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Examining Correlates of Math Anxiety Among Single-Sex & Co-Educational Schools in Nigeria

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Received: 14 December 2011 Accepted: 1 January 2012 Published: 15 January 2012

Abstract

A global view of Mathematics as a subject reveals that it is widely recognized as a problem area and most students have phobia for it. In view of this, the present study examined correlates of math anxiety among single-sex and co-educational schools in Nigeria. The study adopted an ex-post facto descriptive survey research design, and a total of 450 participants were randomly sampled for the study; 153 (34

Index terms— Single-sex; Co-educational; Math Anxiety; South-western.

1 I. ntroduction

Tai Solarin University of Education. E-mail : kingola2001@yahoo.com advancement of any country and there is hardly any way of avoiding math in our day-to-day activities. In the words of Rossnan (2003), she asserted that 'the needs of society require a greater need for mathematics', and there is therefore no way of avoiding it.

That Math anxiety can be a great problem cannot be overemphasized; Rossnan (2003) has said math can greatly affect a child's success throughout their education and their adult life, the reason being that math is connected to so many professional and personal practices. Math anxiety can cause one to forget and loose one's self-confidence and has also been observed to have blocked millions of adults from professional and personal opportunities because they fear or perform poorly in mathematics (Tobias, 1993). For many, these negative experiences remain throughout their adult lives (Evans, 2000; **??**itzSimons, 1994;Civil 2003). Baroody and Costlick (1998) suggested that children who develop a math anxiety tend to fall into a self-defeating, self-perpetuating cycle, which may stay with them throughout life if not attended to. From the foregoing, it is of uttermost importance therefore that attention be paid to math anxiety, particularly among secondary school students in order to be able to assist the phobic to overcome their phobia for math and prepare better for their future career that may be negatively affected if the anxiety for math continues with them. a) What is anxiety? Anxiety has been defined by Noting, (2006) as stress and strain that is brought into one's body and mind. It can be described as an unpleasant emotion which is usually characterized by a feeling of vague, unspecified harm such as fear, and it can cause a state of physical disturbance; unlike fear, it is characterized by the absence of an apparent cause. It usually occurs that the circumstance that precipitates anxiety is hidden and unknown to the person. Evidence exists that some persons may be biochemically vulnerable to an extreme form of anxiety known as "panic attacks." Anxiety itself is a powerful physical experience that may involve rapid or pounding heartbeat, difficult breathing, tremulousness, sweating, dry mouth, tightness in the chest, sweaty palms, dizziness, weakness, nausea, diarrhea, cramps, E Year global view of Mathematics as a subject will reveal that it is widely recognized as a problem area (Wagh, 2003) and most students have phobia for it (irrespective of age and or gender) Johnson, **??**2003). According to Marilyn Burns (1998), nearly two thirds of American adults have hatred for and deep fear of math. In 1992, researchers at the University of Florida circulated a questionnaire to 9,093 students and found that had a moderate to high need of help with math anxiety (Jones 2001). Zaslavsky (1994) also posited that people of all races and economic backgrounds fear math. In the case of Nigeria, Bamidele, (2005) has said students' general impression is that mathematics is a dreadful subject, but ironically, it is the basis for scientific and technologicalA I Author ? ? ? ? ¥ § ? ? ? :

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insomnia, fatigue, headache, loss of appetite, and sexual disturbances. These symptoms may easily be mistaken for physical illness. In addition, anxiety results in a narrowing of one's time perspective so that only the present matters. It also results in an inability to attend to more than one task at a time or to organize thoughts and plans effectively. Low levels of anxiety may temporarily increase a person's ability to do a simple task, because of the greater vigilance and narrowing of attention associated with anxiety, but as anxiety increases, behavior becomes more disorganized and ineffective.

b) What is math anxiety? Several definitions have been advanced for math anxiety; for example, Tobias and Weissbrod (1980) defined math anxiety as "the panic, helplessness, paralysis, and mental disorganization that arises among some people when they are required to solve a mathematical problem". It is both an emotional and cognitive dread of mathematics and it can happen on elementary school children, high school and college students (Tobias 1993). It needs be mentioned however, that, although some anxiety can be motivating or even exciting, too much anxiety can cause "downshifting" in which "the brain's normal processing mechanisms begin to change by narrowing perceptions, inhibiting short term memory and behaving in more primal reactions" (McKee 2002). The Merriam Webster dictionary defines anxiety as an abnormal and overwhelming sense of apprehension and fear often marked by physiological signs (as sweating, tension, and increased pulse), by doubt concerning the reality and nature of the threat, and by self-doubt about one's capacity to cope with it.

Mathematics anxiety according to Luo; Wang, and Luo, (2009) refers to such unhealthy mood responses which occur when some students come upon mathematics problems and manifest themselves as being panicky and losing one's head, depressed and helpless, nervous and fearful; at the same time, it is accompanied by some physiological reactions, such as perspiration of the palms, holding tight the fists, being sick, vomiting, dry lips, and pale face. Students experience a feeling of self-threat in mathematics learning, resulting in the loss of interest in mathematics and the loss of confidence in mathematics learning.

Researchers like Pries & Biggs (2001) have described a cycle of math avoidance, which they presented as having four phases. In the first phase one, the math-anxious person experiences negative reactions to math situations. This will lead to the second phase in which the person avoids math situations. This avoidance leads to phase three, poor mathematics preparation, which brings them to phase four, poor math performance. This generates more negative experiences with math and brings us back to phase one. This cycle can repeat so often that the math anxious person becomes convinced they cannot do math and the cycle is rarely broken.

Several causes have been advanced by researchers for math anxiety: Unrelated life events, trigger events in education and a lack of support (Zopp, 1999); Parents as well as teachers with math anxiety pass it along to their children and students respectively (Fiore 1999); gender bias, insensitive/uncaring instructors (Jackson et al 1999); Math myths" (Preis & Biggs 2001); "Student avoidance", Ashcraft (2002) for Norwood (1994) math anxiety does not appear to have single cause, but was, in fact, the result of many different factors such as truancy, poor self image, poor coping skills, teacher attitude and emphasis on learning math through drill without understanding. However, Greenwood (1984) further stated that the principal cause of mathematics anxiety has been in teaching methodologies. He said math classes did not encouraged reasoning and understanding. Butterworth (1999) believes that a lack of understanding is the cause of anxiety and avoidance and that understanding based learning is more effective than drill and practice. A lack of confidence when working in mathematical situations is described by Stuart (2000) as the cause of math anxiety. It is evident from the aforementioned that there are several variables that come to play in causing math anxiety among people in different categories. However, there seems to be a vacuum regarding the examination of demographic variables that may correlate with math anxiety among students (especially when one compares students in single sex and co-educational schools. Therefore, the justification for the present study.

3 Theoretical background

An eclectic approach has been adopted in the establishment of a theoretical background for this study. This approach has been deemed appropriate because the variables that may precipitate anxiety in an individual are numerous and may not be adequately explained by just one theory, hence the adoption of an eclectic approach.

4 c) Learning Theory

In learning theory, anxiety is seen both as a response to learned cues and as a drive, or motivator, of behavior. Most learning theorists maintain that anxiety is derived from reaction to pain. Anxiety can thus be reduced by removing or avoiding the source or sources of the situations that have produced pain. Avoidance may become firmly established and lead to constricted or bizarre behavior. In relation to math anxiety therefore, the anxiety manifested may therefore be a reaction to the learnt cues that math as a subject is a difficult one and it is only the genius that does well in it. Since many people will always want to avoid pain, most students therefore try to avoid perceived pain from taking math. It

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Volume XII Issue X Version I is therefore hypothesized that math anxiety, which is manifested by most students is a function of what they have been able to learn from their immediate environment about mathematics. The

criticism however is that, even in environment where positive cues are given about math as a subject; many students still manifest math anxiety. In some schools there are sufficient motivation for students to learn math with ease, many of such students still manifest phobic reaction to math. It thus follows that there are may be more factors than the learning from the environment that can precipitate math anxiety in students.

6 d) Cognitive Theory

In the control of anxiety, some psychologists have focused on the role of cognition as the origin of anxiety. Cognitive theories emphasize the process of appraisal and the often unnoticed internal dialogue that amplifies emotional response. Experiments have shown that the interpretation of a situation determines whether a person feels anxiety or some other emotion. In other words, many students already have this cognitive dissonance regarding mathematics as a subject. In fact many students have said frantically that they hate math as a subject and they can never pass it at any level. They seem to have concluded and close up their cognitive make up that they can never get to understand math, no matter the strategies, methods or motivation provided for teaching and understanding math as a subject. It thus follows that attention must be paid to cognitive restructuring in order to be able to assist those students.

7 e) Psychoanalytic Theory

Two types of anxiety are recognized in psychoanalysis. The first, traumatic anxiety, results from over stimulation. Events happen faster than the mind can comprehend them. This produces a feeling of crisis. Sigmund Freud believed that this feeling has a physical basis in the capacity of the nervous system and that birth throws every child into a state of traumatic anxiety. In his view, this birth trauma becomes the template for later episodes of anxiety. The second type of anxiety, signal anxiety, is believed to arise from a person's need to guard against traumatic anxiety. The ego appraises its ability to cope with external demands and the push of internal drives. When normal methods of coping with these pressures threaten to fail, the ego responds with anxiety, which then mobilizes the person to take new action. The small-scale discomfort of signal anxiety helps to avoid a more devastating experience. The second type of anxiety fits more in explaining math anxiety, in the sense that, the need to avoid traumatic experience makes the individual to react with anxiety as a defense mechanism. f) Review of related literature "There just aren't gender differences anymore in math performance," says University of Wisconsin-Madison psychology professor Janet Hyde, who gathered data from 7million students in order to challenge the stereotype and cultural beliefs that boys perform better in math than girls. The result of the study showed that there is no significant difference in boys performance in math compared to girls. Hyde and her colleagues; using data from more than 7 million students, they calculated the "effect size," a statistic that reports the degree of difference between girls' and boys' average math scores in standardized units. The effect sizes they found -ranging from 0.01 and 0.06 -were basically zero, indicating that average scores of girls and boys were the same. "Boys did a teeny bit better in some states, and girls did a teeny bit better in others," says Hyde. "But when you average them all, you essentially get no difference." Some critics argue, however, that even when average performance is equal, gender discrepancies may still exist at the highest levels of mathematical ability. So the team searched for those, as well. For example, they compared the variability in boys' and girls' math scores, the idea being that if more boys fell into the top scoring percentiles than girls, the variance in their scores would be greater. Again, the effort uncovered little difference, as did a comparison of how well boys and girls did on questions requiring complex problem solving. They thus concluded that there are no significant statistical difference in the performance of boys and girls in math. (Hyde, Lindberg, Ellis and Williams, 2008). Some of the previous researches such as Betz (1978); Ma (1999); Woodard (2004) and Tapia (2004) who examined math anxiety and achievement have indicated that there is a relationship between mathematics anxiety and achievement; which indicates that as math anxiety scores increase, achievement scores decrease. The more recent findings of Effandi and Norazah (2008), have confirmed also that there is a relationship between math anxiety and motivation. Effandi and Norazah (2008), focused on examining such variables as math anxiety and motivation; sampling a total of 88 university undergraduates in one of the universities in Malaysia, the researchers found that the mean achievement scores and motivation scores of low, moderate and high anxiety groups were significantly different. Findings also revealed a low (r=-0.32) but significant ($p < 0.05$) negative correlation between mathematics anxiety and achievement and also a strong (r=-0.72) significant ($p<0.05$) negative correlation between mathematics anxiety and motivation. The study also revealed a significant low positive correlation (r=0.31) between motivation and achievement.

One of the first studies about math anxiety was by Richardson and Suinn (1972), whose work drew attention to the problem. Since then, the literature has included results of studies about math anxiety and its effect on math achievement **??**Betz, 1978). Research has shown that females, as a group, do not enjoy math and often see it as having little relationship to their lives or their futures (Fennema & Sherman, 1978). Females display more math anxiety than males in secondary school and college **??**Woodard, 2004). Mash, (2004) has noted that at various ages may have cultural or social pressures that help shape their attitudes about mathematics as a subject of study or an element in a future career, results with this sample of college-age students showed that the main effect of gender was insignificant. From these results, we conclude that feeling good about mathematics is not related to gender among this group of college students, but rather it is likely to be something related to

individual, personal experiences. While the literature has reported a high relationship between math anxiety and gender, in this sample of students it is clear that math anxiety is unrelated to gender.

To explain the observed variance in test anxiety scores, individual difference variables must be taken into account **??**Zeidner, 1998). Gender and age differences in test anxiety have been reported in the literature **??**McDonald, 2001; **??**eidner, 1998). Research has consistently found gender differences in test anxiety **??**McDonald, 2001; **??**eidner, 1998), with female participants scoring higher than male participants on self-report measures of test anxiety (Seipp & Schwarzer, 1996; **??**ren & Benson, 2004;Zeidner & Schleyer, 1999). Seipp and Schwarzer conducted a meta-analysis on gender differences in test anxiety among 6,340 school-age students across 12 different cultures (China, Czechoslovakia, Germany, Holland, Hungary, India, Iran, Italy, Jordan, Korea, Turkey, and the United States). Cross-cultural adaptations of the Test Anxiety Inventory (TAI; Spielberger, 1980) were used in each of these independent studies. Seipp and Schwarzer found statistically significant gender differences in test anxiety in all countries except China. Girls scored statistically significantly higher than boys on the TAI, with a mean gender effect size reported of .29.

Although the pattern of gender differences reported in the test anxiety literature has been consistent, the pattern of age differences found in the test anxiety literature has been less consistent. Hembree (1988) examined test anxiety among students in Grades 2 through 12. Hembree conducted a meta-analysis of 78 studies involving 17,538 elementary and secondary school students. Hembree found that test anxiety increased in the early elementary school grades, stabilized near Grade 5, and remained constant throughout the junior high and high school years. In contrast, Wigfield and Eccles (1989) reported an increase in students' test anxiety scores in the junior high school years, and then the students' scores leveled off during the high school years. According to the literature, age and gender differences in evaluative situations do exist, and it is important to take these variables into account to explain the observed variance in students' scores on test anxiety measures **??**Zeidner, 1998).

8 g) Rationale for the Study

It is no longer news that, a credit grade is compulsory for any graduating secondary school student who is aiming at pursuing a higher degree in the higher institution (irrespective of the discipline he/she is pursuing). The irony however is that majority of these students dread mathematics as a subject. In desperate move to pass at all cost, many of these students have resulted to using dubious means to pass at all cost, which has grievous implication both for the students and the society at large later in life. This situation of course can be remedied by putting machineries in place to correct the wrong impression that mathematics is a difficult subject and must be dreaded. It is in the light of this that the present study set out to examine the demographic correlates of mathematics anxiety among secondary school students, with the intention of making useful recommendation based on the findings of the study.

Again, the general assumption by many people is that male students are usually better in mathematics compare to female students. The study also set out to find out the truth about this assumption (particularly in the Nigerian context), hence, the need to sample participants for the study from single-sex (male only and female only) and mixed schools (male and female together).

For the purpose of this study therefore, three hypotheses were tested:

1. There will be a significant positive correlation among the variables of interest in the study. 2. Male students will be significantly higher on maths anxiety than their female counterparts 3. School type will significantly influence students' mathematics anxiety level.

9 II. Method a) Design

This study adopts the ex-post facto survey design. This was deemed suitable because the study went out to gather information that was already existing among the population understudy.

10 b) Population

The target population for the study was randomly selected from nine senior secondary schools in southwestern Nigeria. Secondary school students have been selected as the population of study because researchers like Lazarus (1974) and Jackson and Leffingwell (1999) E Year mathematics at the elementary and secondary level. If this is not attended to, it may be carried into higher levels of study in the university which may have negative effect on the students' career choice and academic performance.

11 c) Participants

Self-report measures were administered to a randomly selected sample of 450 senior secondary school students who were drawn from 9 different schools in southwestern Nigeria. Participation was voluntary and participants' anonymity was guaranteed.

12 (

) males and 297 ( ) females participated in the study with their ages ranging between 16years and 24years. Mean age was 16.2years (SD = 1.8). All participants registered for mathematics since it is a compulsory subject for all students in the secondary school.

13 d) Sample and Sampling Procedure

This research adopted the simple random sampling (ballot technique) in selecting the 450 participants that participated in the study.

14 e) Instrument

Validated instrument was used for data collection. The instrument was made up of two sections 'A' and 'B'. section 'A' dealt with the demographic characteristics of the participants, while the section 'B' was the revised edition of the 24item Mathematics Anxiety Rating Scale, which was developed by Plake and Parker **??**1982). The Alpha reliability co-efficient of the scale as reported by Plake et al **??**1982) was .98, while the alpha reliability co-efficient of the scale for the present study is .90. The scale is in the likert format, with responses ranging from 1(no anxiety) to 5(high anxiety).

15 f) Procedure for data collection

The researchers went personally to administer the questionnaires in the different schools that were randomly selected to participate in the study (in southwestern Nigeria). After obtaining permission from the respective school's principal, researchers went to each of the schools on an agreed date and administered the instruments to the students that were randomly selected from the schools to respond to the questionnaires. The questionnaires were properly filled and collected back the same day. g) Method of Data Analysis Data was analyzed using correlation statistics, ttest for independent samples and one way analysis of variance.

16 III. Results

The correlation analysis that was done to establish the relationship that exists among the major variables of interest in the study showed that only gender and conception about mathematics had significant relationship with math anxiety. Gender correlated significantly negatively ($p<.001$, r = -.216**); while conception about mathematics and age correlated significantly positively with math anxiety respectively ($p<.05$; r = 103*; 114*). Other variables such as age, assertiveness, emotional intelligence, need achievement motivation, life satisfaction and self-esteem did not have significant correlation with math anxiety.

For hypothesis two, the result of analysis is presented in table 1 below. between math anxiety level of male and female students. Specifically, the mean difference shows that male students are higher on math anxiety compared to their female counterparts (mean = 75.38, 66.23; df =448, t=4.68, $p<.001$). For hypothesis 3, the result of analysis is presented below.

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Table 1 show that there is a significant The ANOVA results as shown in Table 2b, revealed that there is a significant difference in the level of anxiety of the students based on their school type. F (8.87) =3.75, $p<0.001$. School type significantly predicted math anxiety score as shown by the result. Students in single sex school (male only) were significantly higher on math anxiety (X=79.42), followed by those in the mixed schools (X=69.82), while the students in single sex school (female only) seems to be significantly lower compare to their counterparts (X=66.35).

18 IV. Discussion

The result of data analysis revealed that there is a significant relationship among the variables of, gender, age, conception about mathematics and math anxiety. This seems to be in line with previous works of **??**embree, (1988); McDonald, (2001) and Zeidner, (1998) who have reported gender and age difference in math anxiety. In furtherance, the relationship between class level and math anxiety cannot be far fetched, since the higher a student moves in his/her academic level, the more he/she becomes aware of what lies ahead of him/her regarding his/her life goals, it follows that, at the lower classes, the students may not have understood the essence of being in school and may not have been very serious with their studies, whereas at the higher classes, when they must have realized that math is one of the compulsory subjects that must be passed in order to be able to take courses in the higher institution, they may develop anxiety and may eventually device different unacceptable mechanisms of attending to their anxiety.

Although the pattern of gender differences consistent, the pattern of age differences found in the test anxiety literature has been less consistent. For instance, **??**embree (1988) examined test anxiety among students in Grades 2 through 12 and found that test anxiety increased in the early elementary school grades, stabilized near Grade 5, and remained constant throughout the junior high and high school years. In contrast, Wigfield and

Eccles (1989) reported an increase in students' test anxiety scores in the junior high school years, and then the students' scores leveled off during the high school years. According to the literature, age and gender differences in evaluative situations do exist, which has also been established with the significant relationship that we found in our study also. It is therefore important to take these variables into account to explain the observed variance in students' scores on test anxiety measures **??**Zeidner, 1998).

It needs be mentioned that there seems to be a dearth of literature regarding students' conception about mathematics in relation to math anxiety. This we found in this study that there is a relationship between the two variables. It follows that a student who has a negative conception of the subject will have manifest anxiety for it, which is most likely going to be as a result of the wrong or negative perception he has for the subject. With wrong or negative conception, there might not be sufficient inner motivation to study the subject. It also follows that the person who has a positive conception of mathematics will not have anxiety for the course as he may have sufficient motivation to continue with the subject. It is of utmost importance that teachers and educators should work towards helping students to

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Volume XII Issue X Version I reported in the test anxiety literature has been have the right conception of mathematics so that they may be able to overcome the anxiety for the subject. If there is a change in the conception of students about mathematics, the possibilities are that they will have reduced anxiety and possibly no anxiety for mathematics.

More specific analysis was done to ascertain the gender difference in math anxiety. The t-test for independence sample that was conducted revealed that boys were higher on math anxiety than girls ($p<.001.$) of course there are several conflicting research reports along this line, some researchers have reported that girls are higher on math anxiety while a host of others have reported that boys are higher. For this research, we found that boys are significantly higher on math anxiety compared to girls.

The most probable explanation for this of course will be the fact that in the most recent times there has been aggressive in awareness creation regarding the education of the girl child as well as several programs and propaganda to motivate girls into taking courses that are ordinarily regarded as men's. Nigeria in the most recent times has experienced more aggressiveness on the emancipation of women and the education of the girl child more than never before and this must have started to yield its dividends with the result being observed in this study.

The possibility is also that boys might have been looking at themselves as the 'head' the strong; believing that there are certain fields of study that are supposedly male dominated and may therefore see no need to make efforts towards improving themselves in such areas. They have the perception that come rain come shine, they will excel in such areas. However, they are being proved wrong as it were.

The third hypothesis also affirmed that boys have significantly higher level of math anxiety than girls since the mean difference showed that student in male only and mixed schools were significantly higher in math anxiety than students in female only school. This is particularly interesting because, for decades, the presumption was that co-ed schools provided a more equitable environment for learning than single education schools, but in recent years a number of researchers have built an increasingly persuasive case that this is not so. A leading role in highlighting the problems faced by girls has been played by the American Association of University Women (AAUW), in a series of studies published throughout the 1990s. A national poll commissioned by AAUW, Shortchanging Girls, Shortchanging America (1991), highlighted that girls aged 9-15 suffered from lower self esteem, less willingness to stand up for their views with teachers, and lower interest in science and mathematics. The report How Schools Shortchange Girls (1992), also published by the American Association of University Women, sparked an intense national debate with its findings that girls were frequently and encouraged less than male students. American University professors Myra Sadker and David Sadker added to the debate with the publication of Failing at Fairness: How America's Schools Cheat Girls **??**1994). The report, based on a three-year study involving structured visits to more than 100 classrooms in several states, asserted that girls were called upon less than boys, that boys received more attention when answering questions, and that boys received more encouragement to work through problems. In 1995, the AAUW, in its report Growing Smart: What's Working for Girls in School, took the next step and endorsed singlesex schooling as a response, while urging for changes in existing co-ed schools. Specifically, the report noted: "Single-sex programs deserve consideration as a vehicle to address specific needs or remedy existing inequities" (Valerie and Helen, 1990). By that point, substantial research confirmed the benefits of single-sex education for girls. Similarly positive results were found in secondary schools, too. The same seems applicable in the present study where students in female school were found to have less math anxiety compared to their male counterparts from male only schools.

20 V. Conclusion

From the foregoing, it is clear that there is gender difference in math anxiety among secondary school students, school type also showed significant influence on the manifestation of math anxiety among students. This should therefore guide teachers, educators and counselors in guiding and counseling students and parents.

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Figure 1:

1

	Group Statistics Gender	N	Mean	Std. Deviation	Std. Error Mean	Df	t	P
Math Anxiety	Male	153	75.38	18.96	1.533	448	4.68	<.001
	Female	297	66.23	19.97	1.159			

Figure 2: Table 1 :

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2

	N	Mean	Std. Deviation	Std. Error
female only	200	66.35	21.386	1.512
mixed school	200	69.82	17.914	1.267
male only	50	79.42	19.912	2.816
Total	450	69.34	20.090	.947

Figure 3: Table 2 a

2

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6919.450	2	3459.725	8.873	.000
Within Groups	174299.53	447	389.932		

Figure 4: Table 2 b

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35.
36. Wigfield, A., & Eccles, J. (1989). Relations of expectancies and values to students' math grades and intentions. Paper presented at the meeting of the American Educational Research Association, San Francisco.
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Figure 5:

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