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ABSTRACT

The study investigated social processes and sex differences that might inhibit or enhance the development of interest, self confidence, and competence in the study of mathematics and in the pursuit of careers which require advanced mathematical knowledge and skill among 120 seventh graders, all identified as having superior mathematical ability by the Study of Mathematically Precocious Youth at Johns Hopkins University. A student questionnaire and a parent questionnaire were developed. The Vocational Preference Inventory was administered to students. Questions investigated covered the following areas: characteristics related to family background and aptitude, attitudinal characteristics, support from significant others, home learning, interrelationships between variables, and teacher characteristics. Ss were divided into five groups: A-1 consisted of girls considered to be highly motivated on the basis of their having accelerated their study of mathematics; A-2 included girls who were considered to be not as highly motivated as A-1; B-1 was a sample of boys considered to be highly motivated; B-2 was a sample of boys considered to be not highly motivated; and C was a sample of girls who appeared to have low interest in mathematics and high interest in the humanities. Among findings were the following: no significant differences were found among the five groups on measures of socioeconomic and family constellation variables; A-1 girls had lower levels of self confidence in mathematics than B-1 boys; mothers of boys noticed ability in their sons at a much earlier age than mothers of girls; and most parents of girls felt careers would need to be interrupted for child bearing purposes. Although all the girls were extremely talented in mathematics, they had not been viewed as unusually gifted or unique by the teachers. (SW)

Final Report to the National Institute of Education

on its Grant to the

Intellectually Gifted Child Study Group

in the Evening College and Summer Session

of The Johns Hopkins University

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THE STUDY OF SOCIAL PROCESSES THAT INHIBIT OR ENHANCE THE DEVELOPMENT OF COMPETENCE AND INTEREST IN MATHEMATICS AMONG HIGHLY ABLE YOUNG WOMEN

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PREFACE

We would like to express our appreciation to the many people whose assistance was invaluable in preparing this report. We would first of all like to thank Dr. Julian Stanley, Director of the Study of Mathematically Precocious Youth, and Mr. William George, Director of Talent Identification for the Office of Talent Identification and Development, for allowing us to invite the students from the 1979 and 1980 Talent Searches to participate in our study and for their assistance and guidance in the development of the questionnaires.

We also would like to thank Sharon Dietz, Kim Weston and Barbara Zirkin, classroom teachers and graduate students at The Johns Hopkins University, who assisted with some of the research. A special thank you to our secretary, Deborah Loomis, for her attention to details and patience with the preparation of this manuscript.

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INTRODUCTION

The purpose of this study was to investigate social processes that might inhibit or enhance the development of interest, self-confidence, and competence in the study of mathematics and in the pursuit of careers which require advanced mathematical knowledge and skill among young men and women who were identified as having superior mathematical ability in early adolescence. The study focused on the factors within the home environment that fostered mathematical interest, learning and self-confidence as well as the degree to which this influence was or was not supported by school programs, teachers, and peers, and the extent to which these factors were the same or different for young women and men.

Educational researchers have debated the nature and extent of sex differences in mathematical ability (Maccoby and Jacklin, 1974; Fennema and Sherman, 1977; Benbow and Stanley, 1980). Whether or not differences in ability do exist, there is evidence that even among those students who are gifted in mathematics, sex differences may exist with respect to course-taking in mathematics and educational risk-taking. Gifted boys are more likely than gifted girls to take college courses while in high school, participate in accelerated mathematics classes, and study calculus in high school (Fox, 1977; Fox and Cohn, 1980; Benbow, 1981).

Three research reviews related to sex differences in mathematical aptitude, achievement, and interest were commissioned by NIE in 1976 and are published in a single volume <u>Women and Mathematics: Research Perspectives for Change</u>. These papers cite numerous studies which suggest the importance of home and parental factors upon the development of mathematical interest and efficacy. For example, Helson's (1971) study of mathematicians suggests that identification with the father, birth order, lack of male siblings, and other socio-economic factors were important in the development of women mathematicians. The importance of the parent as a role model, particularly fathers, in the development of mathematical ability has also been suggested by Aiken (1975, 1976), Block (1973), Carlsmith (1964), Elton & Rose (1967), and Plank & Plank (1954). The influences of parental aspirations, attitudes and behaviors have also been found in studies by Casserly (1975) and Levine (1976). The research studies highlight the importance of parental behavior, home environments, and role models, but do not explain the dynamics by which parents impact learning, interest, and self-confidence in mathematics, particularly for the highly able boy and girl.

In the fall of 1977, NIE funded 10 projects on women and mathematics. Analysis of the National Assessment of Educational Progress (Armstrong and Kahl, 1979) and the Project Talent data (Steel & Wise, 1979; Wise, 1979) found that career interest at grade nine or earlier was a significant factor for later course-taking and achievement and, in the case of Project Talent, for later career realization for the highly able. Self-confidence as a learner of mathematics was found to be a significant variable in several studies (Armstrong and Kahl, 1979; Casserly, 1979; Fox, Brody and Tobin, 1979; Kaczale, Futterman, Meece and Parsons, 1979). Two studies suggested that perception of the usefulness of mathematics is a key factor in participation although more so for boys, and that enjoyment of mathematics was a more potent factor for girls (Armstrong and Kahl, 1979; Casserly, 1979). Active encouragement by parents, particularly the father, was found to be important in two studies (Armstrong and Kahl, 1979; Casserly, 1979), but these same studies had somewhat conflicting results as to the importance of role models, perhaps in part because this variable was defined rather differently in the two studies. The study by Fox, Brody and Tobin (1979) suggested that ability and the opportunity for special accelerated mathematics experiences are alone not sufficient to motivate highly able young women to pursue the study of calculus in high school or explore career possibilities in mathematics or science. Thus, several of the 10 NIE studies indicate a need to assess home variables which contribute to girls' and boys' interest in mathematics and the development of the ego-strength or self-confidence to persist in the study of mathematics beyond the pre-calculus course level.

The purpose of the study reported here was to investigate the influences of parents with specific focus on the learning of mathematics, development of career interest, and self-confidence in mathematics within the homes of boys and girls who have a high degree of ability. Related factors such as support from teachers, peers, and school programs and the availability of role models were investigated as well.

RESEARCH DESIGN

Subjects

A series of talent searches to locate highly able adolescents was initiated at The Johns Hopkins University in 1971 by the Study of Mathematically Precocious Youth. In 1978 the Office of Talent Identification and Development (OTID) was created at the university to expand and continue the searches on an annual basis. Subjects for this study were chosen from among high scorers in mathematics in 1979 and 1980.

In 1979 seventh-graders who had scored at the 97th percentile or above on national norms on the mathematics part of a standardized achievement test and who attended schools in Delaware, Maryland, Pennsylvania, New Jersey, Virginia, West Virginia or the District of Columbia were eligible for the search. Although students were administered both verbal and mathematical parts of the Scholastic Aptitude Test (SAT), the searches focused on mathematical talent until 1980. In 1980 the search was expanded to include verbal ability as well as mathematical talent. Students who qualify for the search take the SAT in a regular administration at a location near them. High scorers in mathematics are generally considered to be those who score 500 or more on the mathematics part of the SAT (SAT-M). Some educational counseling and score interpretation are provided to all participants and high scorers are invited to talent recognition ceremonies and to participate in a variety of special summer or school year academic programs. Each year the performance on the SAT-V has been about the same for boys and girls; each year, however, the mean score for boys has been about 30 points higher than for girls on the SAT-M, and about twice as many boys than girls score 500 or higher on the SAT-M. A detailed history of the development of the searches and sex differences in performance are contained in several books (Stanley, Keating, and Fox, 1974; Keating, 1976; Stanley, George and Solano, 1977; Fox, Brody and Tobin, 1980).

This study focused on samples of seventh grade students from the Talent Search who scored $\geq$ 500 on the SAT-M and thus could be assumed to have a high level of ability in mathematics. Five groups were selected as follows on the basis of sex and interest and motivation in mathematics:

A_1 Girls who scored $\geq$ 500 on SAT-M as 7th graders in the 1979 Talent Search and who are considered highly motivated on the basis of accelerating their learning of mathematics.

A_2 Girls who scored $\geq$ 500 on SAT-M as 7th graders in the 1979 Talent Search and who are considered not highly motivated on the basis of their turning down an opportunity to accelerate their mathematics learning.

B_1 Boys who scored $\geq$ 500 on SAT-M as 7th graders in the 1979 Talent Search and who are considered highly motivated on the basis of accelerating their learning of mathematics.

B_2 Boys who scored $\geq$ 500 on SAT-M as 7th graders in the 1979 Talent Search and who are considered not highly motivated on the basis of their turning down an opportunity to accelerate their mathematics learning.

C A sample of girls from the 1980 Talent Search who scored at or above 500 on the SAT-M, but who indicated a low interest in mathematics and high interest in the humanities on the application, were chosen as a sample of girls with high mathematical ability and low interest.

In selecting samples A_1, A_2, B_1, and B_2, the 3,675 participants in the 1979 Talent Search were first screened to identify those who scored $\geq$ 500 on the SAT-M. For the 193 boys and 76 girls who met this criterion, background information was obtained from the Talent Search application and coded. Of this group, 67 boys and 23 girls had participated in an accelerated summer mathematics program and data from their files were coded.

Group A_1 includes 20 of the 23 girls who had participated in the summer class. Three were omitted because one was a 10th grader, one dropped out of the class, and the third did not agree to participate in the study. Four other girls who were not in the class but who had participated in accelerated programs in their schools and thus were considered highly motivated were included in the A_1 group.

Groups B_1, B_2, and A_2 were randomly selected from the three groups of (1) boys in the class, (2) boys not in the class, and (3) girls not in the class, respectively, with consideration given to the following variables: distance, an even distribution of attendance at public vs. private schools, and aptitude. Because length of time to drive to Hopkins may have been a factor in decisions to come to the classes, driving distance was considered. Driving distance to Hopkins from the students' homes was computed as a) less than 1 hour, b) 1-2 hours, c) more than 2 hours. An attempt was made to make the number of students who lived moderately close, moderately far, and very far from Hopkins in Groups B_1, B_2 and A_2 approximately the same as A_1 by selecting the random samples within the three levels of distance in the same ratio as it appeared in A_1. Also, consideration was given to equalizing the number of students in each group that came from private schools so that this would not be a biasing factor.

After selecting the samples on these two factors, the distributions of SAT-M scores of the groups were compared so that the groups would be approximately equal in ability. A boy in the class with a 720 SAT-M, which was considerably higher than the highest girl in the class with 670, was omitted. A decision was made not to omit a girl from the A_2 group who scored 760 since the bias would be against rather than toward the participants in the class.

Group C was selected from the approximately 450 girls who scored at least 500 on the SAT-M in the 1980 Talent Search. These girls were screened for career goals that did not include a highly scientific or mathematical career, and interest in participating in a summer program in the humanities but no interest in participating in a summer mathematics program. In addition, they did not check "a strong liking for mathematics" on the Talent Search questionnaire.

The proposal suggested a sample of 25 students in each group. Over-sampling was done with all groups (except A_1, where the universe of girls who met the criteria was included). Twenty-eight were selected for A_2, 29 for B_1 (including the boy whose score was considered too high for him to be part of the sample), 28 for B_2 and 27 for C.

Responses were received from 24 students in the A_1 group, 27 in the A_2 group, 27 in the B_1 group, 28 in the B_2 group and 26 in the C group. Enough cases were dropped so that all five groups would consist of 24 cases, thus allowing for analysis with equal numbers of cases in each group. The decision to drop cases was made first on the basis of a missing parent questionnaire and secondly, if there were still more than 24 in the group, on the basis of those questionnaires returned last since many of them arrived considerably after the deadline originally given to the students.

Instruments

A student questionnaire and a parent questionnaire were developed. The development process was extensive and included four revisions. Questionnaires used by grant recipients in the 1977-79 NIE Women and Mathematics grants were examined for ideas, and the staffs of the Office of Talent Identification (OTID) and the Study of Mathematically Precocious Youth (SMPY) were asked for comments on the various drafts.

Care was taken to be sure that all of the hypotheses in the proposal were tested in the questionnaire, and questions were pilot-tested on students at Hopkins to be sure that the purpose of each was clear and not misleading. The parent questionnaire, while identical for both, was administered to the subjects' mothers and fathers separately. Attitude scales were included in both the students' and parents' questionnaires. Some items were based on items in the Fennema-Sherman Mathematics Attitude Scale with the word Calculus substituted for Mathematics in some cases because of the high ability level of the group. Additional items were written by the investigators. The questionnaires were mailed to the A_1, A_2, B_1 and B_2 groups in April 1980 and to the C group in early 1981.

The Vocational Preference Inventory (VPI) was administered to students in all groups as part of the questionnaire packet. These tests were scored and the results analyzed for group and sex differences. A letter was sent to each student along with a copy of their own individual interest profile.

Additional information including number of siblings, parents' education and occupations, course-taking data and test scores were obtained by examining the Talent Search applications already available in the Office of Talent Identification and Development at Hopkins.

A protocol was also developed for the purpose of interviewing selected teachers nominated by the A_1 and A_2 girls as having had a positive influence on their interest in learning mathematics. This was pilot tested prior to its final use with the sample.

Copies of the student questionnaire, parent questionnaire, and the 1980 Talent Search Application are included in the Appendix.

Research Questions

The questionnaires and test results were used to study the characteristics, attitudes and behaviors of the students in the five groups and their parents. It was hoped that an understanding of how the students in the five groups are alike or different with regard to such variables as ability, socio-economic and family variables, attitudes concerning mathematics and careers, learning of mathematics, and their perception of support from significant others, would shed light on the factors that enhance or inhibit interest and motivation in mathematics. Also investigated were the way the fathers and mothers of the students in the five groups were alike and different and some characteristics of exemplary teachers of the gifted. The questions investigated in the study are summarized below:

(1) Characteristics related to family background and aptitude

What, if any, differences exist among the five groups on such socio-economic and family constellation variables as: a) education of parents, b) occupation of parents, c) birth order, and d) sex of siblings? Are there any differences in ability among the five groups on tests of mathematical reasoning and verbal reasoning? Are there differences in spatial and mechanical ability and the ability to do abstract reasoning between the A_1 girls and the B_1 boys?

(2) Attitudinal characteristics

In what ways are the students in the five groups alike and different with respect to variables assumed to be relevant to the study of advanced mathematics and career choices? The variables investigated included: a) self-confidence as a learner of mathematics, b) willingness to take educational risks, c) perception of the usefulness of the study of mathematics, d) enjoyment of mathematical activities,

e) career interests, and f) access to role models.

(3) Support from significant others

How do the students in the five groups perceive the support or lack of support from significant others for self-confidence, enjoyment of mathematics, risk-taking, usefulness of mathematics, and interest in mathematical and scientific careers? Are there differences among the parents of the students in the five groups with respect to the amount of support they give their children on each of these variables? To what extent do the parents stereotype mathematics as more appropriate for men than women?

(4) Home learning

Are there differences among the five groups with respect to mathematical and related skills learned at home before the child entered school or before the topics were taught in school? Are there differences among the groups with respect to who taught the child?

(5) Inter-relationships between variables

What are the inter-relationships between the different attitudinal variables for the five groups? Is there a relationship between socio-economic and family constellation variables and other variables studied? How do students' attitudes compare to their perception of their parents' attitudes and, in some cases, to the parents' actual attitudes?

(6) Teacher characteristics

What are the characterisics, attitudes, and behaviors of teachers nominated by A_1 and A_2 girls as having had a positive influence on the development of their self-confidence and interest in the study of mathematics and/or related careers?

CHARACTERISTICS RELATED TO FAMILY BACKGROUND AND APTITUDE

Some socio-economic and family constellation variables were analyzed to serve as a general description of the home background of the five groups and to make sure that the differences among the groups were not artifacts of social class or birth position variables. Data on these variables were obtained from the original questionnaire which the students completed when they first entered the Talent Search. Analyses were done on family size, birth order, the sex of siblings, the educational and occupational background of parents, and the types of schools which the students attended.

Family Constellation Variables

The distribution of students, by group, for the variables of family size, birth order, and sex of siblings is shown in Table 1.

Insert Table 1

Most of the students are from families of two or more children with 47 percent of the students from two children families and 48 percent of the students from families of three or more children. At least half of the students in each group are either oldest or only children. Most of the students are from families having at least one sibling of the opposite sex. There were no significant differences among the groups on these variables.

Because Helson (1971) found an unusually high number of women who were oldest daughters in all girl families in her study of adult female mathematicians, the data for the A_1 group were looked at carefully to see if there was an indication that the highly motivated girls were the oldest daughters of all girl families. Only 5 of the 24 girls

Table 1: Family Constellation Variables for Students in the Five Groups in Percents*

		Family Size			Birth Order			Sex of Siblings		
Group	N	One Child	Two Children	Three or More Children	Oldest or Only	Middle	Youngest	No Siblings	Same Sex Siblings	Opposite Sex Siblings
A_1	24	8.3	45.9	45.9 *	54.2	29.2	16.7 *	8.3	29.1	62.5 *
A_2	24	4.2	62.5	33.4 *	54.2	33.3	12.5	4.2	45.8	50.0
B_1	24	0.0	41.7	58.4 *	70.8	25.0	4.2	0.0	41.7	58.3
B_2	24	8.3	37.5	54.2	50.0	41.7	8.3	8.3	25.0	66.7
C	24	4.2	45.8	50.0	62.5	20.8	16.7	4.2	25.0	70.8

*Numbers do not always add up to 100 percent due to rounding.

(29 percent) in the A_1 group were oldest girls in families of daughters only, all but one from two children families. This does not differ significantly from what one would expect by computing the mathematical probability of this happening.[1] Thus, within this group of highly motivated and gifted 13-year-olds, there is no evidence of the impact of birth position and sex of siblings which was found among adult women mathematicians by Helson. Indeed, none of the five oldest girls expressed a strong interest in a mathematical career.

Because girls in the A_2 group were matched with the A_1 group on the type of school attended, the distribution of girls in A_1 and A_2 attending public as opposed to private schools was the same. As seen in Table 2,

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Insert Table 2

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a slightly higher percentage of students in the B_1, B_2 and C groups attended public schools, but the differences between the groups was not significant. The majority of children in all groups were attending public schools and thus were not disproportionately in elite private schools.

Parents' Level of Education

The level of education that the parents of the groups attained was also analyzed by group. Questionnaire responses were given codes ranging from one, for parents with less than a high school degree, to eight for parents who held a doctorate or advanced professional degree

[1]For example, in a 2 child family, the probability of being the oldest daughter with a younger female sibling is 25 percent, the probability of being an oldest daughter having 2 younger female siblings is 12.5 percent.

Table 2 : Type of school attended by students in the five groups, in percents

	N	Public	Private-Independent	Private-Religious
A_1	24	66.7	12.5	20.8
A_2	24	66.7	16.7	16.7 *
B_1	24	83.3	12.5	4.2
B_2	24	75.0	20.8	4.2
C	24	83.3	12.5	4.2

Significant Chi-Square Comparisons

None

*Numbers do not add up to 100 percent due to rounding.

such as M.D. or LLB. There were significant differences between fathers' and mothers' levels of education within each group, as assessed by t-tests of significance of the means as shown in Table 3,

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Insert Table 3

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but there were no significant differences between groups for fathers or mothers.

Table 4 shows a distribution of the level of education attained

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Insert Table 4

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by the mothers and fathers of the students in each group. More fathers of the A_1 and A_2 girls had earned doctoral level degrees than fathers of the other groups but most of these were law and medical degrees. Only one A_1 father did not have a college degree. The two mothers who attained doctoral level degrees were both lawyers.

Parents' Occupations

The results of the analysis of the parents' occupations showed similar results with no real differences among groups but with the fathers' occupations reflecting more prestigious, highly trained jobs than the mothers. Table 5 shows a distribution of occupations using a

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Insert Table 5

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slightly modified version of the classification of occupations reported in the study of Terman's gifted population as adults (Terman and Oden, 1959). The "Professional" and "Business" categories were subdivided to include careers with heavy emphasis on mathematics or science, and "Education" was divided into two levels to separate college professors

Table 3 : Mean level of education for mothers and fathers of the five groups

	N	Mothers	Fathers	t	p-value
A_1	24	4.75	6.67	5.04	$p < .001$
A_2	24	4.96	6.29	3.14	$p < .01$
B_1	24	4.75	6.08	3.94	$p < .01$
B_2	24	4.75	6.21	4.50	$p < .001$
C	22	4.73	5.82	3.14	$p < .01$

KEY

1 = less than high school

2 = high school

3 = technical and vocational school beyond high school

4 = college but no 4 year degree

5 = college graduate

6 = more than college

7 = master's degree

8 = doctorate, M.D., LLB, etc.

Table 4: Level of education for the parents of the students in the 5 groups in percents*

Fathers

	N	Doctorate	Masters	More than College	College Degree	College but No Degree	Technical or 2 year College	H.S.	Less than H.S.
A_1	24	45.8	16.7	16.7	16.7	4.2	0.0	0.0	0.0
A_2	24	54.2	8.3	8.3	0.0	16.7	4.2	4.2	4.2
B_1	24	33.3	12.5	8.3	25.0	16.7	4.2	0.0	0.0
B_2	24	16.7	33.3	12.5	20.8	16.7	0.0	0.0	0.0
C	23	26.1	8.7	17.4	30.4	8.7	4.3	4.3	0.0

Mothers

	N	Doctorate	Masters	More than College	College Degree	College but No Degree	Technical or 2 year College	H.S.	Less than H.S.
A_1	24	0.0	20.8	8.3	33.3	20.8	4.2	12.5	0.0
A_2	24	4.2	16.7	16.7	29.2	16.7	4.2	8.3	4.2
B_1	23	0.0	21.7	4.3	43.5	4.3	13.0	13.0	0.0
B_2	24	0.0	4.2	25.0	37.5	16.7	8.3	8.3	0.0
C	23	4.3	8.7	13.0	34.8	13.0	8.7	17.4	0.0

*Percents do not always add up to 100 due to rounding

Table 5: Occupations of Parents in Percents by Group*

	FATHERS					MOTHERS				
	A_1 N=23	A_2 N=24	B_1 N=24	B_2 N=23	C N=23	A_1 N=24	A_2 N=24	B_1 N=24	B_2 N=24	C N=22
Professional										
Education										
College Level	13.0		12.5	4.3	8.7	4.2				4.5
K-12	4.3	8.3	4.2	4.3	8.7	12.5	16.7	8.3	37.5	13.6
Engineers/Architects	17.4	4.2	8.3	21.7	8.7					
Lawyers	13.0	16.7	4.2	0.0	13.0	4.2				4.5
Mathematician/Scientist	8.7	4.2	12.5	4.3	13.0					
Medical										
Physician	4.3	20.8	4.2	4.3						
Nurse								4.2		
Social Services		8.3				8.3	12.5	8.3		
Other		4.2				4.2	4.2			
Business										
Accountant	4.3		4.2	4.3	4.3					
Computer Specialist			8.3	4.3	4.3	4.2				
Executive	13.0	8.3	20.8	30.4	13.0			4.2		
Other			4.2	8.7	4.3		12.5	4.2		
Public Administration/ Military	21.7	8.3		8.7	13.0				16.7	
Semi Professional/Trades		4.2	16.7	4.3	8.7		8.3	12.5	8.3	27.3
Agriculture		8.3								
The Arts										
Artist						4.2				9.1
Musician		4.2					4.2			
Writer						8.3				4.5
Homemaker						45.8	37.5	58.3	37.5	36.4
Student						4.2	4.2			

*Percentages do not always add up to 100 due to rounding from educators working with younger children.

If the occupation was reported as mathematician, it was classified under Professional - Mathematician/Scientist; if reported as Professor of Mathematics, it was classified as Education - College Level; if reported as Mathematics Teacher, it was classified as Education K-12. Five of the fathers classified as College Level were Professors in fields related to mathematics and science (2 in group A_1 and B_1, respectively, and 1 from group C), approximately half the total group in that category.

The category listed as "Semi-professional/Trades" includes technicians and clerical office personnel as well as skilled workers and craftsmen. "Homemaker" and "Student" were added as categories because some of the mothers could not be classified properly without those additions. The two mothers who are reported as students are going to school full time, one for a doctorate and the other for a medical degree. The mothers reported as "Homemakers" listed no other occupation. If they worked outside the home, even part-time, they were categorized under the part-time job they listed.

The greatest percentage of mothers in all groups except B_2 reported homemaker as their occupation, closely followed by careers in education. In the B_2 group equal percentages (37 percent) reported education and homemaking as their primary occupation. About 25 percent of the mothers' occupations fell into the professional classification while closer to 50 percent of the fathers' occupations were classified as professional. The difference was larger when educators were eliminated and even larger still if mothers reporting part-time employment were eliminated.

Few mothers in all groups were employed in areas related to business. Only six mothers (5 percent) have jobs that fit this category, one in computer science, one in an executive capacity and three in various other business-related jobs. Many more fathers' occupations fell into this category, with most of those classified as "Executives".

Some interesting, although not significant, differences were seen among the groups. Each of the sample girls' groups had at least 3 fathers who were lawyers, and A_1 and C each had a mother practicing law while there was only one lawyer father represented in the boys' sample groups. More fathers in the A_2 group were physicians than in any other group, although in this group no father was reported as a college level professor.

These slight differences in occupations do not alter the fact that in general the occupations of the fathers reflect a high socio-economic level for the students in all groups, and the occupations of the mothers approximate a national trend of mothers increasingly in the work force in traditional female occupations.

Aptitude

In the process of selecting groups for the study, a strong effort was made to ensure that the ability level of the groups would be comparable. The minimum requirement for selection was an SAT M $\geq$ 500. In addition the groups were selected so that the range of scores, and the mathematics and verbal patterns would be similar. The A_1 group served as the pattern, since the totality of eligible students in the A_1 group was selected for the study. Seventy-six girls were available as a pool for selecting the A_2 group, 67 boys for the B_1 group and 193 boys for the B_2 group. Because the C group was to be a group of girls with no interest in mathematics even though they scored above 500, a search through the 1980 Talent Search records revealed 27 girls who had expressed interest in attending verbal classes but not mathematics, had only a moderate liking for mathematics, and expressed no career interest of a mathematical nature. The 27 girls selected to receive questionnaires as group C, therefore, represented the universe of girls who met the criterion and limited the feasibility of matching the patterns for the A_1, A_2, B_1 and B_2 groups with the C group. The mean scores for the five groups on the SAT-M is found in Table 6 and reflects this situation. The ANOVA on the SAT-M was significant

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Insert Table 6

($F = 10.75$, $p < .001$), but results of the Tukey test showed that the significance was caused only by the lower scores for the C group. The range of scores, 510 to 670 for the A_1 group, 500 to 760 for the A_2 group, 520 to 670 for the B_1 group, 500 to 660 for the B_2 group, and 500 to 580 for the C group also reflects the difference between the C group and the others.

Scores on the SAT-V did not show any significant differences when an ANOVA was done. The range of scores on the SAT-V were 440-610 for the A_1 group, 330-630 for the A_2 group, 340-630 for the B_1 group, 390-620 for the B_2 group and 400-670 for the C group. The two low scores in the A_2 and B_1 groups were by students for whom English is not a native language. If those students are not counted, the range for the groups is more evenly distributed. Five students in A_1, A_2 and B_2 had a higher verbal than mathematics score, three in group B_1 and nine in C. The higher number of girls in C with a verbal score greater than their mathematics score is probably related to their selection on strong verbal interests.

Table 6: Means & standard deviations of the SAT-M Scores for the five groups.

GROUP	N	MEAN	SD
A_1	24	582.08	40.21
A_2	24	572.92	55.52
B_1	24	598.75	48.03
B_2	24	566.67	40.50
C	24	521.67	24.61

Students who participated in the accelerated classes at Hopkins during the summer of 1979 received additional tests of ability. The Ravens Test of Progressive Matrices was administered as a test of general reasoning ability. The Mechanical Comprehension test and the Minnesota Paper Form Board were given to assess mechanical aptitude and spatial ability, respectively. Only the students in the A_1 and B_1 groups received those tests since they were the only ones who participated in the accelerated classes. An analysis of variance by group was done for each of those tests and the results are summarized in Table 7. The only test that showed differences between the students

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Insert Table 7

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in the A_1 and B_1 groups was the Mechanical Comprehension Test. There were no significant differences in spatial ability or abstract reasoning ability as measured by the tests given.

In summary, the sample groups, therefore, all represent students with high ability in mathematics and verbal areas as tested on the SAT-M and V. Differences in mathematics exist between the C group and the others. The A_1 and B_1 groups were similar in abstract reasoning and spatial ability and differed only in mechanical comprehension. The students in all the groups were from the middle to upper economic and social classes, had well educated parents, were enrolled in public schools and were likely to have one or two older or younger siblings.

Table 7 : Analysis of Covariance of scores on the Ravens Test of Progressive Matrices, the Minnesota Paper Forum Board and the Mechanical Comprehension Test for group controlling for Talent Search SAT-M and SAT-V scores.

Ravens	Source of Variation	SS	df	MS	F
	Group	.674	1	.674	.089
	Error	288.939	38	7.604	

Minnesota Paper Form Board-1st Time	Source of Variation	SS	df	MS	F
	Group	53.063	1	53.063	1.147
	Error	1851.309	40	46.283	

Minnesota Paper Form Board-2nd Time	Source of Variation	SS	df	MS	F
	Group	22.479	1	22.479	.679
	Error	1323.761	40	33.094	

Mechanical Comprehension Test	Source of Variation	SS	df	MS	F
	Group	481.424	1	481.424	8.267*
	Error	2329.331	40	58.233	

* $P < .01$

ATTITUDES AND INTERESTS

Since the A_1 and B_1 groups were chosen as highly able and motivated on the basis of behavior (accelerating their study of mathematics), it was hypothesized that they might have more positive attitudes and interests related to mathematics than their equally able but less motivated peers in A_2 and B_2. The C group was chosen as a group of girls with high mathematical ability but low levels of interest and thus were expected to differ markedly from A_1. An additional question of interest was the nature of any differences between boys and girls. If sex were not a factor, A_1 and B_1 should be more similar to each other than they are to the other three groups.

The attitudes studied included self-confidence, risk-taking, the usefulness of mathematics, enjoyment, perceptions of mathematics as a male domain, educational and career plans, and perceptions of barriers to careers in mathematics and science for women. These attitudes were measured by a combination of forced-choice and open-ended questions.

Self-confidence

Eight of the 56 likert scale items were specifically related to self-confidence in mathematics. The mean score across the eight items for each group is shown in Table 8.

Insert Table 8

An analysis of variance was significant ($F = 12.27$, $p < .001$). A Tukey test of multiple mean comparisons showed a significant difference between the A_1 and B_1 groups and for the C group versus all other groups. Thus, we can conclude that girls who have ability but low interest in mathematics (group C) express lower levels of self-confidence in

Table 8 : Means & standard deviations for scores on the self-confidence in mathematics scale for the five groups

GROUP	n	MEAN	SD
A_1	24	22.00	5.88
A_2	24	24.00	3.36
B_1	24	26.04	2.74
B_2	24	24.63	4.20
C	23	17.65	5.51

mathematics as compared with the other four groups. The highly motivated and able A_1 girls, however, were significantly less confident than their male counterparts (B_1).

Responses to some of the eight items showed few differences among the five groups. For example, the vast majority of students in all five groups disagreed with the statements that mathematics was hard for them or that they typically "mess up" in mathematics compared with other subjects. At least two-thirds of each group said they were surprised by the results of the Talent Search in which they were identified as mathematically gifted. When asked if they were good enough at mathematics to become a mathematician, however, the groups differed. Only one boy in B_1 (4 percent) and one in B_2 (4 percent) felt they were not good enough, while six girls in A_1 (25 percent), eight in A_2 (33 percent) and 16 girls (67 percent) in the C group did not believe they were good enough. The majority of boys in both groups and A_2 girls thought that math was their best subject, but the majority of girls in A_1 and C did not. Girls in A_1 and C groups also responded less positively than boys and A_2 girls to the statement, "I have a lot of confidence when it comes to mathematics." The girls in the C group were also less likely than the other students to think that they would be good enough for a mathematics team in high school. When asked to respond to the statement, "I'm sure I can learn calculus", the response varied in degree to the extent that 19 B_1 boys (79 percent) said they strongly agreed as compared to only 13 girls in A_1 (54 percent), 10 girls in A_2 (42 percent), 11 boys in B_2 (46 percent) and 6 girls in C (26 percent); a third of the girls in C were undecided.

Risk-taking

The construct of risk-taking was defined primarily in terms of willingness to accelerate one's progress in mathematics. If students chose to do so by self-pacing while staying in grade, it was viewed as less risky than agreeing to take advanced courses with older students or skipping ahead totally in grade placement. Choosing to take no more mathematics (thus, terminating the acceleration of mathematics) would be the least risky behavior.

The actual behaviors of students in the study are shown in Table 9.

Insert Table 9

Students in A_1 and B_1 were chosen because they were accelerated in their mathematics study, largely because of participation in a special summer program at Hopkins. A few students in the other groups did turn out to be accelerated. Some, however, were just beginning to accelerate; for example, two of the four accelerated girls in A_2 and one boy in the B_2 group who were advanced were so because their school offered Algebra I and Algebra II in 8th grade in a combined course. Thus, they were not accelerated at the beginning of 8th grade but the program should result in their being one year accelerated at the end of 8th grade. Several students had accelerated their grade placement (one girl in A_2, one boy in B_2, and three girls in C) but they were not considered accelerated in mathematics since they were taking the normal level mathematics for their grade placement.

Four multiple-choice items were constructed to measure risk-taking. Students were given hypothetical situations and asked to select their most preferred alternative from among three choices that

Table 9: Percent of students in the five groups who are accelerated by one or more years beyond their grade placement in their mathematics course taking

GROUP	N	YES	NO
A_1	24	100.00	0.0
A_2	24	16.7*	83.3
B_1	24	83.3	16.7
B_2	24	8.3	91.7
C	24	8.3**	91.7

*Includes 2 girls in a special school system program which combines Algebra I and II in 8th grade

**Includes one boy in a special school system program which combines Algebra I and II in 8th grade

<u>Significant Chi-Square Comparisons</u>

A_1 vs. A_2	$X^2 = 34.29$	$p < .001$
A_1 vs. B_2	$X^2 = 40.62$	$p < .001$
A_1 vs. C	$X^2 = 40.62$	$p < .001$
B_1 vs. A_2	$X^2 = 21.33$	$p < .001$
B_1 vs. B_2	$X^2 = 27.19$	$p < .001$
B_1 vs. C	$X^2 = 27.19$	$p < .001$

varied in degree of risk. The scores were the combined scale such that the lower the scores the more willing was the student to take a risk. Since students in A_1 and B_2 had accelerated their study of mathematics significantly more than students in the other three groups, it was hypothesized that they would score lower (more willing to take risks) on the scale than students in A_2, B_2 and C. The mean scores are shown in Table 10.

Insert Table 10

An analysis of variance, however, was not significant.

Although there were no significant differences between groups in mean scores across the four questions, the pattern of answers for all students is still interesting. Two of the questions required students to speculate as to their future behavior with regard to mathematics course taking in high school. The other two questions focused on their current situation, one with regard to acceleration and course-taking options and the other in terms of classroom behavior. The percentages in each group who chose the highest risk option are shown in Table 11.

Insert Table 11

Students were first asked if they were ready for an advanced placement (college level) calculus course but none was offered in their school, which of the following three options would they choose: take the course at a college on released time from high school, do the course work as a self-paced independent study course during a study hall, or take no mathematics. The majority of students (about two-thirds)

Table 10: Means and standard deviations of the scores on the risk taking scale for the five groups

	N	Mean	SD
A_1	23	2.57	1.62
A_2	24	2.96	1.20
B_1	23	2.65	1.53
B_2	24	2.83	1.46
C	24	3.75	1.54

Table 11: Students in percents who choose the highest risk alternative in four questions, by group

		High School		Middle School	
	N	College Course While in High School	Enter College Early	Enter High School Early	Solve a Problem In front of the class
A_1	24	70.8	20.8	29.2	66.7
A_2	24	70.8	8.3	4.2	79.2
B_1	24	58.3	37.5	25.0	70.8
B_2	24	66.7	33.3	12.5	75.0
C	24	62.5	8.3	12.5	54.2

in all five groups said they would pursue the first alternative. The second choice of self-study was the next most frequent response. Only one girl in A_1, and one in A_2, no boys, and three girls in the C group said they would take no mathematics. For this item, students were asked what their decisions would be if four other students in their school faced with the same situation chose each of the three options in turn. When the four other students were described as selecting the college course option, some students switched responses so that the number of students selecting the first alternative increased. When the four hypothetical other students were described as selecting the self-paced study course; some students switched to this option for themselves, so that the number who still chose to take the college course decreased for all five groups, especially A_1 and C. In this case, choices of the college course dropped from 17 to 10 for A_1 and from 15 to 9 for C, from 14 to 9 for B_1, from 17 to 13 for A_2, and from 16 to 12 for B_2. When the four others were described as taking no mathematics, the choices of most students reverted back to the first alternative. This suggests that most of these gifted students are not strongly influenced by the behaviors of their peers. Some might decide to do a self-paced study course rather than move to a more advanced class with older students if their friends were going to self-pace, but only one girl in A_1 and two in C reported that they could be persuaded to take no mathematics because of their peers' influence. The percentages of students who chose the most risky alternative as a function of the choices of peers are shown in Table 12.

Insert Table 12

Table 12: Students, in percents, who would choose to take a college course in mathematics while still in high school as a function of choices of peers, by group

	N	Initial Choice College Course	If peers Chose College Course	If peers Chose Self-Pacing	If peers Chose No math
A_1	24	70.8	87.5	41.7	66.7
A_2	24	70.8	87.5	54.2	70.8
B_1	24	58.3	79.2	37.5	58.3
B_2	24	66.7	95.8	50.0	66.7
C	24	62.5	70.8	37.5	54.2

The second question asked students what they would do if they had completed all the mathematics course work available in their high school in grade 11. The options were to leave high school for early admission to college, to stay in high school but take their mathematics course at a college, or to take no mathematics. In this situation, the most popular choice for A_1, A_2, B_1 and B_2 was to take the college course while remaining in high school, but nine boys in B_1 and eight in B_2, five girls in A_1 and two in both A_2 and C chose going to college early. The percentages who chose the last option, take no mathematics, increased for all groups, and group C increased the most with 50 percent of the girls choosing this option. Thus, when self-pacing was eliminated as an option and a higher risk-taking option was introduced, the students in A_1, A_2, and especially the boys in B_1 and B_2 moved towards higher levels of risk-taking, while the girls in the C group became more conservative with 50 percent choosing to take no mathematics.

Interestingly, responses to the question about course taking options in the middle school years elicited less risky choices than those for high school. Students were asked what they would do if they had exhausted the middle school offerings in mathematics. The choices were to accelerate to high school, stay in middle school but take a mathematics course in the high school, or self-pace the course in the middle school. Girls in A_1 and boys in B_1 were divided almost evenly between the three options while the students in the A_2, B_2 and C groups seldom chose the total acceleration option but were divided between the other two choices. Thus, when the issue of risk-taking was moved from the distant future of high school to the more immediate school years, the trend was for A_1 and B_1 to be more risky than all others, as is consistent with their actual behaviors.

The final question was rather different from the other three. Students were asked how they would behave if they solved a difficult homework problem no one else in their class had solved. The choices were: volunteer to solve the problem at the blackboard during class, keep quiet in class but hand in the solution to the difficult problem to the teacher, keep quiet in class and not hand in the solution to the teacher. It was hypothesized that bright adolescent girls might be more reluctant than the boys to appear "mathematically gifted" in front of peers. The majority of students in all groups, however, said they would volunteer to solve the problem in class. Only two girls in C but no others selected the third alternative. Thus, responses to a hypothetical situation elicit almost no evidence of avoidance behavior.

Usefulness of Mathematics

Six Likert-type items dealt with the perception of the usefulness of mathematics. The mean scale scores for each group are shown in Table 13.

Insert Table 13

An analysis of variance was significant ($F = 4.57$, $p < .01$) and the Tukey comparison for multiple means showed a difference for the girls in the C group compared with all other groups. Thus, girls who have ability but little interest in mathematics do perceive the study of mathematics as less useful than other able boys and girls with higher levels of interest, but the perception of the usefulness of mathematics, as measured by these items, is not different for boys

Table 13: Mean & standard deviations of the scores on the perception of the usefulness of mathematics scale for the five groups.

GROUP	N	MEAN	SD
A_1	24	14.46	3.92
A_2	24	14.17	3.13
B_1	24	14.96	4.05
B_2	24	14.54	3.95
C	24	10.83	4.10

and girls in the other comparison groups.

The distribution of responses to specific items illustrates the differences between the C group and the others, particularly B_1 boys. Only 32 percent of the C group, but over 70 percent of all others, agreed with the statement that mathematics was important for their future. When asked about the importance of accelerating their study of mathematics, 46 percent of the C group were undecided and 21 percent felt it was not important, whereas over half of the students in each of the A_1, B_1, and B_2 groups felt acceleration was important for their future.

The word <u>calculus</u> was substituted for mathematics in four of the usefulness items taken from the FSMAS and the differences were notable on three of these. Although 29 percent of the C group felt they needed to study calculus, only 4 percent thought calculus was the most useful subject they could study in high school and over half said it was less useful than other high school subjects. The B_1 group, by comparison, felt calculus was important. Over 70 percent felt they needed to study it, half (53 percent) felt it was the most useful subject in high school, and only a fourth thought other subjects were more important for their future.

<u>Perception of Mathematics as a Male Domain</u>

The male domain scale was composed of only four statements. The lower the score the more stereotyped were the perceptions of mathematics as masculine. The mean scale scores for the five groups are shown in Table 14.

Insert Table 14

Table 14 : Means & standard deviations of scores on the perception of mathematics as a male domain scale for the five groups

GROUP	N	MEAN	SD
A_1	23	13.91	2.39
A_2	24	14.21	2.04
B_1	24	11.79	3.34
B_2	24	12.71	2.53
C	24	13.08	2.32

An analysis of variance was significant ($F = 3.40$, $p < .01$), and the Tukey comparison of multiple means showed significantly higher scores for A_1 and A_2 girls as compared with the B_1, B_2, and C groups. None of the groups, however, responded with strongly stereotyped responses. For example, 75 percent or more of each group agreed that mathematics was not more appropriate for men than women, and over half disagreed with the idea that it was "feminine" for girls to ask for help in mathematics (38 percent of the B_1 boys were, however, undecided about this). Although a third of the boys in B_1 did agree with the statement that women who enjoy mathematics are a bit peculiar, no girls in A_1 or C and only 4 percent of the A_2 and B_2 groups agreed. Over half in each group agreed that men are not naturally better than women in mathematics but the degree of concurrence varied from 92 percent of the A_2 group to only 54 percent of the boys in B_1.

Enjoyment

The mean scores for the ten Likert items that dealt with enjoyment of mathematics are shown in Table 15.

Insert Table 15

The analysis of variance was significant ($F = 6.75$, $p < .001$) due to the differences between C girls and all other groups.

The distribution of responses to specific items were more varied for some items than others. The differences in responses of C girls and all other students were on the items about enjoying mathematics enough to do it outside of school, finding math games and puzzles to be more fun than other things they do, and finding difficult mathematics exciting. Boys in B_1 and B_2 were far more likely than the

Table 15: Means & standard deviations of scores on the enjoyment of mathematics scale for the five groups

GROUP	N	MEAN	SD
A_1	24	24.21	7.49
A_2	24	25.83	5.80
B_1	24	25.83	5.56
B_2	24	26.71	6.77
C	22	18.09	6.04

girls in the other three groups to love strategy games and to disagree with the statement that reading science and mathematics books was dull. Over half the students in all groups, however, did not feel that mathematics was their favorite class (especially the C group with only 12 percent saying it was their favorite). A sizeable number (25 to 30 percent) of students in the A_1, A_2, B_2 and C groups said their mathematics class was boring and about half (46 percent) of the B_2 boys find it a bore. It may well be that very able students enjoy mathematics but not in their mathematics classes because the pace of the class is too slow for them. It was also interesting to note that A_2 and C girls and B_2 boys think they would enjoy being on a math team. Thus, enjoyment of mathematics is perhaps a complex variable, dependent upon the specific situation. Overall the girls, especially those in C, are less likely to report that they enjoy mathematics as a playful leisure time pursuit than the boys in both the B_1 and B_2 groups.

It was hypothesized that if students enjoy mathematics they would report engaging in mathematical activities in their leisure time. When asked how frequently they play mathematical games or do mathematical puzzles either alone or with family or friends, over half the boys said as often as once a week, but only 13 percent of the C girls, 21 percent of A_2 girls, and 29 percent of A_1 girls did so, and 30 percent of the C group and 21 percent of A_2 said they did this on rare occasions or never. The distribution of responses is shown in Table 16.

Insert Table 16

Table 16: Frequency with which students pursue a mathematical activity other than schoolwork alone or with friends or parents, by group

	N	Every Day	Once a Week	Once a Month	Several Times A Year	Rarely Or Never	
A_1	24	4.2	25.0	50.0	20.8	0.0	
A_2	24	12.5	8.3	33.3	25.0	20.8	*
B_1	24	25.0	33.3	25.0	8.3	8.3	*
B_2	24	12.5	41.7	33.3	12.5	0.0	
C	23	0.0	13.0	34.8	21.7	30.4	*

*Numbers do not add up to 100 percent due to rounding.

When asked who played games or puzzles of a mathematical/logical nature with them, the trend was for more students to name friends and fathers than mothers or teachers except for the C group where teachers were mentioned about as frequently as fathers and more often than friends. The differences between father and mother were significant for B_1 and C, and friends more than teachers for B_1. Responses are shown in Table 17.

Insert Table 17

When asked to list five activities they liked to do in their leisure time when alone, 79 percent of the B_1 boys listed a related activity as compared with only a third or less of all other groups. Students were also asked to list five activities they did with friends in their leisure time. The boys in the B_1 group were again more likely to report a math related activity (71 percent) as compared with girls in the A_1 and C groups (29 percent and 13 percent, respectively). A distribution of these responses is shown in Table 18.

Insert Table 18

Career Interests

Students in all groups were given the Vocational Preference Inventory (VPI) and were asked their career preference on the questionnaire. On the VPI, valid profiles were received from 17 of the 24 A_1 girls, 21 of the A_2 girls, 13 of the B_1 boys, 16 of the B_2 boys and 17 C girls.

A sizeable number of the students in each group had a response pattern considered to be invalid according to the test manual as a

Table 17: Percentage of students in the five groups who indicate that significant others play games or puzzles of a logical or mathematical nature with them *

	N	Mother	Father	Teacher	Friend
A_1	24	16.7	20.8	8.3	33.3
A_2	24	16.7	29.2	12.5	33.3
B_1	24	4.2	33.3	8.3	45.8
B_2	24	25.0	45.8	20.8	41.7
C	24	4.2	25.0	20.8	16.7

Significant Chi-Square Comparisons

Mother B_1 vs. Mother B_2	$X^2 = 4.18$	$p < .05$
Mother B_2 vs. Mother C	$X^2 = 4.18$	$p < .05$
Friend B_1 vs. Friend C	$X^2 = 4.75$	$p < .05$
Father B_1 vs. Mother B_1	$X^2 = 6.70$	$p < .01$
Father C vs. Mother C	$X^2 = 4.08$	$p < .05$
Friend A_1 vs. Teacher A_1	$X^2 = 4.55$	$p < .05$
Friend B_1 vs. Teacher B_1	$X^2 = 7.49$	$p < .01$
Friend B_1 vs. Mother B_1	$X^2 = 11.1$	$p < .001$

*Students were asked to check all that applied.

Table 18: Distribution of students who report engaging in mathematical and scientific activities in their spare time, in percents

	N	Mathematical		Scientific	
		Alone	With Friends	Alone	With Friends
A_1	24	25.0	29.2	8.3	4.2
A_2	24	33.3	45.9	0.0	0.0
B_1	24	79.2	70.9	29.2	0.0
B_2	24	33.3	50.0	16.7	12.5
C	24	16.7	12.5	0.0	0.0

Significant Chi Square Comparisons

Students Engaging in Mathematical Activities Alone

A_1 vs B_1 $X^2 = 14.108$ $p < .001$

B_1 vs C $X^2 = 18.783$ $p < .001$

B_1 vs B_2 $X^2 = 10.243$ $p < .01$

A_2 vs B_1 $X^2 = 10.243$ $p < .01$

Students Engaging in Mathematical Activities with Friends

A_1 vs B_1 $X^2 = 8.333$ $p < .01$

B_1 vs C $X^2 = 16.800$ $p < .001$

A_2 vs C $X^2 = 6.454$ $p < .05$

Students Engaging in Scientific Activities Alone

A_2 vs B_1 $X^2 = 8.195$ $p < .01$

B_1 vs C $X^2 = 8.195$ $p < .01$

result of answering "no" to most items (Holland, 1965). The VPI is designed for high school, college and adult populations and requires the subject to check those occupations they think they might enjoy. With these younger gifted students, the low response rate may indicate lack of motivation to take the test, unfamilarity with many occupational titles, or a pre-determined concept of a limited number of appealing occupations.

The VPI is scored by summing the number of keyed occupations checked in each of six categories: Realistic, Intellectual, Social, Conventional, Enterprising and Artistic. The raw number of occupations is then plotted on a normative graph separately by sex. The composite profiles for the five groups based only on responses judged valid are shown in Figure 1. The five groups have similar profiles. On a raw

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Insert Figure 1

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score analysis, there were some differences as shown in Table 19. Boys

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Insert Table 19

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were more likely to have more checks for intellectual occupations than A_2 and C girls while A_1 and A_2 girls checked more artistic careers than did boys. The C girls had more enterprising choices than all other groups.

Students' career goals as stated on the questionnaire were categorized as mathematical or scientific, medical ~~or~~ other. The distribution is shown in Table 20. If medical careers had been included in the

Figure 1: Composite Profile on Vocational Preference Inventory for the Five Groups

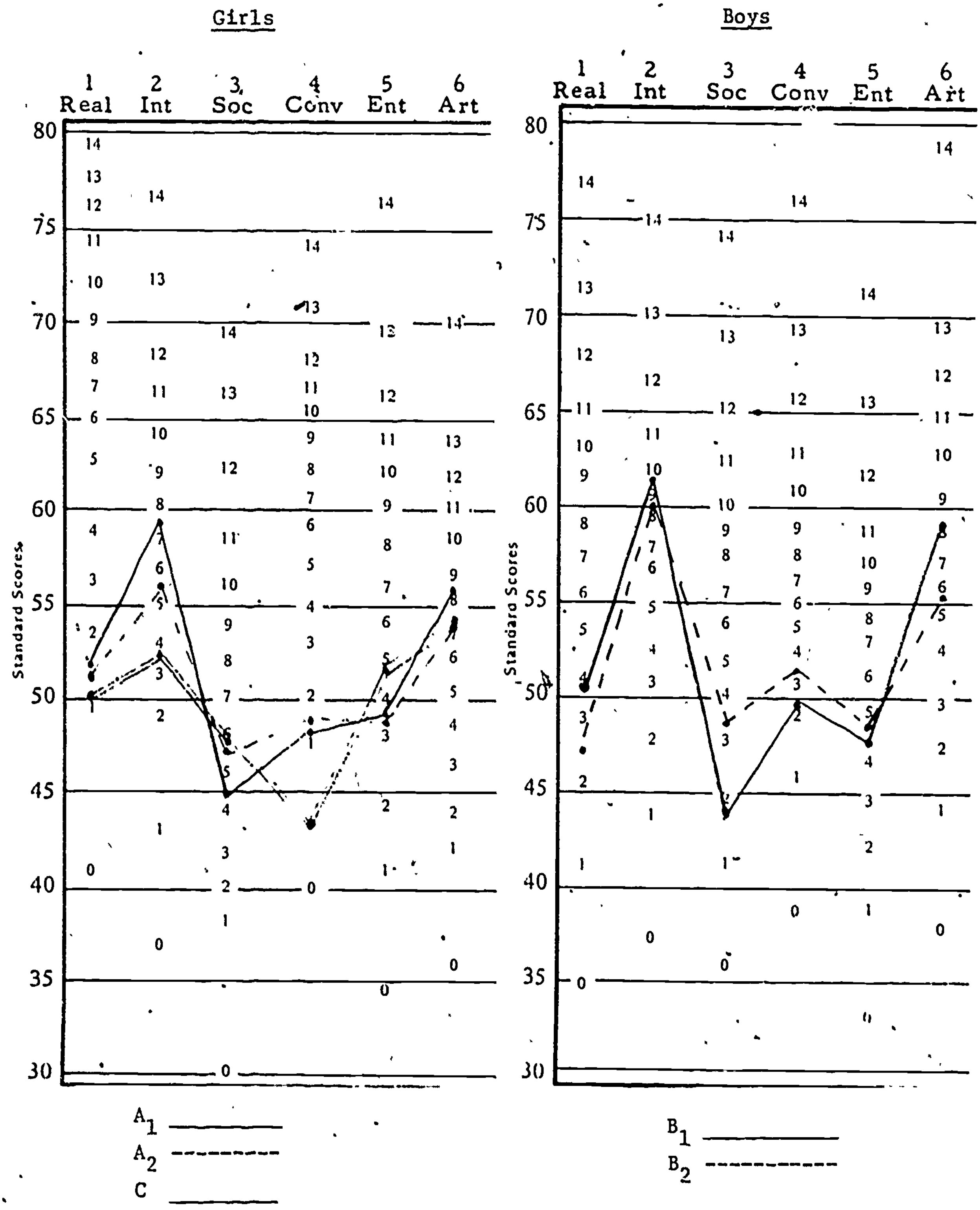

Table 19: Distribution of groups, by highest occupational code on the Vocational Preference Inventory

	A_1	A_2	B_1	B_2	C
<u>Highest Code</u>					
Realistic (R)	0	0	1	0	2
Intellectual (I)	6	2	7	9	1
Social (S)	1	4	0	1	0
Conventional (C)	0	1	0	1	0
Enterprising (E)	1	2	0	0	8
Artistic (A)	8	6	3	3	5
<u>Tied Codes</u>					
I = S	0	1	0	0	0
I = A	1	2	1	0	0
S = A	0	2	0	0	0
C = A	0	1	0	1	0
E = A	0	0	1	1	1

Insert Table 20

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mathematical and scientific choices, the students in A_1, A_2, B_1 and B_2 would have appeared quite similar, with 50 to 75 percent choosing careers in fields which require advanced training in mathematics and/or the sciences. When medical career choices (primarily physician) are categorized separately, however, there appears to be some difference such that girls in A_1 and A_2 are about evenly divided between medical careers and others in the mathematical/scientific domain, whereas the boys lean more heavily towards the more mathematical or technical scientific fields.

The girls in the C group do indeed select more careers in the humanities, but this is partly an artifact of the way in which they were selected. On the talent search questionnaire administered earlier, none had indicated that their first choice career was in a mathematical or physical science area.

The vast majority of all students aspired to careers which required work beyond the bachelor's level. In a separate question, students were asked about the highest level of education they expected to attain. The distribution of responses is shown in Table 21.

Insert Table 21

The level of expectation is indeed high with almost half of B_1, B_2 and C, two-thirds of A_2, and 71 percent of A_1 desiring the doctorate or equivalent law or medical degree.

Although at least 90 percent of the students wanted a career even

Table 20: Distribution of students, in percents, by type of career choice, by group

	N	Mathematical or Scientific	Medical	Other	No Choice
A_1	24	37.5	29.2	29.2	4.2 *
A_2	24	20.8	29.2	37.5	12.5
B_1	24	66.7	8.3	16.7	8.3
B_2	24	45.8	12.5	37.5	4.2
C	24	4.2	8.3	87.5	0.0

*Percents do not total 100 due to rounding.

Table 21: Students, in percents, by highest level of education they expect to attain, by group

	N	Bachelor's	Master's	Doctorate	Undecided	
A_1	24	4.2	16.7	70.8	8.3	
A_2	24	0.0	29.2	66.7	4.2	*
B_1	24	0.0	33.3	58.3	8.3	*
B_2	24	20.8	29.2	50.0	0.0	
C	24	8.3	45.8	45.8	0.0	*

*Percents do not total 100 due to rounding.

if it were not financially necessary for them to work, girls were more likely than boys to envision a need for part-time or no career at some point in their lives due to the demands of raising children (71 percent of A_1 and A_2 and 79 percent of C). Although a third of B_1 boys and almost a third of B_2 boys spoke of wanting a part-time career or no career at some point in their lives, the reasons for this were based on the desire to travel, or time for self-development, not for child rearing. This data is summarized in Table 22. One might

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Insert Table 22

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speculate that the choice of a medical career by so many girls may reflect a view of this profession as having more flexibility for women than other careers such as engineering.

Students were asked to rate the importance of various factors which might account for fewer women than men in careers in mathematics and science. The percentages of students who perceived each factor a problem are shown in Table 23. All groups agreed that

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Insert Table 23

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conflict with family responsibilities was the major problem (100 percent of girls in A_1 and over 90 percent in all other groups). Lack of role models was viewed as a major problem by A_1, A_2, and B_1. Girls in A_1 and A_2 also saw lack of information as serious. The C group and A_1 group concurred on lack of encouragement as a major problem. The long years of preparation required was overall viewed as a lesser problem than others. At least half of all but the

Table 22: Attitudes toward employment, by group

	N	Want a Career Even if Not Financially Necessary	Work Part-time Or Interrupt Career		Full Time Always
			For Child Rearing	Other	
A_1	24	91.7	70.8	12.5	16.7
A_2	24	95.8	70.8	12.5	16.7
B_1	24	95.8	0.0	66.7	33.3
B_2	24	95.8	0.0	70.8	29.2
C	24	95.8	79.2	4.2	16.7

Significant Chi Square Comparisons for Part Time or Interrupted Career

A_1 vs B_1 $X^2 = 27.228$ $p < .001$
A_1 vs B_2 $X^2 = 43.465$ $p < .001$
A_2 vs B_1 $X^2 = 27.228$ $p < .001$
A_2 vs B_2 $X^2 = 43.465$ $p < .001$
B_1 vs C $X^2 = 33.569$ $p < .001$
B_2 vs C $X^2 = 34.040$ $p < .001$

Table 23: Barriers to careers in science for women as perceived by 75 percent, 50 to 75 percent, or 25 to 50 percent of students, by group

	75%	50 to 75%	25 to 50%
A_1	Family/career conflict Lack of encouragement Lack of role models Lack of information	Difficult work Career seen as unfeminine Career seen as cold/impersonal	Years of preparation
A_2	Family/career conflict Lack of role models Lack of information	Years of preparation Career seen as unfeminine	Difficult work Lack of encoruagement Career seen as cold/impersonal
B_1	Family/career conflict Lack of role models	Lack of encouragement Career seen as unfeminine Lack of information Career seen as cold/impersonal	Difficut work Years of preparation
B_2	Family/career conflict	Lack of role models Lack of encouragement Career seen as unfeminine Difficult work	Lack of information Years of preparation Career seen as cold/impersonal
C	Family/career conflict Lack of encouragement	Lack of role models Difficult work Lack of information	Years of preparation Career seen as unfeminine Career seen as cold/impersonal

C group saw the stereotype of mathematics as unfeminine as a problem. Since these girls are not oriented toward such a career they apparently do not perceive a conflict, but girls and boys who do lean toward mathematically related fields are perceiving some discrimination or at least problems for women because of sex-role stereotypes.

Access to role models was assessed in a variety of ways. Students were asked whether or not they had someone in the profession of their choice with whom they could discuss the career, and if they had done so. Of those who named a career, only 22 percent of the girls in A_1, about a third of B_2 boys and C girls, but half of A_2 and about two-thirds of B_1 had spoken with someone in the career. This data is summarized in Table 24.

Insert Table 24

Students were also given a list of 26 professions, half of which were categorized as investigative by the Holland system for classification of occupations (Viernstein, 1972),and were asked to indicate whether or not they knew anyone of the same or opposite sex in those professions with whom they could talk about these careers. The number of role models the students knew was tabulated the following four ways: total, total of the same sex, investigative (mathematical or scientific) and investigative of the same sex. The mean number of role models for each category is shown in Table 25.

Insert Table 25

Table 24 : Access to role model for first-choice career goal

	N	Know Someone in Career	N	Talked with Them About the Career
A_1	23	43.5	23	21.7
A_2	21	66.7	21	52.4
B_1	22	72.7	22	68.2
B_2	21	76.2	21	38.1
C	24	54.2	21	42.9

Significant Chi Square Comparisons

Students who knew people in a career

A_1 vs B_1 $X^2 = 3.343$ $p < .05$
A_1 vs B_2 $X^2 = 4.859$ $p < .05$

Students who talked with people about career

A_1 vs A_2 $X^2 = 4.454$ $p < .05$
A_1 vs B_1 $X^2 = 9.823$ $p < .01$
B_1 vs B_2 $X^2 = 3.909$ $p < .05$

Table 25: Mean number of role models known by students in each group

	N	All Role Models		Investigative Role Models	
		Total	Same Sex	Total	Same Sex
A_1	24	8.0	4.5	3.8	1.6
A_2	24	10.2	5.0	4.2	1.3
B_1	24	8.1	6.6	4.3	3.9
B_2	24	8.7	7.0	4.0	3.6
C	24	8.0	7.8	3.2	1.5

An analysis of variance was significant only for the investigative role models of the same sex ($F = 8.939$, $p < .001$). The multiple means comparisons showed B_1 and B_2 to be significantly different from the three groups of girls. The specific careers for which there were group differences are listed in Table 26. It is not too surprising that

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Insert Table 26

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boys in both groups knew more male computer analysts, astronomers, physicians or engineers than girls in all three groups knew women in these fields, or that girls knew more women than boys knew men who were librarians (not an investigative career). It is interesting that there were no sex or group differences in the careers of mathematicians, chemists, biological scientists and actuary/statisticians.

An indirect measure of access to role models was the degree to which students perceived their parents, teachers, and friends as good at and interested in mathematics. The percentages of students who perceived significant others as unusually good at mathematics are shown in Table 27. Mothers were perceived as unusually good by a fifth of the

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Insert Table 27

A_1 and B_1 groups, but by fewer students in groups A_2, B_2 and C. These differences were not statistically significant. Fathers were perceived as good more often than all others by A_1, B_1 and B_2, about equal to teachers for C and less so than teachers for A_2. Girls in A_2 were significantly less likely to view fathers as especially able than all other groups. Teachers were viewed as able by significantly more C

Table 26: Summary of statistically significant differences among groups on the numbers of students who knew a person of their same sex employed in 13 investigative careers

Actuary/statistician	none
Archeologist	none
Astronomer	B_1, and B_2 vs. A_1, A_2 and C
Biological scientist	none
Chemist	none
College professor	B_1 vs. A_1, A_2, and C
Computer systems analyst	B_1 and B_2 vs. A_1, A_2 and C
Engineer	B_1 and B_2 vs. A_1, A_2 amd C
Mathematician	none
Psychiatrist	none
Psychologist	none
Physician	B_1 and B_2 vs. A_1, A_2 and C
Veterinarian	B_1 vs. A_1 and A_2,

Table 27: Percentage of students in the five groups who perceive significant others as unusually good at mathematics*

	N	Mother	Father	Teacher	Friend
A_1	24	20.8	58.3	41.7	20.8
A_2	24	12.5	25.0	45.8	25.0
B_1	24	20.8	58.3	29.2	33.3
B_2	24	4.2	66.7	37.5	33.3
C	24	12.5	54.2	58.3	16.7

Significant Chi-Square Comparisons

Father A_1 vs. Father A_2 $\chi^2 = 5.49$ $p < .02$

Father A_2 vs. Father B_1 $\chi^2 = 5.49$ $p < .02$

Father A_2 vs. Father B_2 $\chi^2 = 8.39$ $p < .01$

Father A_2 vs. Father C $\chi^2 = 4.27$ $p < .05$

Teacher B_1 vs. Teacher C $\chi^2 = 4.15$ $p < .05$

*Students were asked to check all that applied.

girls than B_1 boys with other groups falling in between. In all groups, more students saw teachers than mothers as able. The C girls were significantly more likely than A_1 boys to report teachers as very able. Peers were generally seen as more able than mothers but less able than teachers or fathers.

When asked about interest, students generally saw fathers and teachers as more interested than mothers and friends (but A_2 girls did see fathers less interested than teachers). No C girl but about a fifth of the other groups saw friends as interested, as shown in Table 28.

Insert Table 28

The perception that fathers more than mothers serve as role models for interest and ability in mathematics was held by both parents in the A_1, B_1, B_2, and C groups as shown in Tables 29 and 30.

Insert Tables 29 and 30

The responses of the fathers of A_2 girls were about evenly distributed, between those who saw their father, mother or neither as being good in mathematics and interested. Half of the mothers in the A_2 girls said neither parent had a strong interest.

Table 28: Percentage of students in the five groups who perceive a strong interest in mathematics by significant others*

	N	Mother	Father	Teacher	Friend
A_1	24	29.2	54.2	54.2	20.8
A_2	24	12.5	29.2	62.5	20.8
B_1	24	16.7	45.8	54.2	25.0
B_2	24	20.8	58.3	58.3	29.2
C	24	12.5	45.8	62.5	0.0

Significant Chi-Square Comparisons

None

*Students were asked to check all that applied.

Table 29: Parents' perceptions of which parent is unusually good in mathematics

		N	Self	Spouse	Both	Neither
MOTHER	A_1	23	0.0	65.2	21.7	13.0
	A_2	24	16.7	45.8	12.5	25.0
	B_1	24	4.2	66.7	12.5	16.7
	B_2	24	4.2	66.7	8.3	20.8
	C	24	4.2	66.7	8.3	20.8
FATHER	A_1	22	63.6	0.0	13.6	22.7
	A_2	24	33.3	25.0	4.2	37.5
	B_1	24	54.2	8.3	20.8	16.7
	B_2	24	66.7	12.5	8.3	12.5
	C	23	56.5	4.3	8.7	30.4

Significant Chi-Square Comparisons

Fathers of A_1 vs Fathers of A_2, $\chi^2 = 9.71$ $p < .05$

Table 30: Parent perceptions of who has a strong interest in mathematics

		N	Self	Spouse	Both	Neither
MOTHER	A_1	24	8.3	66.7	8.3	16.7
	A_2	24	8.3	29.2	12.5	50.0
	B_1	24	4.2	62.5	20.8	12.5
	B_2	24	8.3	58.3	16.7	16.7
	C	23	4.3	65.2	4.3	26.1
FATHER	A_1	23	60.9	4.3	17.4	17.4
	A_2	24	33.3	25.0	8.3	33.3
	B_1	23	65.2	4.3	21.7	8.7
	B_2	24	62.5	12.5	8.3	16.7
	C	23	69.6	0.0	0.0	30.4

<u>Significant Chi-Square Comparisons</u>

Mothers of A_2 vs Mothers of B_1, $\chi^2 = 9.14$ $p < .05$

Fathers of A_2 vs Fathers of B_1, $\chi^2 = 10.57$ $p < .02$

Fathers of A_2 vs Fathers of C, $\chi^2 = 10.72$ $p < .02$

Fathers of B_1 vs Fathers of C, $\chi^2 = 8.81$ $p < .05$

In summary, there were few differences among the A_1, A_2, B_1, B_2 groups on measures of attitudes, but the C girls had lower scores than all others on measures of self-confidence, perception of the usefulness of mathematics and enjoyment. The girls in A_1, however, scored significantly lower on the self-confidence scale than B_1 boys. Although the actual behaviors of A_1 girls and B_1 boys in terms of accelerating their study of mathematics were more risky than those of A_2, B_2 and C, there were no differences among the groups on responses to projected educational risk-taking. While enjoyment as measured by a Likert item scale was not significantly different for B_1 versus B_2 or A_1 and A_2, the reported behaviors of B_1 boys did differ from all others. Boys in B_1 were the ones who pursued mathematical activities in their leisure time alone or with friends, and more frequently than all others. Boys in both groups were somewhat more likely to stereotype mathematics as a male domain than the girls.

Specific career choices of students varied in that girls in group C were not oriented towards science careers and more girls in A_1 and A_2 than boys in B_1 and B_2 were interested in medical careers. All groups felt that conflict with family responsibilities would be a barrier to careers in science for women, and some felt access to role models was a barrier. Indeed, girls but not boys expected to need a part-time career or no career while raising small children, and boys in both groups knew more males on a checklist of science-related careers than girls knew women in these fields.

Overall, there were no major differences between A_1 and A_2 girls. The boys in B_1, however, did appear to be somewhat different from A_1 girls on some measures such as self-confidence, enjoyment, and career related variables. The B_1 boys were very similar to B_2 boys, with the exception of enjoyment behavior. The C girls differed markedly from all other groups on almost all measures.

SUPPORT FROM SIGNIFICANT OTHERS

In investigating differences between boys and girls with high and low mathematical interests, an area of concern was the amount of support and encouragement they receive from their parents, teachers, and peers. It was hypothesized that greater support might lead to increased interest in mathematics while less support might inhibit interest in mathematics. In this study, it was expected that the A_1 and B_1 groups would perceive the most support, followed by the A_2 and B_2 groups. Group C, a group of girls with suspected low interest in mathematics, was expected to receive the least support and encouragement.

The students' perception of support from parents, teachers and peers in the following areas was investigated: self-confidence in mathematics, risk-taking, enjoyment of mathematics, and career interests. Parents' actual support on these variables was also assessed, as well as the degree to which they stereotype mathematics as a male domain, by questions which the parents answered directly. The investigation included analyses for group differences, sex differences, and differences between fathers' and mothers' responses.

Self-Confidence

The students and their parents in all groups were asked who encourages the child's self-confidence: the mother, the father, both, or neither. The percentages of parents who saw themselves, either alone or with their spouse, as having encouraged self-confidence are shown in Table 31, along with the percentages of students who

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Insert Table 31

Table 31: Mothers', fathers' and students' perceptions, by group, of who fosters the student's self-confidence in mathematics, in percents

	N	Mother	Child's Perception of Mother	Father	Child's Perception of Father
A_1	24	70.8	62.5	78.3*	54.2
A_2	24	91.6	79.2	58.3	70.8
B_1	24	75.0	37.5	66.7	33.3
B_2	24	87.5	58.3	79.2	45.8
C	24	83.3	50.0	73.9*	58.3

*n = 23

Significant Chi-Square Comparisons

Mothers vs. Child's Perception of Mothers

B_1 $X^2 = 6.86$ $p < .01$

B_2 $X^2 = 5.17$ $p < .05$

C $X^2 = 6.00$ $p < .05$

Fathers vs. Child's Perception of Fathers

B_1 $X^2 = 5.33$ $p < .05$

B_2 $X^2 = 5.69$ $p < .05$

Child's Perception of Mothers

A_2 vs. B_1 $X^2 = 8.57$ $p < .01$

A_2 vs. C $X^2 = 4.46$ $p < .05$

Child's Perception of Fathers

A_2 vs. B_1 $X^2 = 6.76$ $p < .01$

perceived support from each parent. Chi-square tests of significance revealed differences in the B_1, B_2 and C groups between the mothers' responses about themselves and the students' perception of their mothers. This was particularly striking in the B_1 group where only 38 percent of the boys saw their mothers as contributing to their self-confidence in mathematics even though 75 percent of their mothers thought they had.

There was also a significant difference between the fathers' reports about their encouraging self-confidence in mathematics and the students' perception of their fathers, for the two groups of boys but not for any of the girls' groups. Only the A_2 girls saw their fathers as doing more for their self-confidence in mathematics than the fathers saw themselves doing. In general, the students perceived both parents as having contributed less to their self-confidence in mathematics than the parents themselves thought they had.

In group comparisons, groups B_1 and C perceived their mothers as contributing significantly less to their self-confidence in mathematics than did the A_2 group. The B_1 boys also saw their fathers as contributing significantly less than the A_2 girls. In general, therefore, the A_2 girls are perceiving the most support from their parents while the B_1 are perceiving the least, which is not what might have been anticipated. It may be that the B_1 boys are perceiving their confidence as coming from themselves or from elsewhere, but not from their parents.

The students were also asked if they perceive their current mathematics teachers and their friends as contributing to their self-confidence in mathematics. The responses are summarized in Table 32.

Insert Table 32

There were no significant group differences on responses related to support from friends, but there were differences with regard to current mathematics teachers. Of the A_1 and B_1 groups, only one-third of each group reported their teachers to be contributing to their self-confidence in mathematics. This was significantly less than the B_2 group where two-thirds reported such support. Of the students in the A_2 and C groups, 54 percent reported support for self-confidence from their mathematics teachers. Although the difference was not statistically significant, there was also greater perceived support in these groups than in A_1 and B_1. Two explanations are possible for the low level of perceived support from mathematics teachers by the A_1 and B_1 groups. One is that since these students are taking accelerated and difficult mathematics courses they feel less confident in these classes than they would otherwise. Another possibility is that these students already feel a high level of confidence within themselves, and don't see any outside influence contributing to it at this point. This may be especially true of the B_1 boys who also did not see their parents contributing very much to their self-confidence in mathematics.

Six of the Likert items on the parents' questionnaire were related to the amount of confidence the parents have in their child's mathematical ability. The mean scores across the six items for the fathers' responses are shown in Table 33. An analysis of variance was

Table 32: Percentage of students in the five groups who perceive support from teachers and friends for confidence in mathematics

	N	Teachers	Friends
A_1	24	33.3	41.7
A_2	24	54.2	54.2
B_1	24	33.3	29.2
B_2	24	66.7	41.7
C	24	54.2	37.5

Significant Chi-Square Comparisons

Teachers A_1 vs. Teachers B_2 $X^2 = 5.33$ $p < .05$

Teachers B_1 vs. Teachers B_2 $X^2 = 5.33$ $p < .05$

Insert Table 33

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significant ($F = 3.304$, $p < .02$). A Tukey test of multiple mean comparisons showed the fathers of the A_1 girls to be significantly more confident of their daughters' ability in mathematics than the fathers of the C girls.

Although a significant difference was evident in analyzing the scale scores, an examination of the individual items revealed a difference on only one item: "I'm sure my child is good enough in mathematics to be on the mathematics team in high school." Group C fathers were less likely to agree with this item than groups A_1 ($p < .01$), B_1 ($p < .01$) or B_2 ($p < .05$).

The mean scores across the six items for the mothers' responses are shown in Table 34. An analysis of variance was significant ($F = 5.565$,

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Insert Table 34

$p < .001$), and a Tukey test of multiple mean comparisons revealed a significant difference between the B_2 mothers and both the A_1 and C mothers, with the mothers of the B_2 boys exhibiting the most confidence in their sons' mathematical abilities and the mothers of the A_1 and C girls the least.

Although the fathers of the A_1 girls appear to have a higher level of confidence in their daughters' mathematical abilities than do the mothers, a t-test showed that the difference was not statistically significant. A t-test comparison between the B_2 fathers and mothers, however, revealed a significant difference, with the mothers showing

Table 33: Means and standard deviations of scores on the self-confidence scale for fathers of the five groups

GROUP	N	MEAN	SD
A_1	23	19.22	3.18
A_2	23	17.52	2.86
B_1	24	18.63	2.41
B_2	23	18.52	2.78
C	24	16.50	3.05

Table 34: Means and standard deviations of scores on the self-confidence scale for mothers of the five groups

GROUP	N	MEAN	SD
A_1	24	17.80	2.83
A_2	24	18.75	2.77
B_1	23	19.17	2.23
B_2	24	20.54	2.59
C	24	17.08	3.24

more confidence in their sons than the fathers ($t = -2.78$, $p < .02$).

An examination of individual Likert items revealed some group differences in responses of mothers. On the item, "I think my child will have to study mathematics very hard to continue to do well in it", only approximately two-thirds of the C mothers disagreed with this statement, while 92 percent of the B_2 mothers disagreed with it ($p < .05$). A difference was also noted between the B_2 mothers and the A_1 mothers ($p < .05$) where only 63 percent of the A_1 mothers disagreed with the statement. A difference between B_2 and C mothers was found on the item, "My child is probably not good enough in mathematics to be a real mathematician", where again two-thirds of the C mothers disagreed, as compared to 92 percent of the B_2 mothers ($p < .05$). The last item that showed differences was "I'm sure my child is good enough in mathematics to be on the mathematics team in high school". Over 95 percent of the B_1 and B_2 mothers agreed with this as compared to 75 percent of the C mothers ($p < .05$).

A series of Likert items was also administered to the students to assess their perception of support from mothers, fathers, teachers and peers for self-confidence in mathematics. When the responses were combined into a scale for total perceived support from significant others, no significant group differences were found. Some differences were found on individual items, however.

Two of the items related to teachers. Seventy-nine percent of the A_2 girls agreed with the statement, "My mathematics teacher strongly encouraged me to enter the Talent Search", while only 50 percent of the A_1 girls did so ($p < .05$). On the item, "My mathematics teacher was surprised at how well I did in the Talent Search", more B_2 boys

(33 percent) disagreed with this than B_1 boys (8.7 percent), ($p < .05$). This supports the earlier findings that the A_1 and B_1 groups perceive less support from teachers than some of the other groups. There were no differences on the items related to friends.

Six items related to support from mother and six to support from father. Significant differences were found on the same three items for each parent, although the groups found to be different varied somewhat. On the item, "My father has always thought I was good in mathematics", differences were noted between the C group and groups A_2 ($p < .05$), B_1 ($p < .01$), and B_2 ($p = .01$). Only 67 percent of the C girls agreed with the statement as compared with 92 percent of A_2 and 96 percent of B_1 and B_2. When responding to the same statement about their mothers, fewer C girls agreed with the statement than students in groups A_2 ($p < .05$) and B_2 ($p < .01$). A difference was also found between groups A_1 and B_2 ($p < .05$) with fewer A_1 girls in agreement with the statement.

On the items, "My father/mother doesn't think I am good enough in mathematics to become a mathematician", group C was less likely to disagree with this statement with respect to their fathers than groups B_1 ($p < .01$) or B_2 ($p < .05$). Group A_2 was also less likely to disagree with the statement than group B_1 ($p = .01$). With respect to their mothers, a difference was found between groups C and B_2 ($p < .05$), with more B_2 students than C disagreeing with the statement.

The final items which showed a difference were "My father/mother thinks I will have to study mathematics very hard to continue to do well in it". In responding about their fathers, A_2 girls were more likely to disagree with the statement than the B_1 or B_2 boys ($p < .05$). The A_2 girls also most often disagreed with this statement with respect to their mothers. This difference was significant in comparison to the B_1 boys ($p < .05$).

The parents were also given an open-ended question, "Please describe any ways in which you have fostered your child's self-confidence in learning mathematics". The responses did not lend themselves to systematic analyses but instead were used to learn of some specific examples of ways parents had helped. Encouragement and praise for good work were mentioned frequently. Never suggesting "that math was difficult to learn or unfeminine" and having an expectation of high achievement in math because of ability were cited by a number of parents. Letting the child solve math problems by himself with or without encouragement from parents was another common theme. For example, one parent said, "In assisting him with his school work, I never solve his problems for him but only discuss principles and techniques. He must always come up with his own solutions." Another parent wrote, "I seldom ever have 'done' a problem for my children ... Coming up with the right answer 'on her own' is a confidence builder."

A few parents wrote they did nothing because their child didn't need support but had confidence on his/her own. It appears that even those who did something did not make a conscious effort to boost self-confidence in mathematics. They reacted to their child's ability by having high expectations, and they rewarded achievement with praise. The child was expected and encouraged to perform at a high level and to solve most of his/her mathematics problems on his/her own.

Risk-taking

The same three hypothetical situations dealing with course-taking options used to measure the students' willingness to take educational risks (and summarized earlier in this report) were administered to the parents who were asked what they would recommend for their child. In addition, the students were asked their perception of what their parents, teachers and peers would recommend for them. The scores were combined in a scale so that the lower the scale scores the more willing the person was to take risks.

The mean scale scores for the fathers' responses are shown in Table 35. An analysis of variance was significant ($F = 8.145$, $p < .001$),

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Insert Table 35

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and a Tukey test of multiple mean comparisons showed the fathers of the C girls to be significantly less willing for their daughters to take educational risks than the fathers of A_1, B_1 and B_2. The mean scale scores for the students' perceptions of what their fathers would recommend for them are shown in Table 36. An analysis of variance was

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Insert Table 36

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significant ($F = 4.508$, $p < .01$) and a Tukey test of multiple mean comparisons showed the C girls' perceptions of their fathers as being less willing for them to take risks than the B_1 boys saw their fathers. The responses of the C group did not differ significantly, however, from A_1 and B_2 as it did with the fathers' actual responses.

The mean scale scores for the mothers' responses are shown in Table 37. An analysis of variance on the mothers' scale scores was

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Insert Table 37

Table 35: Means and standard deviations of scores on the educational risk-taking scale for fathers of the five groups

GROUP	N	MEAN	SD
A_1	23	1.91	1.12
A_2	22	2.50	1.22
B_1	23	1.61	1.08
B_2	23	2.[illegible]5	0.98
C	24	3.29	1.04

Table 36: Means and standard deviations of scores on the perception of support from fathers for educational risk-taking scale for the five groups

GROUP	N	MEAN	SD
A_1	21	2.00	1.30
A_2	23	2.04	1.19
B_1	21	1.43	1.17
B_2	23	2.39	1.08
C	22	2.91	1.23

Table 37: Means and standard deviations of scores on the educational risk-taking scale for mothers of the five groups

GROUP	N	MEAN	SD
A_1	22	1.86	1.21
A_2	24	2.63	1.21
B_1	22	1.45	1.14
B_2	24	2.58	0.97
C	24	2.50	1.38

significant ($F = 4.346$, $p < .01$) and a Tukey test of multiple mean comparisons showed the B_1 mothers as more willing to recommend risky educational choices than the C, B_2 or A_2 mothers. For students' perceptions of their mothers, however, no significant group differences were found.

A t-test comparison between the mean scale scores of the mothers and fathers in each group revealed a significant difference only in group C ($t = 2.53$, $p < .02$). The C fathers were less willing to recommend the riskier alternatives than were the C mothers.

Of the three items that comprised the scale, most of the group differences for fathers and mothers were the result of differences in response to one item:

> Assume your child is in the eleventh grade and had completed all the mathematics courses offered by the local high school. When your child begins to plan his/her program for the following year, which of the following would you recommend assuming they are all possible?

Options were: a) leave high school with or without a high school diploma at the end of the 11th grade and enter college full-time, b) remain in high school, but take a mathematics course at a nearby college at night or on released time from high school, or c) remain in high school for the 12th grade and take an elective in place of an advanced mathematics course. The percentage of mothers and fathers who chose each option in each group are shown in Table 38, along with

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Insert Table 38

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results of significant chi-square comparisons. Option (c) which consisted of taking no mathematics was selected by over half of the C fathers while it was selected by no B_1 fathers. No C fathers chose

Table 38: Parents' recommendation as to their child's mathematics course taking in the final year of high school in the event that they complete all the mathematics courses offered, by group, in percents

MOTHER

	N	A	B	C	
A_1	22	31.8	59.1	9.1	
A_2	24	8.3	58.3	33.3	*
B_1	24	33.3	62.5	4.2	
B_2	23	8.7	69.6	21.7	
C	24	8.3	58.3	33.3	*

FATHER

	N	A	B	C
A_1	23	17.4	73.9	8.7
A_2	23	13.0	60.9	26.1
B_1	23	26.1	73.9	0.0
B_2	23	17.4	60.9	21.7
C	24	0	41.7	58.3

Key:

A = Enter College Full Time

B = Take Mathematics in High School

C = Take no Math

Significant Chi-Square Comparisons

Mothers A_1	vs. Mothers C	$\chi^2 = 6.34$	$p < .05$
Mothers A_2	vs. Mothers B_1	$\chi^2 = 9.08$	$p < .02$
Mothers B_1	vs. Mothers C	$\chi^2 = 9.08$	$p < .02$
Fathers A_1	vs. Fathers C	$\chi^2 = 14.80$	$p < .001$
Fathers A_2	vs. Fathers B_1	$\chi^2 = 7.29$	$p < .05$
Fathers A_2	vs. Fathers C	$\chi^2 = 6.85$	$p < .05$
Fathers B_1	vs. Fathers C	$\chi^2 = 21.80$	$p < .001$
Fathers B_2	vs. Fathers C	$\chi^2 = 8.91$	$p < .02$

*Percents do not total 100 due to rounding.

option (a), the riskiest alternative. Thus the C fathers appear to be less willing to have their daughters leave high school early, either to enter college full-time or take a course at a nearby college, than are the fathers of the other groups. Of the mothers, one-third of the A_2 and C mothers chose option (c) compared with only 9 percent of A_1 and 4 percent of B_1. In comparison with some of the other groups, the A_2 and C mothers appear to be the least willing to take risks on this item.

Of the students' responses about what they feel their fathers would recommend for them on this item, half the B_1 boys saw their fathers selecting the riskiest alternative, more than any other group, and significantly more than the C group where only one girl saw her father recommending that alternative ($p < .01$). In comparisons between the students' perceptions of their fathers and the fathers' responses, no group showed a significant difference. For students' perception of their mothers on this item, there were no significant group differences; nor were there differences between the students' perceptions of their mothers and the mothers' perceptions of themselves.

The parents were more in agreement on the other two items in the scale. Asked what they would recommend if their child had completed all of the mathematics courses available at his/her middle or junior high school prior to the final year at that school, the majority of parents in all groups recommended staying in the junior high school for the final year but taking an advanced mathematics course the first or last period of the day at the high school. This option was included in the scale as the second riskiest item. The most risky item, leaving the middle school to go to high school a year early, was selected by approximately one-third of the A_1 and B_1 mothers as well as 30 percent of the B_1 fathers and 26 percent of the A_1 fathers, suggesting a trend in the direction of greater risk-taking among the A_1 and B_1 parents as compared to the other groups where fewer parents selected this option. Chi-square comparisons, however, revealed statistically significant differences only between the mothers of A_1 and B_2 ($p < .02$) and between the mothers of B_1 and B_2 ($p < .01$).

The students were asked what they felt their parents would recommend for them. In responding about their fathers, more B_1 boys (44 percent) chose the riskiest item than any other group, and significantly more than either the B_2 group ($p < .01$) or the C group ($p < .01$). There were no significant differences between the students' perceptions of their fathers and the fathers' perceptions of themselves. The groups did not differ significantly in responding about their mothers, but there was a discrepancy in the B_2 group between the boys' perceptions of their mothers and the mothers' perceptions of themselves ($p < .05$). Seventeen percent of the boys saw their mothers as being willing to recommend leaving the middle school to go to high school a year early while none of the mothers said they would recommend this.

The third item was concerned with choosing an alternative when the child was ready for an Advanced Placement Calculus course that the school did not provide. The largest percentage of parents in all groups selected the riskiest item: to take a college course. Chi-square tests revealed significant differences, however, between A_1 mothers where 79 percent chose this option and B_1 mothers where 96 percent chose this option ($p < .05$), between B_1 mothers (96 percent) and B_2 mothers (83 percent) ($p < .05$), and between B_1 fathers (92 percent) and C fathers (63 percent) ($p < .05$).

On this item, there were no group differences on students' perceptions of what their father would recommend but there was a discrepancy in the B_1 group between the fathers' responses and the students' perceptions of their fathers ($p < .05$). In this case, more fathers (92 percent) said they would recommend taking the college course than their sons thought would (75 percent). Significantly more A_1 girls (88 percent) than B_1 boys (67 percent) or C girls (73 percent) thought their mothers would recommend taking the college course. In comparing the students' responses about the mothers to the mothers' responses, more B_1 mothers (96 percent) said they would recommend taking the college course, while only 67 percent of the boys thought they would ($p < .01$).

In general, responses to the three risk-taking items suggested that students' perceptions were similar to their parents' actual recommendations. In those cases where significant differences were found, the parents were more risky than the students thought they would be.

Students in all groups were asked their perception of support from teachers and peers for educational risk-taking based on the same three items discussed above. No significant group differences were found on the scale scores for the students' perceptions of teachers' or peers' recommendations. There were some differences on individual items, however.

When asked what option their friends would recommend for them if there was no mathematics course to take in their last year of high school, significantly more B_2 boys (30 percent) thought their friends would recommend leaving high school early than A_2 girls (4 percent) or C girls (0 percent) ($p < .05$). On the item where the students were asked what their friends would recommend if they had completed all the mathematics offered by the middle school prior to the last year of middle school, 29 percent of the B_2 boys thought their friends would suggest entering high school early, while no C girls thought their friends would recommend this ($p < .05$). On both of these items, therefore, the B_2 boys are seeing their friends as most supportive of risk-taking behavior especially when compared with the C girls. There were no group differences on perceptions of friends' risk-taking on the item related to taking an AP Calculus course.

There were no group differences in students' perceptions of teachers' recommendations on the items related to the high school or middle school math courses. On the item asking about taking an AP course, however, fewer B_2 boys (57 percent) thought their teachers would recommend taking a college course than any other group, where at least 83 percent thought their teachers would make that recommendation.

Items were included on the students' questionnaires to determine their perceptions of who (parents, teacher and/or peers) encourages them in several risk-taking areas. Similar items were also included on the parents' questionnaire to ascertain their feelings about themselves on these items.

The students and parents were asked who encouraged the students' participation in the Talent Search. No significant group differences were found for mothers, fathers, child's perception of mothers, child's perception of fathers or child's perception of peers on this item. No differences were found within groups between the mothers' responses and the students' perceptions of their mothers or between the fathers' responses and the students' perceptions of their fathers. Differences were found, however, for the students' perceptions of their mathematics teachers. Over half of the A_2 girls reported encouragement for participating in the Talent Search from their mathematics teacher compared with 21 percent of A_1 and B_1 ($p < .02$).

Group and within group comparisons were also done for parents and for students' perceptions of their parents, teachers and peers on who favors the child's accelerating their study of mathematics. No significant differences were found. At least half of the mothers and fathers in all groups reported favoring acceleration in mathematics for their children, and the students' perception of their parents was similar. Fewer students reported support for acceleration from their teachers (ranging from 21 percent for A_1 to 43 percent for B_2) and even fewer from peers (ranging from 4 percent for A_2 to 13 percent for A_1), but group comparisons yielded no significant differences.

Parents and students were also asked who favors the child skipping a grade. Table 39 shows the distribution of parents who indicated that

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Insert Table 39

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they favor grade skipping and the distribution of students who perceive their parents as favoring their skipping a grade. The results of significant chi-square comparisons are shown beneath the table. For mothers, unusually low support (4 percent) was found in the A_2 group, while the highest level of support (57 percent) was found in A_1. The students' perception of support by their mothers on this variable did not differ significantly from the mothers' report of support. For fathers, the only significant difference was between A_1 (44 percent)

Table 39: Mothers', fathers' and students' perceptions by group, of who favors the child skipping a grade, in percents

	N	Mother	Child's Perception of Mother	Father	Child's Perception of Father
A_1	24	56.5*	33.3	43.5*	20.8
A_2	24	4.2	4.2	17.3*	8.3
B_1	24	41.7	33.3	37.5	45.8
B_2	24	16.6	25.0	25.0	20.8
C	24	25.0	12.5	13.0*	12.5

*n = 23

Significant Chi-Square Comparisons

Mother

A_1 vs A_2 $X^2 = 15.392$ $p < .001$

A_2 vs B_1 $X^2 = 9.552$ $p < .01$

A_2 vs C $X^2 = 4.181$ $p < .05$

A_1 vs B_2 $X^2 = 8.080$ $p < .01$

A_1 vs C $X^2 = 4.846$ $p < .05$

Child's Perception of Mother

A_1 vs A_2 $X^2 = 6.701$ $p < .01$

A_2 vs B_1 $X^2 = 6.701$ $p < .01$

A_2 vs B_2 $X^2 = 4.181$ $p < .05$

Father

A_1 vs C $X^2 = 5.254$ $p < .05$

Child's Perception of Father

A_2 vs B_1 $X^2 = 8.545$ $p < .01$

B_1 vs C $X^2 = 6.454$ $p < .05$

Mother vs Child's Perception of Mother

None

Father vs Child's Perception of Father

None

and C (13 percent). For the students' perception of support from their fathers, though it did not differ significantly from the fathers' reporting, the students in the B_1 group indicated significantly greater support than either A_2 or C. No significant group differences were found on comparisons for perception of support by teachers and peers.

The final item involving risk taking asked who favors the child's entering college early. Table 40 shows the distribution of

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Insert Table 40

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parents who indicated that they favor their child's entering college early and the distribution of those students who perceive their parents as favoring this option for them. The results of significant chi-square comparisons are shown below the table. For mothers, the greatest support was found in groups A_1 (52 percent) and B_1 (42 percent) and the least was found in the A_2 group (13 percent). The students' perceptions about their mothers was not significantly different from the mothers' own perceptions about themselves. No significant group differences were found for fathers, although there was a difference between group B_1's perception of their fathers, where 50 percent thought their fathers favored this option, and all the other groups where 20 percent or less of each group perceived their fathers favoring this option. There were no significant differences in comparisons of responses for students' perceptions of teachers and peers on this item.

Usefulness of Mathematics

Parents were administered four Likert items to assess their

Table 40: Mothers', fathers', and students' perceptions, by group, of who favors their child's entering college early, in percents

	N	Mother	Child's Perception of Mother	Father	Child's Perception of Father
A_1	24	52.4***	37.5	34.7*	16.7
A_2	24	12.5	12.5	18.1**	8.3
B_1	24	41.7	45.8	34.7*	50.0
B_2	24	17.3*	20.8	27.2**	20.8
C	24	17.4*	16.7	18.2**	12.5

*n = 23 **n = 22 ***n = 21

Significant Chi-Square Comparisons

Mother

A_1 vs A_2 $X^2 = 8.311$ $p < .01$

A_1 vs B_2 $X^2 = 5.981$ $p < .05$

A_1 vs C $X^2 = 5.981$ $p < .05$

A_2 vs B_1 $X^2 = 5.169$ $p < .05$

Child's Perception of Mother

A_2 vs B_1 $X^2 = 6.454$ $p < .05$

A_1 vs A_2 $X^2 = 4.000$ $p < .05$

B_1 vs C $X^2 = 4.752$ $p < .05$

Fathers

None

Child's Perception of Father

A_2 vs B_1 $X^2 = 10.084$ $p < .01$

B_1 vs C $X^2 = 7.854$ $p < .01$

A_1 vs B_1 $X^2 = 6.000$ $p < .01$

B_1 vs B_2 $X^2 = 4.463$ $p < .01$

Fathers vs Child's Perception of Father

None

Mothers vs Child's Perception of Mother

None

perception of the usefulness of studying mathematics. The responses to the four items were combined in a scale. An analysis of variance of the fathers' scale scores showed no significant group differences. Although an analysis of variance of the mothers' scores was significant at the $p < .05$ level, a Tukey test of multiple mean comparisons showed no group differences to be significant at that level. A t-test comparison between mothers' and fathers' responses was significant for the A_2 group only ($t = -2.25$, $p < .05$) whose mothers saw mathematics as more useful than did their fathers.

In spite of no differences on the scale scores, examination of the responses to individual items revealed some differences. Group differences were evident for both fathers and mothers on the item, "Studying calculus in high school is not necessary for my child's future." Only 29 percent of the C mothers disagreed with this statement as compared with 63 percent of the B_1 mothers ($p < .05$). For the fathers, significant differences were found between the C fathers where only 17 percent disagreed with the statement and the A_1 ($p < .01$), B_1 ($p < .05$) and B_2 ($p < .05$) fathers where 61 percent, 46 percent, and 46 percent, respectively, disagreed with the statement. On the item, "Knowledge of calculus is not important for most careers", a difference was found between the A_1 mothers where 42 percent disagreed with the statement and the A_2 mothers where 13 percent disagreed with it. Differences were not significant for fathers on this item, nor fathers or mothers on any of the other items in the scale.

The students were also asked a series of Likert items to determine their perception of the extent to which their parents, teachers and peers believe that mathematics is useful. An analysis of variance of the combined scale of items related to parents, teachers and peers on the usefulness of mathematics revealed no significant group differences. On individual items, there were no differences on those items relating to teachers' and peers' attitudes, but there was a difference on two of the four items relating to mother and on one of the four items relating to father.

Differences were noted on the item, "My father thinks calculus will be the most useful course I take in high school" between the B_1 boys where 46 percent agreed with the statement and both the A_1 girls ($p < .05$), where only 17 percent agreed with the statement, and the A_2 girls ($p < .01$), where only 8 percent agreed with the statement. There was a significant difference ($p < .01$) between the A_1 and A_2 girls on the item, "My mother thinks I should not accelerate my study of mathematics," where 79 percent of the A_1 group disagreed with the statement as compared with only 38 percent of the A_2 girls. The last item that revealed group differences was "My mother thinks I don't really need to learn calculus." On this item, 79 percent of the A_1 girls disagreed with the statement while only 38 percent of the C group disagreed with it ($p < .01$).

Mathematics as a Male Domain

Four Likert items were included on the parent questionnaire to determine if the parents stereotype mathematics as more appropriate for men than women. When the four items were combined in a scale, an analysis of variance of the scores of the mothers and fathers of the five groups was not significant for either fathers or mothers. An examination of the responses on the four individual items revealed that the majority of parents in all groups answered non-stereotypically, and there were no significant differences between groups.

A t-test comparison between the fathers' and mothers' responses was significant ($t = -2.32$, $p < .05$) for the B_2 group only. The mothers of these boys view mathematics less stereotypically than do their fathers.

Enjoyment of Mathematics

The students and parents in all groups were asked who encourages the child's enjoyment of mathematics: the mother, father, both or neither. The percentages of parents who saw themselves, either alone or with their spouse, as having encouraged enjoyment are shown in Table 41.

Insert Table 41

Along with the percentages of students who perceived support from each parent, the results of significant chi-square comparisons are shown below the table.

There were no significant differences among the five groups for the number of mothers who reported encouraging enjoyment of mathematics, or for the number of students who cited their mothers as encouraging them. There was a discrepancy, however, for the A_1, A_2 and B_1 groups between the students' perc.ption of their mothers and the mothers' perception of themselves on this variable. In all three groups, the mothers were more likely to say they'd encouraged their child's enjoyment of mathematics than were their children likely to say that their mothers had.

Significantly more A_1 fathers (83 percent) than A_2 fathers (54 percent) reported encouraging their child's enjoyment of mathematics. The students' responses regarding their fathers showed the B_1 boys reporting significantly less encouragement than the A_1, B_2 or C groups. In a comparison between the fathers' responses and the

Table 41: Mothers', fathers' and students' perceptions, by group, of who encourages the child's enjoyment of mathematics, in percents

	N	Mother	Child's Perception Of Mother	Father	Child's Perception Of Father
A_1	24	75.0	45.8	82.6*	50.0
A_2	24	75.0	41.7	54.2	33.3
B_1	24	70.8	20.8	79.2	12.5
B_2	24	66.7	45.8	75.0	58.3
C	24	58.4	37.5	69.5*	41.7

*n = 23

Significant Chi-Square Comparisons

Mothers

None

Child's Perception of Mothers

None

Mothers vs. Child's Perception of Mothers

A_1 $X^2 = 4.27$ $p < .05$

A_2 $X^2 = 5.49$ $p < .05$

B_1 $X^2 = 12.08$ $p < .001$

Fathers

A_1 vs. A_2 $X^2 = 4.37$ $p < .05$

Child's Perception of Fathers

B_1 vs. B_2 $X^2 = 11.02$ $p < .001$

B_1 vs. A_1 $X^2 = 7.85$ $p < .01$

B_1 vs. C $X^2 = 5.17$ $p < .05$

Fathers vs. Child's Perception of Fathers

A_1 $X^2 = 5.56$ $p < .05$

B_1 $X^2 = 21.48$ $p < .001$

students' perception of their fathers, discrepancies were evident in both the A_1 and B_1 groups, where the fathers claimed having done more to encourage their child's enjoyment of mathematics than the students in those groups thought their father had contributed.

Table 42 shows the percentage of students in each group who

Insert Table 42

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perceive support from their current mathematics teacher and their peers for encouraging enjoyment of mathematics. Reported support from peers on this variable was generally low with no more than one-third of any group reporting encouragement. There was a significant difference between the B_2 group where 33 percent reported support and the C group where 8 percent reported support. On perceived support from teachers, the A_1 group reported significantly less support from their teachers than did the A_2 and B_2 groups.

Open-ended questions were included for both the students and their parents asking how the parents had fostered the child's enjoyment of mathematics. Although many of the respondents had difficulty separating how the parents had fostered enjoyment as distinguished from comparable questions regarding self-confidence and mathematics learning, those who did respond mentioned the following ways parents had helped: 1) by supplying puzzles, books, games, computers and other supplies related to mathematics; 2) by playing math games, solving math problems and/or writing computer programs with the child; 3) by being a role model, saying that math is fun and enjoying mathematics him/herself; and 4) by discussing the application of mathematics to daily life with the child.

Table 42: Students' perceptions of support from teachers and peers for encouraging the enjoyment of mathematics

	N	Teachers	Peers
A_1	24	29.2	16.7
A_2	24	58.3	16.7
B_1	24	54.2	29.2
B_2	24	58.3	33.3
C	24	41.7	8.3

Significant Chi-Square Comparisons

Teachers

A_1 vs. A_2 $X^2 = 4.15$ $p < .05$

A_1 vs. B_2 $X^2 = 4.15$ $p < .05$

Peers

B_2 vs. C $X^2 = 4.55$ $p < .05$

Career Interests

The students and parents in all groups were asked who encourages the child's interest in a math-related career: the mother, the father, both or neither. The percentages of parents who saw themselves, either alone or with their spouse, as having encouraged this career interest are shown in Table 43 along with the percentages of students who

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Insert Table 43

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perceived support from each parent. Of the mothers, the C group had the lowest number who indicated encouraging a math-related career, and it was significantly less than the A_1, B_1 and B_2 mothers. In a comparison between the mothers' perceptions and the students', the B_1 boys saw their mothers as encouraging them in this area significantly less than the mothers said they did. There were no significant group differences among the fathers, but there was a difference within the C group between the fathers' responses, where 39 percent said they had encouraged their daughters, and their daughters' perceptions, where only 8 percent said their father had encouraged their interest in a math-related career.

The students were also asked if their teachers and peers had encouraged their interest in a math related career. The results are shown in Table 44. The number reporting support from peers in this

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Insert Table 44

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area was low in all groups. It was also fairly low for teachers, although the difference between B_2 (38 percent) and B_1 (13 percent) was significant.

Table 43 : Mothers', fathers' and students' perception, by group, of who encourages the child's interest in a mathematical career, in percents

	N	Mother	Child's Perception Of Mother	Father	Child's Perception Of Father
A_1	24	50.0	41.7	52.1*	45.8
A_2	24	37.5	25.0	41.7	25.0
B_1	24	65.2*	20.8	52.2*	33.3
B_2	24	54.1	37.5	58.3	62.5
C	24	13.6**	16.7	39.1*	8.3

*n = 23 **n = 22

Significant Chi-Square Comparisons

Mothers

A_1 vs. C $X^2 = 6.91$ $p < .01$

B_1 vs. C $X^2 = 12.47$ $p < .001$

B_2 vs. C $X^2 = 8.31$ $p < .01$

Child's Perception of Mothers

None

Mothers vs. Child's Perception of Mothers

B_1 $X^2 = 9.46$ $p < .01$

Fathers

None

Fathers vs. Child's Perception of Fathers

C $X^2 = 6.21$ $p < .05$

Table 44: Students' perceptions, by group, of teachers and peers who encourage their interest in a math-related career

	N	Teachers	Peers
A_1	24	25.0	16.7
A_2	24	20.8	16.7
B_1	24	12.5	8.3
B_2	24	37.5	12.5
C	24	25.0	4.2

Significant Chi-Square Comparisons

Teachers

B_1 vs. B_2 $X^2 = 4.0$ $p < .05$

Peers

None

In a related question, parents were asked if they have actively encouraged their child to consider a career in mathematics or science. The results are shown in Table 45.

Insert Table 45

Less than one-third of the A_2 and C mothers and the A_2, B_2 and C fathers answered yes to this question, while approximately one-half of the other groups did. Chi-square comparisons showed that significantly fewer C mothers responded yes than B_1 or B_2 mothers.

Table 46 shows the responses to the question, "If you had to

Insert Table 46

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select a career for your child, what would you select or want for your child?" Their answers were put into two categories: math/science or other. The results of chi-square comparisons are shown beneath the table. A large percentage of A_1, B_1 and B_2 mothers and fathers selected mathematical or scientific careers for their children compared with much lower percentages of A_2 and C parents.

Parents were also asked if they think their child will pursue a career in science, engineering or mathematics. The responses are shown in Table 47. More than three-quarters of the A_1, B_1 and B_2

Insert Table 47

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parents responded "yes", compared with about half of the A_2 mothers

Table 45: Parents reporting active encouragement of a mathematics or science oriented career by groups, in percents

		N	YES	NO
MOTHER	A_1	23	47.8	52.2
	A_2	24	29.2	70.8
	B_1	23	56.5	43.5
	B_2	24	50.0	50.0
	C	24	20.8	79.2
FATHER	A_1	23	52.2	47.8
	A_2	24	25.0	75.0
	B_1	23	52.2	47.8
	B_2	24	25.0	75.0
	C	23	30.4	69.6

<u>Significant Chi-Square Comparisons</u>

Mothers B_1 vs. Mothers C $\chi^2 = 6.33$ $p < .02$

Mothers B_2 vs. Mothers C $\chi^2 = 4.46$ $p < .05$

Table 46: Parents perception of career area for their child, by groups, in percents

		N	MATH/SCI	OTHER
MOTHER	A_1	13	76.9	23.1
	A_2	11	36.4	63.6
	B_1	17	82.4	17.6
	B_2	14	85.7	14.3
	C	10	20.0	80.0
FATHER	A_1	15	86.7	13.3
	A_2	14	42.9	57.1
	B_1	16	87.5	12.5
	B_2	14	85.7	14.3
	C	10	50.0	50.0

Significant Chi-Square Comparisons

Mothers A_1 vs. Mothers A_2	$\chi^2 = 4.03$	$p < .05$
Mothers A_1 vs. Mothers C	$\chi^2 = 7.34$	$p < .01$
Mothers A_2 vs. Mothers B_1	$\chi^2 = 6.15$	$p < .02$
Mothers A_2 vs. Mothers B_2	$\chi^2 = 6.51$	$p < .02$
Mothers B_1 vs. Mothers C	$\chi^2 = 10.14$	$p < .01$
Mothers B_2 vs. Mothers C	$\chi^2 = 10.36$	$p < .01$
Fathers A_1 vs. Fathers A_2	$\chi^2 = 6.15$	$p < .02$
Fathers A_1 vs. Fathers C	$\chi^2 = 4.00$	$p < .05$
Fathers A_2 vs. Fathers B_1	$\chi^2 = 6.70$	$p < .01$
Fathers A_2 vs. Fathers B_2	$\chi^2 = 5.60$	$p < .02$
Fathers B_1 vs. Fathers C	$\chi^2 = 4.40$	$p < .05$

Table 47: Parents' perceptions of whether they think their child will pursue a career related to mathematics or science, by group, in percents

		N	Yes	No
MOTHERS	A_1	21	76.2[1]	23.8
	A_2	16	50.0	50.0
	B_1	23	87.0	13.0
	B_2	20	80.0[1]	20.0
	C	22	18.2	81.8
FATHERS	A_1	20	80.0[2]	20.0
	A_2	17	52.9	47.1
	B_1	21	85.7	14.3
	B_2	18	83.3	16.7
	C	16	25.0	75.0

[1] One pre-med included [2] Two pre-meds included

Significant Chi-Square Comparisons

Mothers

A_1 vs. C $X^2 = 14.69$ $p < .001$

B_1 vs. C $X^2 = 21.37$ $p < .001$

B_2 vs. C $X^2 = 16.05$ $p < .001$

A_2 vs. C $X^2 = 4.34$ $p < .05$

A_2 vs. B_1 $X^2 = 6.36$ $p < .05$

Fathers

A_1 vs. C $X^2 = 10.89$ $p < .001$

B_1 vs. C $X^2 = 13.89$ $p < .001$

B_2 vs. C $X^2 = 11.69$ $p < .001$

A_2 vs. B_1 $X^2 = 4.91$ $p < .05$

and fathers and only 25 percent of the C fathers and 18 percent of the C mothers. The pattern is similar to the pattern for the previous item on what careers they'd like their child to pursue. The parents may have responded to what they perceive as the child's actual interest when they answered the question about what they'd like their child to pursue.

When the parents were asked if they would want their child to have a career if it were not financially necessary to work, almost all the parents responded "yes". In response to whether they would expect there to be times in their child's life when he/she would have a part-time career or no career at all, a majority of the parents of the girls said "yes" while fewer parents of the boys said "yes". The distribution of responses is shown in Table 48. When asked when and

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Insert Table 48

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why, a large percentage of the girls' parents mentioned interrupting a career for raising children. This was rarely mentioned by the boys' parents. The distribution of parents who mentioned children is shown in Table 49.

Insert Table 49

The distribution of parents' expectations for the highest level of education they expect their child to achieve is shown in Table 50.

Insert Table 50

Table 48: Parents' preference for part time careers at some point in their child's life, by group, in percents

MOTHER	N	YES	NO
A_1	24	81.8	18.2
A_2	23	82.6	17.4
B_1	22	34.8	65.2
B_2	24	17.4	82.6
C	24	95.5	4.5

FATHER	N	YES	NO
A_1	22	59.1	40.9
A_2	22	77.3	22.7
B_1	19	31.6	68.4
B_2	23	39.1	60.9
C	21	76.2	23.8

Significant Chi-Square Comparisons

Mothers A_1 vs. Mothers B_1	χ^2 = 10.20	$p < .01$
Mothers A_1 vs. Mothers B_2	χ^2 = 18.68	$p < .001$
Mothers A_2 vs. Mothers B_1	χ^2 = 10 85	$p < .01$
Mothers A_2 vs. Mothers B_2	χ^2 = 19.56	$p < .001$
Mothers B_1 vs. Mothers C	χ^2 = 18.06	$p < .001$
Mothers B_2 vs. Mothers C	χ^2 = 27.75	$p < .001$
Fathers A_2 vs. Fathers B_1	χ^2 = 8.64	$p < .01$
Fathers A_2 vs. Fathers B_2	χ^2 = 6.71	$p < .01$
Fathers B_1 vs. Fathers C	χ^2 = 8.02	$p < .01$
Fathers B_2 vs. Fathers C	χ^2 = 6.14	$p < .02$

Table 49: Parents citing interruption of careers or part-time careers for raising children by groups, in percents.

		N	YES	NO
MOTHER	A_1	22	86.4	13.6
	A_2	23	78.3	21.7
	B_1	22	4.5	95.5
	B_2	23	0.0	100.0
	C	20	90.0	10.0
FATHER	A_1	22	68.2	31.8
	A_2	22	68.2	31.8
	B_1	18	5.6	94.4
	B_2	23	0.0	100.0
	C	17	82.4	17.6

Significant Chi-Square Comparisons

Mothers A_1 vs. Mothers B_1	$X^2 = 29.7$	$p < .001$
Mothers A_1 vs. Mothers B_2	$X^2 = 34.38$	$p < .001$
Mothers A_2 vs. Mothers B_1	$X^2 = 25.05$	$p < .001$
Mothers A_2 vs. Mothers B_2	$X^2 = 29.57$	$p < .001$
Mothers B_1 vs. Mothers C	$X^2 = 30.88$	$p < .001$
Mothers B_2 vs. Mothers C	$X^2 = 35.60$	$p < .001$
Fathers A_1 vs. Fathers B_1	$X^2 = 16.18$	$p < .001$
Fathers A_1 vs. Fathers B_2	$X^2 = 23.52$	$p < .001$
Fathers A_2 vs. Fathers B_1	$X^2 = 16.18$	$p < .001$
Fathers A_2 vs. Fathers B_2	$X^2 = 23.52$	$p < .001$
Fathers B_1 vs. Fathers C	$X^2 = 21.06$	$p < .001$
Fathers B_2 vs. Fathers C	$X^2 = 29.14$	$p < .001$

Table 50: Parents expectation for the highest education level they expect their child to achieve by group, in percents

MOTHERS

	N	BA	MA	PH. D.
A_1	21	0.0	12.5	87.5
A_2	21	19.0	14.3	66.7
B_1	19	0.0	21.1	78.9
B_2	21	4.8	33.3	61.9
C	21	14.3	42.9	42.9

FATHERS

	N	BA	MA	PH. D.
A_1	23	4.3	0.0	95.7
A_2	23	8.7	21.7	69.6
B_1	20	0.0	15.0	85.0
B_2	23	4.3	43.5	52.2
C	23	26.1	39.1	34.8

Significant Chi-Square Comparisons

Fathers of A_1 vs. Fathers of A_2 $\chi^2 = 6.28$ $p < .05$

Fathers of A_1 vs. Fathers of B_2 $\chi^2 = 12.94$ $p < .001$

Fathers of A_1 vs. Fathers of C $\chi^2 = 19.10$ $p < .001$

Fathers of B_1 vs. Fathers of C $\chi^2 = 12.09$ $p < .01$

Mothers of A_1 vs. Mothers of C $\chi^2 = 10.65$ $p < .01$

Mothers of B_1 vs. Mothers of C $\chi^2 = 6.34$ $p < .05$

Fewer parents of C girls than any other group expected a Ph.D. level. This was significantly different from the A_1 and B_1 parents. The vast majority of A_1 fathers (96 percent) expected their daughters to obtain a Ph.D., significantly more than A_2, B_2 and C fathers.

In summary, parents in all groups felt that they had fostered their child's self-confidence and enjoyment with respect to mathematics. Students perceived somewhat less support than parents felt they gave, significantly so for B_1 boys. Parental support for risk-taking was highest for B_1 boys and lowest for C girls. Most parents felt mathematics was useful but specific items with respect to calculus did show lower support from C fathers and A_2 mothers. None of the parents showed a strong tendency to stereotype mathematics as a male domain. The C parents also were less likely to have encouraged careers in mathematics and the sciences, and had lower educational expectations for their daughters. Parents of girls but not boys felt that child-rearing responsibilities would require some interruption in the child's career. Overall, most parents appear to be very supportive of their children, with C parents only somewhat less encouraging of risk-taking and careers in mathematics than parents in the other groups.

RELATIONSHIPS AMONG VARIABLES

In addition to assessing differences on attitudinal and socio-economic variables for the five groups in the study, the relationships of those attitudinal, career, and socio-economic variables to each other were studied. Students' actual attitudes, their perceptions of their parents' attitudes and their parents' actual attitudes were correlated with each other, and multiple regressions were done to determine if socio-economic or family constellation variables were predictive of attitudinal variables.

The intercorrelations of the attitudinal and career variables are shown in Table 51. The pattern of relationships among the variables

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Insert Table 51

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was somewhat different for boys and girls. Career interest in this analysis was treated as a dichotomous choice between careers in mathematics/science or all other fields. Boys who are the most confident are the most likely to enjoy mathematics. Those reporting the highest level of enjoyment see mathematics as more useful than others and stereotype it less as a male domain. Those who see mathematics as useful are likely to have a mathematical or scientific career interest and vice versa. Surprisingly, risk-taking correlated with usefulness such that those who saw the most use for mathematics reported less willingness to take risks. (Access to role models was not correlated with any of the other variables.) Like the boys, girls who were confident also enjoyed mathematics, but for girls both enjoyment and confidence correlated with the perception of usefulness of mathematics

Table 51 : Correlations between attitudinal and career variables for boys and girls

Girls

	Confidence	Risk-Taking	Usefulness	Male Domain	Enjoyment	Career Interest	Role Models	Role Models of Same Sex
Confidence		$-.22^{b}$	$-.33^{b}$	.09	$.38^{b}$	$.28^{b}$	-.07	$-.17^{a}$
Risk-Taking	-.05		$-.23^{b}$	-.13	$-.33^{b}$	-.01	.04	.16
Usefulness	.12	$-.21^{a}$		.10	$.37^{b}$	$.40^{b}$	-.08	-.10
Male Domain	-.08	-.05	-.03		.14	.06	-.09	-.04
Enjoyment	$.21^{a}$	.06	$.29^{b}$	$-.26^{b}$		.11	-.10	$-.19^{a}$
Career Interest	.10	.17	$.29^{b}$	-.12	$.29^{b}$		.01	.05
Role Models	.09	-.10	-.04	.15	-.10	.15		$.66^{b}$
Role Models of the Same Sex	.02	-.08	.04	.11	-.05	.18	$.78^{b}$	

GIRLS (N = 72)

BOYS (N = 48)

a = $p < .05$

b = $p < .01$

and with willingness to take educational risks. Career interest was positively correlated with confidence as well as usefulness. Access to role models and the stereotyping of mathematics were uncorrelated with other variables except for a low and negative correlation between confidence and the number of same sex role models.

Thus, for both boys and girls there is a significant positive relationship between enjoyment and usefulness and between usefulness and career interest and between self-confidence and enjoyment. For boys, however, enjoyment, not confidence, correlates with career interest while for girls confidence, not enjoyment, does so. The risk-taking questions were correlated with enjoyment, confidence and usefulness for girls, but only with usefulness for boys and in the opposite direction. One might speculate that among able boys self-confidence may enhance enjoyment, but it is enjoyment that leads to a science-oriented career choice. For girls, however, it appears that, while self-confidence may increase enjoyment, it is the confidence not the enjoyment that correlates with career choice. Interestingly, it is self-confidence and career choice for which significant sex differences were found for students in this study.

Although there were no significant differences among groups on socio-economic and family constellation variables, analysis was done to see if these measures were predictive of attitudinal and career related variables. Multiple regression techniques were used for this analysis. The prediction variables were education of father, education of mother, birth position, sex of siblings, group and occupation of father. The attitudinal measures which served as dependent variables were risk-taking, confidence, usefulness, enjoyment and mathematics as a male domain. Career data which served as dependent variables were risk-taking, confidence, usefulness, enjoyment and mathematics as a male domain. Career data which served as dependent variables were career interest, role models and same sex role models.

Variables which were not already in a form suitable for regression analysis were made into scales, or dichotomous or categorical variables. Birth position was categorized as oldest, middle and youngest and treated as a ranked scale. For purposes of this analysis, only children were treated as oldest children. Sex of siblings was coded as a dichotomous variable; students who were part of all boy or all girl families were treated as one group, and students of mixed sex families as another group. Occupation of father was coded according to the National Opinion Research Center (NORC) long scale (Reiss, 1961). This scale is primarily based on status of occupations in the community and has been used successfully in other studies where occupation is a variable (Hodge, Siegel and Rossi, 1965; Benbow, 1981).

The only regression that proved to be significant was related to predicting accessibility of same sex role models by the socio-economic variables, particularly occupation and education of father, education of mother and group which really reflects the sex differences between B_1 and B_2 versus all three girls' groups. About 50 percent of the variance is explained with these four predictors which reach significance as shown in Table 52. Knowing a scientist, especially one of the same

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Insert Table 52

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sex is more common for boys and especially boys in the homes of fathers in high-status occupations and the most educated parents. Girls in homes where fathers have only moderately high status occupations

Table 52 : Stepwise multiple regression analysis predicting access to same sex role models by socio-economic and family constellation variables

Order of Entering Predictor Variable	Predictor Variable*	Multiple R	R^2	R^2 Change	F	B
1	Occupation of Father	.522	.273		86.972	-.719
2	Education of Father	.663	.439	.166	22.818	.415
3	Group	.684	.468	.029	5.625	.166
4	Education of Mother	.697	.486	.018	3.749	.149
5	Sex of Siblings	.698	.487	.000	0.052	-.016
6	Birth Position	.698	.487	.000	0.016	-.009

*n = 116

and parents have relatively less education, however, know fewer women in investigative careers than others.

Intercorrelations among students' risk-taking scores and those of their mothers and fathers as well as the students' perceptions of parental, teachers' and peer risk-taking support are shown in Table 53. For girls, actual risk-taking choices correlated signifi-

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Insert Table 53

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cantly with all other variables: The largest coefficients were between self and perception of support from fathers and mothers. For boys, only perceived support from parents and peers correlated with student choices. For both boys and girls, perceptions of mothers and fathers correlated more highly than actual parent scores; in other words, parents are perceived as more similar than they in fact are. Parents' actual support correlated significantly with students' perceptions but the coefficients were less than .5.

Thus, boys and girls tend to project risk-taking responses of parents and peers to be similar to their own choices, and girls but not boys do this to some extent for teachers. Parents' real views have only a small relationship to girls' responses and none for boys. Socio-economic variables were not predictors of either student attitudes toward risk taking, students' perceptions of their parents, or parents' actual risk-taking reports when multiple regression was done.

Students' perceptions of the support from significant others for self-confidence and usefulness were correlated with the expressed attitudes and interests of the students. Correlations are shown

Table 53: Correlations on risk-taking scale scores for students, parents and students' perceptions of support from significant others by sex.[1]

	Self	Mother	Father	Perceived Support From Mother	Perceived Support From Father	Perceived Support From Teacher	Perceived Support From Peers
Self		.29**	.38**	.56**	.66**	.32**	.40**
Mother	.11		.36**	.36**	.26**	.24*	.16
Father	.19	.26*		.39**	.43**	.16	.17*
Perceived Support From Mother	.53**	.30**	.31**		.70**	.23*	.26**
Perceived Support From Father	.35**	.34**	.47**	.65**		.20*	.31**
Perceived Support From Teacher	.21	.16	.11	.04	.00		.11
Perceived Support From Peers	.33**	.00	.04	.20	.00	.24*	

* $p < .05$ ** $p < .01$

[1] Correlations for girls are shown in the upper right diagonal of the table, and correlations for boys are shown in the lower left diagonal.

in Table 54. There was a significant correlation between the per-

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Insert Table 54

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ception of support for confidence and usefulness for girls but not boys. Perceived support for confidence correlated with self-confidence and perceived support for usefulness correlated with students' self measure of usefulness for both boys and girls. Boys and girls who perceived the most support from others for confidence were those who chose the higher risk options. For girls but not boys perception of the usefulness of mathematics by significant others correlated with self-confidence and enjoyment. Scientific/mathematical career choices, perceptions of mathematics as a male domain and access to role models were not correlated with perceptions of significant others for boys or girls. Socio-economic variables did not predict students' perceptions of significant others when multiple regression was used.

The network of significant intercorrelations among student attitudes and interest variables, along with correlations between these variables and students' perceptions of support from significant others for confidence and usefulness, are shown graphically in Figure 2.

Insert Figure 2

Clearly, there is a closer relationship among these measures for girls than boys. It is, of course, impossible to infer cause and effect relations from these correlations based on self-report. It is possible that girls who have the most self-confidence and enjoy mathematics the most have received more encouragement from parents,

Table 54 : Correlations between the perception of significant others for confidence and usefulness of mathematics and other attitudinal and interest variables

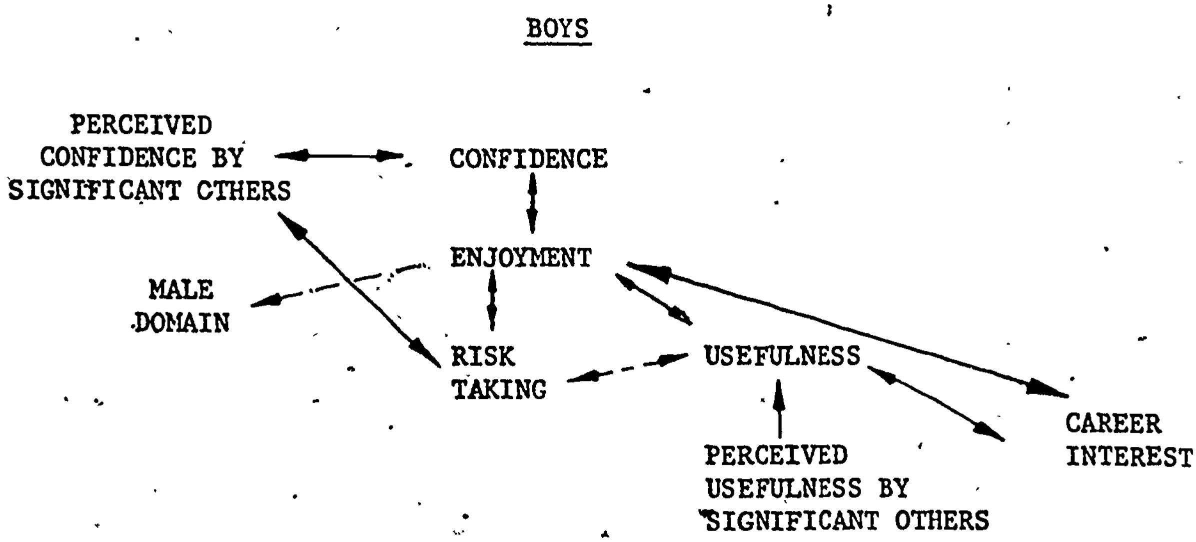
	Girls Significant Others		Boys Significant Others	
	Confidence	Usefulness	Confidence	Usefulness
Significant Others: Self Confidence	---	.21**	---	.12
Significant Others: Usefulness	.21**	---	.12	---
Self Confidence	.40**	.28**	.32**	.07
Risk Taking[a]	-.17*	-.18*	-.22*	.09
Usefulness	.06	.34**	.05	.43**
Enjoyment	-.01	.20*	.16	.07
Male Domain	.03	.09	-.08	-.10
Career Interest[b]	.07	.05	-.05	.03
Role Models	.01	-.14	.05	-.01
Same Sex Role Models	-.05	-.12	.12	.06

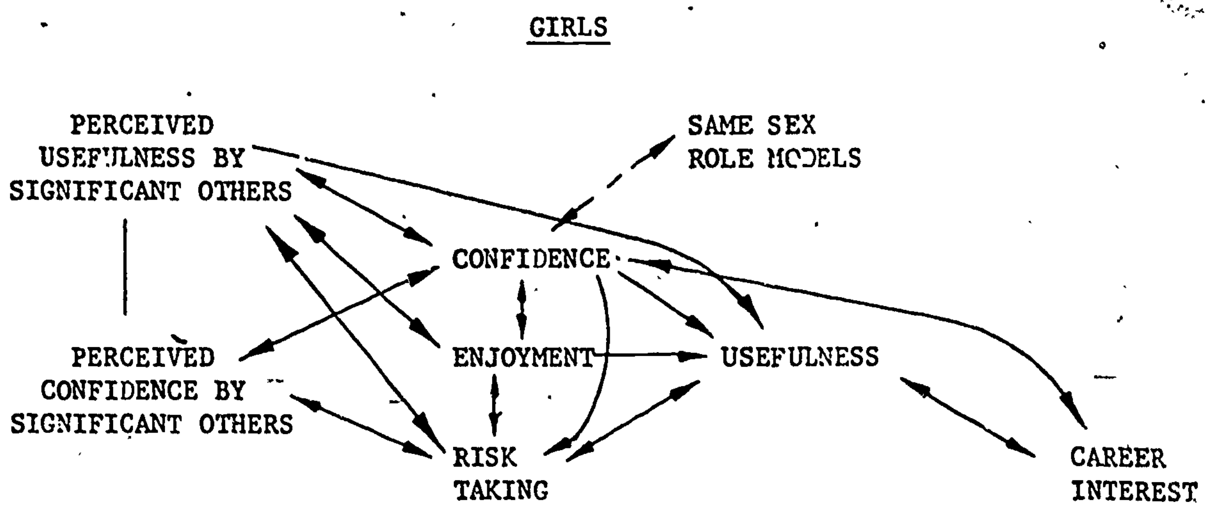
* $p < .05$
** $p < .01$

a. Low scores on risk-taking mean students choose the highest risk option; thus a negative correlation with other variables means higher risk takers perceived more support from significant others.

b. Career interests were treated as a dichotomous variable for mathematical/scientific choices.

Figure 2: Network of significant correlates of attitudinal and interest variables*





* - - - - denotes negative correlation

teachers, and friends; however, it is equally plausible that girls who respond most positively for themselves merely project or assume positive support from others.

Clearly, for girls self-confidence and enjoyment of mathematics are key variables. Confidence correlated positively with six other variables: enjoyment, usefulness, risk-taking, career choice, and perceptions of support for confidence and usefulness. Enjoyment correlated with confidence, usefulness, risk-taking, and perceptions of support for confidence and usefulness but not career interest. Neither variable correlated with the perception of mathematics as a male domain. Career interest had the fewest intercorrelations, relating only to self-confidence and usefulness.

For boys, there were fewer relationships among these variables. The only variables related to more than three other variables were usefulness and enjoyment. Usefulness correlated significantly with enjoyment, career interest, perception of usefulness by others, and negatively in relation to risk-taking. High enjoyment was related to career interests in mathematics/science, usefulness, willingness to take risks and lower degrees of stereotying mathematics as a male domain. The lesser degree of relationships may be in part a result of the smaller number of boys than girls in each sample, as well as the greater homogeneity among boys on these measures.

HOME LEARNING

A major question of interest was the extent to which mathematically talented students learn mathematics at home either on their own or with the help of a family member. Would the most motivated girls and boys in A_1 and B_1 be more likely to study on their own at home than the other able students in groups A_2, B_2 and C? Would any of the groups report a significant degree of tutorage by parents, especially fathers? Questions were posed to students and parents about the specific skills and concepts the child had learned at home, how the child had learned them, as well as the general level of encouragement for learning mathematics at home and at school. Parents were also asked when they first perceived that the child was mathematically talented, if the child showed early interest in toys of a mathematical nature, and how the parents fostered the child's interest and competency.

Parents were asked what grade their child was in when they first recognized that the child was mathematically talented. The distribution of responses, by group, are shown in Table 55. The responses of mothers of girls

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Insert Table 55

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in A_1 and A_2 were similar and significantly different from those of mothers of boys in B_1 and B_2. The mothers of B_1 and B_2, however, differed significantly from each other. Many mothers of A_1 and A_2 girls had not felt the child was talented until the 7th and 8th grade, the time the girl was in the talent search at The Johns Hopkins University. The mothers of boys were more likely to notice talent at an earlier grade with over half of the B_1 mothers saying the pre-school years and 86 percent of the B_2 mothers noticing talent in

Table 55 : Parents' perception of the grades at which they first felt their child was mathematically talented, in groups, by percents

MOTHER

	N	Pre-Kin.	Kin - 3	4 - 6	7 - 8	
A_1	21	23.8	19.0	19.0	38.1	*
A_2	17	23.5	17.7	17.6	41.2	
B_1	21	57.1	9.5	28.6	4.8	
B_2	22	40.9	45.5	4.5	9.1	
C	19	42.1	26.3	10.5	21.1	

FATHER

	N	Pre-Kin.	Kin - 3	4 - 6	7 - 8	
A_1	22	22.7	22.7	18.2	36.4	
A_2	21	19.0	38.1	14.3	28.6	
B_1	19	47.4	21.1	26.3	5.3	*
B_2	20	30.0	35.0	20.0	15.0	
C	16	25.0	25.0	25.0	25.0	

Significant Chi-Square Comparisons

Mothers A_1 vs. Mothers B_1	$\chi^2 = 9.39$	$p < .05$
Mothers A_1 vs. Mothers B_2	$\chi^2 = 9.10$	$p < .05$
Mothers A_2 vs. Mothers B_1	$\chi^2 = 9.38$	$p < .05$
Mothers A_2 vs. Mothers B_2	$\chi^2 = 8.98$	$p < .05$
Mothers B_1 vs. Mothers B_2	$\chi^2 = 11.98$	$p < .01$

*Numbers do not add up to 100 percent due to rounding.

either the pre-school or early elementary school years. Although the patterns of responses for fathers were similar to those of the mothers, the differences between groups were not statistically significant.

When the parents were asked to describe the specific mathematical skills the child had mastered in the pre-school years, most parents recalled that their child could count and do simple addition and sometimes subtraction. This would be typical of generally bright children and was categorized as mastery of simple arithmetic operations. Parents of the B_1 boys, especially mothers, were more likely to report that the child could also multiply and divide. This was categorized as advanced arithmetic operations and considered to be evidence of mathematical precocity. Some parents could recall nothing or made very general statements that could not be categorized. The distribution of responses is shown in Table 56.

Insert Table 56

The somewhat higher incidence of recall of advanced mathematical competency in the pre-school years by B_1 parents than others is consistent with the trend for B_1 parents to have reported recognizing their child's talent in the pre-school years more often than other parents. One cannot know for sure whether or not more boys in B_1 were actually precocious than students in the other groups, but their parents at least were more likely to have been "struck" by this early behavior and remembered it.

Parents were also asked to give examples of the child's learning of mathematics at home before being formally taught at school during the elementary and middle school years. With the exception of B_1 mothers, most parents did

Table 56: Distribution, in percents, of parents' recall of child's mathematical knowledge in the pre-school years, by group

		N	Simple Arithmetic	Advanced Arithmetic	Don't Know**
MOTHERS	A_1	24	70.8	12.5	16.7
	A_2	24	58.3	12.5	29.2
	B_1	24	54.2	33.3	12.5
	B_2	24	54.2	8.3	37.5
	C	24	75.0	4.2	20.8
FATHERS	A_1	23	52.2	8.7	39.1
	A_2	24	62.5	4.2	33.3
	B_1	24	45.8	20.8	33.3 *
	B_2	24	50.0	8.3	41.7
	C	24	58.3	4.2	37.5

*Percents may not add to 100 due to rounding.
**Includes responses such as "generally good at math", "chess", "a good reasoner".

Significant Chi-Square Comparisons

MOTHERS A_1 vs B_1 $X^2 = 6.75$ $p < .05$

MOTHERS B_1 vs C $X^2 = 6.75$ $p < .05$

not recall specific examples of the child's learning concepts and skills at home. Therefore, the responses are summarized as the percentages of parents who recalled the child's learning any mathematical topics prior to school instruction in Table 57.

Insert Table 57

When asked to describe the ways in which they had helped the child to learn mathematics at home most parents responded that their teaching had been informal and indirect or that they had done little or nothing. Direct teaching was reported by less than a fourth of parents in each group. Responses are summarized in Table 58. The informal or indirect modes of in-

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Insert Table 58

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struction were described as supplying materials, answering the child's questions or working to influence the school's efforts to help the child.

The students were also asked to report on their rememberances of home learning. Responses were categorized as learning of arithmetic operations, advanced topics such as algebra, and combinations of both, or none. The responses are summarized in Table 59. The C girls were the least likely

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Insert Table 59

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to recall any home learning (50 percent). Boys, especially those in B_1, recalled learning the advanced topics at home.

Table 57: Percentages of parents who recalled specific examples of child's learning mathematics at home, before being taught in school, by group

	N	Mother	Father
A_1	24	33.3	21.7*
A_2	24	25.0	8.3
B_1	24	54.2	20.8
B_2	24	20.8	20.8
C	24	25.0	29.2

*N = 23

Significant Chi-Square Comparisons

Mothers B_1 vs. Mothers B_2 $X^2 = 5.689$ $p < .05$

Table 58: Distribution, in percents, of parents' responses as to how they helped their child learn mathematics, by group

		N	Direct Teaching	Indirect and Informal	Little Or None/ Blank
MOTHERS	A_1	24	16.7	50.0	33.3
	A_2	24	16.7	41.7	41.7
	B_1	24	16.7	70.8	12.5
	B_2	24	16.7	58.3	25.0
	C	24	8.3	54.2	37.5
FATHERS	A_1	23	21.7	56.5	21.7
	A_2	24	12.5	41.7	45.8
	B_1	24	20.8	62.5	16.7
	B_2	24	4.2	62.5	33.3
	C	24	12.5	54.2	33.3

Significant Chi-Square Comparisons

None

*Numbers do not add up to 100 due to rounding.

Table 59: Distribution in percents of students' recall of topics learned before being taught in school, by group

	N	Arith-metic	Advanced Topics	Both	None	
A_1	24	29.2	33.3	12.5	25.0	
A_2	24	20.8	29.2	12.5	37.5	
B_1	24	0.0	45.8	25.0	29.2	
B_2	24	12.5	54.2	16.7	16.7	*
C	24	29.2	16.7	4.2	50.0	*

*Percents do not total 100 due to errors of rounding.

Significant Chi-Square Comparisons

Students who knew Advanced Mathematics Topics vs. those who did not

B_1 vs. C $\quad X^2 = 12.084 \quad p < .001$

B_2 vs. C $\quad X^2 = 12.084 \quad p < .001$

Students were asked if they had learned any algebra, computer programming or geometric theories prior to being in the talent search and if so, where and how. The percentages of students who had studied these topics on their own or with the help of a family member or friend were surprisingly small and are shown in Table 60. The only notable difference among groups

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Insert Table 60

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was the fact that no girls but about a third of the boys had learned some computer programming outside of school.

Parents were also asked whether or not they had made a conscious effort to supply their child with toys and materials of a mathematical or scientific nature. The parents who reported that they did are shown in Table 61.

Insert Table 61

Over 60 percent of the mothers in all five groups felt they had made an effort. Somewhat fewer fathers than mothers recalled making such an effort in every group except B_1. It seems plausible that fathers are generally less involved than mothers in selecting toys for their children.

Mothers and fathers were asked to describe their child's interest in toys and materials in the pre-school and early school years. The toys and games mentioned were classified as counting and sorting activities, spatial and manipulative such as erector sets and blocks, or other such as books or dolls. The percentages of parents who specifically mentioned their child's interest in these types of toys are

Table 60: Distribution, in percents, of students' reports of learning advanced mathematics outside of school, by group

		Algebra		Computer		Geometry	
	N	Self-Taught	Family Member	Self-Taught	Family Member	Self-Taught	Family Member
A_1	24	16.7	16.7	0.0	0.0	4.2	8.3
A_2	24	12.5	4.2	0.0	0.0	4.2*	4.2
B_1	24	20.8	0.0	33.3	4.2**	0.0	8.3**
B_2	24	20.8	8.3	20.8	12.5*	12.5	8.3
C	24	8.3	4.2	0.0	0.0	0.0	0.0

*Self and parents

**Friend/other included

Significant Chi-Square Comparisons

Students self-taught in computers vs. those not knowledgeable

B_1 vs. A_1 $X^2 = 9.600$ $p < .01$

B_1 vs. A_2 $X^2 = 9.600$ $p < .01$

B_1 vs. C $X^2 = 9.600$ $p < .01$

Table 61 : Percents of parents, by group, who reported making a conscious effort to supply their child with mathematical and scientific toys and materials

	Mothers		Fathers	
	N	Percent	N	Percent
A_1	24	66.7	23	47.8
A_2	24	62.5	24	37.5
B_1	24	62.5	23	65.2
B_2	24	79.2	24	62.5
C	23	78.3	24	58.3

Significant Chi-Square Comparisons

None

shown in Table 62. Interest in counting and sorting activities were re-

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Insert Table 62

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called by well over half of the mothers in all groups and by as many as 92 percent of the B_2 group. Specific recall of interest in spatial and manipulative activities was somewhat less frequent with a low of only 25 percent of the A_2 mothers but as many as 71 percent of the B_2 mothers recalling specific toys and activities. Fathers of B_1 and B_2 boys did recall more play with spatial toys than did fathers of A_1 and C girls.

Parents were asked to describe the ways in which they may have fostered their child's enjoyment in mathematics. The single most common response was by playing games with the child, ranging from informal mental games created by the parent while driving in the car to the use of commercial games like monopoly. Other responses included supplying toys or materials, setting an example for the child, and pointing out the usefulness of mathematics in everyday life. The responses are summarized in Table 63.

Insert Table 63

When asked which parent played mathematical games with the child, the parents of A_1, B_1 and C were likely to report that the father did so more than the mother. Mothers of B_2 also saw themselves as less involved than fathers but the fathers seemed to see the mothers as more nearly equal to them in involvement. The A_2 parents both reported a nearly equal involvement of both mother and father. Well over half of the parents in all groups saw

Table 62: Distribution in percents of parents' perceptions of child's interest in counting and/or spatial toys in the early childhood years

		N	Little or None	Counting	Spatial	Counting and Spatial	Don't Know/ No Response	
MOTHER	A_1	24	20.8	25.0	16.7	37.5	0.0	
	A_2	24	33.3	33.3	0.0	25.0	8.3	*
	B_1	24	20.8	12.5	8.3	58.3	0.0	*
	B_2	24	8.3	20.8	0.0	70.8	0.0	*
	C	24	33.3	16.7	0.0	45.8	4.2	
FATHER	A_1	23	26.1	30.4	0.0	8.7	34.8	
	A_2	24	41.7	20.8	4.2	25.0	8.3	
	B_1	24	16.7	8.3	8.3	41.7	25.0	
	B_2	24	25.0	16.7	4.2	33.3	20.8	*
	C	24	37.5	25.0	8.3	8.3	20.8	

*Numbers do not add up to 100 due to rounding.

Table 63: Distribution, in percents, of parents' responses as to how they fostered their child's enjoyment of mathematics, by group.

		N	Games	Other	Little or None And Blank	
MOTHERS	A_1	24	33.3	29.2	37.5	
	A_2	24	37.5	20.8	41.7	
	B_1	24	41.7	25.0	33.3	
	B_2	24	58.3	8.3	33.3	*
	C	24	45.8	12.5	41.7	
FATHERS	A_1	23	26.1	30.4	43.5	
	A_2	24	37.5	4.2	58.3	
	B_1	24	25.0	33.3	41.7	
	B_2	24	20.8	29.2	50.0	*
	C	24	20.8	20.8	58.3	

*Percents do not total 100 due to errors in rounding.

Significant Chi-Square Comparisons

None

at least one parent engaged in such activities with the child. The responses are shown in Table 64. If one compares these responses with students'

Insert Table 64

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perceptions of significant others who play games of a mathematical nature which wa shown in the earlier section on enjoyment (Table 17 on page 44), there appears to be a discrepancy such that parents report themselves as more involved than do students. This may be a result of parents recalling involvement over the years including pre-school while students may recall only the more immediate past and current time.

The majority of parents in each group feel that both parents encourage their child to study mathematics in school as shown in Table 65 . When

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Insert Table 65

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asked who encourages the child to study mathematics at home there are more parents who respond that neither parent does and some A_2 and B_2 parents see the mothers as more involved that the fathers as shown in Table 66 . Yet,

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Insert Table 66

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by in large, both parents are likely to report that the father is the one who helps most with the child's mathematics homework, although less markedly so for A_2 and B_2 fathers. This is shown in Table 67.

Insert Table 67

Table: 64 Parent perception of who plays mathematical games with their child.

		N	Self	Spouse	Both	Neither
MOTHER	A_1	24	20.8	41.7	16.7	20.8
	A_2	24	25.0	54.2	4.2	29.2
	B_1	24	8.3	20.8	12.5	25.0
	B_2	24	25.0	45.8	20.8	8.3
	C	24	20.8	41.7	25.0	33.3
FATHER	A_1	23	60.9	29.2	13.0	17.4
	A_2	24	29.2	25.0	20.8	25.0
	B_1	24	50.0	16.7	12.5	20.8
	B_2	24	37.5	8.7	16.7	16.7
	C	23	47.8	17.4	17.4	17.4

Significant Chi-Square Comparisons

None

Table: 65 Parent perceptions, by group, of who encourages their child's study of mathematics at school.

		N	Self	Spouse	Both	Neither
MOTHER	A_1	24	16.7	4.2	79.2	0.0
	A_2	24	8.3	0.0	79.2	12.5
	B_1	24	8.3	16.7	75.0	0.0
	B_2	24	4.2	8.3	75.0	12.5
	C	24	8.3	16.7	66.7	8.3
FATHER	A_1	23	13.0	17.4	60.9	8.7
	A_2	24	4.2	20.8	62.5	12.5
	B_1	24	16.7	16.7	66.7	0.0
	B_2	24	8.3	12.5	75.0	4.2
	C	23	8.7	17.4	69.6	4.3

Significant Chi-Square Comparisons

None

Table: 66 Parent perceptions, by group, of who encourages their child's study of mathematics at home.

		N	Self	Spouse	Both	Neither	
MOTHER	A_1	23	21.7	21.7	43.5	13.0	*
	A_2	24	12.5	0.0	50.0	37.5	
	B_1	24	12.5	12.5	54.2	20.8	
	B_2	24	25.0	8.3	45.8	20.8	*
	C	24	12.5	12.5	41.7	33.3	
FATHER	A_1	23	21.7	17.4	52.2	8.7	
	A_2	24	0.0	25.0	50.0	25.0	
	B_1	24	12.5	25.0	41.7	20.8	
	B_2	24	0.0	33.3	54.2	12.5	
	C	23	17.4	21.7	39.1	21.7	*

Significant Chi-Square Comparisons

Responses of Mothers of A_1 vs. Mothers of A_2. $X^2 = 8.66$, $p < .05$

*Percents do not total 100 due to rounding.

Table: 67 Parent perceptions of who helps child with their mathematics homework.

		N	Self	Spouse	Both	Neither	
MOTHER	A_1	24	12.5	58.3	0.0	29.2	
	A_2	23	8.7	21.7	8.7	60.9	
	B_1	24	8.3	50.0	16.7	25.0	
	B_2	24	8.3	50.0	8.3	33.3	*
	C	24	12.5	66.7	0.0	20.8	
FATHER	A_1	23	56.5	17.4	4.3	21.7	*
	A_2	24	29.2	37.5	4.2	29.2	*
	B_1	24	41.7	16.7	4.2	37.5	*
	B_2	24	25.0	16.7	16.7	41.7	*
	C	23	60.9	21.7	13.0	4.3	*

Significant Chi-Square Comparisons

Responses of Mothers of A_1 vs Mothers of A_2, $\chi^2 = 8.78$ $p < .05$

Responses of Mothers of A_2 vs Mothers of C, $\chi^2 = 12.21$ $p < .01$

Responses of Fathers of A_2 vs Fathers of C, $\chi^2 = 8.96$ $p < .05$

Responses of Fathers of B_2 vs Fathers of C, $\chi^2 = 10.80$ $p < .02$

*Percents do not total 100 due to rounding.

Students were also asked who encouraged their study of mathematics at school and at home and who helped with homework. Responses to the question about school are shown in Table 68. Over 60 percent of the students in the

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Insert Table 68

A_1, A_2, B_2 and C groups mentioned mothers whereas only 29 percent of the B_1 boys did so. This difference was significant. About two-thirds of all groups except B_1 also noted support from fathers. The B_1 boys differed significantly from only the C girls. Thus, all but B_1 boys seem to concur with their parents to the extent that they perceive a lot of support from both parents. On the student questionnaire the subjects could also indicate support from teachers and peers. Interestingly, it is the A_1 and B_1 groups who feel the least support from teachers and A_2 and C who see the most. Boys in B_2 feel less support from peers than do the A_1 and A_2 girls.

Support from mothers for studying mathematics at home was reported somewhat less frequently than support for studying at school by all but B_1. Slightly more boys in B_1 reported maternal support as shown in Table 69.

Insert Table 69

Fathers were seen as slightly less supportive than they had been for studying at school but about as supportive as mothers by all but A_2. Teachers were seen as more encouraging of home study by C than by A_1, A_2 or B_1 but only one girl in A_1 saw peers as supportive.

Table 68: Percentage of students in the five groups who perceive support from significant others for studying mathematics in school *

	N	Mother	Father	Teacher	Friend
A_1	24	79.2	66.7	45.8	16.7
A_2	24	62.5	66.7	87.5	20.8
B_1	24	29.2	41.7	41.7	4.2
B_2	24	66.7	66.7	66.7	0.0
C	24	75.0	79.2	79.2	8.3

Significant Chi-Square Comparisons

Mother A_1 vs. Mother B_1	$\chi^2 = 12.08$	$p < .001$
Mother A_2 vs. Mother B_1	$\chi^2 = 5.37$	$p < .05$
Mother B_1 vs. Mother B_2	$\chi^2 = 6.76$	$p < .01$
Mother B_1 vs. Mother C	$\chi^2 = 10.10$	$p < .01$
Father B_1 vs. Father C	$\chi^2 = 7.06$	$p < .01$
Teacher A_1 vs. Teacher A_2	$\chi^2 = 11.18$	$p < .001$
Teacher A_1 vs. Teacher C	$\chi^2 = 5.69$	$p < .02$
Teacher A_2 vs. Teacher B_1	$\chi^2 = 11.02$	$p < .001$
Teacher B_1 vs. Teacher C	$\chi^2 = 7.06$	$p < .01$
Friend A_1 vs. Friend B_2	$\chi^2 = 4.36$	$p < .05$
Friend A_2 vs. Friend B_2	$\chi^2 = 5.58$	$p < .02$

*Students were asked to check all that applied.

Table 69 : Percentage of students in the five groups who perceive support from significant others for studying mathematics at home *

	N	Mother	Father	Teacher	Friend
A_1	24	66.7	50.0	8.3	4.2
A_2	24	54.2	33.3	20.8	0.0
B_1	24	41.7	37.5	16.7	0.0
B_2	24	54.2	50.0	37.5	0.0
C	24	45.8	50.0	50.0	0.0

Significant Chi-Square Comparisons

Teacher A_1 vs. Teacher B_2	$\chi^2 = 5.78$	$p < .02$
Teacher A_1 vs. Teacher C	$\chi^2 = 10.08$	$p < .01$
Teacher A_2 vs. Teacher C	$\chi^2 = 4.46$	$p < .05$
Teacher B_1 vs. Teacher C	$\chi^2 = 6.0$	$p < .02$

*Students were asked to check all that applied.

Student reports of who helped with homework were similar to parent reports in that fathers were mentioned more often than mothers as shown in Table 70. Girls in group C reported more help from fathers than did

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Insert Table 70

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girls in A_2 or boys in B_2. Girls reported more help from teachers than did boys and the difference was significant for the comparison of C and B_1 and B_2 and A_2 versus B_1. The girls in A_2 reported as much or more help from peers than they had from parents and teachers whereas A_1, B_1 and C groups reported less help from peers than from fathers.

In summary, the anecdotal accounts from students and parents portray the homes of these students as ones in which ~~the~~ children were nurtured by a warm, supportive environment for learning. Evidence of systematic instruction by parents was, however, far from the norm. While many children did appear to have been accelerated in their learning of mathematics the recollections of parents and students tended to be that the child had learned things on their own more in response to a generally stimulating home environment in which learning was a natural and enjoyable occurance than as a result of systematic study of textbooks. It is perhaps for this reason that students seemed somewhat less aware of the efforts of their parents to nurture their interest and ability than the parents purported that they did. Differences among the groups were not great. There was a trend, however, for the parents of B_1 to recall more evidence of precocity and recognize the talent of their child at an earlier age than did parents in the other groups.

Table 70 : Percentage of students in the five groups who indicate that they receive help with their mathematics homework from significant others *

	N	Mother	Father	Teacher	Friend
A_1	24	29.2	58.3	16.7	16.7
A_2	24	16.7	33.3	29.2	37.5
B_1	24	8.3	41.7	4.2	16.7
B_2	24	8.3	33.3	8.3	29.2
C	24	20.8	66.7	33.3	37.5

Significant Chi-Square Comparisons

Father A_2 vs. Father C	$\chi^2 = 5.33$	$p < .05$
Father B_2 vs. Father C	$\chi^2 = 5.33$	$p < .05$
Teacher A_2 vs. Teacher B_1	$\chi^2 = 5.40$	$p < .05$
Teacher B_1 vs. Teacher C	$\chi^2 = 6.70$	$p < .01$
Teacher B_2 vs. Teacher C	$\chi^2 = 4.55$	$p < .05$

*Students were asked to check all that applied.

The boys in B_1 were somewhat more likely to recall self-study of advanced topics like algebra than early learning of basic arithmetic perhaps because so many had mastered the basics before starting school. One child even commented that he hadn't learned anything new in school until he was introduced to pre-algebra in the sixth grade.

TEACHERS

One of the questions that has appeared in the literature related to mathematically gifted youngsters is the extent to which teachers recognize and nurture such talent. To shed some light on this issue, students in the sample groups were asked to name any teachers they felt had had a strong positive influence on their interest in learning mathematics. Seventeen students in the A_1 and A_2 groups listed at least one teacher. More of the boys remembered a teacher who was a positive influence with 21 of the B_1 boys and 22 of the B_2 boys listing specific teachers. Only 14 of the girls in the C group could remember a teacher who had influenced them positively towards mathematics. Few of the students in any groups nominated teachers who had taught them before sixth grade, except in group B_2 where eight boys reported teachers who they had had in fourth grade or younger. Approximately half the students in every group except B_2 nominated male teachers. In B_2 the percentage was lower, probably due to the fact that the B_2 boys nominated more elementary teachers, where the number of men teaching is very small.

To further assess the impact of teachers, especially on the girls, 14 teachers nominated by the A_1 girls were located and interviewed and an additional 14 from the A_2 group were also interviewed for comparison. The questions asked were analyzed separately for each group of teachers.

In general, the students nominated mature, experienced teachers. Only one teacher nominated by an A_1 girl had been a first year teacher and the remaining 13 had taught at least eight years with a group mean of 13 years of experience. The ages of these teachers ranged from 30 to 64 with a mean of 39. Only three of the teachers nominated by an A_2 girl had taught three years or less and the remainder had taught at least six years with a group mean of 10 years of teaching experience. Their ages ranged from 30 to 54 with a mean of 41. The majority of teachers nominated were mathematics teachers in the middle school years or special teachers for mathematics in the elementary schools; only four of the A_1 and two of the A_2 teachers were regular elementary school teachers. The majority of teachers in each group (75 percent) taught classes of gifted and highly able students most of the time. The teachers were likely to have advanced training at the master's level or equivalent (71 percent of A_1 and 50 percent of A_2). The majority had taken some college level course work in mathematics (79 percent of A_1 and 86 percent of A_2). Very few had taken any courses specifically in the gifted (29 percent of A_1 and 14 percent of A_2), but over half had attended at least one workshop on the subject (57 and 64 percents, respectively).

The teachers were asked several questions about their general classroom management and instructional style, their conception of mathematical giftedness, and their views about sex differences in mathematical achievement. They were asked if they remembered having done anything special to help the student who had nominated them.

The responses relating to management and instructional style are summarized in Table 71. As can be seen in this table, the two groups of

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Insert Table 71

Table 71: Classroom behaviors in percents of teachers nominated by two groups of mathematically gifted girls as having had positive influences on them

	Teachers of A_1 N = 14	Teachers of A_2 N = 14
Types of grouping utilized:		
Large group	85.7	78.6
Small group	85.7	85.7
Individualization	100.0	64.3
Career awareness integrated into curriculum	57.1	85.7
Enrichment activities included in curriculum	100.0	92.9
Permit students to work ahead in the book or work in more advanced books	78.6	71.4
Special arrangements for highly gifted made	85.7	100.0
Special activities for girls included	28.6	21.4

teachers are very similar so most of the discussion of their characteristics will be of the total group. The teachers used a combination of small and large group instructional techniques, and all of A_1 and 64 percent of A_2 teachers believed that they individualized instruction for students even within very homogeneous classes for gifted or highly able students.

More than 70 percent of the teachers included discussion and/or activities related to careers in mathematics in their classes. The frequency of these activities ranged from "almost constantly" to twice a year. Activities varied from informal spontaneous discussions to carefully planned career curriculum. Guest speakers, audio-visual materials, field trips, written and oral research reports, interviews, and simulation games were methods used by the teachers for the career units. A few teachers reported that their school had a separate career program and/or they had very limited time in the enriched or accelerated classes and therefore did not incorporate career information in their classes.

All but one teacher said that they used enrichment activities in their classrooms. In some cases, the entire class time was considered to be a special class for enrichment. In "regular" classrooms, time spent on enrichment activities varied from as little as 10 percent to as much as 50 percent. Some teachers' responses to how often they enrich their classes included: everyday for part of the class, once a week, 10-20 times a year, one week per quarter, two reports a year, four projects a year, a one-month long project, 30 percent of the time, and five times a year. Almost all the nominated teachers reported using games and puzzles frequently for enrichment (100 percent of the A_1 teachers and 93 percent of the A_2 teachers). Answers were similar for the two groups, with architecture, number theory, statistics, graphing, trigonometry, geometry, logic, the stock market, metric system, calculator, computer, history of mathematics, measurement, probability, topology, and math-art projects mentioned by at least two teachers. In some cases, topics mentioned as enrichment may have been considered acceleration by other nominees. The following statement illustrates this mingling of enrichment and acceleration, "My idea of enrichment is not to put them in a corner and give them a project, but to study math more rigorously."

Teachers were asked to define "mathematically gifted." Almost half of the nominees (13 of 28) specifically mentioned the ability to understand abstract relationships and/or having insight into mathematical concepts as attributes of the mathematically gifted. No other answer was widespread. Excellent problem solving ability, motivation, standardized test performance, and creative thinking ability were also mentioned by two or more nominees as traits of the mathematically gifted, as well as the abilities to recognize patterns and to approach a problem in more than one way, not being afraid of a challenging problem, not being dependent on memorized algorithms, finding unique solutions to problems, and being able to proceed in problem solving without much teacher direction. Several of the teachers' definitions of the term "mathematically gifted" follow:

> The ability to take abstract concepts, to visualize them or verbalize them. Able to explore in depth these abstract concepts. Ability to think without the concrete. See beyond what is evident.

> Kids who have an intuitive sense of math. They can visualize how things work. They can figure a way to get started on a problem. They aren't afraid of it.

> Someone who gets it, expands upon it, eats and breathes it and applies it. Can apply math to everyday life. Math is a tool not an end in itself.

All of the nominees thought that they could readily recognize the children in their classes who are mathematically gifted. Half of them felt that general observation of class performance was the way they identified these students. Observing motivation, interest, and/or enthusiasm was mentioned by seven teachers; observing students' quickness to grasp new concepts and problem solving ability were each listed by five teachers; and "by the types of questions they ask" was given in four responses. One teacher included "talking to parents and previous teachers" as a method she uses to recognize the mathematically gifted students in her classroom.

Only 21 percent of the teachers cited test scores as a method for identifying mathematically gifted youngsters. When test scores were mentioned, it was suggested that they served as confirmation of the teachers' judgment , not as the primary identification mechanism. This is especially interesting in view of the research indicating the value of test scores as opposed to teacher nomination for identifying mathematically able students (Fox, 1981).

In describing the ideal learning situation for mathematically gifted students the teachers' opinions varied somewhat. Interaction with intellectual peers was considered necessary by half the nominees. Only one teacher indicated a preference for heterogeneous grouping. About one-third of the teachers believed a small group of students desirable, while 10 percent of the teachers would want twenty or more students in a homogeneous group for better interaction. Other suggestions made were that students should work independently, or get special tutoring.

The "ideal" teacher was described in many ways as well. More of the teachers (21 percent) cited competence and an excellent mathematics background as the most important factor for a teacher of mathematically able students than any other single answer. One-quarter of the teachers had courses in mathematics up to calculus or beyond, but several teachers reported taking no mathematics after high school. Teachers who give attention to social-emotional growth and teachers who facilitate rather than instruct were each suggested as characteristics of an ideal teacher by 10 percent of the teachers. Only one teacher mentioned that a sense of humor was important.

The ideal program as described by the nominees varied so much it was difficult to categorize. One suggested the ideal program should be highly structured, another as unrestricted as possible. Presumably, most of the teachers did not feel the structure of the program mattered at all. Respondents suggested team teaching, flexible time, and allowing one teacher to follow a group of children for more than a year (10 percent for each option) as administrative ideals. Almost half (13) of the 28 teachers specifically endorsed allowing the student to advance in subject matter. Enrichment activities that were mentioned were varied and no activity was specifically mentioned by more than two respondents. Some of the enrichment preferences were open-ended problem solving, the opportunity to teach as well as learn, elimination of textbooks, emphasis on concepts, computer programming, mastering basics first, projects, and field trips. Some sample replies follow:

> ...With intellectual peers and extremely competent teachers who can see them as not only precocious but as children.
>
> Teach the child, not have him sit alone with a book or machine. The gifted student enjoys rapport with teacher and interaction with other students. Plenty of problems and projects to work on related to what was taught.
>
> A book and a quiet room; I'm not sure we do these kids any harm by our daily activities, but I'm not sure we wouldn't serve them well by leaving them alone.

All but two respondents indicated that they make special arrangements for extremely mathematically gifted students. Acceleration alternatives were suggested by almost one half the teachers. Teachers who teach older elementary and/or middle school children specifically mentioned providing algebra instruction early. One fourth of the teachers said they individualize the program by encouraging independent or small group work and others provide enrichment materials. Some teachers reported that they encouraged students to participate in special programs such as clubs, contests, and summer courses and two even spent their own time working with advanced students and contacted parents to involve them in planning appropriate action for their children.

When asked to think of ways in which they specifically encourage gifted students in mathematics, the nominated teachers' responses can be categorized into four themes (listed in order by frequency of responses): (1) making the class enjoyable, exciting and creating a positive atmosphere; (2) recognizing the students' talents, building their self-confidence, and showing them they are special; (3) showing a personal interest in the student, being a friend to them, and talking with them; (4) challenging the students with interesting materials and problems.

The majority of the A_1 teachers (79 percent) and half the A_2 group felt that girls did not need more encouragement than boys to excel in mathematics. The reasons they gave included (1) a feeling that the girls worked harder than the boys, (2) that expectations of parents and school for girls is higher than in the past, and (3) that there is more general awareness of the issue of sex differences. One male elementary school teacher did say he tried very hard to instill the desire to excel in the girls "while they were still competitive...before they are interested in boys".

Those teachers who believed that the girls do need more encouragement than the boys explained their position by saying that bias still exists in society, and schools, and is reflected in differential parental expectations. Some noted that boys are more aggressive in mathematics classes while girls tend to be quiet, inhibited, lack self-confidence, and are reticent to show their talents. The girls prefer safety to experimentation and become frustrated by difficult work.

One quarter of the nominees indicated that they do something special for the girls in their classes. They give the girls special encouragement to take more mathematics and to consider math-related careers, bring professional women into the classroom as role models, or try to gear some activities to girls' special interests. One teacher confessed that although he thought it probably wasn't right, he was more lenient with the girls. The teachers who did not do anything special for girls felt that they wanted to treat all students equally and/or look at the individual student not the sex of the individual.

When asked if they remembered doing anything special for the girls who nominated them, most teachers mentioned very general things like being a friend to the girl or recognizing her efforts. Three teachers mentioned getting extra material for the student, while two had stayed after school to work with the girl. One nominee had tutored his student privately to help her prepare for the SAT as a seventh grader. Although he said he rarely does it, one teacher reported recruiting the girl for the math team. Two teachers remember the girls as members of outstanding and enjoyable classes.

Four teachers of students in the A_1 group and one former teacher of an A_2 girl specifically mentioned that the particular girl who had nominated them was lacking in self-confidence. The girl was described as "having an inferiority complex", "a very quiet student who had been thought of as a lazy underachiever", "lacking in confidence", "low self-confidence, needed to be pushed to achieve". One teacher said he didn't do anything special except that he would not allow the girl who nominated him to drop-out when she wanted to during the first week of class. He felt she could do the work and kept her at it. Although he did not see himself as doing anything special, he clearly went out of his way to pep up this girl when she needed it.

These perceptive teachers did not necessarily feel special activities had to be planned for girls in general but they noticed the needs of the girls in their class. That even five of these girls of such outstanding ability should have lacked confidence in themselves in mathematics indicates that, despite the equal achievement and test scores, girls may need special encouragement if they are to achieve to their potential in mathematics. Most teachers, however, did not indicate that they had sensed anything special about the particular girl, nor did they report special efforts to encourage the particular girl more than her classmates.

SUMMARY AND CONCLUSIONS

If the numbers of women in high level careers in mathematics, the physical sciences and engineering are to increase, young girls who have demonstrated ability must be encouraged to prepare for and pursue these careers. Since mathematically gifted girls appear to be less eager to accelerate their study of mathematics and less interested in many careers in the sciences than their male counterparts, it is important to search for social factors that may inhibit or enhance the development of interest and motivation. The present study addresses the following six broad questions:

1. What relationships exist between mathematical abilities and interests and socio-economic and family constellation variables such as education or occupation of parents, birth order, and sex of siblings.

2. In what ways are mathematically able boys and girls alike and different with respect to such variables as self-confidence, willingness to take educational and intellectual risks, perception of usefulness of the study of mathematics, enjoyment of mathematical activities, career interests, and access to positive role models? What are the relationships between these variables?

3. How do mathematically able youths perceive the support they receive from parents, teachers, and peers? Are perceptions of support independent of socio-economic and family constellation variables and are they different for boys and girls?

4. How do parents think they have fostered the development of mathematical interest and skills? Do parents consider mathematics more appropriate for men than women?

5. Do mathematically able boys and girls learn mathematical and related skills at home before entering school or before topics and skills are taught in school? Who teaches them? Are there differences between boys and girls or between girls high and girls low on measures of interest?

6. What are the characteristics, attitudes, and behaviors of teachers who are perceived by highly able girls as having had a positive influence on the development of their self-confidence and interest in the study of mathematics and/or related careers?

In order to answer these questions five groups of mathematically able students and their parents were asked to complete a set of questionnaires. The survey instruments included a mixture of open-ended questions, check-lists, and scales of Likert items adapted from the Fennema-Sherman Mathematics Attitude Scales. The five groups were chosen as follows:

A_1 The universe of girls who scored $\geq$ 500 on SAT-M as 7th graders in the 1979 Talent Search and who were considered to be highly motivated on the basis of their having accelerated their learning of mathematics. This included primarily girls who participated in an accelerated summer mathematics program offered by The Johns Hopkins University.

A_2 A sample of girls who scored $\geq$ 500 on SAT-M as 7th graders in the 1979 Talent Search and who were considered to be not as highly motivated as A_1 on the basis of their turning down the opportunity to accelerate their mathematics learning in the summer at The Johns Hopkins University.

B_1 A sample of boys who scored $\geq$ 500 on SAT-M as 7th graders in the 1979 Talent Search and who were considered highly motivated on the basis of accelerating their learning of mathematics.

B_2 A sample of boys who scored $\geq$ 500 on SAT-M as 7th graders in the 1979 Talent Search and who were considered not highly motivated on the basis of their turning down an opportunity to accelerate their mathematics learning.

C The universe of girls from the 1980 Talent Search who scored at or above 500 on the SAT-M, but who appeared to have low interest in mathematics and high interest in the humanities.

Results: Question 1

No significant differences were found among the five groups on measures of socio-economic and family constellation variables. Nor were these variables predictive of attitudes and interests across the groups. The typical student was the oldest child of a two or three child family that could be described as upper-middle class with well educated parents and fathers employed in either professional or public service careers or middle to high level management positions.

Results: Questions 2 and 3

Significant differences were found between groups on some measures of students' attitudes and interests, parental support, and students' perceptions of support from significant others. These results are summarized in a series of group by group comparisons. Comparisons between A_1 and A_2 and between A_1 and C should seek to explain the reasons why A_1 girls but not A_2 or C girls were willing to accelerate their study of mathematics. Differences between A_1 and C that are also found for A_2 and C should relate to the development of enjoyment of mathematics and career interests. A question of interest is whether or not the factors influencing students' willingness to accelerate are the same or different for boys and girls and therefore B_1 boys are compared with B_2 boys. These first sets of comparisons deal with identifying factors that influence behavior and interest. The last sets of comparisons involve the question of gender-based differences. Will the A_1 and B_1 groups be more like each other than they are like A_2 and B_2, respectively; or will there be differences between A_1 and B_1 that also occur in comparisons of A_2 and B_2?

A_1 compared with A_2

Although the girls in A_1 were considered to be more motivated than girls in A_2 because they had accelerated their study of mathematics significantly more than had A_2 girls, the A_1 and A_2 girls did not differ on any of the measures of attitudes or interests. More girls in the A_2 group than the A_1 group, however, reported discussing their career choice with someone in that field.

There were a few significant differences between the two groups on variables related to parents' support and perceived support from significant others. The A_1 girls were more likely than A_2 girls to see their fathers as having ability in mathematics and more fathers of A_1 than A_2 girls described themselves as mathematically able. Fathers of A_1 were more likely to report that they fostered their daughter's enjoyment of mathematics. Mothers of A_1 girls reported more help with homework from the fathers than was reported for fathers by A_2 mothers. Fathers of A_1 girls had higher levels of expectation with respect to educational attainment of their daughters than A_2 fathers and A_1 fathers were far more likely to desire a career in mathematics or the sciences for their daughters than were A_2 fathers. Mothers of A_1 girls were more likely than A_2 mothers to be favorable towards acceleration, to be perceived as favorable towards acceleration by their daughters, and to desire their daughters to pursue a career in mathematics or the sciences. The A_1 girls were less likely than A_2 girls to see their mathematics teachers as encouraging their enjoyment of mathematics and their study of mathematics at school.

A_1 compared with C

The C group were chosen for their presumed low level of interest in mathematics and they did indeed differ from A_1 girls on many measures of attitude and interest. The C girls reported less self-confidence in their mathematical ability, less enjoyment of mathematics, less usefulness and more stereotyping of mathematics than girls in A_1. The C girls were far less likely than the A_1 girls to aspire towards a career in mathematics or the sciences and less likely to perceive the lack of women or role models as a barrier to career choices in the sciences and mathematics.

Fathers of the A_1 girls reported more confidence in their daughters' abilities in mathematics, more support for educational risk-taking and acceleration than fathers of C girls. The A_1 fathers reported higher levels of expectation for the educational attainment of their daughters and were more likely to desire a career in the sciences or mathematics for their daughters than fathers of the C group.

Mothers of A_1 girls were more likely to be favorable toward risk-taking and acceleration, and perceived so by their daughters than mothers of C girls. The mothers of A_1 girls expected higher levels of educational attainment and were more likely to desire a career in mathematics or the sciences for their daughters, to report havng encouraged such a career choice, and to expect the girls to actually pursue one than mothers of C girls.

The girls in group C were more likely than girls in A_1 to perceive their teachers as encouraging their study of mathematics at home and in school.

A_2 compared with C

Even though the A_2 girls were no more likely to be advanced in their study of mathematics than the C girls, A_2 girls did report more self-confidence in their mathematical ability, more enjoyment of mathematics, more activities of a mathematical nature when with friends, more interest in mathematical or scientific careers and greater usefulness of mathematics for their futures and less stereotyping of mathematics than girls in C.

The girls in group C were more likely than girls in A_2 to see their father as having mathematical ability and the C fathers reported more interest in mathematics than A_2 fathers. Mothers, fathers and girls in group C were more likely than mothers, fathers and girls in group A_2 to see the father as helping with mathematics homework. The A_2 fathers were slightly more supportive of risk-taking behavior, however, than were C fathers.

Although mothers of A_2 girls were more likely to expect their daughters to choose a career in mathematics or the sciences, they were not more likely to desire such a career for the da ghter. Mothers of A_2 girls were less favorable towards acceleration than mothers of C girls. The girls in group A_2 perceived their mothers as being more supportive of self-confidence in mathematics than did the C girls.

The girls in C reported more encouragement from teachers for studying mathematics at home than did girls in A_2.

B_1 compared with B_2

Although B_1 boys were considered to be more motivated than B_2 boys because the B_1 boys were more accelerated in their study of mathematics, on measures of attitudes and interests there were only two significant differences. More B_1 boys than B_2 boys reported engaging in mathematically related activities alone in their leisure time. The B_1 boys were also more likely than B_2 boys to have discussed their career choice with someone employed in that field.

There were no differences in reports by the fathers. The B_2 boys did, however, report more support from fathers for the enjoyment of mathematics than did B_1 boys,but the B_1 boys saw their fathers as more supportive of acceleration than B_2 boys saw their fathers. Mothers of B_1 boys were more supportive of educational risk-taking than were the mothers of B_2 boys. Mothers of the B_1 group also recalled more evidence of precocity and the child's study of mathematics on their own in the pre-school and early childhood years than did mothers of the B_2 boys. More boys in B_2 than B_1, however, felt their mothers played games with them and supported learning in school.

The B_2 boys reported more support from teachers for self-confidence in mathematics than B_1 boys. The boys in B_1 also reported less encouragement from teachers for a career in mathematics and sciences than did the B_2 group.

Group differences related to behavior and interest

A few significant differences between the A_1 and A_2 groups were also found between A_1 and C. They were:fathers' educational expectations for daughters, fathers' desire for a career in the sciences for the daughter, mothers' support of acceleration,and mothers' desires for careers in science for daughters. Although both the A_1 and A_2 groups differed from C girls on variables such as self-confidence, enjoyment, usefulness of mathematics, perceptions of mathematics as a male domain and scientific or mathematical career choices, the pattern of differences on variables related to the support from significant others for A_2 and C was not similar to differences between A_1 and A_2 or between A_1 and C.

The only differences between A_1 and A_2 which were also found for B_1 and B_2 were the perceptions about teachers such that A_2 and B_2 students felt they received more support than A_1 or B_1 but not on the same specific variables. The only differences between A_1 and C and between A_2 and C that were also found for B_1 and B_2 comparisons were the perceptions of more support from teachers by the C, A_2 and B_2 groups.

Thus, the fact that the A_1 girls accelerated their programs in mathematics significantly more than girls in A_2 or C may have resulted from encouragement for acceleration from their parents because both parents saw careers in mathematics and the sciences as desirable and because the mothers were favorable toward acceleration and risk-taking, and the fathers expected high levels of educational attainment for their daughters. Since the data was collected after the girls had already accelerated, this interpretation must be tempered with the possibility that these attitudes of the parents developed after their daughter's successful acceleration experience rather than that they fostered it. No differences were found, however, in the attitudes of B_1 and B_2 boys who differed in acceleration experiences. Since girls presumably should require more parental support for "atypical" risk-taking behavior such as accelerating in mathematics the hypothesis of strong parental support before the acceleration experience for A_1 girls is more appealing.

If no comparisons had been made between the A_2 and C groups, it might have appeared that differences in attitudes and career interests found between A_1 and C girls were the result of parental influences. Such is not the case. The A_2 girls were like A_1 and different from C girls with respect to the variables of career interest and enjoyment and usefulness of mathematics, yet the differences on support and perceived support from parents were not consistent across the groups in expected directions.

The network of intercorrelations of the attitudinal measures for girls and boys, respectively, suggests that the relationships among attitudes may not be the same for boys and girls. Caution must be taken in this respect as the samples are small and there is less variance among the boys on the attitudinal measures such as self-confidence. Nonetheless, one can speculate that mathematically able boys have relatively high levels of self-confidence and this is not significantly related to their behavior with respect to acceleration or career interest. Girls who are able do vary on self-reports of confidence in their mathematical ability, and the girls who express the most confidence also express other positive attitudes towards mathematics and scientific careers. Expressed confidence in mathematics may or may not relate to acceleration behavior. The A_1 girls were more confident than C girls but not more so than A_2.

A_1 compared with B_1

The highly able and presumably most motivated girls differed significantly from their male counterparts in several ways. First, the A_1 girls expressed lower levels of self-confidence in mathematics than the

B_1 boys. Significantly more B_1 boys than A_1 girls reported mathematical activities either alone or with friends in their leisure time. Indeed, boys recalled more learning of advanced mathematics topics on their own outside of school, and significantly more boys than girls reported learning computer programming on their own. Although the proportions desiring an investigative career were the same in each group the choices of the girls but not the boys reflected an interest in medical careers. Girls, but not boys, expected to interrupt their careers or take part-time work in order to combine career and child-rearing roles. Boys knew more role models of the same sex for careers in the sciences and were more likely to know someone in their specific career choice area and have spoken with that person about the career than girls. Boys' responses on the mathematics as a male domain scale were somewhat more sex-role stereotyped than those of the A_1 girls.

More B_1 boys saw their fathers as more favorable towards early entrance to college than A_1 girls but more A_1 than B_1 boys reported paternal encouragement of enjoyment. There were no differences between B_1 boys and A_1 girls in terms of parental reports of support or students' perceptions of support. More mothers of B_1 boys than A_1 girls reported recognizing the fact that their son was mathematically gifted in the pre-school years. The A_1 girls were often not recognized by their mothers as talented until they were identified in the Talent Search at grade seven. Fathers of B_1 boys recalled more spatial play by their sons in the pre-school and early childhood years than did fathers of A_1 girls. This is interesting because the

A_1 and B_1 groups did differ on a test of mechanical ability but not on tests of abstract reasoning or spatial visualization ability. Significantly more mothers and fathers of A_1 girls than B_1 boys expected their child to interrupt their career or work part-time while raising small children.

A_2 compared with B_2

Career choices and plans of A_2 girls differed from those of B_2 in that girls mentioned medical careers more than boys; and girls, but not boys, expected to need time out or a reduced career role for child rearing purposes. Boys knew more men employed in science related careers than girls knew women. The B_2 boys reported somewhat more stereotyped responses than A_2 girls as to mathematics as a male domain scale. There were no group differnces on variables related to self-confidence, enjoyment, usefulness of mathematics or mathematical activities alone or with friends.

Fathers were perceived as mathematically able by more B_2 boys than A_2 girls, and more fathers of B_2 boys desired a science career for their child than fathers of A_2 girls. Fathers of A_2 but not B_2 expected the child to need a reduced career load for child-rearing purposes.

Mothers of B_2 boys had noticed the mathematical ability of their son at an earlier age than had mothers of A_2 girls. Mothers of B_2 were perceived as more supportive of acceleration by their sons than were mothers of A_2 girls by their daughters. More mothers of B_2 boys desired a career in the sciences for their child. The A_2 mothers but not B_2 mothers believed their child would need time out or a parttime career for child-rearing duties.

Girls in A_2 reported more support from friends for studying mathematics in school than did B_2 boys.

Gender differences

Differences found from comparisons of girls with boys were on items relating to career interest, access to role models, and the perception of mathematics as a male domain. Parents of girls in both groups differed from parents of boys in both groups only in that mothers of boys reported having noticed ability in their sons at a much earlier age than mothers of girls, and both mothers and fathers of girls, but not boys, expect child-rearing responsibilities will necessitate a reduced or interrupted career plan.

The reason some mathematically able girls are interested in careers in medicine may be because they have strong social service drives, but it is also possible that this career choice reflects their concern with the problems of combining careers and family responsibilities. Perhaps the girls and their parents feel that there would be more flexibility in the medical professions than in careers in engineering or computer science. Access to same sex role models would not seem to be a factor in that girls were not more likely to know women physicians than women engineers or computer scientists.

What set A_2 girls apart from both B_2 and A_1 groups were the least frequent perceptions of the father as mathematically able and the lower percentages of both parents who desired a career in the sciences for their child. The B_1 boys were unique from both A_1 girls and B_2 boys because they engaged in more mathematical activities alone in their leisure time and were more likely to have discussed career plans with an adult employed in that career.

Results: Questions 4 and 5

A major weakness of the study is the reliance on retrospective recall of parents. The actual lives, home environments and experiences of the students may or may not have been accurately described. Clearly reports of mothers, fathers, and children within the same family were not always identical. Overall students tended to credit their parents with somewhat less involvement or encouragement. This trend was statistically significant on some variables for the boys, particularly those in the B_1 group. Since parents, especially mothers, often answered the questions in terms of their behaviors in the pre-school and early childhood years it is possible that students have forgotten or were not very aware of their parents'efforts at that age. Parental recall of direct help or teaching was not very common.

In general the accounts from parents and students portray the homes as ones in which the children are nurtured in a warm, supportive environment for learning. Children are most often remembered as having learned mathematical concepts and skills on their own or in a very informal way in interacting with a parent or older sibling, sometimes within the context of playing games. Parents tended to describe themselves as generally supportive of the child's total intellectual development and interests as opposed to recalling special efforts to foster interests in mathematics.

There appeared to be no significant differences in reports of home learning across the three groups of girls. Boys did, however, seem to recall more self study of advanced topics in mathematics, computer programming and more general activity related to mathematics outside of school. This was most striking for B_1 boys.

Although parents did not appear to stereotype mathematics as a more masculine than feminine activity, parents of boys and A_1 girls were more likely to say they would choose a mathematical or scientific career for their child than parents of C and A_2 girls. In the case of the C parents it may be that they were simply reacting to what they believed to be a real lack of interest in those careers on the part of their daughter as opposed to a negative feeling about those careers as appropriate for women.

The greatest difference in parental responses were to the questions about interrupting a career or working part-time. Most parents of girls, but not boys, volunteered the response that this would be necessary for child-rearing purposes. Thus, most of these girls are hearing their parents express the expectations that motherhood is a responsibility that interferes with careers while boys are not told that parenting demands will affect their careers.

Results: Question 6

Teachers nominated by girls in A_1 and A_2 as the teacher they felt had had a positive influence on their interest or enjoyment in mathematics were interviewed. Teachers' responses to questions about their classroom management style, definitions of mathematical talent, and sex differences in mathematics varied such that there was no single trend nor were there noticeable differences in responses of teachers nominated by A_1 girls as compared with those named by A_2 girls. The majority of teachers did report including career activities and/or guest speakers on careers as a general practice and all but one teacher nominated by an A_2 girl used games and puzzles as enrichment of mathematics.

Although all the girls are extremely talented in mathematics as evidenced by their performance on the SAT-M in grade seven, they had not been viewed as unusually gifted or unique by the teachers. They were more likely to have been remembered as a good student within a class of very able students. Four of the A_1 girls and one A_2 girl were, however, remembered as having low levels of self-confidence and needing some encouragement. A few other examples of special attention were cited such as recruiting a girl for the math team or providing extra materials in class for the student. For the most part, however, the teachers did not recall singling-out the student for any encouragement beyond what they tried to provide for all students.

All of the teachers appeared to be dedicated to their profession and very positive about working with students and the teaching of mathematics. Indeed as a group these teachers probably make more effort to emphasize the relevance of mathematics and foster the enjoyment of mathematics than would be found in a typical classroom.

Implications for Research and Intervention

On the basis of this study of five samples of very mathematically able girls and boys, there appear to be only a few differences in the attitudes and experiences of these students and the attitudes or behaviors of their parents or teachers that suggest some of the social processes that may influence the development of interest in pursuing scientific careers or accelerating the learning of mathematics at home or school.

Perhaps the two most important findings in terms of further research and intervention are those relating to the possible importance for girls of self-confidence in one's mathematical ability and the perception of possible conflict between family responsibilities and careers for girls but not for boys. Clearly more research is needed to understand the factors in the classroom that may impact the development of confidence in one's mathematical abilities. It would be interesting to see whether or not self-confidence is actually lowered for girls after a successful acceleration experience when they are in a somewhat competitive situation with very able boys. It would also be interesting to know whether or not gifted girls who score lowest on measures of self-confidence in mathematics would also score lowest within this group on measures of self-confidence for other subjects or other aspects of their lives.

Long-term follow-up of these students may eventually provide more insight into how the attitudes and experiences in the early and middle school years predict eventual course-taking in mathematics in high school and college, college majors, career attainments, and life-style arrangements. In 20 years how will the A_1 girls be alike and different from the A_2, C, B_1, and B_2 groups?

One may well speculate that the only major differences between these gifted boys and girls that will influence career choice and attainment is the societal demand or expectation for greater maternal than paternal responsibility for child-rearing. Unless there are some extensive changes in child-care and child-rearing values and practices many of these gifted girls are likely to gravitate away from professional careers that are perceived as either too demanding or too inflexible in terms of the dual role.

The most immediate direction for "intervention" to increase gifted women's participation in professional careers in the sciences would seem to be to bring these girls together for career exploration and counseling. They need to see and talk with adult women who are successfully coping with the demands of both family and careers. Clearly, the path to career attainment and success must be viewed with the realities of the dual-role problem. Career awareness experiences of this type should perhaps not be limited to girls. Boys may need to become more sensitive to the problem and encouraged to increase their paternal responsibilities and lobby for more flexible work arrangements for both parents. It also may be necessary to provide guidance for parents of able girls. Some parents may inadvertently send "double messages" to girls as a result of their own confusion about the career realities for their daughter. This may counter their otherwise general support and encouragement.

Although there is no evidence that mathematically gifted boys in this study received more support from parents (and indeed the B_1 boys often reported the least awareness of any support from parents or teachers) than gifted girls in any of the three groups, it may well be that girls need extra support to counteract stereotypic thinking of others. They are probably aware, for example, that their gifted male counterparts hold somewhat more stereotyped views about women and mathematics than they do themselves. Steps must be taken to encourage these highly able girls to develop their talents to the fullest and to help them at the least to look closely and seriously at the career opportunities in scientific and technical fields. The responsibility for such efforts should perhaps be divided among parents, teachers, counselors, and professional and scientific organizations. The special guidance needs of gifted and talented girls and their parents must not be ignored if women are to ever attain parity in the scientific professions.

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APPENDIX *

*Includes samples of the Student, Parent and Talent Search Questionnaires

Date_______________

QUESTIONNAIRE TO STUDENT PARTICIPANT
IN 1980 TALENT SEARCH

Name_______________________________ Age______ Grade (1979-80)________

Address_______________________________ County__________

City______________ State______________ Zip Code__________

Phone #______________ Social Security #______________

If you need more space to answer a question, please continue on the back of the paper.

Please do not discuss the answers on this questionnaire until after you have completed it. We are interested in your remembrances.

Thank you.

Part I: Biographical Inventory

1. What mathematics course(s) are you currently taking?______________________________

____

2. What mathematics course(s) do you plan to take next year?______________________________

____

3. What is the highest level of education you expect to complete? (Check one)

_____bachelor's degree level

_____master's degree level

_____doctoral level

_____other (describe) ______________________________

4. Please describe any experiences with teachers (Note grade you were in at the time if you remember) that have encouraged or discouraged your:

A. Self-confidence in learning mathematics

B. Enjoyment of mathematics

C. Interest in a mathematical or scientific career

5. If you recall a particular teacher who had a positive influence on the development of your interest in and learning of mathematics, please give us as much of the information below as you can.

Teacher's name______________________________

Grade you were in when you had him/her______________________________

Subject(s) teacher taught you______________________________

School and/or home address where we may be able to contact the teacher

____

____

6. Please describe any <u>programs</u> in which you have participated (note grade you were in at the time if you remember) that have <u>encouraged or discouraged</u> your:

A. Self-confidence in learning mathematics

B. Enjoyment of mathematics

C. Interest in a mathematical or scientific career

7. Please describe any ways in which your <u>friends and classmates</u> have <u>encouraged or discouraged</u> your:

A. Self-confidence in learning mathematics

B. Enjoyment of mathematics

C. Interest in a mathematical or scientific career

8. Please describe any ways in which your <u>parents</u> have <u>encouraged</u> your:

A. Self-confidence in learning mathematics

B. Enjoyment of mathematics

C. Interest in a mathematical or scientific career

D. Learning of mathematics

9. For each of the items below, indicate the person(s) with whom you strongly associate each of the feelings and behaviors described in items A-M by placing a (✓) in the appropriate column(s). You may check more than one column for an item. If "other", write in the person (for example, write Brother.) If the statement applies to no one, leave it blank.

Feelings & Behaviors	mother	father	current math teacher	your friends	other
A. Encourages your enjoyment of mathematics					
B. Encourages your self confidence in math					
C. Encourages your studying math in school					
D. Encourages your studying math at home					
E. Encourages your interest in a math related career					
F. Encouraged you to be in the Talent Search					
G. Favors accelerating your study of math					
H. Favors your skipping a grade					
I. Favors your entering college one year or more early					
J. Shows a strong interest in mathematics					
K. Is unusually good at mathematics					
L. Helps you with your mathematics homework					
M. Plays games or puzzles of a logical or mathematical nature with you					

10. When you have free time and are alone, what are you most likely to spend your time doing? Please list five activities to which you most often devote your free time.

1.
2.
3.
4.
5.

11. When you are with friends, what activities do you do most often together? Please list five.

1.
2.
3.
4.
5.

12. Do you engage in mathematical/scientific activities like puzzles or games with your parents in your leisure time? yes_____
If yes, describe the activities and how often you do them. no _____

13. Overall, either alone or with friends or parents, how often do you engage in mathematical activity or study not assigned for school (include mathematical games, puzzles, problems, study of a math textbook on your own, etc.)
(Circle the letter of the appropriate answer.)

A. Almost every day.

B. At least once a week.

C. At least once a month but less than once a week.

D. Several times a year.

E. On very rare occasions or never.

14. Prior to the Talent Search, had you done any work in the following areas?

A. Algebra I topics. yes_____
no _____
If yes, describe how you learned the topics.

B. Computer programming. yes_____
no _____
If yes, describe how you learned the topics.

C. Geometric Theorems. yes_____
no _____
If yes, describe how you learned the topics.

15. Describe any mathematical skills or ideas you remember learning at home by yourself before you normally would have learned them in school.

16. Describe any mathematical skills or ideas others taught you before you normally would have learned them in school, and indicate who taught you (such as mother, teacher in a special program, etc.)

17. Below is a list of careers. Do you know people who are employed in these fields with whom you could talk about their jobs and perhaps the training they received to prepare for their jobs? Check the appropriate column to indicate if the person you know is male or female or if you know people of both sexes in that career. If you know no one, leave it blank.

Career	Male Only	Female Only	Both Male & Female
chemist			
engineer			
historian			
lawyer			
psychiatrist			
musician			
physician			
accountant			
artist			
astronomer			
librarian			
banker			
architect			

Career	Male Only	Female Only	Both Male & Female
psychologist			
writer/journalist			
computer systems analyst			
veterinarian			
actor/actress			
actuary/statistician			
biological scientist			
archeologist			
social worker			
mathematician			
business executive			
politician			
college professor			

18. Have you ever discussed careers with any of these people? yes____
If yes, which careers. no ____

19. Did any of the people you talked to influence you for or against that career? yes____
If yes, please indicate the career and describe how you were influenced. no ____

20. What is your major career interest? ______________________

Do you know someone employed in that field? yes____
no ____

Have you talked to them about their career? yes____
no ____

21. If it were not financially necessary for you to work, would you still want to have a career? yes_____ no _____

Why?

22. Do you expect there will be some times in your life as an adult when you will want only a part-time career or no career at all? yes_____ no _____

Describe when and why.

23. In the past, fewer women than men have pursued careers in mathematics, science and engineering. The reasons listed below have been mentioned as factors contributing to this. Indicate whether you think these reasons constitute serious problems, minor problems or no problem to most mathematically talented girls today by placing a (✓) in the appropriate column.

	NO PROBLEM	MINOR PROBLEM	SERIOUS PROBLEM
Long years of formal preparation required			
Possible conflicts combining a career and family responsibilities			
Perception of women majoring in engineering or sciences as unfeminine			
Lack of encouragement from teachers and counselors			
Perception that the work will be more difficult than they can handle			
Lack of information about careers in science, and mathematics			
Lack of contact with women employed in those fields			
Perception of scientists and engineers as cold and impersonal			

24. Suppose you and four classmates in your high school are ready for an advanced placement calculus course. The school says they can not provide a teacher for such a small class. They offer two alternatives: first, students can take a calculus course at a nearby college on released time from high school, or second, students can do self-paced independent study during a study hall using the advanced placement course syllabus. What would you choose to do? (Circle the letter of the choice you would prefer of the choices listed below.)

A. Elect to take the college course

B. Elect to do the self-paced mathematics program

C. Take no mathematics

Why did you make the above choice?

Which behavior would others recommend for you? (Put the letter of the option by each person)

_____ your mother　　　_____ current mathematics teacher

_____ your father　　　_____ most friends of the same sex

25. Suppose the other four students all chose to take the college course. What would your choice be in that situation? (Circle the letter of the choice you would prefer.)

A. Elect to take the college course

B. Elect to do the self-paced mathematics program

C. Take no mathematics

26. Suppose the other four students all chose to do the self-paced mathematics program. What would your choice be in that situation? (Circle the letter of the choice you would prefer.)

A. Elect to take the college course

B. Elect to do the self-paced mathematics program

C. Take no mathematics

27. Suppose the other four students all elected to take no mathematics. What would your choice be in that situation? (Circle the letter of the choice you would prefer.)

A. Elect to take the college course

B. Elect to do the self-paced mathematics program

C. Take no mathematics

28. Assume you are about to enter the last year of middle school or junior high school. You have already completed the mathematics courses offered by your school. In order to take mathematics this year which of the following alternatives would you prefer assuming they were all possible? (Circle the letter next to the statement you prefer.)

A. Skip the final year of middle school or junior high and enter high school early.

B. Stay in the final year at your middle or junior high school but take the advanced mathematics course at the high school the first or last period of your day.

C. Remain in the middle or junior high school and do the advanced course by self-paced independent study.

D. Other: describe ______________________________

Why did you make the above choice?

Which behavior would others recommend for you? (Put the letter of the option by each person)

______your mother ______current math teacher

______your father ______best friend of same sex

29. Assume you are in the 11th grade and have completed all the mathematics courses offered by your local high school. When you begin to plan your program for the following year, which of the following would you prefer, assuming they are all possible? (Circle the letter next to the statement you prefer.)

A. Leave high school at the end of the 11th grade and enter college full-time.

B. Remain in high school but take a mathematics course at a nearby college.

C. Remain in high school and take an elective instead of mathematics.

D. Other: describe ______________________________

Why did you make the above choice?

Which behavior would others recommend for you? (Put the letter of the option by each person)

______your mother ______current math teacher

______your father ______most friends of same sex

30. Suppose there is a very difficult homework problem in mathematics class that you think you may have solved but no one else in your class was able to figure out. The teacher asks for volunteers to put their homework problems on the board. She later collects all the written homework from everyone. What would you be most likely to do in this situation? (Circle the letter of the choice you prefer)

A. Volunteer to solve the problem at the board in front of the class.

B. Keep quiet in class but turn in the difficult problem with the rest of the work.

C. Keep quiet in class and not turn in the difficult problem.

D. Other: describe ______________________________

Part II: Viewpoint Inventory

Name ______________________

On this and the following pages is a series of statements. There are no "correct" answers for these statements. They have been set up in a way which permits you to indicate the extent to which you agree or disagree with the ideas expressed. Suppose the statement is:

Example Statement: I like mathematics. SA A U D SD

As you read the statement, decide if you agree or disagree with it. If you strongly agree, <u>circle the letters</u> SA (which stand for strongly agree). If you agree but with reservations, that is, you do not fully agree, circle the letter A (which stands for agree). If you disagree with the idea, indicate the extent to which you disagree by circling letter D if you disagree or letters SD if you strongly disagree. If you neither agree nor disagree, that is, you are not certain, circle letter U (which stands for undecided). Also, if you cannot answer a question circle letter U.

Circle the letters that correspond to your answer:

SA=Strongly Agree A=Agree U=Undecided D=Disagree SD=Strongly Disagree

(1)	My father thinks calculus will be the most useful course I take in high school.	SA	A	U	D	SD
(2)	I can handle most subjects, but I have a knack for messing up mathematics.	SA	A	U	D	SD
(3)	I don't enjoy working in a mathematics book enough to do it unless it's assigned for school	SA	A	U	D	SD
(4)	My mother doesn't think I am good enough in mathematics to become a mathematician.	SA	A	U	D	SD
(5)	I am sure I can learn calculus.	SA	A	U	D	SD
(6)	When a woman has to solve a mathematics problem it is feminine to ask a man for help.	SA	A	U	D	SD
(7)	A strong mathematics background is very important for my future.	SA	A	U	D	SD
(8)	I think reading science books and magazines is dull.	SA	A	U	D	SD
(9)	My mathematics teacher thinks calculus would not be particularly useful for my future.	SA	A	U	D	SD
(10)	I'm probably not good enough in mathematics to become a real mathematician.	SA	A	U	D	SD
(11)	Mathematics has been my best subject.	SA	A	U	D	SD
(12)	I expect calculus to be the most useful course I could take in high school.	SA	A	U	D	SD
(13)	My mathematics class is boring.	SA	A	U	D	SD
(14)	My mother thinks I will have to study mathematics very hard to continue to do well in it.	SA	A	U	D	SD

Remember: Circle the letters that correspond to your answer:

SA=Strongly Agree A=Agree U=Undecided D=Disagree SA=Strongly Disagree

(15)	I love to play games of strategy such as chess.	SA	A	U	D	SD
(16)	My close friends were surprised at how well I did in the Talent Search.	SA	A	U	D	SD
(17)	My father has always thought I was good in mathematics.	SA	A	U	D	SD
(18)	Accelerating my study of mathematics is not necessary for my future.	SA	A	U	D	SD
(19)	My mother expects me to learn mathematics very easily.	SA	A	U	D	SD
(20)	Most of my friends think studying calculus is not important.	SA	A	U	D	SD
(21)	I have a lot of confidence when it comes to mathematics.	SA	A	U	D	SD
(22)	Males are not naturally better than females in mathematics.	SA	A	U	D	SD
(23)	I feel sure that I need to learn calculus.	SA	A	U	D	SD
(24)	My father strongly encouraged me to enter the Talent Search.	SA	A	U	D	SD
(25)	I don't think studying calculus is as useful as some of my other subjects.	SA	A	U	D	SD
(26)	I really enjoy working on mathematics or logic puzzles in a book or magazine.	SA	A	U	D	SD
(27)	Knowledge of calculus is not important for most professions.	SA	A	U	D	SD
(28)	My mathematics teacher was surprised at how well I did in the Talent Search.	SA	A	U	D	SD
(29)	I'm good enough in mathematics to be on the mathematics team when I reach high school.	SA	A	U	D	SD
(30)	My father thinks I should not accelerate my study of mathematics.	SA	A	U	D	SD
(31)	My close friends strongly encouraged me to enter the Talent Search.	SA	A	U	D	SD
(32)	My mathematics teacher strongly encouraged me to enter the Talent Search.	SA	A	U	D	SD
(33)	My mathematics teacher thinks I should accelerate my study of mathematics.	SA	A	U	D	SD
(34)	My favorite class is mathematics.	SA	A	U	D	SD
(35)	Women who enjoy studying mathematics are a bit peculiar.	SA	A	U	D	SD
(36)	My mother was surprised at how well I did in the Talent Search.	SA	A	U	D	SD

Remember: Circle the letters that correspond to your answer:

SA=Strongly Agree A=Agree U=Undecided D=Disagree SD=Strongly Disagree

(37)	My father doesn't think I am good enough in mathematics to become a mathematician.	SA A U D SD
(38)	For some reason, even though I study, mathematics seems unusually hard for me.	SA A U D SD
(39)	My father thinks a knowledge of calculus is crucial for most professional/important jobs.	SA A U D SD
(40)	Solving a hard mathematics problem is exciting.	SA A U D SD
(41)	My mother has always thought I was good in mathematics.	SA A U D SD
(42)	My mother thinks I don't really need to learn calculus.	SA A U D SD
(43)	I find games involving mathematical operations such as Wff-N-Proof and Equations rather boring.	SA A U D SD
(44)	My father expects me to learn mathematics very easily.	SA A U D SD
(45)	I was surprised at how well I did on the mathematics part of the Talent Search.	SA A U D SD
(46)	My mother thinks calculus will be the most useful course I take in high school.	SA A U D SD
(47)	In general I think working on mathematical games and puzzles is not as much fun as other things I do.	SA A U D SD
(48)	Careers in mathematics are not more appropriate for men than for women.	SA A U D SD
(49)	My mother thinks I should not accelerate my study of mathematics.	SA A U D SD
(50)	My father thinks I don't really need to learn calculus.	SA A U D SD
(51)	Most of my friends think it is important to accelerate one's study of mathematics.	SA A U D SD
(52)	I would really enjoy being part of a math team in high school.	SA A U D SD
(53)	My mother strongly encouraged me to enter the Talent Search.	SA A U D SD
(54)	My father was surprised at how well I did in the Talent Search.	SA A U D SD
(55)	My mother thinks a knowledge of calculus is crucial for most professional/important jobs.	SA A U D SD
(56)	My father thinks I will have to study mathematics very hard to continue to do well in it.	SA A U D SD

Date_______________

QUESTIONNAIRE TO PARENTS
OF STUDENTS WHO PARTICIPATED
IN 1980 TALENT SEARCH

Child's Name____

Your Name____

Telephone # where you can be contacted during the day_______________________

on evenings and weekends_______________________________

Please circle your relationship to the child:

father mother other (describe)_______________

If you need more space to answer any of the questions, please continue on the back of the paper.

Please do not discuss the answers on this questionnaire until after you have completed it. We are interested in your remembrances.

Thank you.

1. Please describe any ways in which you have fostered your child's

   A. Self-confidence in learning mathematics

   F

   B. Enjoyment of mathematics

   C. Learning of mathematics

2. Please describe any experiences with teachers or in programs (Note grade child was in at the time if you remember) that have encouraged or discouraged your child's

   A. Self-confidence in learning mathematics

   B. Enjoyment of mathematics

   C. Learning of mathematics

   ~~D. Interest in a mathematical or scientific career~~

3. How would you describe the support or lack of support your child receives for his/her mathematical interest and ability? For each group listed below on the left, place a (√) in the appropriate column to indicate the amount of support you believe your child receives to pursue his/her mathematical interest and ability.

	Support strong	Support moderate	Neutral	Discouragement moderate	Discouragement strong
From peers in school					
From teachers in current school					
From current school program					
From school program in previous years					

4. How would you describe your feelings and behaviors relative to your spouse with regard to the statements listed below? Place a check (√) in the appropriate column to indicate for whom the statement is most appropriate.

	Me more than spouse	Spouse more than me	Both me & spouse	Neither me nor spouse
A. Encourages child's enjoyment of mathematics				
B. Encourages child's self-confidence in mathematics				
C. Encourages child's studying mathematics in school				
D. Encourages child's studying math at home				
E. Encourages child's interest in mathematics related career				
F. Encouraged child to be in the Talent Search				
G. Favors accelerating child's study of mathematics				
H. Favors child skipping a grade				
I. Favors child entering college one year or more early				
J. Shows a strong interest in mathematics				
K. Is unusually good at mathematics				
L. Helps child with mathematics homework				
M. Plays games or puzzles of a logical or mathematical nature with child				

5. a. List or describe any mathematical skills or ideas your child knew before he/she entered first grade?

b. List or describe any mathematical skills or ideas your child learned after entering school but before being formally taught in regular elementary school mathematics classes.

c. In brief, please summarize how much mathematics learning has occurred in the home before formal instruction in school. Would you say this learning has oocurred in a systematic way with instruction from a parent, or other family member, or informally and largely self-taught?

6. Did you make a conscious effort to supply your child with toys and materials that could be described as mathematical or scientific in nature? yes_____

no_____

If yes, please describe.

7. During the preschool and early school years did your child show a very strong interest in playing with certain types of toys or materials such as construction sets, electronic devices, counting and sorting materials, puzzles, telescopes, etc.? Please describe the toys and give the appropriate age of the child.

8. Do you engage in mathematical/scientific activities like puzzles or games with this child in your leisure time? yes____
no ____
If so, describe the activities and approximately how often you do them.

9. What is the highest level of education you expect your child to obtain? (Check one)

_____bachelor's level degree _____doctoral level degree

_____master's level degree _____other (specify)______________________

10. How old was your child when you first felt that he/she was mathematically talented?_______
What made you think this was so?

11. Prior to being nominated for the Talent Search at Hopkins, had your child been identified as mathematically gifted by a teacher or school? yes____
no ____
If yes, when and by whom.

12. Assume your child is about to enter the last year of middle school or junior high school. He/she has already completed the mathematics courses offered by his/her school. In order to take mathematics this year which of the following alternatives would you recommend assuming they were all possible? (Circle the letter next to the statement you would recommend to your child.).

A. Skip the final year of middle school totally and enter high school a year early.

B. Stay in the final year at the middle or junior high school but take the advanced mathematics course at the high school the first or last class period of the day.

C. Remain in the middle or junior high school and do the advanced course by self-paced independent study.

D. Other: (describe) ____________________

13. Assume your child is in the 11th grade and has completed all the mathematics courses offered by the local high school. When your child begins to plan his/her program for the following year, which of the following would you recommend assuming they are all possible? (Circle the letter next to the statement you would recommend to your child.)

A. Leave high school with or without a high school diploma at the end of the 11th grade and enter college full-time.

B. Remain in high school but take a mathematics course at a nearby college at night or on released time from high school.

C. Remain in high school for the 12th grade and take an elective in place of an advanced mathematics course.

D. Other: (describe) ____________________

14. Suppose your child and four classmates in his/her high school are ready for an advanced placement calculus course. The school says they can not provide a teacher for such a small class. They offer two alternatives: First, students can take a calculus course at a nearby college on released time from high school, or second, students can do self-paced independent study during a study hall using the advanced placement course syllabus. (Circle the letter of the choice below you would recommend to your child.)

A. Elect to take the college course

B. Elect to do the self-paced mathematics program

C. Take no mathematics

15. If it were not financially necessary for your child to work, would you still want him/her to have a career? yes_____

no_____

Why or why not?

16. Do you expect there will be times in your child's adult life when you would prefer he/she have a part time career or no career at all? yes_____

no_____

Describe when and why.

17. If you had to select a career for your child, what would you select or want for your child?

18. Do you think your child will pursue a career in science, engineering or mathematics?
yes_____
no_____
Why or why not?

19. Have you actively encouraged your child to consider a career in mathematics or science?
yes_____
no_____
If yes, describe how.

20. On this page is a series of fourteen statements. There are no "correct" answers for these statements. They have been set up in a way which permits you to indicate the extent to which you agree or disagree with the ideas expressed. Suppose the statement is:

Example Statement: I like mathematics. SA A U D SD

As you read the statement, you will know whether you agree or disagree. If you strongly agree, circle the letters SA (which stand for strongly agree). If you agree but with reservations, that is, you do not fully agree, circle the letter A (which stands for agree). If you disagree with the idea, indicate the extent to which you disagree by circling letter D if you disagree or letters SD if you strongly disagree. If you neither agree nor disagree, that is, you are not certain, circle letter U (which stands for undecided). Also, if you cannot answer a question circle letter U.

Circle the letters that correspond to your answer:

SA-Strongly Agree A=Agree U=Undecided D=Disagree SD=Strongly Disagree

(1)	I am sure my child can learn advanced work in mathematics like calculus.	SA	A	U	D	SD
(2)	Careers in mathematics are not more appropriate for men than for women.	SA	A	U	D	SD
(3)	Knowledge of calculus is not important for most professions.	SA	A	U	D	SD
(4)	I strongly encouraged my child to enter the talent search.	SA	A	U	D	SD
(5)	Women who enjoy studying mathematics are a bit peculiar.	SA	A	U	D	SD
(6)	I think my child will have to study mathematics very hard to continue to do well in it.	SA	A	U	D	SD
(7)	I expect calculus to be the most useful course my child can take in high school.	SA	A	U	D	SD
(8)	My child is probably not good enough in mathematics to be a real mathematician.	SA	A	U	D	SD
(9)	When a woman has to solve a mathematics problem it is feminine to ask a man for help.	SA	A	U	D	SD
(10)	I'm sure my child is good enough in mathematics to be on the mathematics team in high school.	SA	A	U	D	SD
(11)	I was surprised at how well my child did on the mathematics part of the talent search.	SA	A	U	D	SD
(12)	Accelerating the study of mathematics will be very important for my child's future.	SA	A	U	D	SD
(13)	Males are not naturally better than females in mathematics.	SA	A	U	D	SD
(14)	Studying calculus in high school is not necessary for my child's future.	SA	A	U	D	SD

Questionnaire for the January 1980 Talent Search
Final Postmark DEADLINE: January 25, 1980

Please fill out all of this questionnaire carefully and completely, and BE SURE to send it in the enclosed envelope to OTID, The Johns Hopkins University, Baltimore, Maryland 21218 postmarked not later than January 25, 1980. Unless OTID has received your fully completed questionnaire by that time, you will not be eligible to participate in the talent search; that is, you will receive no information concerning your performance on the SAT exam relative to other contestants, nor any counseling service, and you will not be eligible for scholarships and prizes offered by OTID. All information will be kept STRICTLY CONFIDENTIAL; you will not be identified with the information herein in any public way. This information will help OTID help you, but will not affect your standing in the talent search. Please be frank, honest, complete, and prompt.

I. GENERAL INFORMATION

A. Print your full name: ______________________________
Last First Middle

Your home address: ______________________________
Street No. Street

______________________________ County: ____________
City State Zip Code

Your telephone no: ____________ ______________________
Area Code 7-digit number

B. Your mailing address, if different from your home address:

____

IMPORTANT

C. Please write the name and address of a relatively young **but stably** located mature adult, not living in your home, who is likely to know your address in case you move. We need this information in order to keep in touch with you in the coming years.

Name: ______________________________
Last First Middle

Address: ______________________________
Street No. Street

____
City State Zip Code Tel. No. with Area Code

D. Your sex (circle): F M Your birthdate: ____________ Today's date: ____________
Month/day/year Month/day/year

E. Name of the school that you attend: ______________________ Grade: ______

Address of school: ______________________________
Street No Street

______________________________ County: ____________
City State Zip Code

Pennsylvania students please indicate your Intermediate Unit No. ____________

F. I qualified for this talent search because of my high test score(s) in the

________ mathematics, ________ verbal, and/or ________ general ability areas.

Type of school (check one): ☐ Public ☐ Private (non-church) ☐ Church

Go to next page.

II. FAMILY

(If you have a step-mother, adoptive mother, step-father, adoptive father, step-brother, step sister, half-brother, or half-sister, also please answer on a separate sheet of paper as much of Part II about them as you care to divulge. They should not be included in your answers to the following questions.)

A. How many full older brothers do you have? ☐ Their birthdates: ____________

How many full older sisters do you have? ☐ Their birthdates: ____________

How many full younger brothers do you have? ☐ Their birthdates: ____________

How many full younger sisters do you have? ☐ Their birthdates: ____________

B. Is your natural father alive? ☐ Yes ☐ No ☐ Not sure Comments: ____________

____

His full name: ____
Last First Middle

C. Check only the **highest** educational level he **completed**:

☐ Less than high school

☐ High school graduate

☐ Technical or vocational school beyond high school

☐ Some college, but no 4-year degree

☐ College graduate

☐ More than college graduate

D. Colleges, vocational, and/or technical schools (beyond high school) attended, if any, location and degrees received (both undergraduate and advanced), and date of receipt:

____

____

____

____

____

E. His occupation (or, if he is deceased, his main occupation when alive), please tell the name of his job and what he does (or did): ____________

____

F. Is your natural mother alive? ☐ Yes ☐ No ☐ Not sure Comments: ____________

____

Her full name: ____
Last First Middle Maiden

G. Check only the **highest** educational level she **completed**:

☐ Less than high school

☐ High school graduate

☐ Technical or vocational school beyond high school

☐ Some college, but no 4-year degree

☐ College graduate

☐ More than college graduate

H. Colleges, vocational, and/or technical schools (beyond high school) attended, if any, location and degrees received (both undergraduate and advanced), and date of receipt:

____

____

____

____

____

I. Her present occupation (or, if she is deceased, her main occupation when alive), please tell the name of her job and what she does (or did) (if full-time homemaker, say "homemaker").

____

Go to next page.

B. Which **one** of the following statements **best** describes the most frequent way you are learning science this school year? (Check only **one**.):

- ☐ In regular classwork with other students
- ☐ In school, but working on your own with some help or direction from your teacher
- ☐ On your own outside of school, helped by a tutor or parent
- ☐ On your own outside of school, with little help from anyone

VI. HUMANITIES AND SOCIAL STUDIES

A. What humanities course(s) are you taking this year?

- ☐ English - 7th grade (reading and literature)
- ☐ English - 8th grade (reading and literature)
- ☐ Writing - 7th grade
- ☐ Writing - 8th grade
- ☐ Social Studies - 7th grade (includes history)
- ☐ Social Studies - 8th grade (includes history)
- ☐ Foreign Language ____________________
  (If so list name of language and year.)
- ☐ Other(s) (please list): ____________________

B. Which **one** of the following statements best describes the most frequent way you are learning humanities and social studies this school year? (Check only one.):

- ☐ In regular classwork with other students
- ☐ In school, but working on your own with some help or direction from your teacher
- ☐ On your own outside of school, helped by a tutor or parent
- ☐ On your own outside of school, with little help from anyone

VII. ACADEMIC ACTIVITIES OUTSIDE OF SCHOOL

Check each of the following statements that applies to you. Fill in information pertaining to those items you have checked:

☐ Have taken special courses or participated in programs given at places other than your regular school (such as the Maryland Academy of Sciences).

Course	Institution	Date

☐ Have participated in the Summer Programs for the Gifted and Talented sponsored by your state.

Center ____________________ (State)

Area of work ____________________ Session dates: ____________

Teacher: ____________________

☐ Have participated in science, art, music, or writing competition(s) or fair(s):

	Project #1	Project #2
Subject Areas		
Project Title		
Type of Fair (school, area, state, national, etc.)		
Date		
Award		

(If you need more space use a separate sheet of paper.)

Go to next page.

☐ Have worked on or are working on independent study projects as part of other group activities such as scouting, or on your own.

Description of projects: ______________________________

____

____

VIII. FUTURE OCCUPATION

A. To the right of each subject area are four boxes representing how important you think each such area is for your future career. For each subject check only **one** box under the column heading which best describes how important you feel that subject will be for the job you will have some day.

	Very	Fairly	Slightly	Not at all
Math	☐	☐	☐	☐
Biology	☐	☐	☐	☐
Chemistry	☐	☐	☐	☐
Physics	☐	☐	☐	☐
English (reading and literature)	☐	☐	☐	☐
Writing	☐	☐	☐	☐
Social Studies (includes history)	☐	☐	☐	☐
Foreign Languages	☐	☐	☐	☐

B. Please list the four specific occupations that, at the present time, appeal to you most for your life work. List them in order of preference, **number 1** being the **most** preferred occupation.

1. ______________________ 3. ______________________

2. ______________________ 4. ______________________

IX. MISCELLANEOUS

A. If you have been considering college(s), to which one(s) have you thought about applying when the appropriate time comes? (Let number 1 be the **most** preferred college, etc.)

1. ______________________ 3 ______________________

2. ______________________ 4. ______________________

B. What is your main reason(s) for wanting to participate in this year's Talent Search?

____

C. Where did you find out about this year's Talent Search? (Check all that apply.):

☐ Parent ☐ Radio or T.V. ☐ Newspaper

☐ Math teacher ☐ Guidance counselor ☐ Letter from Talent Search

☐ Friend ☐ Principal ☐ English Teacher

☐ Home-room teacher ☐ Other(specify): ______________ ☐ ITYB

D. From whom did you receive the **most** encouragement to enter this year's Talent Search?

____

E. What type(s) of summer programs would you be willing to attend at Johns Hopkins if given the opportunity? (Check all that apply.):

☐ Two or three week residential programs

☐ Two-week commuter-type programs

☐ Six to eight week programs, attending one day per week (Tues., Wed., or Thurs.)

☐ None

Go to next page.

J. Her former occupation(s): ____________________

____

K. Any comments you care to make to clarify the above answers about your family:

____

____

III. ACADEMIC ATTITUDES

Check the box under the words that best describe each of the following, regardless of whether or not you have taken a course in it:

	Strong liking	Moderate liking	Neutral	Moderate dislike	Strong dislike
A. Your liking for school	☐	☐	☐	☐	☐
B. Your liking for arithmetic and other mathematics	☐	☐	☐	☐	☐
C. Your liking for biology	☐	☐	☐	☐	☐
D. Your liking for chemistry	☐	☐	☐	☐	☐
E. Your liking for physics	☐	☐	☐	☐	☐
F. Your liking for English (reading and literature)	☐	☐	☐	☐	☐
G. Your liking for writing	☐	☐	☐	☐	☐
H. Your liking for foreign languages	☐	☐	☐	☐	☐
I. Your liking for social studies (includes history)	☐	☐	☐	☐	☐

IV. MATHEMATICS

A. What math course(s) are you taking this year?

☐ General math - 7th grade ☐ Algebra I

☐ General math - 8th grade ☐ Algebra II

☐ Pre-algebra ☐ Other, if **higher** ____________

List title and author of textbook(s): ____________________

B. Which **one** of the following statements **best** describes the most frequent way you are learning mathematics this school year? (Check only **one**.):

☐ In regular classwork with other students

☐ In school, but working on your own with some help or direction from your teacher

☐ On your own outside of school, helped by a tutor or parent

☐ On your own outside of school, with little help from anyone

V. SCIENCE

A. What science course(s) are you taking this year?

☐ General science - 7th grade ☐ Biology ☐ Other(s): ____________

☐ General science - 8th grade ☐ Chemistry ____________

☐ Earth science ☐ Physics

☐ Lab science - list topics ____________________

List title and author of textbook(s): ____________________

Go to next page.

F. In which of the following subject-matter area(s) would you probably take courses during the summer if given the opportunity? (Check all that apply.):

- ☐ Algebra Institute (Mathematics)
- ☐ Geometry Institute (Mathematics)
- ☐ Humanities Institute
- ☐ Computer Programming Institute
- ☐ Science Institute
- ☐ Language Institute
- ☐ Career Education Institute

G. What are the most important issues that need to be covered if a counseling workshop was made available to your parents? (Rank order, please, 1 being the most important.)

- ☐ Curriculum planning
- ☐ Dealing with schools
- ☐ Explanation of student's cognitive abilities
- ☐ Family dynamics
- ☐ Finding appropriate educational resources
- ☐ Long-term career planning
- ☐ Long-term educational planning

H. Comments of any kind: ______________________________

____

____

____

____

I. I hereby certify that I have read over my responses carefully and thoroughly. They are as complete and accurate as I can make them.

____
Signature

Final Postmark DEADLINE: January 25, 1980