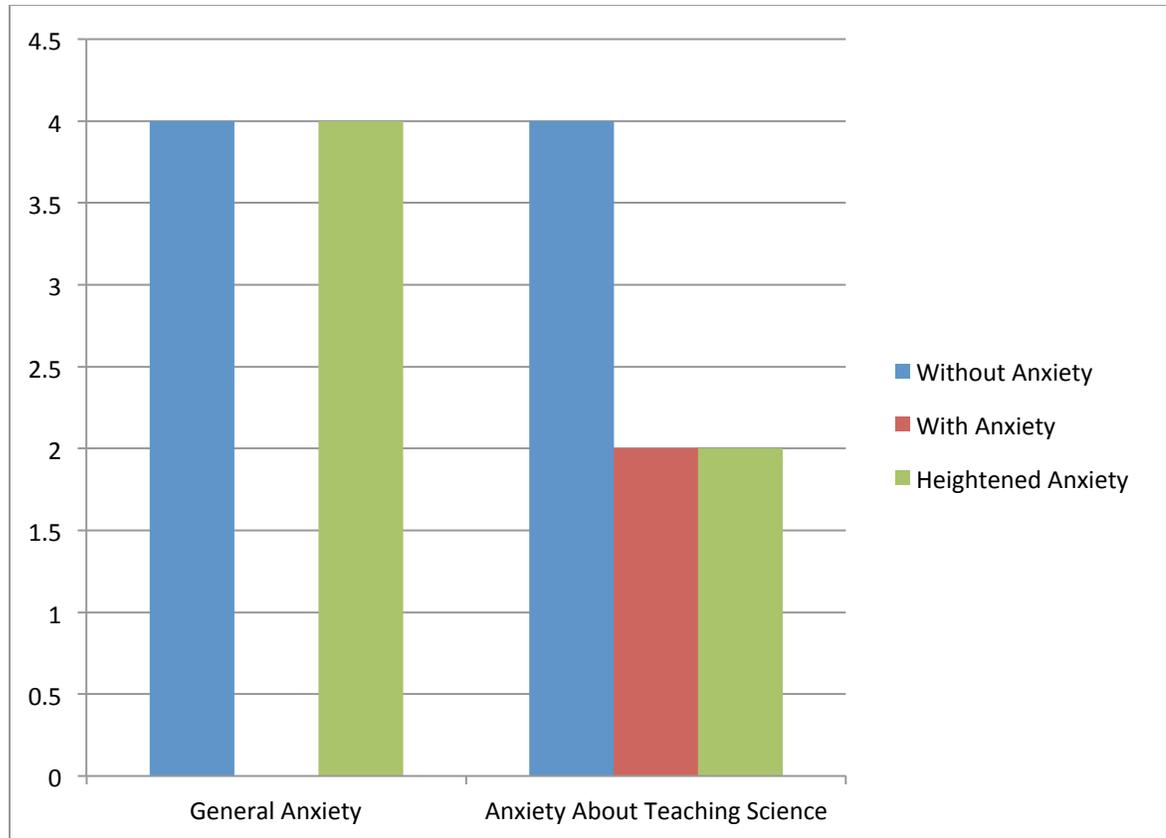
Figure 6. Anxiety Among the Sample In-service Population (N=8)

S-anxiety raw score ranges

(20-35 – without anxiety), (36-47 – with anxiety), (48-80 – heightened anxiety)

T-anxiety raw score ranges

(20-35 – without anxiety), (36-45 – with anxiety), (46-80 – heightened anxiety)



The presence of anxiety was determined by comparing study participants to the developer's norm group of working females (N=451). Their mean for trait anxiety was 34.79 with a standard deviation of 9.22. The female in-service study group had a mean of 33.57 and a standard deviation of 11.33. This indicated that the participants of this group fell within the normal general anxiety range. For the single male participant, the presence of anxiety was determined by looking at the developers norm group of working males (N=1387). Their mean for trait anxiety was 34.89 with a standard deviation of 9.19. The male participant of this study group had a score of 41 for his trait (general) anxiety.

When looking at state anxiety, the female norm group had a mean score of 35.20 with a standard deviation of 10.61. The males had a mean of 35.72 with a standard deviation of 10.40. The female in-service participants presented with a mean of 36.57 with a standard deviation of 12.74. The difference between the norm group and the study group was slight, and too small to be meaningful given the number of responses. The male presented with a score of 43, which indicated the presence of anxiety about teaching science. Since there were only eight participants this data cannot illustrate the whole groups' levels of anxiety both in general, and about teaching science.

Conclusions

The goal of this project was to see if pre-service and in-service teachers have anxiety about teaching science. We hypothesized that both populations would present as science anxious. Having the pre-service teachers participate in the STAI survey and having the ability to collect qualitative data from their own experiences allowed us to get a sense of how anxious they were compared to the STAI norms gathered from the STAI developers. The participants in the pre-service STAI overwhelmingly presented as science anxious. Their written reflections drew more cause for concern given that students, especially those of the same gender as their teacher, are likely to imitate the actions of same-gender adults (Bussey & Bandura, 1984). Alarming statements that were expressed were, “I am very nervous about teaching science to children. It has always been my worst subject and I worry I won’t know enough to teach them what they need to know.” Based on our current evidence, there is a significant amount of data that points to anxiety about teaching science amongst pre-service teachers. Unfortunately, there was not enough in-service teacher data to provide representative sample of the in-service teacher population; therefore we cannot draw conclusions at this time about levels of science anxiety in this population.

The results of our study generate the following questions for further investigations: (a.) Are practicing teachers also presenting as anxious about teaching science? (b.) How does a teacher’s level of anxiety effect their students’ science achievement? (c.) Is there a gender effect? E.g., are female students of female teachers at a higher risk of developing science anxiety? (d.) Why do so many of the pre-service teachers identify as math teachers, which is a related STEM discipline, but not science?

A Call for Action

As suggested in previous research, this study shows that science anxiety is real and present. It has been shown that science anxiety discourages its victims from wanting to study science and can hinder the learning process. This research study adds to the body of research that demonstrates these points. The problem is that these points have been stressed since the early 80s, and yet, few gains have been made in promoting efficacy in this subject, especially amongst females. This study was intended to shed more light upon this issue and encourages educators and curriculum writers to help find ways to address this issue. Since doing these observations, and reflecting upon this experience, I believe universities should make it mandatory for pre-service teachers to have more science internship experience. The data in this study, from the pre-service teacher responses indicated that the students had lower levels of anxiety about teaching science when they were required to teach science lessons. If this is not done soon, our pre-service teachers will continue to avoid science, and the children they will soon teach will be the ones who suffer. However, if universities mandate this training we open the door for many pre-service teachers to alleviate some of their science anxiety before entering the classroom.

Appendix

STAI

The following is an example of questions from the STAI that were used to determine if a participant demonstrates anxiety.

	Not at all	Somewhat	Moderately so	Very much so
* 1. I feel calm.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
* 2. I feel secure.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
* 3. I am tense.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
* 4. I feel strained.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
* 5. I feel at ease.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

IRB

This project EXP2015B311724A was approved by the Texas State IRB on February 17, 2015. Pertinent questions or concerns about the research, research participants' rights, and/or research-related injuries to participants should be directed to the IRB chair, Dr. Jon Lasser (512-245-3413 - lasser@txstate.edu) and to Becky Northcut, Director, Research Integrity & Compliance (512-245-2314 - bnorthcut@txstate.edu).

Research software

Mind Garden is an independent publisher of psychological assessments and instruments, and a professional research data collection website (Mind Garden 2015.) It serves academic and research communities along with consulting professionals. The STAI survey was administered through Mind Garden and data was collected through Mind Garden's data analysis tool, Transform.

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