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AUTHOR Stocking, Vicki Bartosik; Goldstein, David
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ABSTRACT

Recent attention has focused on the decreasing levels of scholastic achievement of youth in the United States, particularly in areas of mathematics and science. In particular, concern has been expressed about the involvement and achievement of girls in traditionally sex stereotyped curricula, such as mathematics and science. This paper reports on an investigation exploring the course-taking and achievement patterns of academically talented girls and boys, selected by Scholastic Aptitude Test (SAT) scores. The subjects in this study were enrolled in the Talent Identification Program's Summer Residential Program at Duke University, an intensive 3-week academic experience. The study found that girls and boys performed equally well in all types of classes. Main effects in achievement and motivation were found only for type of class. The success of the students indicated that the SAT is a valid selection instrument. In addition, the usefulness of the SAT as an identifier of very high academic ability is described. (DK)

Course selection and performance of very high ability students: Is there a gender gap?

Vicki Bartosik Stocking and David Goldstein

Talent Identification Program at Duke University

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Abstract

Recent attention has focused on the decreasing levels of scholastic achievement of American youth, particularly in areas of mathematics and science, and concern raised about the readiness of these students to meet the technological challenges of the future. In particular, concern has been expressed about the involvement and achievement of girls in traditionally sex-stereotyped curricula, such as mathematics and science. This investigation explores the course-taking and achievement patterns of academically talented girls and boys, selected by SAT or ACT scores, enrolled in the Talent Identification Program's Summer Residential Program at Duke University, an intensive three-week academic experience. Girls and boys performed equally well in all types of classes; main effects in achievement and motivation were found only for type of class. The success of the students indicated that the SAT is a valid selection instrument. In addition, the usefulness of the SAT as an identifier of very high academic ability is described.

Course selection and performance of very high ability students: Is there a gender gap?

Recent attention has focused on the decreasing levels of scholastic achievement of American youth, particularly in areas of mathematics and science, and concern raised about the readiness of these students to meet the technological challenges of the future (e.g., Clark, 1988; Stevenson, Lee, & Stigler, 1986). In particular, concern has been expressed about the involvement and achievement of girls in traditionally sex-stereotyped curricula (i.e., mathematics and science; Reis, 1987; Strauss, 1988; see Armstrong, 1985, for a representative review), although a recent meta-analysis suggests that differences in achievement between males and females are declining (Linn & Hyde, 1989). In a review of the literature, Chipman & Wilson (1985) examined cognitive variables (e.g., previous mathematics achievement), affective variables (e.g., perceived utility of mathematics), and social influences (e.g., parental encouragement), in the prediction of enrollment and achievement of girls and boys in mathematics. The authors sifted through the set of interrelated predictors and concluded that previous mathematics achievement (or general scholastic achievement or general cognitive ability) was the strongest predictor of future enrollment in mathematics courses and achievement in those courses. This relationship has implications for college-level study; Ethington and Wolfle (1988) found that the number of math and science courses in high school exerted the strongest direct influence on choice of undergraduate major and also mediated all indirect effects.

It is unclear at present, however, whether these generalizations apply to all types of students. What about the academically talented population? Do these patterns hold for a group of especially talented young people? This study attempts to address the complex issue of gender differences in course taking and achievement by asking two questions: (a) What courses do academically talented boys and girls choose to take during an intensive

summer academic experience? and (b) How well do academically talented boys and girls perform in their respective classes?

Method

Subjects

Participants in this study were selected through the Talent Search of the Talent Identification Program (TIP) at Duke University. Through this Talent Search, which covers a 16 state region in the southeastern and midwestern United States, seventh graders who score in the top three percent on their in-school standardized achievement tests are invited to take the Scholastic Aptitude Test (SAT) or American College Test (ACT). The top 6% of the students taking the SAT or ACT subsequently qualify for the Summer Residential Program (SRP) at TIP, a three-week scholastic program held on the Duke University Campus. Eligible students may return to the SRP until they are rising high school juniors.

The 795 students (299 girls, 496 boys) who took part in Term I or Term II of the Summer Residential Program of TIP during the summer of 1990 served as the subjects of this study. Students ranged in age from 13 to 16 years. Only students who took part in the local campus offerings were included; those at other sites (e.g., international campuses) were not included.

Procedure

Students chose from a list of over thirty possible courses, each designed to provide an intensive intellectual experience. Students were assigned to courses; 82% of the students were placed in their first or second choice of class. Each course had certain entry requirements, such as specific minimum SAT or ACT scores. Entry requirements for courses were more stringent for returning students, as these scores were found to increase with age. Students took one course per term. Term I and Term II courses were considered

together in this paper. Six students took part in both Term I and Term II courses; for these six, the information from Term I was used in the analysis.

Courses were organized into the following five categories for the purposes of efficiency in analysis: (a) history courses included American History, Southern History, The Roman World, International Relations, People and Power, and The Sixties; (b) language courses included French, Russian, Chinese, French Seminar, German, and Latin; (c) math courses included Math Problem Solving, Number Theory, and a series of Precalculus courses; (d) science courses included Chemistry, Physics, Logic, and Computer Science; (e) social science courses included Psychology, Philosophy, Microeconomics, and Macroeconomics; and (f) writing/literature courses included Satire, Places of the Heart, Whose Voice is That?, Weltschmerz, Writing and Literature Experience, and Southern Literature. Some courses outside the writing/literature category were also writing intensive; those courses were designed to meet the goal of teaching about a subject matter through writing and other exercises; the goal of the writing/literature experiences, among others, was improved writing in and of itself.

Instruments

Independent variables included SAT or ACT scores. Students took these tests as part of the Talent Search application process. Of the 795 students included in this sample, 722 (i.e., 90.8%) submitted SAT-Math scores and 687 (i.e., 86.4 %) submitted SAT-Verbal scores. Due to the relatively low number of ACT scores available for this sample, only SAT scores were used for further analysis. Of the 728 students indicating in which grade they took the SAT, 589 (80.9%) took the test in seventh grade; the remaining students submitted scores from a test taken in eighth grade ($n = 86$; 11.8%), ninth grade ($n = 53$; 7.3%), or tenth grade ($n = 34$; 4.7%).

The three criterion measures included the following two concurrent indices of success in the class provided by the instructor and a state mathematics examination (for

math students only): (a) the instructors rated students' achievement in the class on a four-point Likert-type scale (1 = student lacked basic skills necessary to 4 = student exceeded course expectations); (b) instructors rated students' motivation levels on a three-point Likert-type scale (A = rarely motivated to C = always motivated); and (c) math students took a statewide mathematics examination in the relevant course domain (e.g., algebra, geometry) designed for use at the end of the school year.

Analysis and Results

Analyses were conducted on students' achievement scores, motivation scores, and state mathematics examination scores (for math students), with gender of student and type of course (e.g., history, writing/literature) taken into account. Performance measures were also examined in terms of SAT scores.

Course enrollment

Girls and boys took different courses, as evidenced by a chi-square test of independence ($X^2_5 = 66.541$, $p < .001$). Table 1 presents the breakdown of course selection by gender. Differential course selection was especially apparent in three types of

Table 1
Course Selection as a Function of Gender

Type of course	Girls	Boys	Total
History	41	34	75
Language	44	35	79
Mathematics	100	260	360
Science	13	63	76
Social Sciences	58	76	134
Writing/Literature	43	28	71
Total	299	496	795

classes, mathematics, science, and writing/literature, with selection falling along traditional gender lines.

Class performance

Overall, mean student achievement in summer classes was 3.08 out of a possible 4.0 (s.d. = .74). Instructors rated student motivation 2.50 out of a possible 3.0 (s.d. = .64).

Table 2 presents mean achievement scores of students by type of class. A 2 (gender) X 6 (type of class) analysis of variance of students' achievement scores identified a significant effect only for type of class ($F_{5,776} = 5.62$, $p < .001$). Post-hoc analysis indicated that math students received significantly lower achievement ratings than students

Table 2
Mean Achievement and Motivation Scores as a Function of Type of Class and Gender

Type of Class	Achievement in class[a]		Motivation[b]	
	Girls	Boys	Girls	Boys
Mathematics	2.92 (s.d. = .64)	2.98 (s.d. = .74)	2.63 (s.d. = .58)	2.43 (s.d. = .70)
Science	2.77 (s.d. = .73)	3.25 (s.d. = .73)	2.38 (s.d. = .65)	2.68 (s.d. = .53)
History	2.90 (s.d. = .76)	2.92 (s.d. = .97)	2.34 (s.d. = .68)	2.38 (s.d. = .64)
Foreign languages	3.33 (s.d. = .71)	3.14 (s.d. = .75)	2.35 (s.d. = .68)	2.32 (s.d. = .63)
Social sciences	3.23 (s.d. = .65)	3.15 (s.d. = .76)	2.55 (s.d. = .60)	2.45 (s.d. = .66)
Writing/literature	3.23 (s.d. = .65)	3.43 (s.d. = .57)	2.63 (s.d. = .54)	2.71 (s.d. = .46)

[a]Maximum score = 4. [b]Maximum score = 3.

studying writing/literature, languages, and social sciences. Similarly, a 2 (gender) X 6 (type of class) analysis of variance of the motivation score identified a significant effect only for type of class ($F_{5,777} = 3.59$, $p < .005$). Post-hoc comparisons indicated that

motivation was significantly higher for students in writing (compared to history and languages) and science (compared to language).

Math students took a statewide mathematics examination at the end of the term. Students scored from 74% to 100%, with no variation by gender (mean $_{boys}$ = 94.81; mean $_{girls}$ = 94.16; correcting for unequal variances, approximate $t_{270} = 1.086$, $p > .05$).

SAT scores and class performance

Overall, SAT-Verbal and Math scores were significantly related to student achievement scores ($r_{682} = .17$, $p < .001$; $r_{716} = .10$, $p < .01$, respectively), and the SAT-Verbal scores were related to motivation scores ($r_{717} = .08$, $p < .05$). SAT-Math scores were associated with scores on the state mathematics examination for those students who took that test ($r_{253} = .16$, $p < .05$). These patterns of association varied with gender. For boys, the SAT-Verbal and Math scores were related to performance in the class ($r_{430} = .17$, $p < .001$; $r_{454} = .15$, $p < .005$, respectively) but not to motivation, and the Math scores corresponded to scores on the state mathematics examination ($r_{184} = .17$, $p < .05$). For girls, the SAT-Verbal score was related to achievement in the class ($r_{252} = .15$, $p < .05$) and the Math score was related to motivation ratings ($r_{262} = .15$, $p < .05$), while neither was associated with the state math examination score.

These relationships between SAT scores and class performance must be evaluated in terms of practical significance as well as statistical significance; these indications of correlation are somewhat "inflated" due to the large N's. However, a relationship exists, and since these boys had higher SAT-Math scores than girls (mean $_{boys}$ = 594.36; mean $_{girls}$ = 548.14; approximate $t_{498} = -7.15$, $p < .001$) and girls had higher SAT-Verbal scores than boys (mean $_{girls}$ = 519.58; mean $_{boys}$ = 490.60; $t_{685} = 4.40$, $p < .001$), we attempted to take SAT scores into account by analyzing two subsets of the data, each with equal numbers of boys and girls, one subset each matched by SAT-Math or SAT-Verbal score, respectively. The set with subjects matched by SAT-Math scores included 220 each

girls and boys; the set matched by SAT-Verbal included 230 each girls and boys. Table 3 provides the means of relevant scores for each group. Mean scores were also computed by each type of course. Note that the mean SAT scores for these matched groups are similar to the means for the sample as a whole. In only one comparison did the mean scores differ significantly by gender; in the group matched by SAT-Verbal scores, the boys taking math had higher grades in class than the girls ($t_{158} = 2.58$, $p < .05$), reflecting the higher SAT math scores of boys in this particular comparison. Therefore, even with SAT scores controlled, the differences in achievement by gender and class were significant only for type of class.

Table 3
Student Scores While Controlling for SAT-Math and SAT-Verbal Scores

	Matched by SAT-Math			Matched by SAT-Verbal		
Score	Girls	Boys	Total	Girls	Boys	Total
SAT-Math	569.50	569.50	569.50	547.09	592.86	569.98
SAT-Verbal	516.38	496.76	506.51	518.10	518.10	518.10
Performance in class[a]	3.07	3.07	3.07	3.05	3.18	3.12
Motivation[b]	2.52	2.46	2.50	2.51	2.50	2.50

[a]Maximum score = 4. [b]Maximum score = 3.

In summary, even for this academically talented sample, students chose courses along traditional gender lines, with girls choosing proportionately more literature/writing courses than boys and boys disproportionately choosing math and science classes. However, once students chose classes, boys and girls performed equally; variations in performance were found by type of class rather than by gender.

Discussion

Gender differences in achievement found throughout the relevant literature (e.g., Wilder & Powell, 1989) were not found for this sample of exceptionally talented students; these girls and boys had the same high level of performance. Clearly, at this level, females can compete with males, in contrast to the view (e.g., Benbow & Stanley, 1980) that males are "superior" in math . Similarly, these talented boys performed as well as the girls in traditionally "feminine" courses, such as writing/literature classes.

These findings are directly relevant for classroom practice; teachers of the academically talented need to know that girls can and do excel in math and science, and that the same is true for boys in writing/literature courses (see Bartkovich, 1988; Malcolm, 1988). The current findings are particularly notable in light of recent studies (e.g., Subotnik & Strauss, 1990) which suggest that girls do better in single-sex math classes than in co-ed classes; in this investigation, the mixed nature of the math classes did not appear to hamper the achievement of the girls.

It is unclear at this point why our findings and those of other investigators differ. One reason may lie in the fact that the most notable feature of the TIP Summer Residential Program is that the participants are extraordinarily talented; these students are selected based upon standardized test performance effectively at or above the 99.8%ile. Whatever factors are responsible for such high ability do not seem to be tied to gender, at least in light of this investigation.

One limitation to this study is that the dependent measures used were based on a somewhat gross scale. However, even though possibilities of analysis were limited by the performance scales, we know from the strength of the relationship between the instructors' grades and the state math examination scores that in the case of the math students the achievement measure worked quite well.

On a final note, this investigation provides supporting evidence for the usefulness of the SAT in selecting highly talented students for an accelerated program. In particular, literally all of the math students chosen in this fashion performed at very high levels on the state mathematics examinations, designed to test a year of high school mathematics learning, after only a three-week summer course. Indeed, only two of the 360 students enrolled in math classes obtained scores below a B (i.e., 80%), and these scores were above a passing grade (i.e., 74% and 79%). Amidst the current controversy concerning the value of standardized testing for students in general (e.g., Cheney, 1990; Sternberg, 1982), it would be counterproductive to ban the use of these instruments for the identification of highly talented students. These standardized tests are valid identifiers of academic talent, regardless of gender, as evidenced by the fact that boys and girls chosen by this method performed equally well in an intensive summer program. Used in this way and for these purposes, the SAT does not appear to reflect any gender bias, and its continued use is recommended.

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Footnotes

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