Mathematics Anxiety and Cross Gender Identity in Young Adult Males and Females

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CERTIFICATE

I hereby certify that the work which is being presented in the thesis entitled "**Mathematics Anxiety And Cross Gender Identity In Young Adult Males And Females**", in the partial fulfilment of the requirements for the award of degree of Masters of Philosophy in *Psychology* submitted in the School of Management and Social Sciences of Thapar University, Patiala, is an authentic record of my own work carried out under the supervision of Dr. Santha Kumari, Associate Professor,SMSS.

The matter presented in thesis has not been submitted for the award of any other degree of this or any other university.

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Abstract

The present study investigates the relationship between Cross Gender Identity and Mathematics Anxiety. Masculine Gender Identity Scale (Freund and Blanchard, 1988) and Feminine Gender Identity Scale (Blanchard and Freund, 1983) were administered to 236 males and 189 females respectively. On the basis of scores obtained on these tests, high and low Cross Gender Identified males and females were selected. To these selected subjects Mathematics Anxiety Rating Scale (short version) by Suinn (2003) was administered. High masculine females exhibited low mathematics anxiety as compared to low masculine females. There was no significant difference between high and low feminine males on mathematics anxiety. The findings are explained in terms of advantages of Cross Gender Identification for mathematics performance and gender differences.

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CHAPTER 1

INTRODUCTION

Recently the concept of mathematics anxiety has received much attention. Mathematics anxiety is one of the most serious limitations to education. It can be thought of as either an aversion or fear of working with numbers or equations for purpose of understanding the mathematics to solve practical problems in everyday life. Many children and adolescents develop fear of mathematics while they are in schools and colleges. This often is a result of inappropriate learning e.g. using rote memories to learn things.

Studies on gender differences and mathematics anxiety have found significant gender differences in math anxiety (Tapia, 2004). Women tend to feel more math anxiety as compared to men (Meece et al 1982). Studies on math performance and sex differences demonstrate that men perform better in mathematics as compared to women (Feingold, 1988), which is in line with the studies from the past that point to the male superiority in mathematics achievement. Moreover, biological studies explaining sex differences in math performance reveal that such differences may be due to the lateralization of the brain and may be attributed to the levels of the sex hormone, i.e. the testosterone in men, which is responsible for high mathematics performance (Benbow & Stanley, 1983). But there are some contradicting findings which reveal no sex differences in math performance (Fennema & Sherman, 1978). It has also been indicated that women who are masculine, do better in mathematics and spatial task performance (Spencer et al 1999).

Math anxiety in individuals is related to their math performance, as indicated by their scores on math achievement tests. Further, low performance of such individuals may force them to refrain from enrolling in mathematical courses. In addition to this, math performance is related to masculinity and femininity as studies on math competence reveal some consistent differences based on these constructs, for example, masculine men score higher than women on many kinds of visual spatial tests. Also, there is a positive relationship between masculine traits, values and math ability, and feminine traits, values and verbal skills.

Further, there are studies which indicated that high masculinity in women and high femininity in men relate to creativeness and intellectuality. That is to say, feminine boys and masculine females tend to show higher level of creativity, scholastic achievement, and giftedness than more sex-typed children do. Specifically, masculine females tends to perform better on mathematical tasks, and feminine males tend to perform better on creative and verbal tasks. Though these variables are related to one another but there is paucity of studies which indicate less math anxiety and better mathematics performance in masculine women.

Moreover, individuals who are high on the trait of androgyny, that is those who maintain a balance between masculine and feminine characteristics, perform low in mathematics. Since performance in mathematics is influenced by math anxiety, and in addition, masculinity and femininity may influence math anxiety and further an individual's scores on mathematical tasks. Thus, it is relevant to investigate the relationship of math anxiety with the variables as masculinity-femininity which may influence performance on mathematical tasks.

1.1 ANXIETY

Anxiety is something most of us feeling time to time. To some extent anxiety can facilitate desirable behavior but it can equally prevent desirable behavior. According to Freud (1924, p. 116), anxiety was "something felt," a fundamental, unpleasant emotional state or condition. This state was characterized by apprehension or anxious expectations in other words it is known as "nervousness." The physiological symptoms of anxiety included heart palpitation, nausea, disturbances in respirations, sweating, muscular tension, tremor, and vertigo. Barlow, 1991; Barlow, Chorpita and Turovsky, 1996 stated that there is difference between fear and anxiety. When the source of danger is obvious, the experienced emotion has been called Fear. But in case of anxiety we cannot clearly specify what the danger is. Fear is external feeling where as anxiety is internal feeling in which we are anticipating some dreadful thing is happening that is not entirely predictable from our actual circumstances (p. 184).

1.1.1 CAUSES OF ANXIETY

Anxiety is often triggered by stress in our lives. It varies in degree from person to person. Some of us are more vulnerable to anxiety than others. But even those who become anxious easily can learn to manage it well. We can also make ourselves anxious with "negative self talk" – a habit of always telling ourselves the worst will happen. There are three components for anxiety responses; the first one is the psychological component where the essential feelings of dread and apprehension are accompanied by restlessness, narrowing of attention, increased alertness and irritability. The second component is the somatic components where the muscles tension and respiration increases. And the third component is the autonomic component where the heart rate and sweating increases, the mouth become dry.

1.1.2 TYPES OF ANXIETY

1.1.2.1 State and Trait Anxiety

Cattell and Scheier (1961, p. 148) identified two distinct anxiety factors, trait or chronic anxiety, which they defined as a relatively permanent and stable characteristic of people e.g. tendency to embarrassment, ego weakness, and guilt proneness. The state or acute anxiety, which they defined as a transitory condition which varies from moment to moment and from day to day e.g. increase in respiration rate and systolic blood pressure.

According to Spielberger (1972, p. 148-149) state anxiety reflects a “transitory emotional state or condition of the human organism that is characterized by subjective, consciously perceived feelings of tension and apprehension, and heightened autonomic nervous system activity”. Spielberger (1972) also define trait anxiety a relatively stable individual differences in anxiety proness and refers to a general tendency to respond with anxiety to perceived threats in the environment. The trait anxiety is a relatively stable aspect of personality. These individuals are more likely to present state anxiety in circumstances with low anxiety generating potential, such as normal day to day activities, and will probably experience higher level of state anxiety in the presence of anxiety-generating stimuli. Where as state anxiety occurs in specific situations. State anxiety manifests itself as an interruption of an individual's emotional state. A person experiencing 'state' anxiety will feel tension or worry or might enter a state of restlessness.

1.1.3 MATH ANXIETY

The concept of mathematics anxiety have received much attention recently, largely owning to the suggestion that it affects many people and threatens both performance and participation (Suinn, Taylor & Edwards, 1988). Nevertheless, many students either avoid mathematics or perform below their actual capabilities because of anxiety aroused by mathematical operations called math anxiety. The empirical investigation of math anxiety was introduced more than three decades ago by Richardson and Suinn and his associates (Richardson & Suinn 1972; Suinn et al, 1970; Suinn & Richardson, 1971). Richardson and Suinn (1972) defined math anxiety as: "Feeling of tension and anxiety that interfere with the manipulation of numbers and solving of mathematics problems in a wide variety of ordinary life and academic situations (p. 83-90)." Mathematics anxiety may prevent a student from passing fundamental mathematics courses or prevent his pursuing advanced courses in mathematics or sciences. Mathematics may be particularly susceptible to the adverse effects of anxiety because of features like precision, logic and the emphasis on problem solving ability (Richardson & Woolfolk, 1980). It is agreed that anxiety can have a motivational role and have a positive effect on performance (Wigfield & Meece, 1988), it is also agreed that higher mental process such as problem- solving and divergent thinking which are required for mathematics will be negatively influenced by mathematics anxiety. Fiore (1999), Tobias and Weissbrod (1980 p. 63-70) define math anxiety as "the panic, helplessness, paralysis, and mental disorganization that arises among some people when they are required to solve some mathematical problems". It is both an emotional and cognitive dread of mathematics. While some anxiety can be motivating or even exciting, but 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).

Preis and Biggs (2001) describe a cycle of math avoidance: In phase one, the person experiences negative reactions to math situations. These may result from past negative experiences with math, and lead to a second phase in which person avoids math situations. This avoidance leads to phase three, poor mathematical preparations, which brings them to phase four, poor math performance. It generates more negative experience 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. Betz (1978) conducted a study on undergraduate students and found that approximately twenty-five percent of the participants felt nervous, uneasy or confused about mathematics.

1.1.4 THEORETICAL EXPLANATIONS FOR MATH ANXIETY

According to anxiety model, math anxiety can be viewed as a personal vicious cycle of unreasonable beliefs, anxiety, and protective behaviors (Baroody, 1987).

The basic assumption of math anxiety Model (Ellis & Harper, 1975) is that one’s emotional responses are not determined by the objective reality but by one’s interpretation of events i.e. one’s subjective reality. Subjective reality may involve unreasonable beliefs, which can lead to over exaggeration. These beliefs lead to view any problem situation as a threat to one’s well-being. Further, it also involves anxiety. Although fear may be an appropriate response to real danger, unreasonable beliefs can create imagined danger so intense that they prompt panic.

In addition to this, protective behaviors are also involved. These behaviors when resorted to, help an individual to control one’s anxiety. The short term advantage of protective behavior is that it reduces anxiety. Unfortunately the maximum disadvantage of a protective behavior is that it does nothing to eliminate the unreasonable beliefs and indeed, may reinforce such beliefs.

1.2 GENDER IDENTITY

Money (1987) suggested that the difference between male and female is something that everybody knows and nobody knows. Everybody knows it, proverbially and nobody knows it, scientifically. Gender identity refers to one's sense of maleness or femaleness and may be distinguished from gender role, to which the masculinity and femininity of one's overt behavior (Money, 1987). Gender role meant everything that a person says or does to dictate to the self or other his/her status as male, female, or ambiguous (Money, 1955) . As soon as a human infant is born, its genital morphology elicits special reaction from adults in the social environment that is the result in the sex assignment and thus determines the sex role to which the neonate eventually will be trained. With the development of language as a mean of communication and a cognitive tool, the child gradually acquires the ability to internalize elements of the childhood sex role and to compare it with her or his own behavior. If a high degree of concordance between the two sexes, a strong and unambiguous gender identity will result. (Reinisch, Rosenblum & Sanders, 1987)

From the sociological perspective, gender identity involves all the meanings that are applied to oneself on the basis of one's gender identification. In turn, these self meanings are a source of motivation for gender-related behaviors (Burke, 1980). A person with more masculine identity should act as more masculine i.e. engage in the behaviors whose meaning are more masculine such as behaving in a more dominant, competitive, and autonomous manner (Ashmore, Del Boca & Wohlers, 1986). It is not the behaviors themselves that are important, but the meanings implied by those behaviors. People have views about themselves along a feminine-masculine dimension of meaning, some being more feminine, some more masculine, and some perhaps a mixture of the two. These meanings with the feminine-masculine dimensions identify their gender, which guide their behavior.

1.3 GENDER IDENTITY DISORDER

Gender Identity Disorder (GID) or transsexualism is defined as strong, persistent feelings of identification with the opposite gender and discomfort with one's own assigned sex. Boys with GID show a marked preoccupation with traditionally feminine activities (Zucker & Bradley, 1995). They may prefer to dress in female clothing. They enjoy stereotypical games of girls, such as playing with dolls, house, drawing pictures of beautiful females and watching television programmers' with favorite female characters. Girls with GID typically balk at parents' attempt to dress them in traditional feminine clothes such as dresses. They prefer boys clothing short hair, and they may be misidentified by strangers as boys. A transgender person is someone who feels like they are the opposite gender from inside. Being a transgendered is different from a gay. Many transgendered people feel sexually attracted to members of their own biological gender, but many others do not.

1.4 CROSS - GENDER IDENTITY (MASCULINITY - FEMININITY)

Femininity and masculinity or one's gender identity (Burke, Stets & Pirog-Good 1988; Spence, 1985) refers to the degree to which persons see themselves as masculine or feminine given what it means to be a man or woman in society. Femininity and masculinity are rooted socially (one's gender) rather than the biologically (one's sex). Societal members decide what being male or female means (e.g. dominant or passive, brave or emotional), and males will generally respond by defining themselves as masculine while females will generally define themselves as feminine and see herself as masculine and male see himself as feminine.

Reinisch, Rosenblum and Sanders (1987) demonstrated that a masculine or feminine person is one who exemplifies those characteristics that have been shown to differentiate the sexes. Thus, 4-year old boy would be considered as masculine if he enjoyed playing with blocks and trucks and if, during free-play periods at nursery school, he tended to play outdoors in the company of other boys. A 4-year old girl would be seen as feminine if she liked to wear dresses, played with dolls and art materials, and didn't get into fights. At the age of 10, a masculine boy would be one who engages in active sports, avoided females; a feminine girl would be one who had one or two close girlfriends, didn't try to join boys sports play groups. At the age of 15, a masculine boy would be one who excelled in spatial-visual task, liked and did well in math, was interested in cars and machinery. A feminine girl would be more interested in English and history than math or science. A masculine or feminine person is one who displays the characteristics prescribed by male and female sex roles.

Here, the term 'role' is using in the sense of social position or status for which certain behaviors are socially expected or required. Thus, the roles of police officer or nurse or bank president are highly gender oriented, while the roles of grocery dark or college students are not. In our society, an individual in a given situation is expected to behave in one way if male, another way if female. The other meaning of masculinity and femininity has to do with the attraction between the sexes. Goffman (1979, p. 300) depicted that culture makes an even stronger statements about the role of individual choice when studied in the terms of gender: "What the human nature of males and females really consists of, then, is a capacity to learn to provide and to read depiction of masculinity and femininity and a willingness to adhere to schedule for presenting these pictures. One might just as well as say there is no gender identity. There is only a schedule for the portrayal of gender" (p. 300).

According to Nyborg (1989), individuals having an excess of estradiol in comparison to testosterone are characterized by feminine, demasculinized gender identity. They are low on self reliance, and physical energy expenditure. They tend to have high preferences for doll play and are high on maternal interests. Their verbal IQ scores exceed their performance IQ scores. On the other hand individuals with an excess of testosterone in comparison to estradiol are characterized by a masculine gender identity. They are high on self reliance and physical energy expenditure, but low on maternal interests. Thus, it is becoming clear that the relative level of circulating male and female hormones have a significant influence in shaping the cognitive and personally functioning of an individual.

Terman and Miles (1936) found that masculinity-femininity was somewhat age-related with individuals, particularly males showing their higher level of masculinity in late teens and early twenties. Not surprisingly masculinity-femininity was related to people's interests and academic pursuits. Masculine men tended to be more interested in science and mechanical things, and feminine men in cultural pursuits and the arts. Among high school and college-aged women, masculinity was found to be associated with broad interests, high level of education, and intellectuality (Terman & Miles, 1936). In other words for women, masculinity was associated with intellectual and educational accomplishment, and if one wanted to place a value judgment on these findings, one might conclude that in this regard, masculinity is "good" for women. Later research replicated these early results, indicating feminine males and masculine females tend to show higher level of creativity, scholastic achievement, and giftedness than more sex-typed children do (Lippa, 1998; Maccoby, 1966). Lubinski and Humphreys (1990), Sex-typed children are those whose traits and behaviors are stereotypic for their sex. Thus in terms of creativity and intellectual achievement, femininity can be considered good for males and masculinity good for females. Lippa (1988) found that high school males who are "feminine" and females who are "masculine" tend to score higher than their more sex-typed peers on the National Merit Scholarship Qualifying Test.

1.5 MASCULINITY IN FEMALES

According to Reinish, Rosenblum and Sanders (1987), tomboy is a girl who behaves according to the gender role of a boy. They wear typically masculine oriented types of clothes and practiced games and activities that are typically considered to be the domain of boys. They preferred to be friendly with boys rather than other girls. Females who have grown up in a family made mostly of male siblings, display masculine characteristics. The most extreme cases have occurred with females who have been raised on farms. And biological cause might be an excess of testosterone and/or insufficient estrogen hormone level. The physical signs might be small breasts, body hair & bad (acne prone) skin and the emotional sign might be stubbornness, a rational (rather than emotional) approach to life, which was nonetheless irrational because females were not supposed to function in this way.

1.6 ANDROGYNY

Androgyny is the combination of both male and female characteristics. Cook (1985) defined that the integration of the masculinity and femininity is inherent in each of us is essential for person’s wholeness. According to Bem (1974), androgyny is a psychological construct which means blending of the positive masculine and positive feminine characteristics. Bem (1979) also asserted that people could be both masculine and feminine or in other words, both instrumental and expressive or both cynic and communal at the same time. The androgynous individuals could tap into these tendencies based on appropriateness of the current situation. Therefore, androgynous individuals have an advantage over sex-typed individuals as they are potentially more comfortable and competent in performing a variety of tasks, along with having greater behavioral flexibility and psychological wellbeing (Bem, 1979). He also reported that women who are androgynous are assertive and competent.

CHAPTER 2

REVIEW OF LITERATURE

2.1 MATH ANXIETY

Studies have demonstrated that highly math- anxious individuals are less proficient on arithmetic tasks, particularly those that involve complex problems (Kellogg et al, 1999). That means math anxiety interferes with not only solving simple problems but also solving complex problems. Mathematics anxiety is related to general anxiety (Hendel, 1980), test anxiety (Dew, Galassi & Galassi, 1984), and other academic anxieties (Marsh, 1988). Richardson and Suinn, (1972); Adams and Holcomb (1986) and Hembree (1990) stated that it exists in people who are not otherwise anxious (Morris, 1981). Math anxiety can occur when participating in a class, listening to a lecture, while doing a math related problem or doing a test. Moreover, such anxiety can happen on elementary school children, high school and college students (Tobias, 1993).

It is important to know that it can happen to anyone at any age no matter of their mathematical ability. Although, math anxiety prevailing in college student is quite limited (Betz, 1978; Everson et al, 1993) but it appears to be very pervasive problem in university settings. Betz (1978) found that most of the students indicated, that math made them uncomfortable, nervous, uneasy and confused. Mathematics anxiety can be seen among school level students whether they are in primary grades or in secondary grades or in middle schools, moreover, it is found among college students as well as university students. Therefore it is concluded that math anxiety is present in all age levels i.e. among children, among adolescents, and among adulthoods.

A study was conducted by Allen (2000) to identify math anxiety and experience with math teachers, math content, and pedagogical practices. Math specialization participants and those participants specializing in other areas were analyzed separately. Results indicated a strong correlation between math anxiety and participants' mathematical content experiences for both groups. Moderate correlations were found for math anxiety and participants' experience with math teachers for both groups. For math specialization participants' math anxiety was not significantly correlated with pedagogical experiences in mathematics classroom. It was identified that experiences with mathematical content is a significant predictor of math anxiety for both math specialization participants and those who were selected as specialization other than mathematics.

Tyack and Cuban (1990) suggested that the manner in which a teacher was taught has great influence on the pedagogical practices, they use to teach there own students. Considering these adults learned math anxious behaviors from their own teachers, the educators themselves will adopt pedagogical practices that are similar in nature to those use by their own teachers. Alexander and Cobb (1984) demonstrated that students with A's and B's grade in algebra or geometry experienced significantly less math anxiety than did students with poorer grades.

Arem (2003) equates a lot math anxiety with math test anxiety; she suggested that it is three-folds: poor test preparations, poor test-taking strategies and psychological pressures. She also stated that it is especially exacerbated by poor health habits, especially diet and sleep. A recent study by Nordin et al (2008) found that there is low but significant negative correlation between mathematics anxiety and achievement and also a strong significant negative correlation between mathematics anxiety and motivation. Mathematics anxiety is a condition in which students experience negative reaction to mathematical concepts (i.e. numbers) and evaluation procedures (i.e. testing) (Richardson & Woolfolk, 1980). Math anxious students complain of such things as nervousness, inability to concentrate, a blank mind, and a feeling of sickness when they are confronted with taking math test. Some researchers have shown that students' report of uneasiness, worry, and anxiety related to mathematics increase during the early adolescent years (Brush, 1985; Meece, 1981; Wigfield & Meece, 1988).

A few studies further reported that achievement related affect may play a particularly important role in determining the achievement outcome of young adolescents (Brush, 1985; Harter & Connell, 1984). Math anxiety can result from environmental factors such as myths, teachers and parents (Steele & Arth, 1998; Trujillo & Hadfield, 1999). Intellectual factors that affect math anxiety include learning style, persistence, self-doubt, and dyslexia (Harper & Daane, 1998; Trujillo & Hadfield, 1999). Personality factors such as low self esteem, shyness and intimidation can also affect math-anxious students (Fotoples, 2000; Levine, 1995).

Findings have shown the relationship between math anxiety and achievement; between math anxiety and gender; and between math anxiety and age. A negative relationship between math anxiety and math achievement has been found across all grade levels (Betz, 1978; Ma, 1999). In the early grades there is no significant difference in the math anxiety experienced in either gender (Gierl & Bisanz, 1995), but females exhibit more math anxiety in secondary schools and in college (Bernstein & Reilly, 1992; Campbell & Evans, 1997). Some studies support the belief that nontraditional-aged students exhibit more math anxiety than traditional-aged students (Betz, 1978; Royce & Rompf, 1992). However, some authors found no evidence of this trend, although they did find that nontraditional-aged students reported more anxiety in general than traditional-aged students (Bitner, Austin & Wadlington, 1994).

Woodard (2004) observed in a study that a significantly low negative relationship was found between exist exam scores and math anxiety scores. This explains that as math anxiety increase, achievement scores decrease. Anxiety negatively effects on subsequent grades (Wigfield & Meece, 1988). Studies pointed out that mathematics anxiety is associated with many hypothetical constructs including working memory (Ashcraft & Kirk, 2001), age (Gierl & Bisanz, 1995), sex (Bradley & Wygant, 1998), self efficacy (Pajares & Graham, 1999), mathematics attitudes (Betz, 1978) test anxiety (Kazelskis et al, 2000), and general anxiety (Zettle & Raines, 2000).

A biological study on math anxiety by Hopko et al (1999) stated that math-anxious individual have a deficiency inhibition mechanism whereby working memory resources are consumed by task-irrelevant distracters. A consequence of this deficiency was that explicit memory performance was poorer for high-anxious individuals. They also found no relationship between competence and math anxiety. Research on mathematics anxiety has typically supported the notion that a small relationship between mathematics anxiety and performance exists (Adams & Holcomb, 1986; Ashcraft & Faust, 1994; Ashcraft & Kirk, 2001; Ma, 1999; Siegel, Galassi & Ware, 1985).

Ashcraft and Kirk (2001) found that math anxiety was related to math performance particularly when a secondary task was being considered. They also found that math anxiety probably affects accuracy because anxious thoughts lead to working memory resources that may be needed for calculations (e.g. counting strategies). If these strategies are affected, this may lead to errors, including losing a running total which may result in errors. In addition, performance and neuropsychological data suggest that anxious thoughts leading the working memory may be responsible for these effects. Developmental and educational factors related to math and working memory, may also contribute to the development of math anxiety (Ashcraft, Krause, & Jeremy, 2007).

According to Meece et al (1990) math anxiety is most directly related to student's math ability perceptions, performance experience, and value perceptions. Some findings indicated that math anxiety is negatively related to measures of prior mathematics achievement and math ability perceptions (Fennema & Sherman, 1977; Hendel, 1980; Rounds & Hendel, 1980; Wigfield & Meece, 1988). Therefore, it can be said that students who have low perceptions or negative perceptions for their math abilities and do not value mathematics may have math anxiety.

2.2 MATH ANXIETY AND GENDER DIFFERENCES

Hyde, Fennema, Ryan, Frost, and Hopp, (1990) have found that women tend to have more negative attitude toward math and are more likely to experience math anxiety (Betz, 1978; Hyde et al., 1990; Meece et al 1982) than men. These negative attitudes are thought to have a detrimental effect on women's immediate and future math performance and their career choices (Hyde, Fennema, & Lamon, 1990). Indeed, anxiety has been explicitly linked to the avoidance of math and science careers among under graduate women (Chipman, Krantz, & Silver, 1992). A study was conducted on mathematics students and psychology students, the results demonstrated psychology students are high on mathematics anxiety as compared to the mathematics students (Morris, Kellaway, & Smith, 1978). According to Anderson (1999), math anxiety in women is not a born fear of math; rather it is a learned behavior. In other words women by nature are not afraid of math, it is nurture or it is learned experience. Further, negative stereotypes regarding women's math ability are widely shared across various cultures (Eccles et al, 1990; Spencer et al, 1999). Studies of mathematics achievement have primarily examined the negative effects of math anxiety. Math anxiety relates negatively to students' performance on standardized tests of mathematics achievement, grades in mathematics, plans to enroll in advanced high school mathematics courses, and selection of math-related college majors (Armstrong, 1985; Betz, 1978; Brush, 1980; Eccles, 1984; Hackett, 1985; Hendel, 1980; Richardson & Woolfolk, 1980; Sherman & Fennema, 1977; Wigfield & Meece, 1988).

There is a consistent positive relationship between perception of mathematical ability and plans to enroll in advance mathematical courses. According to Kaminski, Erikson, Ross and Bradfield (1976), Armstrong and Kahl (1980) students rating of their mathematical ability, predicting the amount of math they planned to take in high school. Furthermore, when sex differences emerge in measures of self concept of math ability, females report lower estimates of their ability than males. During the elementary and junior high school years females perform just as well in math as males (Eccles et al, 1983; Eanest, 1976; Fennema, 1974; Fennema & Sherman, 1977; Fox, 1977; Heller et al, 1978; Kaminski et al, 1976; Robitaille, 1977). It has been demonstrated that even though females and males receive similar grades in mathematics, females reported significantly less enjoyment and pride than males, but more anxiety, hopelessness and shame (Frenzel, Pekrun, & Goetz, 2008). The female emotional pattern was due to the females low competence beliefs and domain value of mathematics, combined with their high subjective values of achievement in mathematics. Yuksel (2008) suggested that female students report significantly higher mathematics anxiety than males. Students who liked mathematics class and those who liked their mathematic teachers had lower anxiety. Moreover, students with higher achievement in math reported lower degrees of math anxiety. However, the same study also predicted no significant difference in students' mathematics anxiety with respect to their grade level and gender stereotype about success in mathematics.

Hembree (1990) did a meta-analysis on 151 studies to scrutinize the construct mathematics anxiety and found that mathematics anxiety was related to poor performance on mathematics achievement tests. It was inversely related to positive attitudes toward math and was bound directly to avoidance of the subject. Variables that exhibited differential mathematics anxiety levels include ability, school grade level, and undergraduate fields of study, with pre service arithmetic teachers especially prone to mathematics anxiety. Females displayed higher levels of mathematics anxiety than males. Therefore, mathematics anxiety appears to be strongly linked with poor performance and avoidance of mathematics.

There was an overall significant effect of math anxiety on self-confidence, enjoyment and motivation with large effect size. Students with no math anxiety scored significantly higher in enjoyment than students with high math anxiety. Students with little or no math anxiety scored significantly higher than students with some or high math anxiety in measures of self-confidence and motivation. Therefore, it explains that self confidence and math performance are also closely related. Students with less math anxiety scores were significantly higher in motivation than those with high math anxiety (Tapia, 2004).

Considering ethnicity in relation with math anxiety, Zaslavsky (1994) reports that people of all races and economic background fear from math, but women and minorities are most hindered by math anxiety.

Furthermore, several contradictory findings regarding the effects of mathematics anxiety and gender on attitudes toward mathematics indicate that gender had no effect on attitudes toward mathematics, and gender and math anxiety had no influence on attitudes toward mathematics (Tapia & Marsh, 2004).

Hunsley and Flessati (1988), a few gender differences were found. Female students frequently reported higher math marks than those reported by male students. They also suggested that the relation between gender and mathematics anxiety may be accounted by gender-linked reporting biases. This study was replicated by Flessati and Jamieson (1991), they concluded that no evidence was found for a gender-linked response bias. An alternative explanation for gender difference in math anxiety is proposed based on the findings that females are more self-critical.

2.3 MATH PERFORMANCE AND GENDER DIFFERENCES

According to National Education Association (1989) sex differences in some tests of quantitative or mathematical ability is robust the largest differences favor males, who tend to outscore females on the quantitative portion of the Scholastic Aptitude

Tests (SAT-M). Some researchers contended that males have a greater ability to understand math. Benbow and Stanely (1980) indicated that males scored higher on (SAT) scholastic aptitude test than females. Therefore, it can be said that there is something more than the environment which affect results. Fennema et al (1998) indicated that male were more likely to report abstract strategies that reflected a deep understanding of mathematics than females who were more likely to report concrete strategies.

Stone, Beckmann, and Stephens (1982) examined the students at ten different colleges on ten different mathematical test categories. No significant difference was found on overall sex differences. However, sex differences were found on the individual subtests by using multivariate procedures that allowed the experiments to consider all test scores at once. Females scored significantly higher than males on the tests of mathematical sentences and mathematical reasoning, whereas males scored significantly higher than females in geometry, measurement, probability and statistics. Feingold (1988) observed that males are not only outperforming in mathematical ability than females, but also they use different mathematical problem solving strategy. According to Gallanghar and DeLisi (1994), females are more likely to use conventional techniques while males are more likely try unconventional shortcuts in mathematical problem solving (SAT). It has also been suggested that a popular stereotype about males being better at mathematics than females may undermine females' math performance because it causes worrying that erodes the mental resources needed for problem solving. Hackett and Betz (1981) investigated that mathematics performance and mathematics self efficacy were significantly and positively correlated with attitudes toward mathematics, masculine sex-role orientation, and a math related major.

Singer and Stake (1983) examined the relationship of math participation and success to self esteem and career goals. The study found no evidence for gender differences in math anxiety or perception of usefulness of mathematics, but women were less likely to select a math related career goal. They also indicated that women math related career were more closely associated with scholastic ability and math background that were men's career choice. On average, men score higher than women on many kinds of visual spatial tests (Linn & Pitersen, 1986; Voyer, Voyer & Bryden, 1995) and this difference is particularly strong for tests of mental rotation. Mental rotation tests assess how well a person can mentally turn around sketches three-dimensional objects to determine if they are the same as the same object presented in a different orientation. Men also do better than women on water-level tests, which ask participants to estimate the surface created by water in containers that are turned to various orientations (Voyer et al, 1995). However women outperform men on tests of spatial location memory, which ask participants to remember, for example, where various objects are located throughout a room after brief observations (Eals & Silverman, 1994).

Elton and Rose (1967) found that sex role was related to performance in mathematics. In line with this, Aiken (1970) and Elton et al (1967) suggested that sex role is one of the personality variable related to attitude towards mathematics. Maccoby and Jacklin (1974) reported that males tend to score higher than females on tests measuring spatial visualization. However Fennema and Sherman (1977, 1978) found that males were not superior to females in mathematics achievement, mathematics problem solving, and spatial visualization (Differential Aptitude Test). We can say that students who chose mathematics courses have less math anxiety.

Elmore and Vasu (1979) demonstrated that men score significantly higher than women in spatial visualization test. However, women students had more positive math attitude towards success in mathematics. Plake et al (1987) reported that lower performance on mathematics test is associated with highly androgynous individuals. Benbow (1988) conducted a study to identify the males and females who were exceptionally talented in mathematics. He found that substantial sex differences were found in number of females and males who were identified as “mathematically precocious.”

Jones (1984) examined the developmental nature of quantitative sex differences in the students aged 13 and 17. No sex differences were found for the 13-year olds, whereas by age of 17 the males were significantly outperforming females. Hyde, Fennema, and Lamon (1990) did a meta-analysis on 100 studies and found that there was a slight female superiority in the elementary and middle-school years, a moderate male superiority in high school, and larger male advantages in college and later adulthood. There were essentially no sex differences in understanding mathematical concepts at any age. Aiken (1987) concluded that the largest differences occur in mathematical problem solving, with males answering more questions correctly than females. Marshall and Smith (1987) reported that third-grade girls surpass boys in computation, an advantage that retain through sixth grade; whereas, boys showed superiority in solving word problems, on geometry and measurement problems. Yee and Eccles (1988) found that parents believe mathematics is more difficult for their daughters than for their sons. Because of these beliefs female receive less encouragement and support for studying advanced mathematics.

2.4 MATH ABILITY and MASCULINITY-FEMININITY

Males seem to perform better than females on tasks involving mathematical and spatial ability, although the difference is narrowing rapidly. The difference in mathematical ability seems to be limited to no classroom tests; in class, females obtain higher grades in mathematics than males. Gender stereotypes and differential opportunities may have an impact on math performance. There is one particular belief that women are inferior to men in 'Masculine' fields like Math and Science (McIntyre et al, 2003, Schmander, 2002, Spencer et al, 1999, Steele 1997). A study found that female math students are significantly more math anxious than male students (Woodard, 2004).

Women, who outperform relatively to their male counterparts, are better in mathematics even in the presence of stereotypes (Spencer et al, 1999). Women who have negative perception of math do not like math. Benbow and Stanley (1983) attributed this higher ability in males to the male sex hormone, testosterone, in the prenatal stage. Supposedly this hormone strengthens the right hemisphere, the part of the brain specialized in spatial visualization. Findings also claimed that this ability is essential in solving math problems. Some studies also suggest that women who endorse gender stereotypes at women's math ability would be less interested in entering math related fields specifically. Nosek et al (2002) found that college women, even those majorities in math-related fields show a strong implicit association between math and maleness. Moreover the strength of this implicit stereotype among women is correlated with lower self identification with math and poorer performance on the quantitative scale of SAT (Nosek et al, 2002).

Geary (1996) suggested that sexual selection and any associated proximate mechanism (e.g. sex hormones) appear to influence these sex differences in mathematical performance indirectly. There is neurocognitive system that supports navigation in 3-D space in males than in females. For this reason male have advantage in geometry and males also co-opt these spatial systems in problem solving situations more readily than females. Geary (1995) also stated that there is potential influence of evolutionary pressure on mathematical abilities. Greenwald (1998) suggested that for females, stronger femininity is associate with stronger stereotyping of mathematics as masculine i.e. the more female identify with femininity, the more they stereotype math as masculine. Also, the more female identify with femininity the less they link mathematics to the self. Finally, the more females stereotype math as masculine the less they link mathematics to self. In other words, it suggest that the link between gender identity, gender stereotyping of mathematics, and linking of mathematics to the self look to be strong for females, but much weaker for males. There is biological justification but, gender inequality gets the credit over with the help of supports of sociobiologists. Benbow and Stanley (1983) found math skills are innate in men because of the lateralization of the brain (specifically the right hemisphere) which is responsible for spatial tasks. They also indicated that females with male hormones behave as tomboys and have higher math scores (Benbow & Stanley, 1981).

According to Mills (1981) there is positive relationship between masculine traits and values and math ability, and feminine traits and values and verbal skills. This study reveals that math ability is a masculine trait, whereas verbal ability is a feminine trait. Sex related differences were found in mathematics attitudes, spatial visualizations, and achievement in the statistics course (Elmore & Vasu, 1980). Burke (1989) demonstrated that those who have feminine gender identity in males and females, they performed better in GPA.

Hackett and Betz (1981) concluded that both mathematics performance and mathematics self-efficacy were positively correlated to with attitude towards mathematics, masculine sex- role orientation and mathematical related majors. Waber (1976) observed that the late maturers performed better than early maturers on spatial task than on verbal tasks. Lambert (1960) conducted a study and demonstrated that the mean masculinity femininity scores on MMPI of female mathematics majors was significantly more feminine than that of female education majors, whereas there was no difference between the mean scores of male education majors.

Signorella and Jamison (1986) found that high masculinity scores and low femininity scores were associated with better performance on spatial and mathematical tasks. So, masculinity is related to mathematics. Baucom, Besh and Callahan (1985) demonstrated that high masculine women are more creative. People who score high on cross gender identity tend to be creative. Cernovsky (1985) demonstrated that high score on MMPI masculinity-femininity scale was linked with better intellectual skills. However, some findings yielded contrary results. Berfield, Ray, and Newcombe (1986) observed that performance on visual spatial tasks was negatively correlated with masculine sex-role orientation. Some findings also stated women have slightly higher grade point averages than men in colleges and universities in every major subject including math and science (Dey & Hill, 2007).

Most psychologists agree that there are no meaningful sex differences in general intelligence (Halpern, 1992). However sex differences are sometimes found for specific kind of mental abilities. On average, men perform somewhat better than women on tests of math ability based (Hyde, 1981; Becker & Hedges, 1984; Rosenthal & Rubin, 1982). In contrast, women perform somewhat better than men on tests of verbal ability according to Hyde and Linn (1988).

CHAPTER 3

FORMULATION OF THE PROBLEM

3.1 MOTIVATION FOR THE STUDY

From the literature review it is evident that males out performed females on mathematical ability tests. This has been attributed to the high spatial ability exhibited by males as compared to females. There are studies attesting to the fact that females having high masculinity perform better on spatial task and mathematical task compare of those having low masculinity scores. The studies also reveal that mathematical performance has been attributed to the math anxiety. There is severe paucity of such studies with respect to femininity in males and performance in spatial and mathematics tasks.

The present study, aim at investigating the relationship between math anxiety and cross gender identity in males and females.

3.2 OBJECTIVES

- To study the mathematics anxiety in males having high and low cross gender identity.
- To study the mathematics anxiety in females having high and low cross gender identity.

3.3 HYPOTHESES

- High feminine males may have less mathematics anxiety as compared to low feminine males.
- High masculine females may have less mathematics anxiety as compared to low masculine females.

CHAPTER 4

METHODOLOGY

4.1 DESIGN

1. Sex, Cross gender Identity and Mathematics anxiety.
2. 2 (Sex: Male, Female) × 2 (cross gender identity: High, Low) between subject factorial design was used.

4.2 SAMPLE

Undergraduates engineering students of the age range 17-21 years participated in this study. The Cross Gender Identity scale was administered on adolescents (236 males and 189 females) to identify the high and low categories of cross gender identification.

4.3 TOOLS and PROCEDURE

4.3.1 Cross-Gender Identity scales

The Feminine Gender Identity (FGI) scale for males developed by Blanchard and Freund (1983) and the Masculine Gender Identity (MGI) scale for females developed by Freund and Blanchard (1988) were used to get the measure of feminine gender identity in males and masculine gender identity in females, respectively. Both MGI and FGI are based on the assumption that gender identity can be constructed as a continuous variable. The FGI consists of 19 items and the MGI consists of 20 items. These items are developmentally oriented and derive a measure of cross-gender identity in an unobtrusive manner. After administering the scales the data was collected and the mean and standard deviation were calculated separately for boys and females. Those having one standard deviation above the mean (for males = 7.951, for females = 18.074) were categorized as high masculine in the case of females and high feminine in the case of males respectively. Those having one standard deviation below the mean (for males = 2.56, for females = 8.42) were categorized as low masculine and low feminine respectively.

4.3.2 Mathematics Anxiety Scale

The Mathematics Anxiety Rating Scale-Short Version (MARS-S) developed by Suinn (2003) was used to measure the mathematics anxiety of the subjects having high and low Cross Gender Identity. The scale is self rating consists of 30 items. The MARS-S was administered on the subjects in a group of 10 each. Each item in the scale represents a situation which may arouse anxiety within the subject. The subject is to decide the degree of anxiety aroused, using the dimensions of “not at all”, “a little”, “a fair amount”, “much”, or “very much”.

CHAPTER 5
RESULTS AND DISCUSSION

5.1 RESULTS

- **Cross Gender Identity (Masculinity and Femininity)**

The high and low Cross Gender Identity categories were identified in males and females by taking one standard deviation above the mean and one standard deviation below the mean using Blanchard and Fraund's independently Feminine Gender Identity And Masculine Gender Identity Scales, respectively.

The mean and standard deviation of Cross Gender Identity for males and females are given in Table-5.1. Table-5.2 gives mean scores for categorizing high and low femininity groups in males. Table-5.3 depicts the mean scores for categorizing high and low masculinity in females.

Table-5.1 The Mean and Standard Deviation of Cross Gender Identity scores for males and females.

Sex	Mean	SD
Males	5.258	2.69
Females	13.225	4.89

Table-5.2 The Mean for categorizing high and low femininity group in males.

C.G.I.	N	Mean	t-value
High	49	9.47	31.357**
Low	32	1.63	

** $p < .01$, df = 80

Thus, from Table 5.2, it is evident that the mean of males having high C.G.I. scores (High C.G.I. = 9.47) differs significantly from the males having low C.G.I. scores (Low C.G.I = 1.63).

Table-5.3 The Mean for categorizing high and low masculinity group in females.

C.G.I.	N	Mean	t-value
High	30	20.67	29.520**
Low	31	6.13	

** $p < .01$, df = 60

Thus, females having high C.G.I. (High C.G.I. = 20.67) and females having low C.G.I. (Low C.G.I. = 6.13) significantly differ in the obtained score of Cross Gender Identity as evident from the Table 5.3.

- **Cross Gender Identity and Mathematics Anxiety**

Table-5.4 shows the mean and standard deviation of MARS Raw scores for males and females having high and low C.G.I. scores. It can be seen that males with high C.G.I. (Femininity scores) have more mathematics anxiety as compared to males with low C.G.I. scores. Females with low C.G.I. (Masculinity scores) have more mathematics anxiety as compared to females with high C.G.I. score.

Table- 5.4 Mean and standard deviation of MARS-S raw scores of the subjects having High and Low Cross Gender Identity (C.G.I.) scores.

Sex	C.G.I.	Mean	SD	N
Males	High	62.76	16.586	49
	Low	55.81	14.711	32
Females	High	58.43	19.076	30
	Low	66.61	17.789	31

Table-5.5 ANOVA Summary for Mathematics Anxiety

Source of variation	SS	Df	MS	F
A. Sex	357.978	1	357.978	1.236
B. Cross Gender Identity	13.050	1	13.050	0.45
A×B	1950.37	1	1950.37	6.75**
Within Cell (Error)	39960.658	138	289.570	

** p<.01

The ANOVA summary is given in Table 5.5. The sex and C.G.I. interaction is significant (F (1,138) = 6.75, p < .01) and is also depicted in the Figure 5.1.

As the interaction effect was significant, simple effects analysis was carried out to probe further. The results are shown in Table-5.6 and in Table-5.7.

Table-5.6 ANOVA Summary for Simple Effect of A

Source of variation	SS	Df	MS	F
A for b1	318.3396	1	318.3396	1.09
A for b2	1989.878	1	1989.878	6.87**
Within cell (Error)	39960.658	138	289.570	

**p<.01

Thus, it is clear from the Table-5.6 that the effect of sex (males and females) is significant only for low C.G.I. (F (1,138) = 6.87, p < .01) and not for high C.G.I.

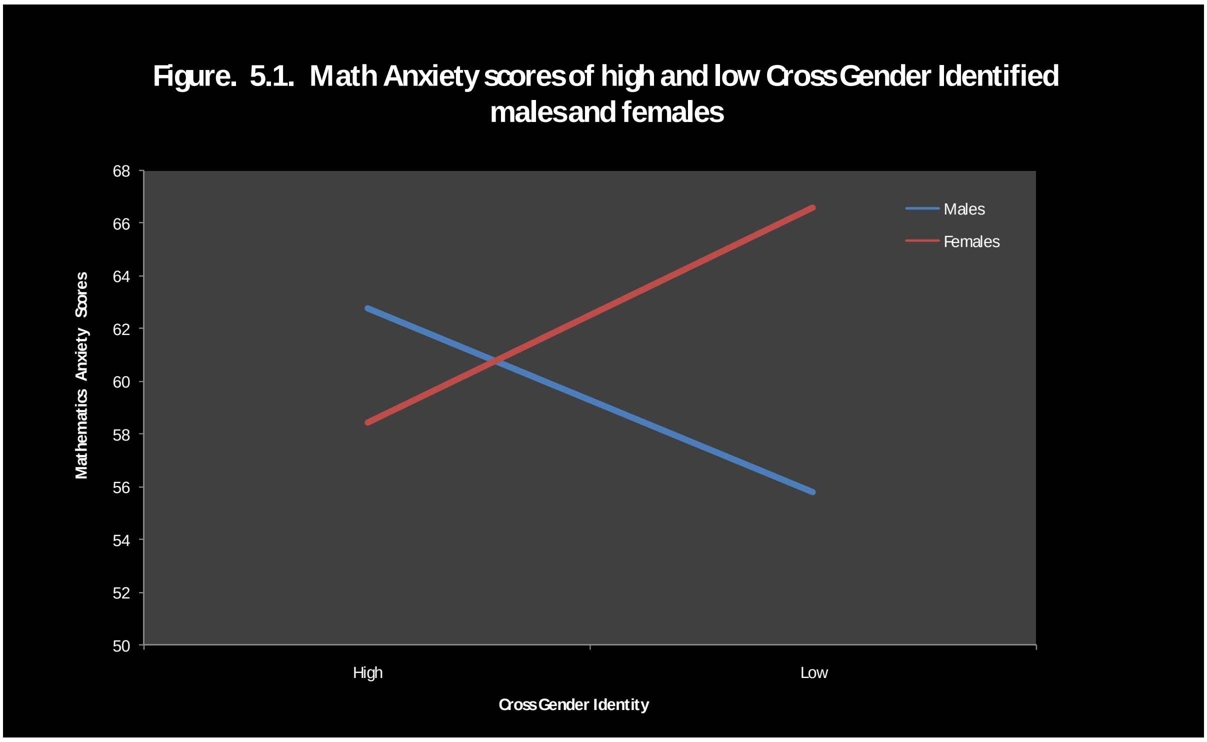
Figure. 5.1. Math Anxiety scores of high and low Cross Gender Identified males and females
68
66
64
62
60
58
56
54
52
50
Mathematics Anxiety Scores
Males
Females
High
Low
Cross Gender Identity

Table-5.7 ANOVA summary for Simple Effect of B

Source of variation	SS	df	MS	F
B for a1	822.178	1	822.178	2.839
B for a2	1141.251	1	1141.251	3.94***
Within cell (Error)	39960.658	138	289.570	

***p<.05

The Table-5.7 depicts that the effect of Cross Gender Identity (C.G.I.) is significant only for females (F (1,138) = 3.94, p < .05) and not for males.

5.2 DISCUSSION

The purpose of the present study was to investigate the relationship between high and low cross gender identity and mathematics anxiety. Findings of the present study did not confirm the first hypothesis which posited that high feminine males may have low mathematics anxiety as compared to low feminine males. No difference in math anxiety was found between high and low feminine males. However, high feminine males show more math anxiety as compared to low feminine males.

Although studies indicated that femininity is good for males in terms of creativity and intellectual achievement, none of the studies show a positive relationship with mathematics performance and femininity. This clearly indicates that high femininity in males and mathematics may not go together. Therefore, the present findings further corroborate lack of relationship between mathematics and femininity in males.

Further, it was found that high masculine females had low mathematics anxiety which supports the second hypothesis that high masculine females may have low mathematics anxiety as compared to low masculine females. Studies in line with the above findings report that high masculinity scores and low femininity scores were associated with the better performance on spatial and mathematics tasks (Signorella & Jaminson, 1986). To add on, Benbow and Stanely (1981) found that females with male hormones behave as tomboys and have high math scores.

Furthermore, high mathematical skills in females associated with masculinity are attributed to the high level of testosterone in the prenatal environment. Therefore, from the findings of the present study, it can be surmised that high masculine females have less math anxiety as compared to low masculine females.

Thus, as math anxiety and math performance are related to gender, an attempt can be made to correlate math anxiety with the masculinity in females and femininity in males. The severe paucity of studies, showing a relationship between masculinity in females and math anxiety in females, indicate that it is necessary to carry out further research in this domain.

CHAPTER 6

CONCLUSION AND IMPLICATIONS

6.1 CONCLUSION

Mathematics anxiety is related to masculinity in females. High masculine females show low mathematics anxiety as compared to low masculine females. However, feminine males did not show any relationship with math anxiety.

6.2 IMPLICATIONS

Mathematics, like reading, is an important skill in our every day life. Identifying individuals with the mathematical difficulties is becoming increasingly important in our education system as it has been indicated that mathematics anxiety is negatively associated with math performance. Studies emphasize that the identification of specific types of anxiety may lead to different kinds of intellectual performance. In today's high-tech world, it is important that the young children grow up to become confident in their ability to do with mathematics in an ever increasingly competitive society. Mathematics anxiety often has been cited as a factor which at times restricts the educational and career choices of college students, particularly women. Math anxious individuals may opt for academic majors within the humanities, fine arts, or social sciences that require minimal course work in mathematics. The present study has implications for identifying individuals having mathematics anxiety in relation to their gender orientation which may serve as an explanation for discrepancies in performance levels in males and females on several tasks and fields of life.

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