Intellectually Talented Boys and Girls: Educational Profiles*

Camilla P. Benbow **Julian C. Stanley**

In the 1920s Terman began his monumental longitudinal study of gifted children (Burks, Jensen, & Terman, 1930; Oden, 1968; R. R. Sears, 1977; P. S. Sears, 1979; Sears & Barbee, 1977; Terman, 1925; Terman & Oden, 1947, 1959), and Hollingworth began her classic investigation of children with IQs of 180 or more (Hollingworth, 1942). Both concluded that gifted children tended to become highly effective and productive adults. Fifty years later, the Study of Mathematically Precocious Youth (SMPY) initiated a similar investigation, but of mathematically gifted children and with an added component of providing educational facilitation for the students studied (Cohn, 1980; Stanley, 1977). The study was designed to be longitudinal, with a new cohort of junior-high-school students each year.

An important aspect of any longitudinal research program is to describe the subjects initially because that provides baseline data. For the SMPY program, this characterization can also be of great utility when evaluating the long-term effectiveness of its development role, in studying sex differences in mathematical ability (Benbow & Stanley, 1980b, 1981) and mathematics and science achievement (Benbow, 1981; Benbow & Stanley, in press, a, b; Fox, 1977), and when identifying possible determinants of later behavior in the group. In the present work we try to meet this need by describing and contrasting by sex the educational experiences and attitudes of the participants in an SMPY talent search.

The family background of this group has already been delineated (Benbow & Stanley, 1980a). It was found that these students tended to come from larger than average families with well-educated parents of high occupational status. Although no strong relationships were revealed between family size or sibling position and ability of the students, parental educational level and father's occupational status were found to be fairly closely related to it.

Method

Sample

Through its December of 1976 Talent Search SMPY identified 873 mathematically talented students. For the first time, this talent search covered the mid-Atlantic region, including Maryland and the surrounding areas of Delaware, the District of Columbia, Pennsylvania, Virginia, and West Virginia. Seventh and under-age 8th graders were encouraged to enter this talent search if they scored in the top 3% nationally on the mathematics part of a standardized achievement-test battery at their grade level. Qualifying students then took the College Board's Scholastic Aptitude Test, both the mathematics part (SAT-M) and the verbal part (SAT-V).

The mean scores of the participants are shown by sex in Table 1. These scores were high and superior to scores of a random national sample of 11th and 12th-grade females, who were four to five years older (CEEB, 1978). On SAT-V the boys and girls performed at approximately the same level, scoring on the average 373 and 368, respectively. On SAT-M, however, the boys' mean score was 459 and the girls' mean score 422, a 37-point difference statistically significant at the .001 level. Sex differences in this and other cognitive abilities have been described in greater detail elsewhere (Benbow & Stanley, 1980b, 1981, in press, a, b; Cohn, 1977; Fox, 1977; George & Cohn, 1977).

Data Set and Analysis

Prior to the talent search, participants were required to fill out a four-page questionnaire about themselves and their families. Analyses were performed, using the SPSS program (Nie et al., 1975), and evaluated by the use of effect sizes (Cohen, 1977). A medium effect was considered important.

Results and Discussion

Age, Grade, and Acceleration

The average age of the talent search participants in December of 1976 was 12.5 years. The range of ages was

Table 1

Mean Scores and Standard Deviations on SAT-M and SAT-V of the 873 Participants in the 1976 Talent Search by Sex and for a National Sample of High School Juniors and Seniors*

		SAT-M		SAT-V	
		Mean Score	Standard Deviation	Mean Score	Standard Deviation
Talent Search Participants	Boys (507)	459	88	373	76
	Girls (366)	422	65	368	69
	t of Mean Difference (Boys vs. Girls)	6.8, $p < .001$, for M			Not significant for V
National Sample	Men	416	117	368	111
	Women	390	104	368	111

*From College Entrance Examination Board (1978).

*We thank Robert M. Benbow, Lynn M. Daggett, Thelma V. DeCarlo, Lola L. Minor, Susan Perkins, and Paula Zak for helpful comments on this manuscript.

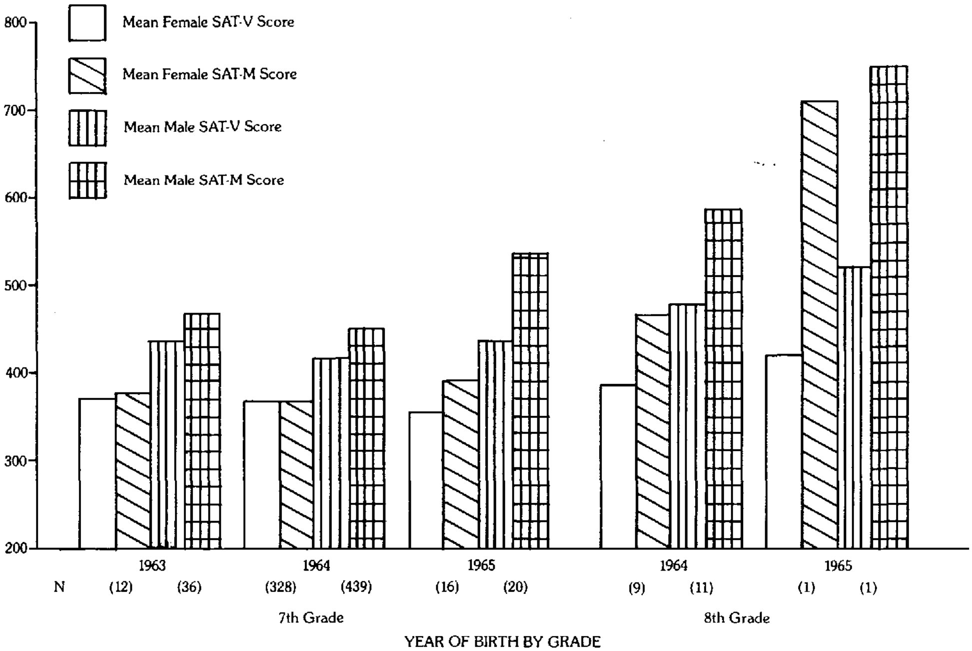

Figure 1. Mean SAT-V and SAT-M scores by grade, by year of birth, and by sex for the 1976 talent search participants.

from 11.0 to 13.4 years. Most (98%) were 7th graders. The remainder were born after 31 December 1963 and had been accelerated. Approximately 7% of the talent search partiticipants were accelerated by at least one year. We expected that the ablest students would be most accelerated. Figure 1 lends support to this hypothesis. On the SAT, accelerated students did as well as or better than students who were not accelerated or were one year behind. These scores are even more impressive when one considers that over half of the accelerants were a year younger than the rest of the group.

To study the relationship of grade-attending and age of the student with SAT scores, canonical correlational analyses were performed. Canonical correlation takes as its basic input two sets of variables and from them derives a linear combination from each of the sets of variables in such a way that the zero-order *r* between the two linear composites is maximized (Kerlinger & Pedhazur, 1973). The two sets of variables used were SAT-M and SAT-V scores, and age (in months) and grade attended by the students.

Two independent canonical *r*'s were computed for girls and two for boys. The resulting principal canonical correlation showed that the SAT scores accounted for only 2% of the canonical variate variance in age and grade placement for girls and 9% for boys. Equivalently, age and grade placement accounted for only 2% of the canonical variate variance of girls' and 9% of the boys' SAT scores.[1] Since the accelerants were younger but still scored as well as or better than the rest of the group, they were probably brighter. We therefore conclude that acceleration occurs at least partly because of superior ability.

Verbal ability was not related to age and grade placement. This may seem surprising, since it is commonly believed that verbal ability needs to "mature." It must, however, be kept in mind that the younger students were probably brighter.

Type of School Attended

The 1976 Talent Search cohort attended public, independent (called "private" here), or parochial schools, with the vast majority (84%) in public schools.

A linear discriminant analysis was performed to detect the variables differentiating students who attended the three types of schools. Variables tested were the two SAT scores, parental educational level, paternal occupational status, degree of liking for school and mathematics, and the way that mathematics was learned. Analyses were performed two ways, within sex and also with sex as a dummy variable. In all analyses, these variables failed to discriminate among students from public, private, and parochial schools. In each analysis only one discriminant function was derived; it accounted for about 4% of the variance. SAT-M scores received the highest weights, followed by parental educational level.

Private school students obtained the highest SAT-M scores, followed by public school students (see Figure 2). The same was true for parental educational level, but we conclude that, of the variables studied, no important differences appeared among students in the three types of schools.

Attitude Toward School

The participants exhibited a strong liking for school (Table 2); girls liked school more than boys did. ($p < .001$). The effect size of the sex difference was small ($d = .33$), however. The Pearson coefficients of correlation (r) between liking for school and SAT-M and SAT-V scores, performed separately by sex, were also small (Table 3); they ranged from .04 to .16. Thus, ability within the group and sex did not relate strongly to liking for school.

Status in Mathematics

At the time of the talent search, participants viewed their status in mathematics as above average (Table 2). Not one participant believed that he or she was working below the level of his or her classmates. The modal response of each sex was "doing better in mathematics than all but one or two other students in their class." The girls' perceived sta-

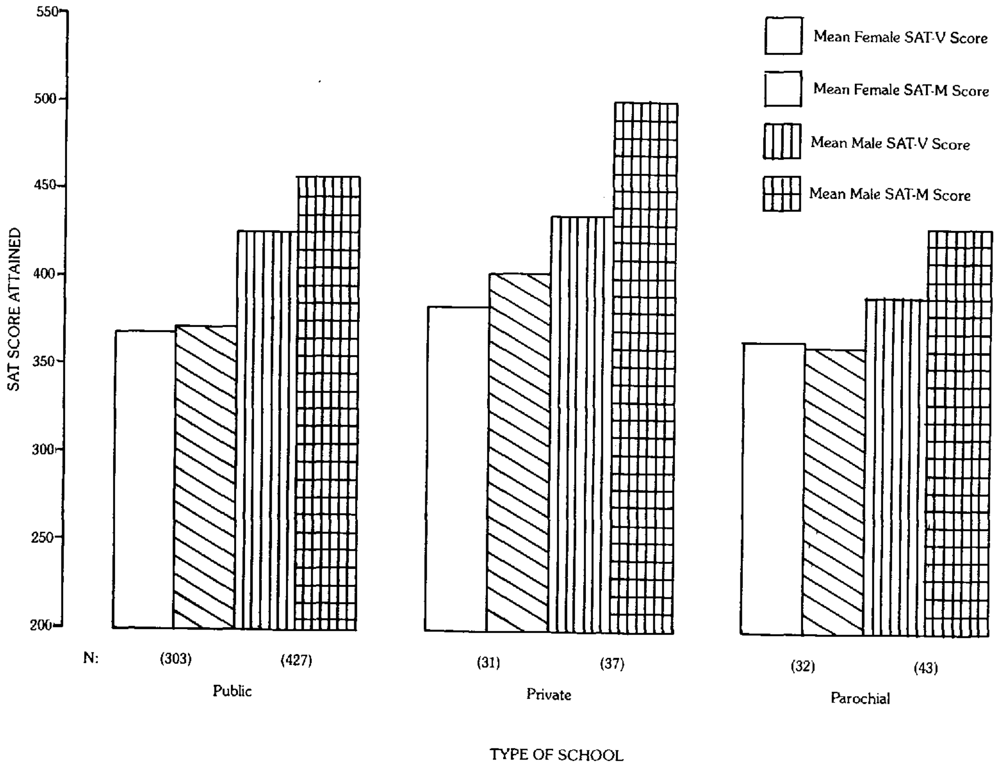

Figure 2. Mean SAT-V and SAT-M scores by type of school and sex for the 1976 talent search participants.

Table 2
Mean Reported Liking for School, Mathematics, Biology, Chemistry, and Physics;
Mean Reported Importance of Mathematics, Biology, Chemistry, and Physics; and
Mean Status in Mathematics and Science Classes of the 1976 Talent Search Group by Sex

		School		Mathematics		Biology		Chemistry		Physics	
		Mean	s.d.	Mean	s.d.	Mean	s.d.	Mean	s.d.	Mean	s.d
Reported Liking[1]	Boys	3.1	0.6	3.6	0.6	3.0	0.8[a]	3.3	0.8[a]	3.0	0.8
	Girls	3.3	0.6	3.4	0.7	3.0	0.8	3.0	0.8	2.7	0.8[b]
t of mean difference		$t = 4.8$, $p < .001$		$t = 3.4$, $p < .001$		Not significant		$t = 3.7$, $p < .001$		$t = 4.1$, $p < .001$	
Rated Importance for Future Job[2]	Boys			3.6	0.7	2.7	1.1	2.8	1.1	3.0	1.0
	Girls			3.5	0.7	2.9	1.1	2.7	1.1	2.7	1.0
t of mean difference				Not significant		$t = 2.8$, $p < .01$		Not significant		$t = 3.63$, $p < .001$	
Perceived Status in Classroom[3]						Science					
	Boys			3.0	0.7			2.8	0.8		
	Girls			2.9	0.7			2.7	0.7		
t of mean difference				$t = 1.98$, $p < .05$				Not significant			

[1]Liking was coded as
1 = Positive dislike
2 = Slight liking
3 = Fairly strong liking
4 = Very strong liking

[2]Importance for Future Job was coded as
1 = Not at all important in future job
2 = Slightly important in future job
3 = Fairly important in future job
4= Very important in future job

[3]Status in mathematics and science class was coded as
1 = Less well than majority of students
2 = About as well as majority of students
3 = Better than all but 1 or 2 classmates
4 = Better than all classmates

[a]The differences between the means of rated liking for chemistry and physics ($t = 4.54$) and for chemistry and biology ($t = 4.88$) for boys were significant at the $p < .001$ level.

[b]The differences between the means of rated liking for physics and biology ($t = 5.34$) or chemistry ($t = 4.28$) were significant at the $p < .001$ level. Physics was the least liked.

Table 3
The Correlation of SAT Scores with Demographic Variables*, by Sex

		Liking of School	Liking of Mathematics	Liking of Biology	Liking of Chemistry	Liking of Physics	Status in Mathematics Class	Mode of Learning Mathematics[1]	Status in Science Class	Mode of Learning Science[1]
Boys	SAT-M	0.04	0.09[a]	-0.09[a]	-0.01	0.14[b]	0.22[c]	0.12[b]	0.15[c]	0.02
	SAT-V	0.08[a]	-0.09[a]	0.08[a]	0.08	0.16[b]	0.12[b]	0.02	0.23[c]	0.07
Girls	SAT-M	0.09	0.17[c]	0.05	0.12[a]	0.17[b]	0.21[c]	0.01	0.13[b]	-0.03
	SAT-V	0.16[c]	-0.04	0.01	0.12[a]	0.07	0.11[a]	0.00	0.16[b]	-0.02

		Importance of Mathematics in Future Career	Importance of Biology in Future Career	Importance of Chemistry in Future Career	Importance of Physics in Future Career
Boys	SAT-M	0.04	-0.08[a]	-0.04	0.01
	SAT-V	-0.05	-0.04	-0.06	0.00
Girls	SAT-M	-0.02	-0.01	0.02	0.03
	SAT-V	-0.13[b]	0.01	-0.04	-0.06

[1]Mode of learning mathematics and science were coded as follows:
1 = Regular classwork
2 = On own in school
3 = On own outside school
4 = On own entirely

*For how these variables are coded, see the tables describing each variable.

[a]$p < .05$ [b]$p < .01$ [c]$p < .001$

tus was slightly lower than that of the boys' ($p < .05$), but the difference was not large enough to be considered even a small effect. The four r's between perceived status in class and SAT-M and SAT-V scores were significantly greater than zero but also small, .11-.22 (see Table 3). It was expected that these r's would be small, since even the least able participant was sufficiently apt so that in-grade mathematics should have posed no problem.

Mode of Learning Mathematics

At the time of the talent search students reported learning most of their mathematics through regular classwork (74% of the boys and 81% of the girls), followed by independent study in school (23% of the boys and 17% of the girls). Although, according to their statements, the boys learned mathematics significantly more on their own than the girls ($p < .05$), the effect size was not large enough to be considered small. Thus, this difference was considered negligible. Furthermore, the mode of learning mathematics did not relate importantly to SAT scores (see Table 3).

Reported Liking for Mathematics

In Table 2 liking for mathematics at the time of the talent search is shown. In general, mathematics was viewed positively. About 92% of the participants reported liking mathematics strongly. Boys enjoyed mathematics more than girls ($p < .001$). As evidenced from the effect size (small, $d = .33$), the difference was not large. The four r's between liking of mathematics and SAT scores were also small, -.04 to .17 (Table 3). Thus, at this stage, ability and sex do not relate much to degree of liking for mathematics.

Rated Importance of Mathematics

The 1976 Talent Search participants generally believed that mathematics would be important in their future careers (Table 2): approximately 90% of both boys and girls rated mathematics as either fairly or very important. No sex difference was found in these ratings. The only significant relationship between the rated importance of mathematics in future jobs and ability was for the females' SAT-V scores (Table 3). The higher the SAT-V score, the less important the girls thought mathematics would be for their careers. The r was small (-.13), however.

Mathematical Aptitude and Science

Science is an area where high mathematical ability is useful; in college and graduate-level physics, chemistry, and biology this is especially true. Because of the long sequence of descriptive science courses in high school and college, however, it is believed that many of SMPY's mathematically precocious youths become "turned off" from these areas (Cohn, 1980). Therefore, the group's perception of science before they entered high school was studied.

Generally, both boys and girls liked biology, chemistry, and physics (Table 2). Their work in science, which had been accomplished chiefly in the regular classroom, was perceived as better than their class average (Table 2). Compared with their perceived achievement in their mathematics class, their performance in science was significantly lower ($p < .01$). However, the effect size of the difference was only small ($d = .28$).

Perceived status in science class was poorly predictable from the talent search SAT scores, as judged from the correlation coefficients in Table 3 and a multiple regression analysis. In the multiple regression scheme predicting science status ratings from the best-weighted composite of the two SAT scores, only 6% of the variance for boys and 3% of the variance for girls was accounted for. Clearly, ability does not relate much to how an SMPY student views his performance in science at this early stage.

Significant sex differences were noted, although the effect sizes evaluating these differences were considered only small. Boys liked chemistry significantly more than either physics or biology ($p < .01$). Girls, on the other hand, preferred biology and chemistry significantly more than physics ($p < .01$). With regard to the importance given to these sciences in their future careers, these girls considered biology to be the most important, followed by chemistry and physics, while the boys considered physics to be most important and then chemistry and biology (Table 2). The sex differences were mostly significant (see Table 2). No sex differences were noted in perceived performance in and learning of science, however.

It is often assumed that chemistry and physics are more quantitatively oriented than biology. Since boys were abler in mathematics than the girls, perhaps the more quantitative nature of these two courses made them less attractive to girls. Mathematics liking correlated better with physics and chemistry liking than with biology liking (Table 4). Moreover, as shown in Table 3, for girls SAT-M scores were more highly correlated with liking physics (0.17) and chemistry (0.12) than biology (0.05), but the differences between r's were not significant, except for the difference between biology and physics liking for the boys. This significant difference had only a small effect size.

Table 4
The Correlations Between Rated Liking of Mathematics and Rated Liking of Biology, Chemistry, and Physics for the 1976 Talent Search Group by Sex

	Biology Liking	Chemistry Liking	Physics Liking
Boys' Mathematical Liking	0.10[a]	0.17[c]	0.23[c]
Girls' Mathematical Liking	0.14[b]	0.25[c]	0.27[c]

[a] $p < .05$ [b] $p < .01$ [c] $p < .001$

Educational Facilitation

This group of students, talented and interested in a variety of fields, should have been prime prospects for educational facilitation. We hoped that the educational system would have provided special opportunities. Unfortunately, only 11% of the boys and 6% of the girls participated in any special program. Only 10% had entered science fair projects individually and only 11% in groups. Disappointingly, little extra stimulation seems to have been given these extraordinarily talented students. The boys did not receive significantly more educational facilitation than the girls.

The purpose of this study was to characterize the educational experiences and values of the intellectually talented (especially mathematically) group of 7th-grade and under-age 8th-grade students who participated in the Study of Mathematically Precocious Youth's (SMPY) 1976 mathematics talent search. The most consistent and noteworthy finding was that, despite their wide ranges in mathematical and verbal scores on the College Board's Scholastic Aptitude Test, these students were remarkably homogeneous in background, experiences, interests, and values.

In most affective respects a 7th grader with a SAT-M score of 700 differed little from one with a score of 500. Most participants exhibit a strong liking for and do well in school, mathematics, and science. They perceive science and mathematics as important for their future careers and report that their knowledge of these areas was mainly obtained through in-classroom experiences. Despite their obvious talents, however, few students received educational facilitation and few were accelerated. Acceleration seemed to have been implemented partly on the basis of ability. Finally, no important differences were seen between students attending public, private, and parochial schools.

Sex differences were noted in mathematical reasoning ability, attitudes toward mathematics and science, perceived performance in mathematics and science, and how mathematics knowledge was considered to have been acquired. All these sex differences, except in ability, were considered only small or negligible because of their associated effect sizes. These findings are in agreement with the results of Fox, Brody, and Tobin (1982). They investigated the family backgrounds of SMPY talent search participants. They found few differences. Especially no indications of differential training or encouragement of boys and girls were discovered.

Footnote

1. For example, the weights for the boys (statistically highly significant first canonical correlation coefficient, .30) were as follows: $0.70z_g - 0.49z_a$ and $0.80z_m + 0.31z_v$. The negative standardized partial regression coefficient for age probably results largely because to qualify for the talent search students who are young in grade had to earn as many points on the mathematics section of an in-school achievement test battery (i.e., at least the 97th percentile of national norms) as the older students did. Thus, they probably had higher ability and therefore tended to do better on SAT-M. In each of SMPY's annual talent searches, the youngest entrants tended to score higher on SAT-M than the older ones.

References

Benbow, C. P. *Development of superior mathematical ability during adolescence.* Unpublished doctoral dissertation, The Johns Hopkins University, 1981.

Benbow, C. P., & Stanley, J. C. Intellectually talented students: Family profiles. *Gifted Child Quarterly,* 1980, *24,* 119-122. (a)

Benbow, C. P., & Stanley, J. C. Sex differences in mathematical ability: Fact or artifact? *Science,* 1980, *210,* 1262-1264. (b)

Benbow, C. P., & Stanley, J. C. Mathematical ability: Is sex a factor? *Science,* 1981, *212,* 4491.

Benbow, C. P., & Stanley, J. C. Consequences in high school and college of sex differences in mathematical reasoning ability: A longitudinal perspective. *American Educational Research Journal,* in press. (a)

Benbow, C. P., & Stanley, J. C. Gender and the science major. In M. W. Steinkamp & W. L. Maehr (Eds.), *Women in science.* Greenwich, CT: JAI Press, in press. (b)

Burks, B. S., Jensen, D. W., & Terman, L. M. The promise of youth: Follow-up studies of a thousand gifted children. *Genetic studies of genius.* Vol. 3. Stanford, CA: Stanford University Press, 1930.

Cohen, J. *Statistical power analysis for the behavioral sciences.* NYC: Academic Press, 1977.

Cohn, S. J. Cognitive characteristics of the top-scoring third of the 1976 talent search contestants. *ITYB* (Intellectually Talented Youth Bulletin), July 15, 1977, *3* (10), 3-6. Reprinted in the *Gifted Child Quarterly,* 1978, *3,* 416-421.

Cohn, S. J. *Two components of the study of mathematically precocious youth's intervention studies of educational acceleration: Chemistry-physics facilitation and longitudinal follow-up.* Unpublished doctoral dissertation, The Johns Hopkins University, Baltimore, MD 21218, 1980.

College Entrance Examination Board. *Guide to the admissions testing program, 1978-1979.* Princeton, NJ: Educational Testing Service, 1978.

Fox, L. H. Sex differences: Implications for program planning for the academically gifted. In J. C. Stanley, W. C. George, & C. H. Solano (Eds.), *The gifted and the creative: A fifty-year perspective.* Baltimore, MD: The Johns Hopkins University Press, 1977, 113-140.

Fox, L. H., Brody, L., & Tobin, D. *The study of social processes that inhibit or enhance the development of competence and interest in mathematics among highly able young women.* Report to the National Institute of Education, January, 1982.

George, W. C., & Cohn, S. J. The 1976 talent search results are in! *ITYB,* (Intellectually Talented Youth Bulletin), February 15, 1977, *3,* (6), 1-2.

Hollingworth, L. S. *Children above 180 IQ Stanford-Binet: Origins and development.* Yonkers-on-Hudson, NY: World Book, 1942.

Kerlinger, F. N., & Pedhazur, E. J. *Multiple regression in behavioral research.* NYC: Holt, Rinehart, & Winston, 1973.

Nie, H. H., Hull, C. H., Jenkins, J. G., Steinbrenner, K., & Bent, D. H. *SPSS: Statistical package for the social sciences* (2nd ed.). NYC: McGraw-Hill, 1975.

Oden, M. H. The fulfillment of promise: 40-year follow-up of the Terman gifted group. *Genetic Psychology Monographs,* 1968, *77,* 3-93.

Sears, P. S. The Terman genetic studies of genius 1922-1972. In A. H. Passow (Ed.), The gifted and talented: Their education and development, *Seventy-eighth Yearbook of the National Society for the Study of Education,* Part I. Chicago, IL: Chicago University Press, 1979.

Sears, P. S., & Barbee, A. H. Career and life satisfactions among Terman's gifted women. In J. C. Stanley, W. C. George, & C. H. Solano (Eds.), *The gifted and the creative: A fifty-year perspective.* Baltimore, MD: The Johns Hopkins University Press, 1977, 28-65.

Sears, R. R. Sources of life satisfaction of the Terman gifted men. *American Psychologist,* 1977, *32,* 119-128.

Stanley, J. C. Rationale of the study of mathematically precocious youth (SMPY) during its first five years of promoting educational acceleration. In J. C. Stanley, W. C. George, & C. H. Solano (Eds.), *The gifted and the creative: A fifty-year perspective.* Baltimore, M.D: The Johns Hopkins University Press, 1977, 75-112.

Terman, L. M. Mental and physical traits of a thousand gifted children. *Genetic studies of genius,* Vol. 1. Stanford, CA: Stanford University Press, 1925.

Terman, L. M., & Oden, M. H. The gifted child grows up: Twenty-five years' follow-up of a superior group. *Genetic studies of genius*, Vol. 4. Stanford, CA: Stanford University Press, 1947.

Terman, L. M., & Oden, M. H. The gifted group at mid-life: Thirty-five years' follow-up of the superior child. *Genetic studies of genius*, Vol. 5. Stanford, CA: Stanford University Press, 1959.

Camilla P. Benbow, Associate Director of SMPY.
Address: The Johns Hopkins University, Department of Psychology, Baltimore, Maryland 21218.
Julian C. Stanley, Director of SMPY & Professor of Psychology.
Address: The Johns Hopkins University, Department of Psychology, Baltimore, Maryland 21218.

In Memoriam

Margaret Olivia Bynum

1921-1982

Margaret, how did we know thee?
It's impossible to count the ways.
But know that your efforts in Gifted Education
Will continue until the end of days.

We knew Margaret O. Bynum as a pioneer in Gifted Education, who served as the State Coordinator for the Gifted in Georgia since July, 1958.

We knew Margaret O. Bynum as one who almost single-handedly guided the growth of gifted education in Georgia from four programs in 1958 to programs now serving forty-four thousand students and involving nine hundred one teachers.

We knew Margaret O. Bynum as an articulate national leader and consultant through her active involvement with numerous organizations such as the Association for the Gifted, National Council of State Directors and the magazine, Highlights for Children.

Most of all, we knew Margaret O. Bynum as one who not only believed that gifted children deserved an appropriate education and well-trained teachers but also spent her every moment putting her beliefs into action—garnering support for gifted education and changing the minds of nonbelievers. Her efforts will continue, for her one candle has lit many which are now, in turn, lighting others.

—Mary M. Frasier