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ABSTRACT

The career aspirations and the factors influencing career decisions were investigated for a group of extremely precocious females to determine why some enter math/science careers and others do not. Using the multiple-case study approach, 15 mathematically precocious females' career paths were characterized. These females had scored before age 13 at least 700 on the Scholastic Aptitude Test-Mathematics (SAT-M) (frequency top 1 in 60,000). Questionnaires completed at age 13, in 8th grade, and after high school graduation were used; in-depth telephone interviews at 19 to 21 years provided further data. Extremely mathematically precocious females have focused career goals by age 18; two-thirds had entered math/science fields by age 19-21. These math talented females viewed their career choice as a reflection of interests which stemmed form early family influences and educational opportunities. (Author)

Factors that influence the career aspirations of mathematically precocious females

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FACTORS THAT INFLUENCE THE CAREER ASPIRATIONS OF MATHEMATICALLY PRECOCIOUS FEMALES

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Several personal, family and educational factors were found to influence the career aspirations of mathematically precocious females. Using a multiple-case study approach 15 mathematically precocious females' career paths were characterized.

These females scored before age 13 at least 700 on the Scholastic Aptitude Test-Mathematics (SAT-M). The estimated frequency is top 1 in 60,000. Questionnaires completed at age 13, in 8th grade, and after high school graduation were used; in-depth interviews provided further data in 1989. All females were identified through the Study of Mathematically Precocious Youth (SMPY) at Johns Hopkins University.

This session will focus on the career aspirations of highly talented females in mathematics. Their career aspirations, educational choices and lifestyle expectations will be shared, as well as personal, family, and educational factors that shaped their career decisions. Perceptions from individual case studies will be shared on a variety of topics, including influence of international experiences on career decisions. Collectively, these young women reinforce an encouraging portrait of success for the future. They are creating challenges for themselves and constructing a life where their potential in mathematics can be realized.

Factors that influence the career aspirations of mathematically precocious females

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Abstract. The career aspirations and the factors influencing career decisions were investigated for a group of extremely precocious females to determine why some enter math/science careers and others do not. Using the multiple-case study approach, 15 mathematically precocious females' career paths were characterized. These females had scored before age 13 at least 700 on the Scholastic Aptitude Test-Mathematics (SAT-M) (frequency top 1 in 60,000). Questionnaires completed at age 13, in 8th grade, and after high school graduation were used; in-depth telephone interviews at 19 to 21 years provided further data. Extremely mathematically precocious females have focused career goals by age 18; two-thirds had entered math/science fields by age 19-21. These math talented females viewed their career choice as a reflection of interests which stemmed from early family influences and educational opportunities.

Introduction. Mathematical reasoning ability is the forerunner of high-level achievement in mathematics and the sciences (Stanley & Benbow, 1986). Yet among young women, even with high abilities in mathematics, many do not pursue mathematical and scientific careers (Albright, 1988; Hollinger, 1986). In addition to the small number of women selecting mathematical, scientific and medical careers, the proportion of young adults is rapidly declining in America (Mumford & Gustafson, 1988). A declining pool of Ph.D. candidates, especially in science and engineering, is a national concern (National Science Board, 1987). Therefore, it is important to society, especially to educators and psychologists, to understand more about the career

development of mathematically precocious females for societal as well as individual reasons.

The theoretical basis of this study includes gender differences in mathematics, the development of potential and career decision-making theory. From the literature review, we asked the following research questions:

1. What are the career aspirations of mathematically precocious females during adolescence and young adult years?
2. What are the educational choices of mathematically precocious females during the young adult years as indicated by college selected, college major, and plans for undergraduate study?
3. What are the lifestyle expectations of mathematically precocious females during the young adult years?
4. What factors (personal, family, and educational) influence the career decisions of mathematically precocious females?

Method. The multiple-case study design (Yin, 1984) was used to develop career aspiration profiles for 15 mathematically talented females, identified through the 1981-1983 talent searches conducted by the Study of Mathematically Precocious Youth (SMPY), Johns Hopkins University. Several sources of evidence were used. Data from four questionnaires, (Talent Search Questionnaire, Student Questionnaire, After High School Follow-up, and a Questionnaire for Parents, were collected when the 700M females were in the 8th grade and after high school. An additional source of information for the career aspiration profiles was telephone interviews with each subject at age 19-21. As each case study was completed, we examined the data and compared data to established criteria to determine if the proposition was verified by each case study. From these findings and subsequent replication of propositions, it was determined whether the patterns or trends in the career aspiration profiles existed across the group of 700M females

Results. Extremely mathematically precocious females have focused career goals by age 18; two-thirds had entered math/science fields by age 19-21. Their career and educational aspirations were high, with 73% aspiring toward the doctorate degree from prestigious institutions and 100% toward professional occupations. Typical lifestyle expectation was to have a full-time career with marriage and family options.

The 700M females aspiring to careers in math/science versus other careers differed along several dimensions. Both groups exhibited achievement-related personal traits; especially for the math/science group, they did not sex-type themselves or occupations. The math/science career group had greater interests in math and science during adolescence, while the other career group exhibited stronger interests and abilities in verbal areas. Family influences on career decisions were important for both groups, but were stronger for those who chose math/science careers. Career choices often corresponded to their father's career field. Both groups achieved academically at an outstanding level; all were accelerated, (all but two skipped a grade). Their solid academic preparation enabled them to enter any career track, especially the nonmath/science career group. Guidance activities were not viewed as helpful by 700M females. Yet, most reported that a significant person (e.g., a teacher or mentor) or an event had affected their career decisions.

Specifically, the 700M females aspiring to careers in mathematics or science were more likely to:

1. Acknowledge the influence of math ability on career decisions.
2. Be positive toward a variety of subjects at age 13 and focus their interests on mathematics and sciences by age 18.
3. Have fathers with careers in science or mathematics.
4. Have a family income over $50,000 in 1983 dollars.
5. Receive both their mother's and father's encouragement for career choice in mathematics and

sciences.
6. Take Advanced Placement (AP) classes in biology, chemistry, or physics in high school.
7. Skip a grade after 7th grade.
8. Choose a career related to father's field of study.
9. Cite the influence of teachers or mentors at age 18.

The 700M females aspiring to careers in other fields (e.g., sociology, law, or undecided) were more likely to:

1. Assume leadership roles in out-of-school activities.
2. Describe self as a risk-taker or venturesome.
3. Not hold positive attitudes in a variety of subjects at age 13, and indicate their broad-base of interests at age 18.
4. Live in urban areas - over 100,000 population.
5. Take AP classes in fine arts, foreign languages or history.
6. Skip a grade before 7th grade.
7. Cite the influence of teachers at age 13.
8. Receive little encouragement from mother or father for career choices in mathematics or sciences.
9. Take college courses in humanities and fine arts during high school.

Discussion. Just as Eccles (1985) and others, we found career choices of gifted women in mathematics to reflect "multiple" interests. While 700M females followed the educational achievements of their parents, and for the math/science career aspiration group, the career field of their father, it was apparent that the career choice of 700M females was a reflection of interests which stemmed from early family influences and educational opportunities.

Overall, career decisions of mathematically precocious females reflect the "individuality or spark" reported by Helson's (1980) work with creative women mathematicians. Collectively, these young women reinforce an encouraging portrait of success for the future. They are creating challenges for themselves and constructing a life, where their potential in mathematics can be realized.

International Experiences of SMPY 700 M Females

1.	Fathers (foreign born)	5	33%
	Mothers (foreign born)	6	40%
	Couples (Asian)	5	33%

2. 13 (87%) traveled outside the U.S. by age 13 (JH)

   4 (27%) listed more than one country/Continent

*Europe	5
*Canada	5
*Mexico	3
Taiwan	2
*Bahamas	1
South America	1
Japan	1

3. One studied in another country during High School years

   *Year- Colegio Santa Francisca, Colombia, S.A.

4. 4 (27%) studied/traveled in another country during college years

   *1- Undergraduate Language study at University of Lenigrad Russia, 4 months

   *1- Graduate work in Philosophy at University College, Oxford England (2-3 years)

   2- Traveled during college (Europe, Taiwan)

5. One participated in a work experience/job in another country

   Paris, France: National Center for Scientific Research

   Two had planned trips to:
   Taiwan to work on Chinese language
   *Soviet Union on Diplomatic Corp Fellowship

*SMPY 700 M females aspiring to non math/science careers

6. 11 (73%) had studied languages by age 13 (JH)
5 (33%) mentioned more than one language

Language	Grades studied
French	8, 6-7, 4, 6-7, 8, 5-8
Spanish	6, 6-7, 5-8, 3
Chinese	K-7, K 3 5-7, K 3-4
German	6-7, 7
Italian	6
Latin	5-7

7. 14* (100%) studied languages in high school
* one skipped high school

Language	# of Years
French	4,4,4,4,3,3,2,2,
Spanish	4,2,2,1
Latin	4,2,2
Russian	4, 1 1/2
German	2

9 (60%) studied their language for 3-4 years

5 (33%) won local awards (4), state (3), and national awards (2), in
Foreign language competitions

8. Languages studied in college

Russian - Major
Spanish - Major
German
French
Portuguese

9. English was the native language for all SMPY females

By Age 13 (JH) none indicated they were fluent in a 2nd language

10. By age 13, 10 (66%) indicated that foreign languages were "very important" or "fairly important" to their future career

10. After High School, 9 (60%) indicated positive attitudes toward the study of languages.

Conclusions

SMPY 700M females were more likely to:

1. have parents born in the United States

2. have English as their first language

3. travel outside the United States by age 13

4. study another language before 7th grade (French, Spanish or Chinese)

5. Take 2-4 years of French during high school

6. express importance of another language to their future career (during junior high)

7. express positive attitudes after high school for the study of languages

Those 700M SMPY females aspiring to non-math/science career fields:

1. received a higher number of awards for foreign language competitions

2. were more likely to study abroad during high school or college

Table 1. Degree goal, college major, and college/university selected by CMPY 700M females, arranged by career aspiration group at age 19-21.

Career Choice/ Code Name	Degree Goal	Undergraduate Major	Undergraduate College/ University Attended
Architcture, Engineering			
Wilma	M.A.	Architecture	Massachusetts Institute of Technology*
Louann	Ph.D	Electrical Engineering^	University of Washington^
Mathematics			
Tara	M.S.^	Mathematical Sciences^	Johns Hopkins University*^
Jane	Ph.D.	Mathematics	Massachusetts Institute of Technology*
Sandy	Ph.D.	Mathematics	Swarthmore College*
Sciences			
Hilda	M.D./Ph.D.	Biochemistry	Harvard University*
Carol	Ph. D.	Physics	Harvard University*
Medicine			
Priscilla	M.D.	Biochemistry	Harvard University*
Tonya	M.D.	Health and Society	Brown University*
Trudy	M.D.	Biology	Massachusetts Institute of Technology*^
Other			
Rhonda	Ph.D.	Sociology	Yale University*
Naomi	J.D.	Spanish/History	Rice University*
Sally	J.D.	Philosophy^	University of California-Berkeley*^
Gayle	M.S.	Russian Studies	Brown University*
Cathy	Undecided	Undecided	Princeton University*

*Prestigious rankings in Barron's Guide.
^Completed degree, major or graduate of institution.

Table 2. Career aspirations of SMPY 700M Females from adolescence to young adult years

	Time 1 (13 yrs.)	Time 2 (18 yrs.)	Time 3 (19-21 yrs.)
Career Choice/ Code Name	Field of study Position Level/Setting	Field of study Position Level/Setting	Field of study Position Level/Setting
Architecture, Engineering			
Wilma	Undecided	Architecture Architect Own firm	Architecture Architect Head of firm
Louann	Undecided Research	Electr.Engineer Res/Prof/Teaching University	Optics Communication Dev/Research Corporate/University
Mathematics			
Tara	Applied Math Statistician Upper Management	Applied Math Computer Scientist No response	Applied Math* Perf. Analyst* Distinguished Member of Tech Staff
Jane	Ph. D.	Mathematics Professor Head of Math Instruction	Mathematics Professor University Head of Dept.
Sandy	No response	Mathematics Teacher, Actuary Public, Private	Mathematics Professor Secondary School or University

*Achieved career aspiration

Table 2. Continued

Career Choice/ Code Name	Time 1 (13 yrs.) Field of study Position Level/Setting	Time 2 (18 yrs.) Field of study Position Level/Setting	Time 3 (19-21 yrs.) Field of study Position Level/Setting
Other			
Rhonda	Undecided	Undecided	Sociology Sociologist University, Company Government
Naomi	Law Lawyer No response	Immigration Law Lawyer No response	Immigration Law Lawyer (Defense) Undecided
Sally	Law, Math Philosophy Professor No response	Law, Philosophy Professsor No response	Law, Philosophy Professor Law School
Gayle	Undecided	Russian, Computer Science Undecided Ph. D.	Undecided
Cathy	Undecided	Graduate School	Undecided

Table 2. Continued

	Time 1 (13 yrs.)	Time 2 (18 yrs.)	Time 3 (19-21 yrs.)
Career Choice/ Code Name	Field of study Position Level/Setting	Field of study Position Level/Setting	Field of study Position Level/Setting
Sciences			
Hilda	No response	Biochemistry Researcher Undecided	Biochemistry Researcher College/Govt.
Carol	Undecided	Neurology Molecular Biology Genetics, Biophysics, etc. Researcher/ Academician Undecided	Molecular Biology 'Researcher/ Professor University
Medicine			
Priscilla	Medicine Physician/ Researcher	Medicine Physician Undecided	Medicine Physician Hospital/ Private practice
Tonya	Medicine Physician	Medicine Physician No response	Medicine Physician Undecided
Trudy	Medicine Physician/ Researcher No response	Medicine Physician/ Researcher/ Professor Med School	Medicine Physician/ Researcher/ Professor Undecided

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