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**ABSTRACT**

The relationships of science anxiety to measures of achievement, test anxiety, year of chemistry taken, and gender were investigated for high school students; the study also attempted to establish reliability data on the Czerniak Assessment of Science Anxiety (CASA) of L. Chiarelott and C. Czerniak (1987). Subjects were 101 students (45 males and 56 females) in grades 10 through 12 in chemistry classes in a public high school in Rockford (Illinois). Sixty-one of the students were in a first-year chemistry class, and 40 of the students were in a second-year chemistry class. Correlations were determined between the CASA and (1) the first chapter test, (2) the quarter grade, and (3) the Test Anxiety Inventory (TAI). The 6-month test-retest reliability on the CASA was 0.69. The internal consistency (alpha) was 0.93 for the test and 0.94 for the retest. There was no significant correlation between the CASA and achievement, the CASA and the TAI, or the CASA and the worry subscale of the TAI. There was a significant correlation between the CASA and the emotionality subscale of the TAI. Females scored significantly higher than did males on the CASA, and first-year students scored higher than did second-year students on the CASA. The mean on the test was significantly higher than on the retest. This study supports the reliability of the CASA. A 25-item list of references is included. (SLD)

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Science Anxiety: Relation with Gender, Year in Chemistry  
Class, Achievement, and Test Anxiety

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## Science Anxiety:Relation with Gender, Year in Chemistry Class, Achievement and Test Anxiety

### Objectives:

The purpose of this study was first to investigate the relationship of science anxiety to measures of achievement, test anxiety, year of chemistry taken and gender. Second, since no well known test of science anxiety exists, this study attempted to establish reliability data on the Czerniak Assessment of Science Anxiety (CASA).

### Literature Review:

Math anxiety has been described in research literature for approximately thirty years. As early as 1957, Dreger and Aiken discussed what they called number anxiety, which they explained as a syndrome of emotional reactions to arithmetic and mathematics (Morris, Kellaway, & Smith, 1987). This was later called mathematics anxiety. It has been defined as the feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations (Richardson & Suinn, 1972). In the last decade, as interest was shown in the emotional component of science learning, the term science anxiety has also been coined. It has been defined as a diffuse or vague fear which arises in response to the prospect of learning science. It results from intervening self-messages rather than from the science learning itself (Mallow & Greenburg, 1983).

Since science anxiety is a new construct, there is little research available on it directly. Some of the pioneering work with students who have identified themselves as being science anxious has been done by Sharon Greenburg, a therapist in private practice and lecturer and Jeffery Mallow, a physics professor, who set up a science anxiety clinic at Loyola University of Chicago in 1977 (Greenburg & Mallow, 1982).

For a study of science anxiety using fourth through ninth graders, Chiarelott & Czerniak (1987) developed a questionnaire to measure science anxiety. This questionnaire (Czerniak Assessment of Science Anxiety) consists of forty items such as "Having someone watch you do an experiment" or "Using a thermometer to measure the temperature of water in an experiment", which are marked by choosing a letter A, "very calm" through E, "very nervous".

The investigation of science anxiety could be related to the investigation of math anxiety and may follow similar patterns to it. Math anxiety has been studied in terms of its relationship to gender, achievement, avoidance behavior and test anxiety. Most studies have shown that females have higher levels of math anxiety (Llabre & Suarez, 1985) (Dew, Galassi & Galassi, 1984). In general there is not a direct relationship shown between math anxiety and achievement, (Gliner, 1987) and one study showed that stress management

conducted in the class did lower anxiety but did not improve performance on a statistics examination (Sime, Ansorge, Olson, Parker, & Lukin, 1987). So it has been suggested that simply lowering anxiety does not raise achievement levels. But it has been also suggested that high levels of anxiety does correlate to avoidance behavior (Geen, 1987) and possibly to interest. Studies have shown that there is a relationship between math anxiety and test anxiety (Rounds & Hendel, 1980) and that math anxiety is related to both emotionality and worry, two subscales of the Test Anxiety Inventory (Dew, Galassi, & Galassi, 1984). One study of science anxiety showed that females were more science anxious than males and that there was a relationship to achievement in science (Chiarelott & Czerniak, 1987).

#### Methods:

High School students in five intact chemistry classes were given the Czerniak Assessment of Science anxiety on the first day of class and again six month later. They were also given the Test Anxiety Inventory. First chapter test grades and quarter grades were recorded, as was race, gender, and year in chemistry.

#### Sample:

The sample consisted of 101 tenth through twelfth grade students enrolled in chemistry class in a public high school in Rockford, Illinois. 61 students were in first year chemistry and 40 were in second year chemistry class. 45 were males and 56 were females. The ethnic background in terms of race were as follows: 74 Caucasian, 11 Black, 13 Asian, and 3 Hispanic.

#### Results:

Test retest reliability with a six month interval on the Czerniak Assessment of Science Anxiety was .69. Internal consistency as measured by the alpha coefficient was .93 for the test and .94 for the retest.

Correlations between the CASA and the first chapter test, quarter grade, TAI, TAI-worry subscale, and TAI-emotionality subscale, were all computed. There was no significant correlation between the CASA and achievement as measured by first chapter test score or the quarter grade percent. There was also no significant correlation between the CASA with the TAI or between the CASA with the TAI-worry subscale. However there was a correlation ( $r=.25$ ) between the CASA and the TAI-emotionality subscale which was significant at the .01 level.

Comparisons for gender and year of chemistry were made on the CASA and the TAI. The mean for the males on the CASA ( $X=84.156$ ) and for females ( $X=95.929$ ) were significantly different at the .005 level. The means for first year students ( $X=96.000$ ) and for second year students ( $X=82.575$ ) were significantly different at the .002 level. No significant difference was found on the TAI for gender.

However there was a significant difference on the TAI for first and second year chemistry students ( $X=35.68$  vs  $X=40.93$  respectively).

The means on the CASA test and retest were shown to be significantly different at the .03 level where the mean for the test was 89.81 and for the retest was 86.07.

Since there was no significant correlation between the CASA with either measure of achievement, the construct of science anxiety does not significantly improve the prediction of grades in Chemistry class. This is consistent with the findings reported for math anxiety such as those by Llabre and Suarez (1985), but is not consistent with the results of Chiarelott and Czerniak on science anxiety (1987).

This study did not look directly at avoidance behavior. However, students in first year Chemistry Class had higher levels of science anxiety than those in second year class. This may indicate that students who have high levels of anxiety do not go on to take elective science classes. Or it could mean that taking more classes in science and being successful (success rate is high in second year Chemistry class and of the forty students in this study there was 0% failure as measured by the semester grade) lowers anxiety.

The results show that while test anxiety, especially the construct of emotionality may overlap with the construct of science anxiety, they are not the same construct. This is consistent with the results found by Mallow and Greenburg, (1983) in their study of students at Loyola Science Anxiety Clinic.

Gender differences in science anxiety were also consistent with those reported by Chiarelott and Czerniak (1987) in their study. Girls in chemistry classes are more science anxious than boys. However there was no gender difference in test anxiety.

#### Implications:

Since there is a concern in our society for the underachievement and underrepresentation of females in the field of science, and the general lack of interest in the field of science, perhaps information on science anxiety can give clues as to these concerns. A significant gender difference, and year in chemistry difference has been established. Perhaps factors in science anxiety could be researched which could then be worked with individually to increase interest and motivate students to participate in the field of science. Since the reliability of the Czerniak Assessment of Science Anxiety has been supported by this study and this instrument could be used for future studies.

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