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A Study to Investigate Predictors of Mathematical Giftedness as Measured by the Scholastic Aptitude Test - Mathematics

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A STUDY TO INVESTIGATE PREDICTORS
OF MATHEMATICAL GIFTEDNESS AS MEASURED
BY THE SCHOLASTIC APTITUDE TEST - MATHEMATICS
(TITLE)

BY

Jolene McGrogan

FIELD EXPERIENCE

THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF

Specialist in Education

IN THE GRADUATE SCHOOL, EASTERN ILLINOIS UNIVERSITY
CHARLESTON, ILLINOIS

1984

YEAR

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A STUDY TO INVESTIGATE PREDICTORS
OF MATHEMATICAL GIFTEDNESS AS MEASURED
BY THE SCHOLASTIC APTITUDE TEST - MATHEMATICS

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ABSTRACT OF A FIELD STUDY
Submitted in partial fulfillment of the
requirements for the degree of
Specialist in Education at the
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Charleston, Illinois
1984
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The purpose of the study was to investigate whether the following were predictors of mathematical giftedness as measured by the Scholastic Aptitude Test-Mathematics:

1. family income
2. father's level of education
3. sex of student
4. student's liking for school
5. time spent on home computer by student
6. marital status of the parents

This study was based on The Study of Mathematically Precocious Youth done by Stanley at Johns Hopkins University.

Two forms of The Questionnaire for Academic Talent Search were developed; (1) a student form and (2) a parent form. The instruments were based on those used by Stanley with a few items added by the researcher. These were sent to 380 students in eighteen counties in east central Illinois. A response rate of ninety-seven percent was obtained. The students contacted were in seventh grade and had scored in the ninety-fifth percentile on a district administered norm-referenced test on either the mathematics and/or verbal subtest.
A review of the literature revealed that there may be several factors impacting on the mathematical differences between boys and girls. These included: 1) sex-role stereotyping, 2) teacher influence, 3) attribution theory, and 4) spatial visualization.

A one-way analysis of variance model was used to compare group means to determine if a significant difference occurred at the .05 level. A significant relationship was found between two of the variables and the math SAT scores; 1) for the family income and 2) the sex of the student. The other four variables were not found to be significant. The conclusions drawn were that family level of income is closely related to the math SAT score and that boys score higher than girls on the math SAT.

Finally, a list of four recommendations were offered by the researcher. These focused on more inservice for teachers, parents and counselors and, early identification with long-range curriculum planning for gifted students.
CHAPTER I

OVERVIEW OF THE PROBLEM

Introduction

Concern for appropriate public education for gifted and talented students is increasing. These students are being viewed as part of the population that will be able to help solve some of society's most difficult problems. Yet in 1980, according to Lyon, only thirty-five percent of the brightest students were being reached (Gold, 1981). The genius of many of the ablest students is languishing for lack of appropriate education. Because of this, it is imperative that the education of a very valuable resource--exceptional students--become a priority. As Lyon, Director of the Office of the Gifted and Talented in the U.S. Department of Education, stated: "It may be difficult to grasp why children with potential to achieve should require special attention. The explanation is that for every Einstein who emerges, a dozen or so do not." (pg. 4)

While there has been much discussion in the literature about educational programming in the gifted and talented area, there has been less agreement on what criteria
constitutes a gifted and talented student. Early definitions of giftedness were quite narrow and identification was based solely on an intelligence score (I.Q.). But in 1962, Getzels and Jackson in *Creativity and Intelligence: Explorations with Gifted Students* broadened the definition by adding two aspects of giftedness not reported by intelligence tests—creativeness and psycho-social excellence. The Revolving Door Identification Model developed by Renzulli in 1981 represents a new conception of giftedness based on the following clustering of traits:

- above average, though not necessarily superior, general knowledge;

- task commitment—the capacity to choose a job or an interest and stick with it; and

- creativity—the capacity to generate diverse, often novel products and solutions to problems.

In 1970 the federal government mandated a fact-finding status report on the education of gifted and talented children. The definition developed then is one that is generally used today. As was stated in the Marland report (1971), the definition is:

Gifted and Talented children are those identified by professionally qualified persons who, by virtue of outstanding abilities, are capable of high performance. These are children who require differentiated educational programs and/or services beyond those normally provided by the regular school programs in order to realize their contributions to self and society.
The report also spearheaded a resurgence of interest in gifted and talented children. One of the leading studies was the *Study of Mathematically Precocious Youth (SMPY)* in the Department of Psychology of the Johns Hopkins University conducted by Julian Stanley. The purpose of Stanley's study was to identify and facilitate the education of youths who can reason extremely well mathematically. Stanley's study focused on the nature of mathematical talent as it develops and unfolds, especially in students from age twelve to twenty. In his study, Stanley found that educational acceleration is not only feasible but also desirable for those young students eager to move ahead. There are a variety of ways in which to accomplish this acceleration: skipping grades, entering college at an early age, and taking college courses part-time. As Stanley (1980) stated: "The time saved, zest gained, and boredom and frustration prevented are priceless."

The study conducted by this researcher is based on Stanley's study, though not a replication per se. The focus of this study is to determine the commonalities or predictors of gifted students who scored high or low on the Scholastic Aptitude Test (SAT). A high score was 500 or above on the Scholastic Aptitude Test-Mathematics (SAT-M), while a low score was 250 or below.
Statement of the Problem

In 1977 the State of Illinois began a replication of the SMPY study. Each of the nine Gifted Area Service Centers began to test seventh graders with the SAT. In order to qualify to take the SAT, the student had to be in seventh grade and had to have scored in the ninety-fifth percentile in a district-administered, norm-referenced achievement test on either the mathematical and/or verbal section. After taking the SAT, each student receives his/her score report and an interpretation of the significance of that score. It was then decided, following SMPY, that students who scored 420 and above on either the mathematical and/or verbal score should receive facilitation. This facilitation was to be an algebra course taught to these same students during their eighth grade year. Since most schools did not have algebra offered to eighth grade students, special classes were scheduled on Saturdays, taught by Illinois certified teachers.

This is the sixth year that Region V Gifted Center has sponsored the test. This year 380 students took the SAT, with 125 scoring 420 or above on either the mathematical and/or verbal.

This study was concerned with the following possible predictors of mathematical giftedness:

1. combined income for the family,
2. level of education achieved by the father,
3. sex of the student,
4. student's liking for school,
5. amount of time spent by the student using a home computer, and
6. marital status of the parents.

Limitations of the Study

This study was conducted in an eighteen county area located in east central Illinois (appendix A). Twenty-eight public school districts which are participating in the Illinois State Gifted Reimbursement program constituted the population. Inferences made from the results of studying this population to other populations should examine the participating districts presented in Appendix A for commonalities before making such inferences. The population in this eighteen county area is largely rural and small city in composition.

Definition of Terms

One of the definitions relevant to this study is the meaning of giftedness. The term giftedness has been defined in many ways, from describing a person who is superior in some ability or who has an exceptionally high IQ, to the U.S. Office of Education definition as stated in the Marland Report (1971):
Gifted and talented children are those identified by professionally qualified persons who, by virtue of outstanding abilities, are capable of high performance. These are children who require differentiated educational programs in order to realize their contribution to self and society.

This was the operational definition of giftedness in this study.

Another term that needs to be defined is mathematically gifted students. Gerald F. Consigua (1982), in *Identifying the Gifted in Science and Mathematics*, found that gifted mathematics students were interested in quantitative relationships and the use of numbers. In addition, they have the ability to apply mathematical principles to a variety of types of situations outside the typical math curriculum. These students are characterized by being capable of abstract thinking and of conceptualization of mathematical principles. These students have insight to problems and their solutions, can find the best way to solve a problem, and can often solve a problem through intuition without being able to explain why this solution is the best.

In the Johns Hopkins program, *The Study for Mathematically Precocious Youth*, Fox (1974) noted some other characteristics. One of her findings was that high scorers on the 1972 competition had learned a considerable amount of mathematics at a rapid pace through independent study. It was also found that students in the program had excellent nonverbal reasoning abilities, as well as excellent knowledge of
science. In most studies, boys usually do better in spatial relationships than girls, but in this particular study the girls did better. In general, both the boys and girls did better than the average child in spatial relationships. A positive relationship between verbal ability and achievement in mathematics was noted. Fox found that when students have mathematical aptitude, their success in learning advanced mathematics, such as algebra, at a rapid rate and scoring well on timed standardized tests is related to their verbal ability. When mathematical aptitude and interest are present, they more easily and quickly can master algebra by independent study. Also, most of these students indicated that they had a strong liking for school and mathematics. Most of the students realized they were more able than most of their classmates and were not threatened by being asked to perform at a higher level. In addition, most of these children were interested in occupations in mathematics and science. It should be noted that most of the children came from middle-class homes where education is highly valued.
CHAPTER II

REVIEW OF RESEARCH AND LITERATURE

Educational Status and the Gifted Student

Research in the area of the educational background and occupation of the parents of gifted children is limited. Dr. Julian Stanley, in his *Study of Mathematically and Scientifically Precocious Youth* in 1972 at Johns Hopkins University, has done the most extensive research on the subject. In his study of 416 seventh and eighth graders who took the SAT, he found that the higher the reported educational level of the parents, the higher the mean test score of the child. By examining just those students who scored very high on the SAT, Stanley found that 47 percent of the fathers and 28 percent of the mothers had education beyond a bachelor's degree. He also found that 29 percent of the fathers and 51 percent of the mothers had less than a college degree. Twelve percent of the fathers reported that they did not even have a college degree. About the only generalization Stanley made was that both the fathers and mothers of the high group also had more education than the parents of the other students being tested.
In Stanley's study of the occupations of the parents, he categorized the occupations according to the Holland System of the Dictionary of Occupation Titles. The categories are: artistic (author, musician, commercial artist, ...), enterprising (buyer, real estate salesman, business executive, ...), investigative (biologist, chemist, scientific research worker, ...), realistic (surveyor, electrician, airplane mechanic, ...), and social (teacher, counselor, psychologist, ...). Stanley (1972) found that 28 percent of the fathers were in careers classified as enterprising, while 25 percent had jobs in the realistic category, and 13 percent were in the conventional category.

In a study done by Lewis Terman in the 1920s and reported in Volume I of Genetic Studies of Genius (Terman, 1925), 661 gifted students (IQs greater than 130) were studied. Terman found that two-thirds of the fathers were working in professional, semi-professional, or higher business occupations. In addition, a greater proportion of both parents had completed high school than the population in general.

Interestingly, Terman conducted a follow-up study of his students thirty-five years later. In this research, he also examined their family background (Terman & Oden, 1959). In examining the families of the men identified as most successful, he found that their parents (especially the fathers) had more education on the average than the
parents of the less successful group. In addition, more fathers of the successful group were professionals.

From the research by Stanley and Terman, it can be generalized that gifted students generally come from homes where the parents are well educated (college or beyond) and are employed in professional occupations. It also seems that the more educated the parents, then the more gifted the child.

**Male and Female Mathematically Gifted Students**

Evidence generally indicates that boys do better in mathematics than girls. On the basis of SMPY's research on the mathematically precocious, it appears that males are more likely than females to perform at a very high level on precollege level tests of mathematical reasoning ability (Fox, Brady, Tobin, 1980). It is very difficult to determine if this difference is biological or related to the environment. In mathematical ability, sex differences are not consistently found until the end of the elementary school years.

Hilton and Berglund observed that significant differences between male and female students appeared at the seventh-grade level and not at any of the earlier grade levels (Stanley, Keating, Fox, 1974). In three years of testing mathematically gifted students, SMPY found 167 boys opposed
to 19 girls, who as seventh and eighth graders scored 640 or above on the SAT-M. The mean score difference between boys and girls in the three contests has been at least 35 points in favor of the boys (Stanley, et.al., 1974). A rather recent review of sex differences by Maccoby and Jacklin (1974) included the following set of conclusions about differences in intellectual ability:

1. Boys and girls do not differ systematically on measures of total or composite abilities—that is, IQ measures.

2. Girls tend to be superior on verbal abilities; boys, on spatial and math aptitudes.

3. These differences in aptitudes do not become significantly apparent until adolescence.

4. Studies of children's aptitudes prior to adolescence do not provide consistent results and do not demonstrate significant differences between sexes.

5. The only significant differences in aptitudes among younger children appear to exist in children of disadvantaged backgrounds. Studies with disadvantaged youngsters show the girls to excel on verbal as well as on mathematical aptitudes even prior to adolescence.

6. In general, of all three aptitudes (math, verbal, spatial), spatial relation emerges as one of the most consistent and strongly differentiating aptitudes between the sexes.

7. There is no difference in variability within sex up to age 11. However, after that age, the standard deviation for boys tends to be between 5 and 6 percent higher than that for girls.
8. Studies that have examined genetic components, hormonal influences, or differential brain development as possible determinants of differential cognitive functioning between the sexes are as yet inconclusive.

9. There are no definitive studies as yet that can demonstrate the relationship(s) between social pressures or aspects of socialization and specific pressures of abilities.

In further study of the topic, several issues appear to be involved including, but not limited to, 1) sex-role stereotyping, 2) teacher influence, 3) attribution theory, and 4) spatial visualization.

**Sex-Role Stereotyping**

In a study conducted by Peterson and Peterson in the 1970s, it was found that parents expressed preference for the first born or only child to be a son. In a study of parents' responses to newly-born daughters or sons, Ruben, Provenzano and Luria found that even though the infants did not differ significantly in birth length, weight, or Agpar scores, within 24 hours of birth daughters were more likely than sons to be described as "little." Thus even in infants, the sex-stereotypic expectations that males are big and strong and females are little and weak are still held by parents (Blaubergs, 1980).

There is also sex stereotyping in relation to the selection of toys with which children play. In a study by Rheinbold and Cook, the rooms of girls between the
ages of 1 and 6 were found to contain more dolls, doll houses, and domestic toys than the rooms of boys of the same age (Blaubergs, 1980). Three-year old boys had twice as many toys as three-year old girls. It was also found that toy stores have a large quantity of new and different toys for boys but not for girls, and that sales people suggested a larger number of different toys for boys than for girls (Blaubergs, 1980). In Casserly's study the following are comments from girls on their toys, illustrating the stereotyping they encountered:

But supposing you don't have an older brother or a daddy? Which reminds me, do you have any idea how demeaning it is to ask your little brother's permission to play with his Lego set?

Yeah, or his tinker toys and erector set?

I got Lego the first Christmas I asked, but there are no boys in our family.

Yeah--lucky you! I had to wait three years for a microscope and when I finally got it, I drove my parents wild because I went around scraping people's teeth for months (Fox, et.al., 1980).

In addition to the types of toys bought for boys, in a study by Astin, parents often reported they had noticed their sons' interest in science and had discussed careers in science, mathematics, medicine, and engineering with their sons. However, with their daughters, the occupations discussed were more likely to be the traditionally feminine ones of nursing and teaching. The girls' parents had given less thought to future educational plans than had
had the parents of boys. Parental concern for a son’s education over a daughter’s is evident in the following example:

A professional couple’s gifted son is chosen for an accelerated mathematics program. They have a college student to drive him to the special tutoring sessions. A few years later, their younger daughter is chosen for the same program. The woman, a busy professional, cannot drive the girl to the tutoring sessions. The father is likewise busy. They don’t have a college student to drive her. She is unable to participate (Navarre, 1980).

Many of these attitudes of sex stereotypes are still prevalent and are detrimental to the expression of the abilities of gifted students. One of the most significant observations from the work of Casserly is that some gifted girls are very much aware of the sex stereotyping evident in the attitudes and behaviors expressed toward them (Fox, et al., 1980). Awareness, by teachers, counselors, and parents, can serve to reduce the impact of sex stereotyping and begin to bring about a change. This seems to be one of the more positive studies done which might lead one to believe that changes will occur.

Teacher Influence

No matter how much support girls may or may not receive at home, they still need encouragement from their teachers and counselors. Unfortunately, current research appears
to indicate that both teachers and counselors have little or no training in dealing with gifted and most especially gifted girls. A study of elementary school teachers found that 41 percent felt boys did better in science and mathematics and 63 percent felt girls did better in English (Stanley, George, Solono, 1977). These findings may have been based on classroom observations, but such expectations reinforce these differences and are likely to influence teacher behaviors.

Welse found that teachers of gifted students gave gifted female students who are analytic, resist conventional approaches, and prefer their own original approaches the very lowest ratings, while males who exhibited the same characteristics received the highest ratings (Blaubergs, 1980). It appears that teachers may like gifted boys better than gifted girls. Teachers and counselors have expressed other negative attitudes toward gifted females. In a study conducted by Fox, male counselors stated that they felt it would be "unfair to the girls" (to put them into advanced placement programs) because the job market was so tight in the physical sciences and the jobs should, of course, go to the men (Stanley, et. al., 1977).

Fox reported on a science teacher's behavior as follows:

Girls were told in science class that the next few remarks were only for boys; the teacher then discussed the applications of unit studied to repairing bicycles (Stanley, etal., 1977).
The following are some remarks from gifted girls concerning school courses:

So this teacher came down from the high school to give a demonstration in physics and said 'Now this is going to make a pretty big noise, so any of you girls who don't like loud noises better cover your ears.'

He said, 'Now this is going to be dirty, so we'd better have a boy do it (Fox, et.al., 1980.)

With attitudes and expectations like these, it is no wonder that gifted girls are represented in fewer numbers in high school mathematics and science courses and therefore graduate from high school not prepared to enter careers and professions which require these courses. It was shown in a study in 1974 that only 17.2 percent of the Advanced Placement (AP) candidates in chemistry were girls, and in 1975, 50,384 AP exams were taken by boys while only 35,402 were taken by girls (Stanley, et.al., 1977).

If these attitudes are to be changed, the first step seems to be to educate the teachers and counselors to the specific problems and issues concerning gifted female students. Early identification of gifted girls is important because it puts them in contact with a peer group which can give them support and encouragement. Once they are identified, the next problem is one of helping gifted female students to discover their potential and to maximize their development.
Attribution Theory

Another factor which might be influencing the study of mathematics by gifted girls is the attribution theory. This is a theory which has to do with the perceived causes of success and failure due to ability, effort, luck, and task difficulty. In an experiment by Etaugh and Brown, female and male fifth, eighth, and eleventh grade students, as well as college students, were asked to decide why a girl or boy failed or succeeded in repairing a bicycle tire (Stanley, et.al., 1974). Students at all levels believed that the girls succeeded because of effort, while boys succeeded due to ability. Conversely, girls' failure was explained by lack of ability more often than boys' failure. If one attributes success to internal causes, particularly the internal stable cause of ability, then one can expect success in the future and will persist at certain tasks. However, if success if attributed to an external cause, success in the future is not assured and one will avoid the task. A different situation exists with failure attributions. If failure is attributed to unstable causes, then failure can be avoided. But if failure is attributed to stable cause (lack of ability), then one will believe that failure can not be avoided.

Another study using the Weiner Model (appendix B) reported by Fennema found similar results in explaining
success/failure. She concluded that males tend to attribute successes to internal causes and failure to external or unstable causes, while females tend to attribute successes to external or unstable causes and failure to internal causes (Fennema, 1981).

Spatial Visualization

Another variable which might help explain differences in achievement between male and female gifted students is spatial visualization. In mathematical terms, spatial visualization requires that objects be mentally rotated, reflected and/or translated.

Studies done about the relationship between spatial visualization and the learning of mathematics have been inconclusive. Several studies do not agree with Fruchter's conclusion that spatial ability is unrelated to academic performance with the possible exception of a few specialized courses such as engineering drawing (Fox, et.al., 1980). Other authors agreed with Guilford, Guin, and Christensen in their conclusion that a positive relationship existed and that spatial visualization ability helped in solving mathematical problems (Fox, et.al., 1980).

It has been shown by Anastasi (1958) that starting at adolescence, male superiority on tasks involving spatial visualization is found (Stanley, et.al., 1977). Also,
Maccoby and Jacklin reported that sex-related differences in performance on spatial visualization tasks become more pronounced between upper elementary years and the last year of high school (Fox, et al., 1980).

One could conclude that if there is a positive relationship between spatial visualization and mathematics achievement, then this is partially explained by sex-related differences in mathematics achievement. However, Fennema (1981) concluded that:

While I am continuing to investigate the impact of spatial visualization skills, I am less convinced than I once was that spatial visualization is important in helping to understand sex-related differences in the studying and learning of mathematics.

Gifted Students' Liking for School

In the area of gifted students' liking for school, there is little research outside of the work done by Julian Stanley. In his Study of Mathematically and Scientifically Precocious Youth at the Johns Hopkins University in 1972, he found that gifted seventh and eighth grade students who got high scores on the SAT had less "liking for school" than the gifted students who had not done as well on the test.

A different attitude toward school was found in a study done by Terman et al (1925, 1947, 1959). He found that only one percent of the gifted were reported by their
parents as having a strong dislike for school (Gallagher, 1960). Another four percent had a "slight liking" for school while 54 percent of the boys and 70 percent of the girls had a "very strong" liking for school.

Lynn Fox (1974) reported on the first program directly run by the Study for Mathematically Precocious Youth in which fourteen boys and seven girls were in the program. Most of the students had completed the sixth grade except for one third grade boy (IQ near 200) and an eighth grade boy. The students were asked about their liking for school. Only one boy expressed a weak liking.

A final illumination of this problem is made by Walberg. In his 1981 study of Childhood Traits and Environmental Conditions of Highly Eminent Adults, he found that 80 percent of the people were successful in school and the majority of them liked school. This research study was conducted on about 200 men born between the 14th and 20th centuries and included such people as Mozart, Newton, Lincoln, Goethe, and Leibnitz with the mean IQ of about 160. From this limited information, it is difficult to make any generalization about gifted students' liking for school.
CHAPTER III

GENERAL DESIGN

Research Questions

This study explored the following questions:

1. Is there a significant relationship between family income and math SAT scores?

2. Is there a significant relationship between the father's educational level and math SAT scores?

3. Do males or females have significantly higher math SAT scores?

4. Is there a significant relationship between the student's liking for school and math SAT scores?

5. Is there a significant relationship between the family situation of the student and math SAT scores?

6. Is there a significant relationship between the student's use of a computer in the home and math SAT scores?

Variables Studied

In that the data for this study were collected in a non-laboratory setting and because the independent variables were not manipulated, this is considered a field study. The dependent variable is the SAT math scores. The independent variables are: (1) parent income, (2) father's educational level, (3) sex of the student, (4) student's liking for school, (5) family
situation (living with both natural, married parents or living with one or the other natural parent who is either married or divorced, and (6) student time spent using a computer in the home.

Sample and Population

The population studied was 367 seventh grade students from 18 counties in east central Illinois. Appendix A presents the eighteen counties studied. All of these students had scored in the ninety-fifth percentile in a district administered, norm-referenced achievement test on either the mathematical and/or verbal subtest. The sample for this study is 367 of the 380 students who completed the "Questionnaire for Academic Talent Search." The 367 respondents represent a 97 percent response rate. The issue of randomness of the sample was not relevant because of the very high response rate. Inferences made from this sample to other populations should consider the relationship between the characteristics of the sample to the population to which such inferences are made.

Instrumentation and Data Collection

"The Questionnaire for Academic Talent Search" was developed by the researcher and served as the criterion measures. Two forms of this instrument were developed:
(1) a student form and (2) a parent form. Appendices D and E present copies of these instruments. These instrument sets were based on those used by Stanley in his study entitled The Study of Mathematically Precocious Youth (SMPY), with several additional items added by the researcher. On the student form 3 questions were added by the researcher. They were questions 13, 14, 15 in appendix D. On the parent form the questions 3 - 8 were added by the researcher (appendix E).

Both the student and parent forms of the "Questionnaire for Academic Talent Search" were sent to the residence of the student for completion by the respective respondents. A cover letter accompanied the questionnaire which explained the purpose of the study and instructions for completing and returning the questionnaire. The instructions are presented along with the instruments in appendices C, D, and E. A pre-addressed, postage paid envelope was included for returning the questionnaire to the author.

Data Analysis

The one-way Analysis of Variance Model was used to compare group means to determine if a significant difference accrued at the .05 level. If more than two group means were involved in an analysis, Duncan's New Multiple Range Test was used to ascertain which means differed from each other at the .05 level.
CHAPTER IV

RESULTS, CONCLUSIONS, AND RECOMMENDATIONS

Research Questions

The format for this chapter will be to present results for each of the six research questions posed for study along with a discussion of results. The six research questions are:

1. Is there a significant relationship between family income and math SAT scores?
2. Is there a significant relationship between the father's educational level and math SAT scores?
3. Do males or females have significantly higher math SAT scores?
4. Is there a significant relationship between the student's liking for school and math SAT scores?
5. Is there a significant relationship between the family situation of a student and math SAT scores?
6. Is there a significant relationship between the student's use of a computer in the home and math SAT scores?

Results and Conclusions for Question 1

Question 1: Is there a significant relationship between family income and math SAT scores?

Table 1 presents the one-way analysis of variance and the Duncan's New Multiple Range Test results for
Table 1

One-way Analysis of Variance and Duncan's New Multiple Range Test Results for determining the Difference Between Income Level of Parents and Student's Mathematics SAT Score (question 1)

<table>
<thead>
<tr>
<th>Groups (income)</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 0 = 10,000-20,000</td>
<td>45</td>
<td>393.77</td>
<td>69.06</td>
</tr>
<tr>
<td>Group 1 = 20,000-30,000</td>
<td>106</td>
<td>375.18</td>
<td>69.25</td>
</tr>
<tr>
<td>Group 2 = 30,000-40,000</td>
<td>90</td>
<td>388.33</td>
<td>73.68</td>
</tr>
<tr>
<td>Group 3 = 40,000-50,000</td>
<td>41</td>
<td>406.82</td>
<td>62.82</td>
</tr>
<tr>
<td>Group 4 = 50,000-60,000</td>
<td>22</td>
<td>394.09</td>
<td>66.59</td>
</tr>
<tr>
<td>Group 5 = over 60,000</td>
<td>23</td>
<td>418.69</td>
<td>63.40</td>
</tr>
<tr>
<td>Total N</td>
<td></td>
<td>327</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>55028.50</td>
<td>5</td>
<td>11005.70</td>
<td>2.295</td>
<td>.0452</td>
</tr>
<tr>
<td>Within groups</td>
<td>1539034.50</td>
<td>321</td>
<td>4794.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1594063.00</td>
<td>326</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Significant difference at the .05 level for Group 1 vs. Group 3 and Group 1 vs. Group 5*

*Based on Duncan's New Multiple Range Test
question 1. The F value of 2.275 is significant at the .0452 level. This indicates that at least two of the six group means differ significantly at approximately the .05 level. Duncan's New Multiple Range Tests indicates that the mean of Group 1 (375.18) differs significantly at the .05 level from the means of Group 3 (406.82) and Group 5 (418.69).

Based on these analyses, it is concluded that there is a significant relationship between family income and math SAT scores for the above-mentioned groups.

Results and Conclusions for Question 2

Question 2: Is there a significant relationship between the father's educational level and math SAT score?

Table 2 presents the one-way analysis of variance results for question 2. The F value of 1.782 is not significant. Based on this analysis, it is concluded that there is no significant relationship between the father's education and math SAT score. In examining table 2, the total number of responses for Group 2, Group 3 and Group 4 is 255. If that total is divided by the total number of responses for all the groups (359), it shows that 71 percent of the fathers reported having had some college courses, having received a college degree, or having had course work beyond a bachelors degree. The total number of responses for
Table 2

One-way Analysis of Variance and Duncan's New Multiple Range Test Results for Determining the Difference Between the Father's Educational Level and Student's Mathematics SAT Score (question 2)

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 0 = less than high school</td>
<td>12</td>
<td>363.33</td>
<td>75.36</td>
</tr>
<tr>
<td>Group 1 = high school graduate</td>
<td>92</td>
<td>387.28</td>
<td>61.68</td>
</tr>
<tr>
<td>Group 2 = some college</td>
<td>111</td>
<td>383.15</td>
<td>66.00</td>
</tr>
<tr>
<td>Group 3 = college graduate</td>
<td>99</td>
<td>384.85</td>
<td>76.82</td>
</tr>
<tr>
<td>Group 4 = more than college</td>
<td>45</td>
<td>410.89</td>
<td>74.45</td>
</tr>
<tr>
<td>Total N</td>
<td>359</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>34422.85</td>
<td>4</td>
<td>8605.71</td>
<td>1.782</td>
<td>.1319</td>
</tr>
<tr>
<td>Within groups</td>
<td>1709920.89</td>
<td>354</td>
<td>4830.29</td>
<td>(not sig.)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1744343.74</td>
<td>358</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

No significant difference between any of the groups at the .05 level.
Group 3 and Group 4 (144) divided by the total number of responses for all the groups (359) shows that 27 percent of the fathers were college graduates.

In the Johns Hopkins SMPY study (Stanley, et al., 1974) it was reported that the father's education level correlated more highly with their children's ability than did the mother's educational level. Of the fathers, 45 percent were educated beyond college. Another 21 percent were college graduates. Only 14 percent of the fathers had received just a high school diploma and about 4 percent had not graduated from high school. The conclusion was that the fathers of the Talent Search participants were highly educated. In the total group tested, the higher the reported educational level of the parents, the higher the mean test scores of their children. This result is not particularly surprising. It does, however, raise some questions. Does this reflect the finding that bright parents tend to have bright children? Does it say something about different types of experiences to which children with higher test scores might have been exposed, or both? These data offer no solution to these problems.

In examining questions 1 and 2, it would seem that the two might be related in that the more education one has, the greater one's income. Yet in this study only the income level was significant, and the father's
educational level was not. However, the SMPY study did not examine the relationship between income and math SAT scores, but only the father's educational level which was found to be significant. Thus, if father's educational level and family income were closely related, this study would have similar findings as those in the Johns Hopkins SMPY study.

Results and Conclusions for Question 3

Question 3: Do males or females have significantly higher math SAT scores?

Table 3 presents the one-way analysis of variance results for question 3. The F value of 6.448 is significant at the .0115 level. This indicates that boys did achieve significantly higher scores than girls on the math SAT.

The results of this study confirm what Stanley found in the SMPY study. On the basis of SMPY's research of the mathematically precocious, it was found that males are more likely than females to perform at a very high level on tests of mathematical reasoning ability (Stanley, et.al., 1974). Stanley also reported that these results destroy the claim that boys and girls are equally good at mathematics until the girls drop out of math courses and therefore have not had
Table 3

One-way Analysis of Variance and Duncan's New Multiple Range Tests Results for Determining the Difference Between the Sex of the Student and the Mathematics SAT Score (question 3)

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 0 = male</td>
<td>164</td>
<td>396.71</td>
<td>70.13</td>
</tr>
<tr>
<td>Group 1 = female</td>
<td>200</td>
<td>378.25</td>
<td>68.06</td>
</tr>
<tr>
<td>Total N</td>
<td>364</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>30697.97</td>
<td>1</td>
<td>30697.97</td>
<td>6.448</td>
<td>0.0115</td>
</tr>
<tr>
<td>Within groups</td>
<td>1723309.45</td>
<td>362</td>
<td>4760.52</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1754007.42</td>
<td>363</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
as much background as boys. It is quite clear that at twelve years of age, when mathematics is still required, boys have significantly higher average math SAT scores than girls. When these sex differences were found by Stanley, one of his doctoral students, Fox, began to explore how to teach mathematics to early adolescent girls. Fox (et.al., 1980) thought that the girls should be taught by female teachers using a theoretical, investigative, analytical approach. However, although attempts at Johns Hopkins University to intervene to raise the level of achievement in mathematics of gifted girls have been somewhat successful, intervention efforts have not yet been able to improve the basic mathematical reasoning ability of gifted girls to equal that of the ablest boys (Stanley, et.al., 1977).

In the review of literature pertaining to male and female mathematically gifted students, it was pointed out that there may be several factors affecting differences in the math SAT scores for boys and girls. Even though findings in this study were similar to those reported by Stanley, it cannot be concluded that this difference is due to genetics.
Results and Conclusions for Question 4

Question 4: Is there a significant relationship between the student's liking for school and the math SAT scores?

Table 4 presents the one-way analysis of variance results for question 4. The F value of .345 is not significant. This indicates that there is no significant difference between the means of any of the four groups. Based on this data, there is not a significant relationship between the student's liking for school and the math SAT score.

In the Johns Hopkins SMPY study, it was reported that gifted seventh grade students who had high math SAT scores reported less liking for school than gifted students who did not score as well on the test (Stanley, et al., 1974). It was also reported that dislike for school is positively related to the student's SAT means on mathematics.

Results and Conclusions for Question 5

Question 5: Is there a significant relationship between the family situation of the student and math SAT scores?

Table 5 presents the one-way analysis of variance results for question 5. The F value of 1.659 is not significant. This indicates there is no significant difference between the means of any of the four groups.
Table 4

One-way Analysis of Variance and Duncan's New Multiple Range Test Results for Determining the Difference Between the Student's Liking for School and Mathematics SAT Score (question4)

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>Means</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 0 = very strong</td>
<td>86</td>
<td>382.55</td>
<td>67.69</td>
</tr>
<tr>
<td>Group 1 = fairly strong</td>
<td>239</td>
<td>387.53</td>
<td>68.01</td>
</tr>
<tr>
<td>Group 2 = slight liking</td>
<td>38</td>
<td>390.26</td>
<td>77.33</td>
</tr>
<tr>
<td>Group 3 = positive dislike</td>
<td>2</td>
<td>425.00</td>
<td>219.20</td>
</tr>
<tr>
<td>Total N</td>
<td>364</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>5048.62</td>
<td>3</td>
<td>1682.87</td>
<td>.345</td>
<td>.7926</td>
</tr>
<tr>
<td>Within groups</td>
<td>1759628.09</td>
<td>361</td>
<td>4874.32</td>
<td>(not sig.)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1764676.71</td>
<td>364</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

No significant difference between any of the groups at the .05 level.
Table 5

One-way Analysis of Variance and Duncan's New Multiple Range Test Results for Determining the Difference Between Family Situation and Student's Mathematics SAT Score (question 5)

<table>
<thead>
<tr>
<th>Groups*</th>
<th>N</th>
<th>Means</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 0 = both natural parents</td>
<td>284</td>
<td>391.73</td>
<td>66.04</td>
</tr>
<tr>
<td>Group 1 = mother natural parent</td>
<td>31</td>
<td>374.52</td>
<td>70.42</td>
</tr>
<tr>
<td>Group 2 = father natural parent</td>
<td>5</td>
<td>346.00</td>
<td>72.32</td>
</tr>
<tr>
<td>Group 3 = divorced; with mother</td>
<td>25</td>
<td>365.20</td>
<td>92.29</td>
</tr>
<tr>
<td>Group 4 = divorced; with father</td>
<td>5</td>
<td>386.00</td>
<td>73.35</td>
</tr>
</tbody>
</table>

Total N = 350

<table>
<thead>
<tr>
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<th>MS</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>31349.39</td>
<td>4</td>
<td>7837.34</td>
<td>1.659</td>
<td>.1591</td>
</tr>
<tr>
<td>Within groups</td>
<td>1629886.31</td>
<td>345</td>
<td>4724.31</td>
<td>(not sig.)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1661235.70</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

No significant difference between any of the groups at the .05 level.

*Group 0 = married and both are the natural parents of the child
Group 1 = married and the mother is the natural parent of the child
Group 2 = married and the father is the natural parent of the child
Group 3 = divorced and the child lives with his/her mother
Group 4 = divorced and the child lives with his/her father
The Johns Hopkins SMPY study did not examine this question. In the light of the past two decades, when the divorce rate has risen to 40 percent, this study hoped to determine if the family situation was having any influence on the scores of the math SAT. By using the number of responses for Group 1 (284) and dividing that by the total number of responses (359), it showed that 81 percent of the students were living with both of their natural parents; therefore, the question posed may not have been relevant.

Results and Conclusions for Question 6

Question 6: Is there a significant relationship between the student's use of a computer in the home and math SAT scores?

Table 6 presents the one-way analysis of variance results for question 6. The F value of 1.612 is not significant. This indicates that there is no significant difference between the means of each of the four groups. Based on these data, there is not a significant relationship between the student's use of a home computer and the math SAT scores.

This was not a question which was examined by the Johns Hopkins SMPY study. However, since computers recently have become a very popular piece of educational equipment, it appeared that the student's use of a computer in the home might correlate with a higher
Table 6

One-way Analysis of Variance and Duncan's New Multiple Range Test Results for Determining the Difference Between Work on a Home Computer and the Student's Mathematics SAT Score (question 6)

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>Means</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 0 = 1½ hrs or less</td>
<td>288</td>
<td>381.70</td>
<td>68.19</td>
</tr>
<tr>
<td>Group 1 = 1-3 hrs</td>
<td>22</td>
<td>398.64</td>
<td>70.93</td>
</tr>
<tr>
<td>Group 2 = 3½-4½ hrs</td>
<td>16</td>
<td>408.13</td>
<td>88.26</td>
</tr>
<tr>
<td>Total N</td>
<td>326</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>15540.35</td>
<td>2</td>
<td>7770.17</td>
<td>1.612</td>
<td>.2011</td>
</tr>
<tr>
<td>Within groups</td>
<td>1557169.16</td>
<td>323</td>
<td>4820.96</td>
<td>(not sig.)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1572709.51</td>
<td>325</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

No significant difference between any of the groups at the .05 level.
math SAT score. It was thought the daily time a student had on a computer at school might be very limited and therefore not important. But the idea that very bright students might have several hours a day to spend on a computer in the home seemed to be important to investigate. However, in examining Table 6 and using the number of responses for Group 1 and group 2 (38) and dividing that number by the total number of responses (359), only eleven percent of the students reported spending one hour or more a day on a home computer. The reason for so few students reporting the use of the home computer could be that the cost for such a piece of equipment is still very high, and possibly the average family might not feel that one is necessary.
Recommendations

Based on the results and conclusions of this study, the following recommendations are offered:

1. There should be more in-service for counselors and teachers as to the needs of the gifted learner, as well as to the general problems of the sex-role stereotyping.

2. In addition to regular mathematics courses designed for future elementary teachers, colleges need to offer a course to improve their attitude toward mathematics and thus transmit a positive attitude to both boys and girls.

3. Schools should attempt to change girls' attitudes and behavior towards mathematics directly by means of special extra-curricular activities, including career-education classes, counseling sessions, and other types of experimental programs aimed at broadening girls' career horizons.

4. For students who have scored above 450 on the SAT-M, schools should consider some programming alternatives which should include acceleration in mathematics.
The 18 counties served are:

Champaign
Christian
Clark
Coles
Crawford
Cumberland
DeWitt
Douglas
Edgar
Effingham
Ford
Iroquois
Jasper
Macon
Moultrie
Piatt
Shelby
Vermilion
### APPENDIX B

**Locus of Causation**

**Weiner Model**

<table>
<thead>
<tr>
<th>Stability</th>
<th>Internal</th>
<th>External</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stable</td>
<td>Ability</td>
<td>Task</td>
</tr>
<tr>
<td>Unstable</td>
<td>Effort</td>
<td>Luck</td>
</tr>
</tbody>
</table>
Dear Student and Parents,

As part of research being conducted by the Region V Area Service Center, we would like you to fill out the attached forms. All the information collected from these questionnaires is strictly confidential and will be used only for research purposes.

It is the purpose of our research to understand more about the gifted mathematics student and his school and family environment. In order for us to compile this information, we need the questionnaire returned by each participant.

Please help us in this matter. We realize that completing the enclosed forms will take your time. It is estimated that the student can complete his/her part in 5 minutes and the parents can complete their part in 5 minutes.

We thank you for your interest and time in furnishing us this information. If you have any questions about this research project, please call (217) 893-4585) or write (Area Service Center, Box 919, 200 S. Fredrick, Rantoul, IL 61866) us.

Sincerely,

Jolene McGrogan, Director

Ann Morris, Consultant
Appendix D

QUESTIONNAIRE FOR ACADEMIC TALENT SEARCH

To be filled out by the Student:

NAME______________________________ Sex: M  F____
(Print) Last  First  Middle

1. Name of school that you attend____________________________________ Grade____

Name of county________________________

2. Full address of school______________________________________________

3. Approximate number of students in your math class_______________

4. Check the type of school you attend:

   _____ K-8,  _____ 6-8,  _____ 7-9,  _____ other and describe__________

5. Home phone number (including area code)_____________________________

6. Date of birth _______ month _______ day _______ year

7. How many older brothers do you have? _______ Their birthdates__________

   How many older sisters do you have? _______ Their birthdates__________

   How many younger brothers do you have? _______ Their birthdates________

   How many younger sisters do you have? _______ Their birthdates________

8. What mathematics courses are you taking this year?

   _____ General 7th grade   _____ Advanced 7th grade   _____ Algebra

   _____ other and describe____________________

9. Circle the words which best describe each of the following:

   a. Your liking for school

      Very strong     Fairly strong     Slight liking     Positive dislike

   b. Your liking for arithmetic and mathematics

      Very strong     Fairly strong     Slight liking     Positive dislike

-42-
10. Check the one statement that best describes how well you are doing in your mathematics class this year.
   a. _______ Better than all of your classmates
   b. _______ Better than all but one or two other classmates
   c. _______ About as well as most of your classmates
   d. _______ Less well than the majority of your classmates

11. This school year, how are you learning most of your arithmetic and mathematics? (Check only one.)
   a. _______ In regular classwork with other students
   b. _______ In school, but working on your own with some help or direction from your teacher.
   c. _______ On your own outside of school, helped by a tutor or parent
   d. _______ On your own outside of school with little help from anyone

12. If you are working on your own in arithmetic or mathematics, rank the main types of work you are doing (1=highest rank):
   a. _______ Working with a textbook mostly on your own
   b. _______ Working with a textbook aided by someone
   c. _______ Working on mathematics puzzles in books or magazines
   d. _______ Working on assignments made by your teacher, other than just extra problems in the class arithmetic book

13. List any other classes you have taken outside of school: such as, summer school, college for kids, etc.

14. List your favorite subjects:
   1) ___________________  2) ___________________  3) ___________________

15. Approximately how many hours each day do you:
   Study? _____________ hrs/day
   Watch TV? _____________ hrs/day
   Play video games? _____________ hrs/day
   Work on your HOME computer? _____________ hrs/day

16. Comments of any sort:
Appendix E

QUESTIONNAIRE FOR ACADEMIC TALENT SEARCH

To be filled out by the Parent:

1. Mother's name ____________________________ Occupation ____________________________
   a. Check the highest educational level completed:
      ______less than high school ______high school graduate ______some college
      ______college graduate, degree ______more than college

2. Father's name ____________________________ Occupation ____________________________
   a. Check the highest educational level completed:
      ______less than high school ______high school graduate ______some college
      ______college graduate, degree ______more than college

3. Combined family income:
      ______$10,000 - $20,000
      ______$20,000 - $30,000
      ______$30,000 - $40,000
      ______$40,000 - $50,000
      ______$50,000 - $60,000
      ______over $60,000

4. Did the child being tested attend a montessori school, nursery school, or other
   pre-formal school? ______Yes ______No (if yes, please describe) ____________________________

5. At what age did the child attend formal school? ____________________________

6. Do you see the child's school work on a regular basis? (i.e. once or twice a
   week) ______Yes ______No

7. How much time each day do you help your child with his school work?
      ______15 min. ______30 min. ______more than 30 min. ______none
8. Family situation: (This section does not have to be completed if you choose not to do so.)

married and both are the natural parents of the child

married and the mother is the natural parent of the child

married and the father is the natural parent of the child

divorced and the child lives with his/her mother

divorced and the child lives with his/her father

If you are separated or divorced, what was the age of the child when the separation occurred?
LIST OF REFERENCES


Fennema, Elizabeth (Ed.), Mathematics Education Research: Implications for the 80's, National Council of Teachers of Mathematics, Reston, VA, 1981


Getzels, Jacob, Jackson, P.W., Creativity and Intelligence: Exploration with Gifted Students, John Wiley, New York, 1962


