DOCUMENT RESUME

ED 308 207 TM 013 422

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TITLE Gender and Mathematics Achievement: Data from High School and Beyond.
PUB DATE Mar 89
NOTE 24p.; Paper presented at the Annual Meeting of the American Educational Research Association (San Francisco, CA, March 27-31, 1989).
PUB TYPE Speeches/Conference Papers (150) -- Reports - Research/Technical (143)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Academic Aspiration; Courses; Females; High Schools; *High School Seniors; Males; *Mathematics Achievement; Parent Participation; *Predictor Variables; *Sex Differences; Socioeconomic Status; Student Attitudes; Verbal Ability
IDENTIFIERS *High School and Beyond (NCES)

ABSTRACT

The relative influence of gender, coursework, affect, and other hypothesized determinants of mathematics achievement among high school seniors was examined, using data from the High School and Beyond (HSB) database. The HSB base-year survey used a multi-stage sampling scheme. Complete data on the variables of this study were available for 16,358 students (8,774 females and 7,584 males); all were members of the sophomore cohort at the beginning of the HSB study. The dependent variable was mathematics achievement. The independent variables were: (1) mathematics courses; (2) mathematics attitudes; (3) educational aspirations; (4) academic orientation; (5) parental involvement; (6) prior achievement; (7) verbal ability; (8) socioeconomic status; and (9) gender, the central consideration. Regression analyses indicated small-to-negligible effects of gender on mathematics achievement among these students as seniors. However, these findings do not mean that educators can ignore the gender gap in achievement that has been documented. The principal determinants of senior-year mathematics achievement were achievement in the sophomore year, amount of coursework in mathematics, and verbal ability. Three tables present data, and an appendix outlines the construction of the variables. (SLD)

Gender and mathematics achievement:

Data from High School and Beyond.

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Paper presented at the 1989 meeting of the

American Educational Research Association, San Francisco.

RUNNING HEAD: GENDER AND MATHEMATICS

Linda Lancaster, a doctoral student in the College of Education, was struck down by a drunken driver February 18, 1989. It is to her memory that this paper is dedicated.

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Introduction

Social scientists have long investigated gender differences on aptitude and academic achievement (e.g., Maccoby, 1966; Maccoby & Jacklin (1974). Recent research on this topic clearly supports two general conclusions: (a) the magnitude of gender differences has declined over the past several decades and (b) gender differences presently tend to be small (Chipman, 1988; Feingold, 1988; Hyde & Linn, 1988).

Nonetheless, these differences persist and. consequently, researchers continue to investigate their magnitude and etiology. The concern typically has been with mathematics achievement, primarily because mathematics is regarded as the "critical filter" that can limit women's access to advanced studies, and careers, in the technical sciences (Sells, 1975).

Both affect and coursework appear to account for much of the existing gender difference in mathematics achievement among high school students (Chipman & Thomas, 1987; Fennema, 1987; Tittle, 1986; Wise, 1985). As early as sixth grade--before gender differences in mathematics achievement surface--females express less confidence in their mathematical abilities and, further, hold less positive attitudes regarding the relevance and utility of mathematics. Perhaps as a consequence, high school females tend to take fewer courses in mathematics than males. By the end of the 1970s, for example, almost two thirds of all high school graduates with the standard four years of mathematics were male (Chipman & Thomas, 1987). Although this disparity has narrowed in the 1980s, a disparity nonetheless remains, particularly in more advanced courses.

Significantly, the gender difference in high school mathematics achievement virtually disappears once coursework in mathematics and affective orientation towards mathematics is taken into account. In one of the more comprehensive studies in this area, Wise (1985) examined the antecedents of mathematics achievement among roughly 7,500 high school students in the class of 1963. Wise found that twelfth-grade mathematics achievement was principally determined by the amount of coursework in mathematics, nineth-grade mathematics achievement, and general academic ability. No direct effect of gender was obtained. Rather, the effect of gender was primarily indirect through females' lesser interest in mathematics and mathematics-related careers.

Method

In the present study we examined the relative influence of gender, coursework, affect, and other hypothesized determinants of mathematics achievement among high school students. Like the Wise (1985) study, ours was based on a representative, longitudinal sample of students across the country. However, we employed the more recent High School and Beyond (HSB) data base, heretofore unexamined in this regard.

Subjects

The HSB base-year survey employed a multi-stage sampling scheme (National Opinion Research Center, 1982). In the first stage, a highly stratified national probability sample of 1,122 high schools was selected in the spring of 1980, yielding a realized sample of 1,015 schools. Next, 36 sophomores[1] were sampled from each school. HSB conducted the first follow-up survey two years later when these students were high school seniors. Of the 25,875 students who participated in both the base-year and follow-up surveys, 16,358 (63%) had complete data on all ten variables in our model (8,774 females and 7,584 males).

[1]HSB also sampled 36 seniors from each school. Our study, however, was based only on the sophomore cohort.

Model

We arranged our variables in a causal order consistent with logic and the existing literature (e.g., Chipman & Thomas, 1987; Fennema, 1987; Tittle, 1986; Wise, 1985). Below, we briefly describe each variable and its hypothesized relationships with other variables in the model. We expected all effects to be positive, except for gender. To avoid needless repetition in our prose, we leave implicit the positive direction of these hypothesized effects. (More detail on variable construction is provided in the appendix.)

Dependent variable. The dependent variable, mathematics achievement (MATH82), was a composite of a two-part 38-item test calling for quantitative comparisons (see Heyns & Hilton, 1982). This test was administered in spring of the senior year.

Independent variables. Our model comprised seven endogenous and two exogenous independent variables. We describe these variables in the order of their hypothesized causal proximity to the dependent variable.

Most proximal to the dependent variable was mathematics courses (COURSES), defined here as the number of select mathematics courses the student had taken by the end of the senior year in high school. The highest value (5) was obtained by the student who had taken first-year algebra, second-year algebra, geometry, trigonometry, and calculus. This variable, of course, was hypothesized to affect senior-year achievement in mathematics (Chipman & Thomas, 1987; Tittle, 1986; Wise, 1985).

We also expected that mathematics attitudes (ATTITUDE) would affect MATH82 directly as well as indirectly through its effect on COURSES (Fennema, 1987; Tittle, 1986; Wise, 1985). Taken from the sophomore-year survey, ATTITUDE was a composite of six Likert-type items assessing the interest, affect, and utility the student attached to mathematics.

Educational aspirations (ASPIRE) reflects how far the student expected to go in school. Asked in the sophomore year, this question yielded responses ranging from "won't finish high school" to "Ph.D., M.D., or other advanced professional degree." ASPIRE was hypothesized to affect MATH82 directly as well as indirectly through ATTITUDE and COURSES (Wise, 1985).

We assessed the student's academic orientation (ACADEMIC) through a composite comprising such variables as time spent on homework, school attendance patterns, television-viewing and pleasure-reading habits, and regard for high-achieving peers. ACADEMIC was posited to carry a direct effect on MATH82. Further, we expected this variable also to affect ATTITUDE and COURSES. That is, in addition to its direct effect on senior-year mathematics achievement, academic orientation was expected to carry indirect effects through intervening variables in the model.

Although the research is mixed, some studies suggest that interest in mathematics, particularly among females, is influenced by parental encouragement and expectations (Stallings, 1985). We constructed a parental involvement (PARENT) composite reflecting (a) the amount of communication between student and parent regarding the former's progress in high school and (b) the parent's post-secondary expectations for the student. We predicted that PARENT would affect MATH82 directly, as well as indirectly through its effect on the ACADEMIC, ASPIRE, ATTITUDE, and COURSES.

In predicting senior-year achievement in mathematics, one should take into account prior achievement in mathematics. Our model, consequently, included the student's mathematics achievement in the sophomore year (MATH80). (Both MATH80 and MATH82 were derived from the same test, given two years apart.) Clearly, we expected prior achievement in mathematics to predict subsequent achievement in mathematics. We also posited indirect effects of MATH80 through the five intervening variables, particularly

ATTITUDE and COURSES. Specifically, we hypothesized that students higher in prior mathematics achievement would have more positive attidues, take more courses in mathematics, and, in turn, evidence greater achievement in mathematics by their senior year.

Verbal ability (VERBAL) was approximated by the total score on a 21-item vocabulary test administered in spring of the sophomore year (see Heyns & Hilton, 1982). We predicted that VERBAL would carry both direct and indirect effects on MATH82.

One of two exogenous variables in our model, socioeconomic status (SES) reflects the extent of mother's and father's education, family income, the prestige of father's occupation, and the number of selected possessions in the home (e.g., encyclopedia). Like VERBAL, SES was hypothesized to have both direct and indirect effects on MATH82.

Gender, the other exogenous variable, was dummy coded 0 (male) or 1 (female). Central to our study, of course, was the effect of gender--directly on MATH82 and indirectly through the seven endogenous variables. We posited that the primary effect of gender would be indirect, mostly through ATTITUDE and COURSES. Specifically, we predicted that high school males would have more positive attitudes toward mathematics, take more courses in mathematics, and, consequently, have higher achievement in mathematics. However, we expected that the direct effect of gender--i.e., with all other independent variables held statistically constant--would be small.

Analyses

We examined the direct and indirect effects of each independent variable on senior-year mathematics achievement through a series of ordinary least-squares regression equations. Standardized regression coefficients were used throughout.

First, we regressed MATH82 on the nine independent variables. The resulting partial regression coefficients were used as estimates of the direct effects of each independent variable on MATH82. Second, to assess indirect effects, we regressed each independent variable, beginning with COURSES, on all antecedent independent variables. The partial regression coefficients from these analyses were used to calculate the indirect effect of each independent variable through the respective intervening variables in the model (Alwin & Hauser, 1975; Davis, 1985).

An example perhaps will clarify the distinction between direct and indirect effects. Consider a model where dependent variable $\underline{Y}$ is predicted by independent variables X_1, X_2, and X_3; X_1 is hypothesized to be causally antecedent to both X_2 and X_3, and X_2 to X_3. First, $\underline{Y}$ is regressed on X_1, X_2, and X_3 to obtain the "path" coefficients p_{Y1}, p_{Y2}, and p_{Y3}. As direct effects, these partial regression coefficients reflect the degree of linear relationship between each independent variable and the dependent variable with the remaining independent variables held constant. Additional regressions are needed to estimate the indirect effects of each independent variable: X_3 is regressed on X_1 and X_2 (yielding p_{31} and p_{32}) and X_2 is regressed on X_1 (yielding p_{21}). The indirect effect of X_2 on $\underline{Y}$, through X_3, is obtained by taking the product of p_{Y3} and p_{32}. This indirect effect will be large where X_2 has a large effect on X_3 (i.e., p_{32} is large) and, in turn, X_3 has a large effect on $\underline{Y}$ (i.e., p_{Y3} is large). The indirect effect of X_1 on Y, through X_2 and X_3, is obtained by summing three products: $(p_{21}*p_{Y2})$ + $(p_{31}*p_{Y3})$ + $(p_{21}*p_{32}*p_{Y3})$.

We conducted all analyses with a modified HSB sampling weight in effect. We first determined the mean of PANELWT--the HSB sampling weight for students participating in both the 1980 and the 1982 surveys. We then divided PANELWT by this mean (146.079) to obtain the modified weight. With the modified weight in effect, we were able to correct for the disproportionate sampling of HSB while preserving the HSB sample size.

Results

Means, standard deviations, and intercorrelations are presented in Table 1. Before presenting results from the regression analyses, we first consider preliminary analyses regarding the unadjusted gender differences on MATH80 and MATH82, as well as on VERBAL, ATTITUDE, COURSES, ASPIRE, and ACADEMIC.

Preliminary Analyses

Males, on the average, had a modest advantage over females on both MATH80 and MATH82; effect sizes (ES) were -.15 and -.22, respectively. While neither ES is large, their relative values are consistent with the magnitude and developmental nature of gender differences in mathematics (Chipman & Thomas, 1987; Feingold, 1988; Wise, 1985). Males similarly held a small advantage on VERBAL (ES = -.11).

Males also tended to have more positive attitudes towards mathematics than females (ES = -.16). Although, surprisingly, the gender difference in COURSES was almost negligible (ES = -.07), 50% more males than females took calculus in high school (although less than 10% of either group took this course). In contrast, females tended to be slightly higher in their educational aspirations and, more so, in their academic orientation (ES = +.10 and +.33, respectively).

These effect sizes were based on those students with complete data on all ten variables in our model. Such "listwise" deletion of missing values, of course, produces a nonrandom subset of the original HSB sample. In fact, the 16,358 students who met this criterion tended to be slightly higher on all variables; that is, they tended to be a more select group. Further, the relationship between (a) sample selectivity and (b) the magnitude of gender differences (Becker & Hedges, 1984; Feingold, 1988) was evident in our data, as well. That is, we found smaller gender differences among the original 25,875 students than among the listwise sample of 16,358. For example, ES was -.08 (vs. -.15) for MATH80 and -.14 (vs. -.22) for MATH82.

Regression Analyses

Path coefficients appear in Table 2. Because of the large sample size, virtually all coefficients were statistically significant, even where values were exceedingly small. Following Pedhazur's (1982) criterion for large-sample analyses, we regarded a coefficient of $\beta = .05$ as the lower limit of meaningfulness.

The decomposition of effects appear in Table 3. Here, the total association (i.e., zero-order correlation) between each independent variable and MATH82 was decomposed into the total effect, direct effect, indirect effect, and spurious effect. The total effect of an independent variable is equal to the sum of its direct and indirect effects and, as such, represents the "causal" component of the zero-order correlation between the variable and MATH82 . Spuriosity, on the other hand, is that portion of total association attributable to the influence of prior variables in the model on both MATH82 and the independent variable. Consequently, spuriosity reflects the "noncausal" component of the zero-order correlation between the variable and MATH82.

Roughly 70% of the variability in senior-year mathematics achievement (MATH82) was explained by the linear combination of the nine independent variables ($R^2 = .71$). Turning first to our primary question, we found a significant, if small, direct effect of GENDER on MATH82 favoring males ($\beta = -.05$). That is, when all other independent variables were statistically controlled, males still held a slight advantage over females in senior-year mathematics achievement. However, only when rounded to two places beyond the decimal point does the effect of GENDER meet Pedhazur's criterion.

If there had been an equal number of males and females in our sample, the standardized partial regression coefficient for GENDER (β = -.05) could be doubled to yield something akin to an adjusted effect size (i.e., a standardized mean difference adjusted for the remaining eight independent variables). In this case, we would obtain a value of roughly -.10, indicating that the average male performance in senior-year mathematics, adjusted for his status on VERBAL, MATH80, PARENT, ACADEMIC, ASPIRE, ATTITUDE, and COURSES, was approximately one tenth of a standard deviation higher than the average female's performance. Interestingly, this value is less than half the unadjusted ES of -.22 reported above. However, because we did not have an equal number of females and males--54% of our sample was female--doubling the regression coefficient associated with GENDER provides only a crude comparison with the unadjusted ES.

Along with its small direct effect on MATH82, GENDER also had almost no indirect effect through intervening variables (-.04).[2] Contrary to our expectations, then, GENDER did not influence MATH82 through its effect on such intervening variables as attitudes towards mathematics or coursework in mathematics. Thus, among these high school students, gender had little consequence for senior-year mathematics achievement, either directly or indirectly.[3]

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[2] Unlike the parenthetical values associated with direct effects, those associated with indirect effects are not path coefficients. Rather, we obtained these values by summing the products of path coefficients, as dictated by the model (see, e.g., Alwin & Hauser, 1975; Pedhazur, 1982).

[3] We also ran these analyses separately for males and females. The regression coefficients--standardized and unstandardized alike--were comparable for both groups, as were the R^2s.

Interestingly, GENDER had a stronger negative effect on <u>attitudes</u> towards mathematics (β = -.09) than on (a) either prior (β = -.04) or ultimate (β = -.05) <u>achievement</u> in mathematics or (b) coursework in mathematics (β = -.03). However, the magnitude of these effects, and the differences among them, is small. Indeed, the principal effect of GENDER in our model was as a predictor of academic orientation (β = .17), which, as will be seen below, had only minor effects on MATH82.

Not surprisingly, prior achievement in mathematics (MATH80) carried the largest direct effect on MATH82 (β = .52). MATH80 also affected MATH82 indirectly (.16), mostly through its effect on COURSES (β = .38). That is, while senior-year mathematics achievement was determined, in large part, by prior achievement in mathematics, students high in prior achievement also tended to take more mathematics courses which, in turn, ultimately resulted in higher mathematics achievement.

After MATH80, the next largest direct effect was associated with COURSES (β = .27). Thus, students who took more <u>coursework</u> in mathematics demonstrated greater <u>achievement</u> in mathematics. And this was true irrespective of the student's prior mathematics achievement, socioeconomic status, educational aspirations, and so forth.

VERBAL carried a modest direct effect on MATH82 (β = .12). However, the influence of this variable was largely <u>in</u>direct (.39), primarily through its effect on MATH80 (β = .53).

One's attitudes towards mathematics (ATTITUDE) had a slight effect on MATH82 (β = .05). That is, regardless of prior achievement and coursework in mathematics, students with more positive attitudes toward mathematics held a slight advantage on senior-year mathematics when compared to students with less positive attitudes. However, as with GENDER, the direct effect of ATTITUDE barely meets Pedhazur's criterion for meaningfulness.

Further, there was no indirect effect of ATTITUDE through COURSES (.02). That is, these data do not support the proposition that those students having a more positive affective orientation towards mathematics, other things equal, will tend to take more courses in mathematics and, as a consequence, enjoy higher achievement in mathematics.

Socioeconomic status (SES) carried no direct effect on MATH82 (β = .03). However, SES had a large indirect effect (.36), primarily through VERBAL (β = .40) and MATH80 (β = .16). The relative magnitude of the direct and indirect effects associated with SES is consistent with other path analytic studies in which socioeconomic status served as an exogenous variable (see, e.g., Keith & Page, 1985).

Finally, no direct effects on MATH82 were obtained for parent involvement (PARENT), academic orientation (ACADEMIC), or educational aspirations (ASPIRE) (all βs < .05). While slight, the indirect effects for these variables exceeded Pedhazur's criterion (.06, .09, .07, respectively).

The relatively small direct and indirect effects of ATTITUDE, PARENT, ACADEMIC, and ASPIRE do not mean that these four variables were unrelated to MATH82. Indeed, we see from Table 1 that each of these independent variables correlated moderately with senior-year mathematics (rs = .30, .29, .39, and .46, respectively). Rather, the small direct and indirect effects of ATTITUDE, PARENT, ACADEMIC, and ASPIRE reflect the comparatively large spuriosity associated with each of these independent variables (Table 3). That is, most of the zero-order correlation between each of these variables and MATH82 reflects the influence of prior variables in our model.

Discussion

We found small-to-negligible effects of gender on mathematics achievement among high school seniors in the United States. While these findings contradict the results of earlier research (e.g., Maccoby & Jacklin, 1974), they are consistent with more recent conclusions regarding gender and ability, particularly with representative samples of youth (e.g., Chipman & Thomas, 1987; Feingold, 1988; Hyde & Linn, 1988). In short, our results echo both the question raised by Chipman and the answer she provides:

> The subject of sex differences in behavior and intellectual performance is far too sexy a topic, of much more interest than it should be. . . . How much, afterall, do we know about a particular individual on any of these dimensions because we know that the individual is male or female? Not much. (Chipman, 1988, p. 48)

Does this mean that researchers and educators can ignore the "gender gap" in aptitude and academic achievement? Not necessarily. First, the magnitude of gender differences on a particular aptitude or achievement subtest can vary by site (Fennema, 1987). A small gender difference based on a national sample can become a large difference when calculated locally. Indeed, the traditional sign of a difference can change, as we see in Hawaii where high school females have outperformed males on measures of mathematics achievement (Brandon, Newton, & Hammond, 1987).

Second, even a small difference between two means can carry important implications. For example, the modest difference favoring males on the PSAT translates into many more males who have very high PSAT scores and, consequently, many more males who receive National Merit Scholarships (Burton & Lewis, 1988).

Finally, any gender difference in academic achievement--however small--raises the possibility that teachers may be treating males and females differently in the classroom. For example, Peterson and Fennema (1986) found that fourth-grade teachers, during mathematics instruction, were less likely to praise girls for correct responses and, further, were less likely to prompt girls for the correct strategy following an incorrect response. Both teacher behaviors were linked to lower mathematics achievement among these girls. Consistent with society's resolve to achieve sex equity in the workplace, we similarly should be concerned about sex equity in the classroom.

In summary, student gender was of little value in explaining variability in mathematics achievement among high school seniors in the United States. Instead, the principal determinants of senior-year mathematics achievement were sophomore-year mathematics achievement, amount of coursework in mathematics, and verbal ability. These results are not dissimilar to those reported by Wise (1985) using data from the 1960s. These findings notwithstanding, gender remains an important variable. Whether because of site differences, the political consequences of even small differences, or underlying implications for teacher-student interactions, student gender is a variable that both educators and researchers cannot afford to ignore.

Table 1
Means, Standard Deviations, and Intercorrelations

Variable	M	SD	Intercorrelations (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) SES	.008	.712									
(2) GENDER	.536	.499	-.06								
(3) VERBAL	11.536	4.211	.40	-.06							
(4) MATH80	.264	1.828	.37	-.08	.59						
(5) PARENT	.219	2.131	.39	.05	.26	.28					
(6) ACADEMIC	1.202	8.647	.32	.16	.35	.37	.49				
(7) ASPIRE	5.397	2.445	.43	.05	.40	.43	.49	.62			
(8) ATTITUDE	.089	1.565	.08	-.08	.11	.29	.14	.21	.19		
(9) COURSES	2.126	1.637	.41	-.04	.49	.63	.39	.52	.58	.28	
(10) MATH82	.313	1.844	.40	-.11	.59	.80	.29	.39	.46	.30	.69

Note: N = 16,358. All correlations are statistically significant (α = .001).

Table 2
Standardized path coefficients

Dependent Variable	Independent Variables: GENDER	SES	VERBAL	MATH80	PARENT	ACADEMIC	ASPIRE	ATTITUDE	COURSES
VERBAL (.16)[a]	-.0333	.4021							
MATH80 (.37)	-.0379	.1558	.5287						
PARENT (.18)	.0791	.3275	.0560	.1289					
ACADEMIC (.34)	.1692	.0668	.1354	.1765	.3863				
ASPIRE (.49)	.0027[b]	.1441	.0787	.1232	.1799	.4102			
ATTITUDE (.12)	-.0918	-.0667	-.1150	.2975	.0297	.1263	.0525		
COURSES (.55)	-.0323	.0667	.0629	.3809	.0432	.1579	.2301	.0692	
MATH82 (.71)	-.0473	.0340	.1170	.5196	-.0196	.0070[b]	.0216	.0485	.2715

[a] R^2

[b] $p > .001$.

Table 3
Decomposition of effects

	Total Association[a]	Total Effect	Direct Effect	Indirect Effect	Spurious Effect
SES	.40	.39	.03	.36	.01
GENDER	-.11	-.09	-.05	-.04	-.02
VERBAL	.59	.51	.12	.39	.08
MATH80	.80	.68	.52	.16	.12
PARENT	.29	.04	-.02	.06	.25
ACADEMIC	.39	.09	.01	.08	.30
ASPIRE	.46	.09	.02	.07	.37
ATTITUDE	.30	.07	.05	.02	.23
COURSES	.69	.27	.27	---	.42

[a]Zero-order correlation with MATH82.

Appendix
Variable construction

SES

BYSES on 1980 base-year survey, this variable comprises father's occupation, father's education, mother's education, family income, and material possessions in the household. SES is the mean of the five component variables, after each was standardized to a common scale (*M* = 0, *SD* = 1).

GENDER

GENDER on base-year survey; recoded 0 (male), 1 (female).

VERBAL

YBVOCBRT on base-year survey. VERBAL reflects the number correct on a 21-item vocabulary test.

MATH80

Sum of YBMTH1RT (28 items) and YBMTH2RT (10 items) on base-year survey, after each was standardized to common scale (*M* = 0, *SD* = 1).

PARENT (Cronbach's alpha: .70)

A composite of the following base-year items:

BB046A: "My mother (stepmother or female guardian) keeps close track of how well I am doing in school."

Recoded 1 (true), 0 (false, does not apply).

BB046B: "My father (stepfather or male guardian) keeps close track of how well I am doing in school."

Recoded 1 (true), 0 (false, does not apply).

YB049A: "How much have you talked to [your father] about planning your school program?"

Coded 3 (a great deal), 2 (somewhat), 1 (not at all).

YB049B: "How much have you talked to [your mother] about planning your school program?"

Coded 3 (a great deal), 2 (somewhat), 1 (not at all).

PARENT (cont.)

BB050A: "What [does your father] think you ought to do after high school?"

Recoded 1 (go to college), 0 (else).

BB050B: "What [does your mother] think you ought to do after high school?"

Recoded 1 (go to college), 0 (else).

To form PARENT, three sums were first obtained: BB046A+BB046B, YB049A+YB049B, and BB050A+BB050B. These three values were then standardized (M = 0, SD = 1) and summed.

ACADEMIC (Cronbach's alpha: .80)

A ccmposite of the following base-year items:

BB047B: "How often do you spend time [reading for pleasure] outside of school?"

Coded 4 (everyday or almost every day) to 1 (rarely or never).

BB047h: "How often do you spend time [reading the front page of the newspaper] outside of school?"

Coded 4 (everyday or almost every day) to 1 (rarely or never).

YB052AA: "How do you feel about students with good grades?"

Recoded 3 (mostly think well of such students) 2 (makes no difference) 1 (mostly do not think well of such a student).

YB052AB: "How do your friends in this school mostly feel about students with good grades?"

Recoded 3 (mostly think well of such students) 2 (makes no difference) 1 (mostly do not think well of such a student).

"Please think of your closest friend in this school who is a sophomore. As far as you know, are the following statements true or false for him/her?" (All four items were recoded 1 (true) 0 (false).)

BB051A: "Gets good grades."
BB051B: "Is interested in school."
BB051C: "Attends classes regularly."
BB051D: "Plans to go to college."

BB061G: "I will be disappointed if I don't graduate from college."

Recoded 1 (true) 0 (false).

ACADEMIC (cont.)

YB072A: "Did you expect to go to college when you were in the sixth grade?"

Recoded 3 (yes), 2 (was not sure), 1 (no).

YB072B: "Did you expect to go to college when you were in the seventh grade?"

Recoded 3 (yes), 2 (was not sure), 1 (no).

YB072C: "Did you expect to go to college when you were in the eighth grade?"

Recoded 3 (yes), 2 (was not sure), 1 (no).

YB072D: "Did you expect to go to college when you were in the ninth grade?"

Recoded 3 (yes), 2 (was not sure), 1 (no).

BB015: "Approximately what is the average amount of the time you spend on homework a week?"

Coded 7 (more than 10 hours a week) to 1 (no homework is ever assigned).

YB016A: "How often do you come to class and find yourself without [pencil or paper]?"

Coded 4 (never) to 1 (usually).

YB016B: "How often do you come to class and find yourself without [books]?"

Coded 4 (never) to 1 (usually).

YB016C: "How often do you come to class and find yourself without [your homework done]?"

Coded 4 (never) to 1 (usually).

BB016: "Between the beginning of school last fall and Christmas vacation, about how many days were you absent from school for any reasons, not counting illness?"

Recoded 7 (none) to 1 (21 or more).

BB017: "Between the beginning of school last fall and Christmas vacation, about how many days were you late to school?"

Recoded 7 (none) to 1 (21 or more).

To create ACADEMIC, each of the 19 items was standardized (M = 0, SD = 1) and then summed.

ASPIRE

BB065 on base-year survey: "As things stand now, how far do you think you will get?"

Coded 9 (Ph.D., M.D., or other advanced professional degree) to 1 (less than high school).

ATTITUDE (Cronbach's alpha: .64)

A composite from the sum of the following base-year items:

BB00AB: "[Mathematics] will be useful in my future"

Coded 1 (checked) 0 (not checked)

BB00AC: "[Mathematics] is interesting to me."

Coded 1 (checked) 0 (not checked)

YB035E: "I am usually at ease in Mathematics class."

Recoded 1 (true) 0 (false).

YB035F: "Doing Mathematics assignments makes me tense."

Recoded 1 (false) 0 (true).

YB035G: "Mathematics class does not scare me at all."

Recoded 1 (true) 0 (false).

YB035H: "I dread Mathematics class."

Recoded 1 (false) 0 (true).

COURSES (Cronbach's alpha: .78)

Taken from the 1982 follow-up survey question: "Which of the following courses have you taken, counting the courses you are taking this semester?"

FY5A: First-year algebra
FY5B: Second-year algebra
FY5C: Geometry
FY5D: Trigonometry
FY5E: Calculus

Each item was recoded 1 (have taken), 0 (have not taken). COURSES was formed by taking the sum of these five items.

MATH82

Sum of FYMTH1RT (28 items) and FYMTH2RT (10 items) on 1982 follow-up survey, after each was standardized to common scale ($M = 0$, $SD = 1$).

References

Alwin, D. F., & Hauser, R. M. (1975). The decomposition of effects in path analysis. American Sociological Review, 40, 37-47.

Becker, B. J., & Hedges, L. V. (1984). Meta-analysis of cognitive gender differences: A comment on an analysis by Rosenthal and Rubin. Journal of Educational Psychology, 76, 583-587.

Brandon, P. R., Newton, B. J., & Hammond, O. W. (1987). Children's mathematics achievement in Hawaii: Sex differences favoring girls. American Educational Research Journal, 24, 437-461.

Burton, N. W., & Lewis, C. (1988). Modeling women's performance on the SAT. Paper presented at the annual meeting of the American Educational Research Association, New Orleans.

Chipman, S. F. (1988). Far too sexy a topic [Review of The psychology of gender differences]. Educational Researcher, 17(3), 46-49.

Chipman, S. F. & Thomas, V. G. (1987). The participation of women and minorities in mathematical, scientific, and technical fields. In E. Z. Rothkopf (ed.), Review of research in education (vol. 14; pp. 387-430), Washington, D. C.: American Educational Research Association.

Davis, J. A. (1985). The logic of causal order. Sage University Paper series on Quantitative Applications in Social Sciences, 07-055. Beverly Hills, CA: Sage.

Feingold, A. (1988). Cognitive gender differences are disappearing. American Psychologist, 43(2), 95-103.

Fennema, E. (1987). Sex-related differences in education: Myths, realities, and interventions. In V. Richardson-Koehler (ed.), Educators' handbook: A research perspective. New York: Longman.

Fennema, E. & Peterson, P. (1986). Teacher-student interactions and sex-related differences in learning mathematics. Teaching and Teacher Education, 2, 19-42.

Heyns, B., & Hilton, T. L. (1982). The cognitive tests for High School and Beyond: An assessment. Sociology of Education, 55, 89-102.

Hyde, J. S., & Linn, M. C. (1988). Gender differences in verbal ability: Results of meta-analysis. Psychological Bulletin, 104(1), 53-69.

Keith, T. Z. & Page, E. B. (1985). Do Catholic high schools improve minority student achievement? American Educational Research Journal, 22, 337-349.

Maccoby, E. E. (Ed.). (1966). The development of sex differences. Stanford (CA): Stanford University Press.

Maccoby, E. E. & Jacklin, C. N. (1974). The psychology of sex differences. Stanford, CA: Stanford University Press.

National Opinion Research Center. (1982). High School and Beyond 1980 sophomore cohort first follow-up (1982): Data file user's manual. Chicago: Author.

Pedhazur, E. (1982). Multiple regression in behavioral research. New York: Holt, Rinehart & Winston.

Sells, L. (1975). Sex, ethnic, and field differences in doctoral programs. Unpublished doctoral dissertation, University of California, Berkeley.

Stallings, J. (1985). School, classroom, and home influences on women's decisions to enroll in advanced mathematics courses. Chipman, S. F., Brush, L. R., & Wilson, D. M. (eds.), Women and mathematics: Balancing the equation. Hillsdale (NJ): Erlbaum.

Tittle, C. K. (1986). Gender research and education. American Psychologist, 41, 1161-1168.

Wise, L. L. (1985). Project TALENT: Mathematics course participation in the 1960s and its career consequences. In S. F. Chipman, L. R. Bush, & D. M. Wilson (eds.), Women and mathematics: Balancing the equation (pp. 25-58). Hillsdale (NJ): Erlbaum.