

# SEX DIFFERENCES: IMPLICATIONS FOR PROGRAM PLANNING FOR THE ACADEMICALLY GIFTED

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## ABSTRACT

*Studies of gifted children have typically ignored sex differences, yet in the past gifted women have achieved far less than men. This paper reviews the research on sex differences in intellectual abilities, achievement, values, and interests that have relevance to educational planning for gifted children. Early admission to kindergarten or first grade, and early college entrance both appear to be valuable for gifted boys and girls. Grade skipping, subject-matter acceleration, and advanced placement programs in mathematics and the sciences in the junior high school years, however, are more effective for gifted boys than for gifted girls. Homogeneously grouped accelerated programs in mathematics can promote achievement of gifted girls as well as gifted boys in some classroom environments but not in others. Part of the differential academic success of the sexes in subjects like mathematics is a result of the sex-role stereotyping activities in early childhood and adolescence. The reduction of sex-role stereotyping should increase both male and female creativity and achievement in many areas. Early identification of children and counseling of parents is needed. Career education and early planned intervention are particularly crucial for gifted girls. Teachers need to help gifted students, especially girls, become better intellectual risk takers.*

In recent years the failure of women to achieve eminence in many aspects of life, especially in academic and scientific areas, has been noted quite often. Therefore, in this year, which is both International Woman's Year and the fiftieth anniversary of the publication of the first volume of

Terman's *Genetic Studies of Genius* (1925), it appeared that some attention to the plight of gifted females is desirable.

Although I decided not to entitle this paper "The Gifted Female," I wondered how many written articles or presented papers on the topic "The Gifted Child" would have been more realistically entitled "The Gifted Male." The failure of many educators and researchers to consider that the sex difference in achievements of gifted adults was a serious educational problem is somewhat understandable in light of our society's expectations for women in the past. Today, however, the issue of the fulfillment of promise for gifted females as well as males must be considered. We should not ignore psychological and biological differences between males and females that relate to their achievements in the classroom, their sense of personal worth, and their successful adjustment to adult life. A major premise of this paper is that research findings and suggestions for program planning for the gifted child should be reexamined to determine their relevance for both sexes.

Unfortunately, this task will be difficult. Many studies in the past did not treat the sex of subject as a variable. Past findings related to sex differences may be less relevant for people of today than for the populations studied ten or more years ago. Also, we should exercise some caution in generalizing from findings of studies of sex differences in the general population to gifted and talented youth.

One further caution is indicated. The concepts of masculinity and femininity are complex. Sex-role appropriate behavior results from a combination of biological and psychological factors. In a discussion of sex as a psychological variable, it is important to keep individuals as well as groups in mind. Not all the seeming correlates to gender identity apply uniformly to the individual.

With these limitations and constraints in mind, let us examine what is known about sex differences and the gifted child. First, we shall consider a brief summary of sex differences in the cognitive and affective domain. Second, we shall review some of the general types of accelerative and nonaccelerative educational strategies for the gifted with respect to their usefulness for males and females. Third and last, we shall consider what modifications and innovations are needed in both research and program planning efforts for the gifted and talented child.

## **SEX DIFFERENCES: A BRIEF REVIEW**

The psychology of sex differences has recently been rather thoroughly researched (Maccoby and Jacklin 1974). The following section briefly summarizes some points from this research that seem relevant to

the discussion of the gifted child. Where possible, these findings are supplemented with specific studies of sex differences in gifted populations.

### Intellectual Ability

Men and women do not appear to differ on measures of global intelligence. As Maccoby (1963) pointed out, this is less meaningful than it first appears. In the process of constructing standardized intelligence tests, items that seem biased in favor of one sex or the other are often eliminated or balanced. Although men and women are probably about equal in general intellectual ability, they do appear to differ with respect to some specific abilities.

In mathematical ability sex differences are not consistently found until the end of the elementary school years. A recent National Assessment report (Mullis 1975), however, found sex differences in geometry skills as early as age nine. By the end of the secondary school years, young men are quite superior to young women with respect to mathematical reasoning ability. Among very gifted seventh and eighth graders the gap at the higher levels of mathematical reasoning ability is quite large. In three years of testing mathematically gifted students, the Study of Mathematically Precocious Youth (SMPY)<sup>1</sup> found 167 boys but only 19 girls who, as seventh and eighth graders, scored 640 or above on the Scholastic Aptitude Test—Mathematics (SAT-M).<sup>2</sup> The mean-score difference between boys and girls in the three contests has been at least 35 points in favor of the boys (Stanley 1973). Although attempts at The Johns Hopkins University to intervene to raise the level of achievement in mathematics of gifted girls have been somewhat successful, intervention efforts have not yet been able to improve the basic mathematical reasoning ability of gifted girls to equal that of the ablest boys (Fox 1974a).

Males in general are superior to females on tests of spatial relationships from adolescence to adulthood (Anastasi 1958). Sex differences in

<sup>1</sup>The Study of Mathematically Precocious Youth (SMPY) was begun at The Johns Hopkins University by Julian C. Stanley in 1971 and is supported by grants from the Spencer Foundation of Chicago and the Robert Sterling Clark Foundation. The rationale of this program is discussed in chapter 5. Detailed reports of the three mathematics contests are reported in *Mathematical talent: Discovery, description, and development* and *Intellectual talent: Research and development* which are volumes I and II, respectively, of the Studies of Intellectual Precocity series published by The Johns Hopkins University Press.

<sup>2</sup>The Scholastic Aptitude Test is administered under the direction of the College Entrance Examination Board in cooperation with The Educational Testing Service, Princeton, N.J.

spatial-visualization ability do appear to be innate (Bock and Kolakowski 1973).<sup>3</sup> The extent to which sex differences in mathematical ability are related to sex differences in spatial-visualization ability is not yet known. In a study of a small group of seventh graders (thirteen boys and eight girls) who participated in a special accelerated mathematics class on Saturday mornings, the expected sex differences on the Revised Minnesota Paper Form Board Test<sup>4</sup> were not found (Fox 1974b). The highest score was earned by a girl, and five of the thirteen boys scored lower than the lowest-scoring girl. The mean score for the boys was about equal to the mean for the twelfth-grade boys reported in the manual. The eight girls scored significantly higher than the mean for twelfth-grade boys and girls. Perhaps girls who have superior spatial abilities are better candidates for special mathematical enrichment than girls with less of this ability. The relationship of spatial abilities to interest and talent in mathematics should be studied further.

Although males seem to be superior to females on measures of quantitative skills, females are generally found to be superior to males on measures of verbal ability before age three and after age eleven (Maccoby and Jacklin 1974). Clearly, more boys than girls are found to have reading problems. In a verbal contest for gifted seventh and eighth graders conducted by the Study of Verbally Gifted Youth (SVGY)<sup>5</sup> at The Johns Hopkins University (McGinn 1976), the expected female superiority was not found. Although fewer boys than girls entered the contest, there were no sex differences in performance on the Scholastic Aptitude Test—Verbal (SAT-V). Some of the highest scorers were boys. In 1973, the girls and boys who entered the mathematics talent search sponsored by SMPY were also tested on the SAT-V. Although the boys outnumbered the girls, they scored as well on the SAT-V as the girls but better on the SAT-M. It is interesting that sex differences in cognitive abilities found in general adolescent populations are found in gifted samples in the quantitative area but not the verbal.

Whether or not these sex differences in performance on tests of specific abilities are innate or a result of differential learning experiences and socialization, or a combination of the two, is not entirely clear. Talent in mathematics, for example, does appear to be related to masculine

<sup>3</sup>A test of spatial-visualizing ability was administered to parents and offspring in a sample of 167 families. The results were consistent with the hypothesis that spatial ability depends in part upon a recessive, sex-linked gene. The magnitude of the familial correlations suggested that about 46 percent of score variance is attributable to genetic variation.

<sup>4</sup>The Revised Minnesota Paper Form Board Test is published by the Psychological Corporation, New York.

<sup>5</sup>The Study of Verbally Gifted Youth (SVGY) was begun in 1972 by Robert Hogan, Catherine Garvey, and Roger Webb at The Johns Hopkins University and is supported by a grant from the Spencer Foundation of Chicago.

interests and values (Aiken 1970; Astin 1974; Carey 1958; Milton 1957). Many educators do believe that sex differences in interests in mathematics and science result, at least in part, from differential childhood experiences and reinforcements of sex-role-appropriate interests (Fox 1977).

The absence of a father in early childhood has been shown to be related to a discrepancy between mathematical and verbal abilities for boys. Father-absent boys have lower mathematical aptitude relative to verbal aptitude than do their father-present cohorts (Carlsmith 1964). It has been hypothesized that this difference is related to a learned conceptual style or approach to problem solving. In general, boys learn an "analytic approach" while girls learn a "global approach." Thus, boys in father-absent homes may learn a more global or feminine approach and thus tend to perform relatively less well on quantitative measures than verbal ones with respect to male norms.

Studies of productive and creative female mathematicians found that these women tended to come from homes where the fathers were professional men and very dominant in the family (Helson 1971). These women tended to be eldest daughters who had no brothers. Significantly more of the creative than the less creative female mathematicians had identified primarily with their fathers and not their mothers. Although these women did not score low on measures of femininity, perhaps they had developed a more analytic than global cognitive style.

Clearly, problem-solving skill is correlated with sex-role identity for both males and females (Milton 1957). Early identification with a father, particularly an intellectual and analytic father, is related to quantitative interests and ability for both sexes.

Early interest in mathematics is likely to be noticed and supported more by parents of boys than parents of girls. Astin (1974) studied the family background questionnaires of a sample of highly mathematically precocious children. Parents of boys far more than parents of girls had noticed their children's mathematical gifts in the preschool years. Parents of girls were far less likely than parents of boys to have bought toys and games of a scientific and mathematical nature for their children.

Gifted girls who took advanced placement courses in science and mathematics in high school reported their early frustrations in trying to get chemistry or construction sets as toys (Casserly 1975). Girls lamented the fact that parents seemed to fear that the girls would hurt themselves with a chemistry set, yet did not fear the girls would hurt themselves in the kitchen.

Gifted boys, too, may suffer from sex-role expectations of parents. This is likely to be particularly true for gifted boys from lower class backgrounds where literary and artistic pursuits are not valued. Some segments of the population do not consider reading to be a masculine

endeavor. Even in families where education is highly valued, boys may be rewarded for physical and aggressive activities rather than for more passive intellectual ones.

### **Achievement**

With respect to grades earned in high school and college, women are more academically predictable than men (Seashore 1962; Stanley 1967). This seems ironic in light of the relatively lower levels of achievement of women in graduate school and beyond. In a study of graduate students in psychology, the single best predictor of success was sex (Educational Testing Service 1972). Females were less likely than males to attain the doctorate.

Women may be less predictable than men with respect to achievement as measured by standardized tests in situations where masculine interests and motivation are important. In a study of gifted junior high school students in a special accelerated after-school algebra class, mathematical aptitude as assessed by the SAT-M correlated with algebra achievement of boys but not of girls (Fox 1976a).

Recent results of the National Assessment testing program indicate that by age seventeen, boys score as well or higher than girls on achievement tests in all areas except writing (Mullis 1975). In the areas of mathematics and science, sex differences in achievement are related in part to differential course taking in high school. Many girls with high mathematical aptitude elect not to take advanced courses such as calculus (Haven 1972). (Differential course taking does not account, however, for sex differences in geometry skills found at age nine.)

Differential course taking of girls in high school is related to girls' perceptions of the value of such courses for their future, and differential encouragement by teachers, parents, and peers. There is some controversy as to whether or not girls have less achievement motivation than boys. Maccoby and Jacklin (1975) say there are no consistent sex differences, whereas Horner (1968) says girls fear success. In the case of advanced mathematics and science courses it seems more likely that girls fear failure and poor grades on the one hand and possible peer rejection on the other. Teachers and peers may reinforce expectations for failure at the high school level.

Although boys and girls in elementary school both believe their own sex-peer group to be superior in all subjects, by high school their expectations have changed. Then both sexes believe that girls are better at English but poorer in science than boys (Ernest 1975).

A study of elementary school teachers found that 41 percent felt boys did better in science and mathematics and 63 percent felt girls did better in

English (Ernest 1975). Although these attitudes may reflect real differences these teachers have observed in their classrooms, such expectations are likely to influence teacher behaviors and thus reinforce the differences.

Casserly (1975) reports that gifted girls felt that their teachers, both male and female, reinforced stereotypes even when they were obviously inappropriate. For example, it often happens that some girls in eighth grade are taller than all the boys in their classes, yet teachers may overlook the real differences and ask for tall, strong boys to help get materials from the cupboard. Girls were told in science class that the next few remarks were only for the boys; the teacher then discussed the applications of the unit studied to repairing bicycles.

## **Creativity**

Studies of children and adults on measures of creative potential do not systematically favor either sex (Maccoby and Jacklin 1974). Yet, as with general intellectual achievement, men and women differ with respect to creative accomplishments in life in most areas of human endeavor. This is at least partly so because women in the past have not seriously aspired to professional levels of excellence. As more women move into professional roles on a full-time basis, the numbers of those judged creative and productive should increase.

Studies of creative people find that such persons have certain masculine and feminine interests and characteristics. A certain openness to all experiences seems necessary for creative productivity (MacKinnon 1962). Thus, persons who struggle to suppress their opposite sex traits and interests may stifle some of their creativity as well.

Women need to develop their capacities for independence and intellectual aggressiveness. Men are more likely than women to need to develop their aesthetic sensitivity and openness to emotional experiences. The reduction of sex-role stereotypic thinking and behavior is likely to be as necessary for fostering creative thinking as the introduction of divergent thinking games and activities into the classroom.

## **Other Talents and Gifts**

At present we are unable to assess potential talent effectively in most nonacademic areas. It is impossible to say whether or not men and women differ significantly in artistic, musical, or leadership potential. Artistic and literary interests are typically considered feminine. Women tend to score higher than men on measures of artistic interest. Yet there

are far more men than women who have won acclaim as professional artists and writers.

Success in the arts is based upon judgments by one's peers. It seems likely that such judgments are influenced by the greater status of men in society. Studies have shown that paintings and written essays receive higher ratings from adults and college students when these products are designated as the products of males rather than females (Goldberg 1968; Pheterson, Kiesler, and Goldberg 1971). There are occasional exceptions when essays on such feminine topics as cooking or child care are rated equally for authors Jane or John Doe. Perhaps women should be encouraged to sign their creative works with initials or, like George Eliot, adopt a masculine pen name.

While women may face great barriers to achieving eminence as adults, men may have difficulties developing their interests in artistic pursuits as children. Artistic sensitivity should be encouraged in both sexes in childhood and adulthood. Sex-role stereotyping and prejudice work against men and women in the arts. For example, parents are often quite upset if their sons score high on femininity scales of personality measures. These scores often reflect not homosexual tendencies, as the parents fear, but artistic sensitivity.

Educational programs for the gifted must deal with two problems: first, sex-role appropriate behavior stereotypes which may inhibit male participation in the arts; and second, barriers to the adult achievement of women.

## Values and Interests

Interests, values, and personality factors as well as cognitive abilities help determine an individual's achievement in school and life. Sex differences in the affective domain appear greater than those in cognitive areas. Men and women differ markedly with respect to interests and values that relate to achievement and creativity.

Adults, college students, and high school students differ consistently with respect to value scores on the Allport-Vernon-Lindzey *Study of Values* (SV).<sup>6</sup> Males score higher than females on the theoretical, economic, and political scales and score lower in the social, aesthetic, and religious values (Allport, Vernon, and Lindzey 1970).

In studies of the values of gifted youth, these same patterns of sex differences were found (Fox and Denham 1974; Fox 1976b). Gifted boys

<sup>6</sup>The Allport-Vernon-Lindzey *Study of Values* is published by the Houghton Mifflin Company, Boston.

scored higher than girls on the theoretical, political, and economic scales and lower on the social, aesthetic, and religious scales. Even when samples of gifted boys and girls were matched on verbal and quantitative aptitude and socioeconomic background, the sex differences in theoretical, aesthetic, and social values were still highly significant.

The pattern of value ordering for gifted boys closely resembled that of a normative high school sample described in the manual. Gifted girls did differ, however, from the normative high school sample of girls. For gifted girls the theoretical value was their third highest score while the religious value was fifth. In the normative high school sample the theoretical value was sixth and the religious value was first.

MacKinnon (1962) and others (Southern and Plant 1968; Warren and Herst 1960) have found that high scores on the theoretical and aesthetic value scales are associated with creativity. Studies of gifted adolescents at The Johns Hopkins University have found many males, but few females, who scored highest on the theoretical value scale. Few males or females score highest on the aesthetic value.

Of 240 gifted females and 416 gifted males tested on the SV in 1973, 37 percent of the boys but only 15 percent of the girls scored highest on the theoretical scale. Only 13 and 5 percent of the girls and boys, respectively, scored highest on the aesthetic scale. Over 55 percent of 135 very mathematically gifted boys scored highest on the theoretical value. Thus, theoretical interests appear to be correlated to mathematical talent. Boys and girls who scored highest on the theoretical value scale also had the highest mean score on the SAT-M in the 1973 contest (Fox 1976b).

Boys who have high theoretical values and mathematical talent are far more interested in accelerating their educational progress in mathematics than boys or girls who have the talent but score higher on social value measures. Differential values and interests appear to be a major factor in the sex differences in mathematical achievement at the high level of ability. Although gifted girls are more likely to have high theoretical interests associated with scientific pursuits than average-ability girls, they are still less theoretically oriented than their gifted male cohorts.

Further evidence that gifted girls have stronger academic interests than less gifted girls comes from a study of career interests of gifted youth (Fox, Pasternak, and Peiser 1976). Gifted seventh-grade boys and girls were compared with a normative sample of ninth graders on the fourteen basic interest scales of the Strong-Campbell Interest Inventory (SCII).<sup>7</sup>

Gifted girls and boys scored significantly higher than their respective normative counterparts on the scales of writing, mathematics, science,

<sup>7</sup>The Strong-Campbell Interest Inventory (SCII) is published by the Psychological Corporation, New York.

public speaking, and medical science. These scales clearly reflect a greater interest in intellectual pursuits. Gifted girls also scored higher than the normative group on the scales of law and politics and mechanical activities. Although the normative sample of girls scored higher than the gifted girls on scales of social and conventional interest, such as domestic arts and office practice, these differences were not statistically significant. Thus, gifted girls are not less interested in the more traditional female areas than average girls, simply more interested in the more masculine areas, such as science, mathematics, and mechanical activities.

Average boys differed from gifted boys in that they had lower scores on the more intellectual scales, as noted above, and significantly higher scores on the adventure scale. The latter scale, according to Campbell (1974), reflects vocational immaturity. Gifted boys scored higher than the normative group on all three artistic scales, but only the difference in the writing scale reached significance.

Thus, both gifted girls and boys differ from their less-gifted cohorts on measures of intellectual interests. For boys, this does not seem to involve a real difference with respect to the masculine stereotype. For gifted girls, however, there appears to be a source of sex-role conflict. Girls have both masculine and feminine interests.

For a number of reasons gifted girls probably experience more conflict than boys in making career choices. First, they must decide whether or not to seek a career instead of, or in addition to, a role of wife and mother. Second, if they elect to pursue a career, they must choose between a traditionally accepted female one or a more intellectual, but masculine one.

Gifted girls are less likely than gifted boys to exhibit sex-role stereotype in naming occupational choices. For example, girls are far more likely to name physician as a career choice than boys are to name nurse. Of course, job status and pay are also tied to career aspirations. Most occupations designated female have less status and monetary reward than more masculine occupations.

On a semantic differential measure, gifted boys and girls matched on measures of ability and socioeconomic background were asked to rate their self-perceptions in eight occupations. Gifted girls perceived themselves favorably in both masculine and feminine careers, whereas boys had negative perceptions of themselves as nurse, homemaker, or professor of English. Elementary school teacher was rated somewhat favorably by boys, but far less so than the occupations of mathematician, physician, professor of science, or computer programmer.

For girls career aspirations as early as grade seven or eight appear to be related to achievement in some subject-matter areas. Girls who see mathematics as useful for their future careers are more likely to take

advanced courses and maintain high levels of achievement in mathematics during the high school years (Astin 1968; Astin and Myint 1971; Haven 1972). Gifted girls who are interested in careers of a scientific or mathematical nature are more likely to persist in special mathematics courses and accelerate their achievement than girls who have social, artistic, or enterprising career aspirations (Fox 1974a, 1975b). A study of 161 girls who took advanced placement courses in mathematics, chemistry, and/or the physical sciences found that 80 percent of these girls were interested in careers in science (Casserly 1975).

In brief, gifted boys and girls do differ significantly with respect to interests and values. These differences, in turn, seem related to differential achievement of the sexes in school and life. Let us now consider how these differences relate to special types of programs for gifted children.

## **FACILITATING THE DEVELOPMENT OF TALENT**

A great variety of educational alternatives and teaching strategies have been advocated for enriching the education of gifted children in academic areas. Some of these methods are clearly accelerative in nature. Others are less specifically designed to promote rapid learning and precocious achievement. Not all educators agree on the relative merits of each method; however, few researchers have systematically analyzed the advantages of these strategies separately for girls and boys. We shall now try to address this problem. We will first consider methods that have clear accelerative components.

### **Accelerative Enrichment**

Studies of children who enter school early have, in general, found early admission to be a viable method for gifted children (Worcester 1956). In most such studies girls have outnumbered boys. In a study by Hobson (1963) of early entrants in 1946 and 1947 in a Boston suburb, girls outnumbered boys by about two to one. Very gifted boys and girls are likely to be ready for the intellectual experiences and demands of first grade a year or more before the standard entering age. Birch (1954) suggested that girls' early verbal superiority might make them more visible to their parents at an early age. To the extent that girls are developmentally ahead of boys in the early childhood years, we might expect that early admission to kindergarten or first grade would be even more effective for girls than boys. Research is needed to determine whether or not this is, in fact, true. If so, parents of gifted girls should be

altered to this because, as we shall see, attempts to foster accelerated achievement among gifted students at older ages appear more difficult for girls than boys.

In a report to Congress, the Commissioner of the U.S. Office of Education (Marland 1971) noted that grade skipping of one or two years has generally been found to be a successful alternative for gifted children. To be most effective, however, grade skipping needs to be well planned to avoid unnecessary adjustment problems for the child. Grade skipping that takes place at natural transition points in the school process is likely to be least disruptive for the child. The ages at which acceleration is least traumatic may differ for the sexes.

Although moderate grade skipping in the elementary school years may be equally successful for boys and girls, grade skipping at the secondary school level does not appear currently to have equal appeal to both sexes. A sample of gifted seventh- and eighth-grade boys and girls who entered a mathematics contest at The Johns Hopkins University were canvassed as to their attitudes toward acceleration. Girls were significantly less favorable than boys toward acceleration for themselves (Fox 1975*b*). Only 54 percent of the girls as compared with 73 percent of the boys expressed a willingness to accelerate. Significantly more girls than boys felt their parents would disapprove of acceleration.

These findings support the observations by the SMPY staff of mathematically gifted adolescents and their parents in counseling situations. Girls appear to be more fearful than boys of possible peer rejection for academic acceleration. Adolescent girls appear more fearful than boys of trying something different because they might not succeed (Fox 1974*b*). Girls who have high self-esteem, as measured by expectations for success in the contest, were significantly more likely to favor acceleration than girls who predicted they would score average or poor relative to the other girls in the contest. Expectations for success, however, were not correlated with actual performance. Thus, the most able girls were not necessarily high on self-esteem or eagerness to accelerate. Girls may or may not truly fear success, but they do appear to be, as adolescents, less confident than boys about their ability to succeed in unknown situations. Perhaps girls are more willing than boys to suffer intellectual boredom to ensure their social standing in the peer group.<sup>8</sup> This, again, would seem to argue that girls are likely to benefit from accelerative experiences in the

<sup>8</sup>Occasionally girls who were reluctant to accelerate in grades 7 or 8 express an interest in acceleration in grade 11. They appear to become "fed up" with high school, both intellectually and socially, and want to go to college early. Unfortunately, they often have not planned their high school programs well for this goal. Therefore, they lack courses like calculus, physics, and chemistry in addition to senior-year English. This makes it difficult for them to go to college early.

early elementary school years before they become socialized against acceleration and intellectual pursuits.

Since double promotions appear to have some drawbacks, SMPY has investigated some alternative acceleration strategies for meeting the needs of mathematically talented students. Let us consider how well some of these strategies meet the needs of gifted boys and girls.

Subject-matter acceleration by advanced placement is a rather straightforward idea but has not been noted in the literature until recently (Fox 1974c). In this scheme, students would be placed in classes appropriate for them in specific content areas. Thus, a twelve-year-old who is mathematically gifted might be in homeroom, physical education, English, and social studies with age peers in a junior high school, but be placed in geometry and chemistry with tenth and eleventh graders at a high school. Subject-matter acceleration of this type works well in situations where elementary, junior, and senior high schools are physically nearby or where transportation from school to school can be arranged.

The extreme of this model is having junior and senior high school students take college courses in those areas in which they are most gifted, and yet remain in the secondary school for most of the school day. This method has many advantages at present. A very mathematically gifted youth may easily learn all the precollege mathematics and science available in the public secondary school one or two years before he or she is ready for full-time entrance to a college or university.

College course work can be taken during the day, at night, in summer or by correspondence in the appropriate subject areas. SMPY has well documented the fact that very gifted adolescents can succeed in college courses (Keating, Wiegand, and Fox 1974; Solano and George 1976).

These methods of subject-matter acceleration all appear to be very effective for gifted males. Gifted adolescent girls, however, are far less likely than boys to take advantage of these options. Gifted girls have been known to actually repeat a course to avoid this type of acceleration. It is not completely clear whether or not girls are actually less successful than boys in these types of accelerative programs because so few girls have tried them.

The rejection of subject-matter acceleration by girls seems to be in part a sex-by-subject-area interaction. At present, mathematics and science lend themselves best to this type of acceleration. Although girls apparently report liking math as much as boys do (Ernest 1975), there is considerable evidence when mathematics and science courses are optional, gifted girls elect not to take them in far greater numbers than boys do (Haven 1972).

Differential course taking for the sexes at advanced levels is very clear in the case of the Advanced Placement Program (APP).<sup>9</sup> The APP allows students to earn advanced standing in college courses, college credit, or both for courses studied in high school. These courses were specifically designed for the academically talented student.

Gifted girls take fewer of these courses than boys, particularly in mathematics and science. In 1974, only 17.2 percent of the APP candidates in chemistry were girls. Only 12.9 percent of the students who took the physics B-level examination and 6.8 percent of those who took the physics C-level examination were girls. In mathematics, only 27.9 percent of those who took the calculus AB-level examination were girls, while only 21 percent of those who took the BC-level calculus examination were girls (Casserly 1975).

In 1975, 50,384 exams were taken by boys and 35,402 were taken by girls. Of the nineteen different exams given, girls outnumber boys in only six: art history, studio art, English, French language, French literature, and Spanish. Boys outnumber girls in American history, European history, the classics, German, and all the science and mathematics courses, including biology (CEEB 1975).

Casserly (1975) did an extensive study of twelve American high schools which enrolled over twice the national percentage of girls in their APP courses in mathematics and science. Her findings are very enlightening.

Schools that enroll sizable numbers of girls in these APP courses tend to have one or both of the following characteristics:

1. Teachers of such courses who actively recruit girls for the classes. These teachers exhibit few signs of sex-role stereotyping in their thinking or in their classroom behavior. They expect high-level performance from the girls as well as the boys, and they demand it from both.
2. Students who were tracked as early as the fourth grade into homogeneously grouped and sometimes accelerative programs. Thus, the taking of APP courses is a natural sequence in a special program for superior students.

It is interesting to note that interviews with counselors in these schools indicated that these counselors were not always supportive of APP courses for the gifted girls. Both male and female counselors admitted that they often discouraged girls from taking these courses. The reasons for such counseling differed by sex. Female counselors tended to project their own dislike or fear of science and mathematics in their counseling strategies. Some said that the girls needed time for social activities, which would be lost if they had to work hard on APP courses. Others said they hated to put girls in situations where they could not

<sup>9</sup>The Advanced Placement Program (APP) is operated by The Educational Testing Service, Princeton, N.J.

succeed, where they might make low grades and thus hurt their otherwise excellent academic records.

The concern for good grades is particularly interesting because interviews with the girls enrolled in APP courses at those schools indicate that the girls earned high grades in these courses. This seemed to conflict with the girls' self-estimates of their actual abilities and performance in the classes. The girls thought themselves to be in the bottom of their classes, yet their grades and achievements indicated they were not. Only 3 of the 161 girls studied were in danger of making poor grades.

Male counselors had a somewhat different argument for counseling girls out of the APP courses. They felt it would be "unfair to the girls" because the job market was so tight in the physical sciences and the jobs should *of course* go to the men.

If these attitudes are found among counselors at schools that have the greatest female enrollments in APP courses in mathematics and science, what must be the attitudes and counseling strategies in schools that have much lower rates of female participation? These findings are staggering. Recall, this study was done in 1974-75. It reflects the kinds of barriers that still exist today for gifted girls. How intrepid the girls must be to pursue the development of their talents.

Advanced placement courses appear to be an excellent model for the types of programs that we might wish for the academically talented child. Alas, these programs do not have a true counterpart at the junior high school or elementary level. Stanley, Keating, and Fox recently created a model for the upper elementary and junior high school grades in mathematics which parallels the APP (Fox 1974*b*; Fox 1975*a*; George and Denham 1976; Stanley 1976). This model is the provision of fast-paced homogeneously grouped classes for fifth through eighth, ninth, or tenth graders.

The first experimental class was conducted on the campus of The Johns Hopkins University for two hours a week on Saturday mornings from the summer of 1972 until 1973. A teacher, well trained in mathematics, paced the best of the students (eight boys and one girl) through four and one-half years of precalculus mathematics in a year's time. The least ambitious students (mostly girls) learned two years of mathematics in a year. Most of the students had only completed the sixth grade when they entered the program.

The boys who completed the precalculus mathematics in a year went on to take calculus in a high school the following year. All but one were successful. The single girl, however, chose to repeat plane geometry in a self-paced course the following two years to avoid acceleration.

By the end of the school year 1974-75, twelve accelerated mathematics classes had been conducted at Hopkins or in public and private schools and school systems in Maryland. These classes have all been

successful in promoting high-level achievement at a rapid rate. There have been, however, notable sex differences. Boys and girls do not achieve equally well under all conditions.

Girls are far more likely to participate in such classes if they are conducted as part of the regular school program rather than as extracurricular activities. Girls apparently are less likely to give up a Saturday morning to study math beyond their regular school program than are boys. Thus, the more closely the program is tied to the school, the more likely girls will participate.

Girls are more likely to achieve as well as or better than boys in these types of classes if they are taught by women in all-girl classes or classes where there is at least a sizable number of girls relative to the boys. When classes are taught by men and the number of girls is very small relative to the boys, the girls often drop out. (There are, of course, exceptions. One girl chose to be in an otherwise all-boy class taught by a male and was highly successful.) In general, the presence of a female role model and other girls seem to be helpful in promoting achievement of girls in accelerated classes.

Hawley (1972) found that women who majored in mathematics and science in college tended to view these areas as less antithetical to femaleness than did college women in other fields. Perhaps the presence of a woman teacher and other girls help dispel the feeling that mathematics is a masculine domain. Since girls appear to be somewhat concerned about establishing their feminine identity in early adolescence, the sex-role appropriateness of the task is apparently a psychologically relevant factor.

Since boys should experience no sex-identity conflict about being accelerated in mathematics, the sex of the teacher should be less important for them. Only three of the twelve classes of students to date have had female teachers for boys. An all-male class taught by a woman was extremely successful. Boys in mixed-sex classes taught by women did not do quite as well as expected. Perhaps if classes become too "feminized" or social, boys will enjoy them less.

The analysis of the twelve classes has not been in any way a true experiment. Therefore, conclusions cannot be drawn, only tentative hypotheses suggested. What needs to be studied explicitly is the differential performance of gifted males and females in educational experiences which are congruent and incongruent with sex-role stereotypes.

I do not mean to suggest that we as educators should try to reinforce sex-role stereotypes, but I would like to argue that we cannot ignore them. What we need to do is examine them critically and unemotionally to determine their significance as classroom environmental variables that need to be considered in educational planning.

For example, what, if any, benefits can arise from explicitly planning for sex differences in educating the gifted? In the summer of 1973, this author taught twenty-six seventh-grade girls algebra I. Eighteen of the girls persisted in the program and were highly successful. The class was specifically designed to foster interest in mathematics and achievement (Fox 1974a). By the end of the ninth grade about half of the girls who had initially come for the class had managed to become accelerated in mathematics by at least one year.

Although this is not as impressive as the acceleration accomplished by many boys in the SMPY program, it was a substantial gain for girls. The girls had been matched on a number of cognitive and social variables with two control groups. The control boys and girls did not participate in the classes but did receive counseling by mail as to the advantages of subject-matter acceleration. Only 20 percent of the control boys and 16 percent of the control girls had become accelerated in mathematics. All three groups were equally gifted in mathematics. Thus, attempts to intervene to encourage girls to develop their mathematical talent can be successful.

Prior to the program, both groups of girls were alike with respect to interests in careers in science and mathematics and considerably less interested than their male counterparts. Two years later, the girls who had accelerated were significantly more interested in these career areas than the control boys or girls. Now it is true that the girls who benefited most from the program were those who initially had investigative career interests. The effect of participation in the program was to help reinforce and maintain that interest (Fox 1976a).

Early admission to college is the final accelerative experience for consideration. Radical early admission to college, as studied by SMPY (Stanley 1974), does indeed appear to be a male domain. To date, SMPY has not in general found girls who appear to be ready for college full-time at age fourteen. This is, at least in part, because most radical accelerates are extremely gifted in the quantitative areas. Such extreme precocity in the quantitative area appears less frequently among females.

Early admission to college by one year, however, does appear to be as effective for gifted young women as men. The studies of the early entrants by Flesher and Pressey (1955) did not find women to be less able than men to succeed in college early. Early admission to college by one year or even two does not seem to be limited to those gifted in the quantitative areas. It is too soon to say whether or not this method of acceleration will be widely used by both sexes.

Counseling efforts by SMPY suggest that some girls who in the seventh and eighth grades were not eager to accelerate are giving serious consideration to graduating from high school a year early or entering

college at the end of the eleventh grade. Until early admissions programs gain wider acceptance, it will be difficult to evaluate their effectiveness for both sexes.

There is no direct evidence that any of the aforementioned accelerative strategies are truly less effective for educating gifted girls than boys, only that they are less likely to be tried by gifted girls. Since acceleration is clearly more feasible in mathematics and science, the reluctance of girls to attempt acceleration may be, in some cases, a form of mathematics-avoidance behavior.

### **Nonaccelerative Strategies**

There are a number of educational strategies recommended for the gifted which do not necessarily lead to advanced grade placement. Homogeneously grouped classes for the purpose of enrichment are an example. What may be accomplished under this type of program is so situation-specific as to make any evaluation of benefits of such programs for either sex difficult, if not impossible.

Self-paced independent study projects, like enriched classes, are difficult to evaluate. It seems likely that success in these activities is related to interest in the subject area, motivation, and the work and study skills of the students. Informal observations suggest that, at least in mathematics, girls achieve more in classes than by self-paced, independent study. Perhaps one reason some girls drop out of accelerated programs is because these classes require more outside independent study of the textbook than do slower-paced classes. It is doubtful that in general girls have poorer study skills and habits than boys. More likely, differential motivations account for the differences. Apparently, the greater theoretical orientation of boys helps them enjoy learning on their own in mathematics. Girls who score high in social interest measures probably dislike solitary learning situations and prefer more interaction with teachers and peers.

Harold C. Lyon, former Director of The Office of Gifted and Talented in the U.S. Office of Education, has spoken repeatedly of the value of mentorship programs for gifted students (Lyon 1975). Adolescents would be placed into close working relationships with adults who have similar interests. Epstein (1970) and Robin (1975) caution that women can have various difficulties in the mentor-mentee relationship if the mentor is a male. Although they are speaking of young adult women, the problem may be true for younger girls as well. Intellectual development may be better fostered for girls if the mentor is female. Mentor relationships that place young girls in contact with successful women

models who have not rejected their femininity in their struggle to achieve would seem to be a particularly desirable program for gifted girls.

Internship and work-study programs that allow students to work in offices, laboratories, hospitals, and so forth, have excellent value for the gifted. Care should be taken, however, to ensure that gifted girls are not placed in situations that will reinforce harmful sex stereotypes.

The whole area of career education for the gifted is a relatively new one. There is perhaps no other single program which has so much potential for helping gifted female and minority students.

## CONCLUSION

On the basis of the existing evidence concerning educational aptitudes, interests, and achievement of the gifted, five major areas of concern for future research and program planning can be identified.

The first area is that of sex-role stereotypes. Creative and productive behavior of both males and females in school and in life is likely to increase as unrealistic sex-role stereotyping of activities gives way. The ideas that smocks in art classes or aprons in cooking class threaten the sexual identity of males while aprons in shop class cause the loss of femininity of females are no more absurd than the ideas that science is a male domain and poetry is for sissies.

Gifted boys and girls both need moral and intellectual role models who exhibit the heights that gifted persons can achieve. For girls the exposure to women who utilize the full range of their talents and gifts seems particularly crucial.

Career counseling is important for both sexes. At present not enough is known about the career counseling needs of gifted women. Models need to be developed and tested. At present the choice of a career as homemaker is still generally limited to women. Therefore, the career counseling needs of women will not be identical to those of men. Since some women may not wish to begin a career outside the home until they are forty or older, consideration should be given to providing continuing educational and career development programs for them. Efforts are needed to encourage women not to eliminate later career possibilities by failing to develop their talents in adolescence and young adulthood.

Counselors and teachers need to become more aware of the special needs of the gifted learner, as well as the general problems of sex-role stereotyping. If teachers are to prepare children for the future, they must themselves be helped to understand social change and adjust to it.

Parents as well as educators need to become aware of the negative outcomes of early sex-role stereotyping. Parents of gifted children should

be counseled about the talents of their offspring as early as possible. Parents of girls may need urging about the values of certain so-called boys' toys and games for their daughters. Parents of gifted boys may need encouragement to be tolerant of their sons' aesthetic and verbal interests. Perhaps groups such as the National Association for Gifted Children could experiment with counseling centers for parents of the gifted.

A second issue is that of homogeneous grouping. At present that concept is too often limited to grouping on the basis of an IQ score. Children with the same overall intelligence score can be very different with respect to specific abilities and interests. Perhaps ability grouping with respect to interests and specific skills would be more beneficial to all.

Whether or not students are actually segregated into special classes or dealt with in teamed class situations, some attention to interest should be considered. Perhaps students with mathematical talents and interests would enjoy language classes more if they read and wrote articles related to mathematics and science. What would be the result of offering a course in mathematics or science taught in German or Russian? Perhaps students with strong social interests would appreciate mathematics more if the course was interlaced with applied problems of a social nature. Courses in statistics and mathematical psychology could be developed which also taught the basic mathematics of algebra through calculus.

Perhaps children would become more creative if educators and parents set better examples in their approaches to teaching. In life, skills are far less compartmentalized than in school. In life, ability, interests, and experience play greater roles in work situations and assignments than age. Yet in schools chronological age is the major factor that determines what child learns what topic at a given level. Gifted boys and girls would both probably benefit if attention to readiness and interest for learning were more important than age.

This leads to the third area of concern: the acceleration of learning and appropriate content for the gifted. At the first World Conference on Gifted, Gallagher (1975) stressed quite eloquently that the major need for progress in educating the gifted is the development of appropriate content to be studied. In mathematics and science such content has been well developed. The problem for gifted learners is one of allowing them to study the mathematics and science content at the most appropriate time and pace. For example, SMPY has clearly demonstrated that some sixth and seventh graders can easily master the content of algebra and geometry at a high level. The problem is how to adjust the school program to allow the natural transition from computational skills to abstract mathematics to occur at the right time for the gifted learner. In the case of girls this problem is particularly difficult because to learn this

material at the appropriate time often requires some type of acceleration of grade placement, either in the subject or overall.

Gifted students, particularly girls, would benefit from changes in school environments that create greater flexibility in the content presented to a given student at any age. The concept of the ungraded school is to be lauded. But, unfortunately, this concept is too often more limited in practice than in theory. Self-pacing independent study is also less than ideal. Talented children need to interact with their intellectual peers and can benefit from the guidance of good teachers.

The acceleration of learning of appropriate content is the major issue. At present some form of grade skipping, or at least subject acceleration, is all that is available to most gifted students. Although these methods do work, they are unattractive to many, especially gifted girls. The ultimate solution for the gifted child, as well as the slow learner, is the abolishment of age-grade segregation.

Stanley (1959) has proposed longitudinal teaching teams in various subject-matter areas. This concept needs to be expanded and tested. It is possible that the creation of learning centers with specialists in subject areas who develop long-range curriculum programs for students might eliminate some of the problems of desegregation as well as problems of the "deviant learner." Major changes in educational strategies come slowly. Thus, while on the one hand educators should experiment with innovation, on the other hand they must deal with today's gifted children, who exist in less than ideal situations.

This leads to the fourth critical issue: the need for early identification and planning for the child who is gifted. Some parents recognize early that their child is exceptional. The extremely precocious child who learns to read at age three or four is not likely to go unnoticed. In some families, however, the gifted child may not be recognized.

Given the present educational process, early entrance to first grade would seem to be desirable for most very bright students. Early entrance is particularly desirable for girls since later acceleration is less appealing to them. Early entrance to school is also likely to benefit the child from the educationally disadvantaged background. Yet few school systems encourage early entrance. Clearly, better screening procedures would seem to be needed in order to identify children who should enter school early. Research is needed to devise ways of finding talented students early to foster advanced school registration. The concept of Head Start seems to be truly needed for gifted girls and the children from educationally disadvantaged homes.

Early identification and admission to kindergarten or first grade by itself is not enough. Program planning for the advanced learner needs to

be started early and continued through college. For girls, early tracking into academic programs that lead to AP courses and early high school graduation seems imperative. The gifted learner will need the level and stimulation of advanced course work earlier than others. College-level work may be necessary for the very bright learners when they are only ten to fifteen years old. Exactly how this is handled will vary with each child. There is no single solution to fit all gifted students.

This leads to the fifth and final issue of concern: counseling for the gifted learner. Since there can be no single plan for all children, there is a real need for early educational counseling and planning services for the gifted child. Gifted children and their parents must be alerted to the various alternative strategies that exist in order to plan a program. Girls, in particular, need early counseling about the value of advanced placement courses, early college admission, and studying mathematics and science. Sensitive counselors are needed who will stimulate, not discourage, the intellectual interests and achievement of gifted girls and boys.

America needs talented scientists, artists, gifted leaders, and informed, concerned citizens. All children today need educational programs that prepare them for the demands of the future. Gifted learners are too often frustrated rather than helped to fulfill their promise by the unnecessary rigidity of our present educational system. The gifted child, especially the female child, is often discouraged from seeking intellectual challenge. In the year that we honor both women and Terman's impressive study of the gifted child, educators and parents should make a strong commitment to quality educational programs that lead to the realization of potential for all children, including gifted and talented boys and girls.

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