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ABSTRACT

The existence of a math/science "ipipeline" in public schooling is well documented in which the number of female students, students with lower socioeconomic status, and students of color in proportion to white males in advanced math and science progressively shrinks during high school. As part of an ongoing gender equity project, separate versions of a survey were administered to eight high schools and five middle schools in both Spanish and English. The sample analyzed in this paper is drawn from five high schools, ranging in size from 470 to 800 students. The analysis of the data focused on four variables: "Educational Aspirations" showed females with higher aspirations than males, and students with the highest socioeconomic status (SES) had higher aspirations than students with the lowest SES. "Pipeline Course Taking" showed males and students with higher SES having taken or planning to take more than three of the five pipeline courses. "Advanced Pipeline Course Taking" showed that males and students with higher SES had taken or planned to take more advanced pipeline courses than females. "Attitudes toward Pipeline Courses" showed males and students with higher SES having more positive attitudes, especially in 12th grade. In response to a question about career aspirations, a lower percentage of females and students with a lower SES aspired to some scientific and technical fields. A higher percentage of students in these same categories aspired to careers in the helping professions. The data indicated that even though they may have high educational and career aspirations, females and students of lower SES tend to opt out of advanced math, science, and computer courses. Ten figures provide graphic results of the survey. (Contains 34 references.) (SPM)

The Pipeline and Student Perceptions of Schooling: Good News and Bad News

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The existence of a math/science "pipeline" in public schooling is well documented, in which, beginning in late middle/junior high school, the number of female students, students with lower socioeconomic status, and students of color in proportion to white males in advanced math and science progressively shrinks during high school (Oakes, 1990, p. 154). Research also suggests that the pipeline continues to operate in college (Holland & Eisenhart, 1990).

As part of an ongoing gender equity project, we undertook a survey to determine the degree to which the pipeline phenomenon exists in the schools that were participating in the project. In our work with public schools, we often encountered the view by teachers and administrators that however much of a problem gender inequity may be elsewhere, there is no problem here. Suspicious of this claim, we, along with like-minded participants in the project, sought to challenge it. We wanted to identify patterns of inequality that might exist in order to create a foundation from which to answer the skeptics, to explore inequality more deeply, and ultimately to devise and try out reforms. In the process, we also sought to contribute to ongoing research on the effects of gender and socioeconomic status (SES) on the educational math/science pipeline. This paper focuses primarily on the second of these two aims.

The Pipeline Phenomenon

> To understand the low participation rates of women and non-Asian minorities in scientific careers, we must first understand the educational experiences of all future scientists. We must also understand how women and minorities fare in the scientific pipeline. Fortunately, recent analyses have identified a critical sequence of precollege and college events that is prerequisite for participation in science.
>
> Jeannie Oakes

Much of the current research on educational equity focuses on the reasons women are underrepresented in math, science, and technology studies. For example, researchers suggest that female students receive fewer science and math related opportunities and less teacher encouragement in these areas (Oakes, 1990; Stage et al., 1985). Perhaps more directly associated with course taking patterns is the influence of school guidance counselors. Some counselors actually discourage women from taking math and science courses (AAUW, 1992; Stage et al., 1985; Ware & Lee, 1988). Parents, too, seem to have higher expectations for their sons in math, science (AAUW, 1992; Scott & McCollum, 1993; Stage et al., 1985; Yee & Eccles, 1988), and technology (Shashaani, 1994).[1]

There is also an underrepresentation of female role models in pipeline courses; for example, men are more likely to teach advanced math classes, mothers are more likely than fathers to have less confidence and interest in mathematics, and there are few female role models in physics and engineering (Stage et al., 1985). It is well documented that curricular materials follow similar patterns (AAUW, 1992; Klein & Ortman, 1994; Sadker & Sadker, 1994; Scott & Schau, 1985).

Boys have traditionally been perceived as superior to girls in math and science (AAUW, 1992). That males are naturally (as opposed to socialized to be) more talented at math and science has been almost entirely rejected by researchers (Oakes, 1990; AAUW, 1992; Linn & Petersen, 1985). Differences in math and science ability (as opposed to performance) "have dwindled to almost nothing over the past twenty years" (Oakes, 1990, p. 170). Therefore, educators are becoming more perplexed and concerned with the lack of females in scientific studies and careers.

Course Taking Patterns

Although Title IX prohibited the exclusion of female students from public school courses, many math, science, and computer courses remain *de facto* segregated by gender. By choosing not to take these courses in middle school or high school, students drop out of the educational pipeline which leads to higher paying and higher status careers in scientific fields.

Students of color and low SES students are underrepresented in these courses as well. Oakes (1990; 1988) suggests that students of low SES and students of color fall out of the pipeline primarily due to tracking decisions made by school administrators. If minority students do not exhibit high achievement in math and science early on for whatever reason (e.g., differing pre-school experiences, cultural differences in communication and learning styles), they are often placed in remedial tracks, which limits their opportunities to study advanced science and mathematics. Indeed, Oakes reports that schools in lower SES areas (where most students of color attend) have limited advanced math and science course offerings, especially as compared with high SES schools (1990; 1988).

Mathematics. Few gender differences exist in middle school mathematics enrollment, but studies continue to show slight differences between male and female math participation in high school (Oakes, 1990). During the 1980s, mathematics course enrollment went up for both males and females.

In 1989 the National Science Board of the National Science Foundation reported that from 1982 to 1987, male and female course taking patterns remain roughly the same until calculus. While 7.6% of males take calculus, only 4.7% of females do (AAUW, 1992). Other researchers agree that calculus seems to be the level at which significant gender differences occur (Stage et al., 1985). In fact, our study echoes these findings. However, some studies have not replicated this finding. Some have found differences occurring at earlier levels (e.g., Algebra II, trigonometry, and pre-calculus); others have found no significant differences in mathematics course taking patterns at all (AAUW, 1992; Oakes, 1990; Stage et al., 1985). Oakes suggests that "girls are more likely than boys to stop taking science and math courses after completing basic college entrance requirements; boys are more likely than girls to concentrate (i.e., take additional, unrequired advanced courses) in mathematics, science, and computer science" (1990, p. 163; see also AAUW, 1992).

SES also seems to be a significant factor. Oakes states that "class discrepancies in science and mathematics *participation* appear in junior and senior high school," and that these "discrepancies among groups grow larger the longer children remain in school" (Oakes, 1988, p. 108). In 1985, the National Center for Educational Statistics gave the following percentages of students exhibiting "academic math" course taking patterns: High SES, 69.1%; Middle SES, 45.7%; Low SES, 25.1% (Oakes, 1990, p. 163). Like those of female students, these numbers have been improving, but the differences remain.

Science. Unlike in mathematics, the gender gap in science does not appear to be narrowing in recent years. In fact, some educators believe it is growing (AAUW, 1992). Although the gender difference in the number[2] of science courses taken does not seem significant, the pattern of courses taken is very different. The gender gap in biology is shrinking, but young women are much less likely to take physics in high school. Among the students we surveyed, this is also the case. The National Science Board reports 25.3% of males but only 15% of females taking physics (AAUW, 1992). This trend has been confirmed by many other studies, one of which found that 60% of first year and 70% of second year high school physics students were male (AAUW, 1992; Oakes, 1990; Sadker & Sadker, 1994; Sadker, Sadker, & Klein, 1991). Again, the difference seems to be in the numbers of students taking courses beyond graduation requirements, what Oakes calls "concentrating." In addition, the figures for various SES groups in "academic science" tracks in high school are as follows: high SES, 58.3%; middle SES, 36.9%, low SES, 19.6% (1990, p. 163).

Computer Science/Technology. Although less is known about gender, class, and race/ethnicity differences in the somewhat newer area of computer science, findings have been similar to those in science. In fact, it is suggested there was a drop in female enrollment in computer science programs in the late 1980s (Badagliacco, 1990). Like both math and science, the most advanced classes exhibit the largest gender differences. Computer programming (Lockheed, 1985) and advanced programming (Shashaani, 1994) have been identified as the levels at which males significantly outnumber females. The differences in percentages of students taking a computer science course by SES are not quite as dramatic as for academic math and science, yet there is still a noticeable disparity: high SES, 17.4; middle SES, 12.4; low SES, 8.4 (Oakes, 1990). With these trends in mind, we now turn to the attitudes these underrepresented groups exhibit towards pipeline courses.

Student Attitudes Toward Pipeline Courses[3]

Educators have long been concerned with the stereotyping of mathematics and science as a male domain. The American Association of University Women (1994) reports that 81% of elementary girls like math and 75% like science. By high school, those figures have fallen to 61% and 63% respectively. Negative attitudes about math have decreased somewhat in the past few years, but females' attitudes toward science have remained distant from those of male students. Females report negative attitudes about science as early as elementary and middle school. Regarding computer science, Shashaani (1994) found that both boys and girls perceive computers to be more appropriate for boys. She further points out that "working with computers was also not intrinsically rewarding to [high school-aged] girls" (1993, p. 179). The girls in her study more often expressed fear and anxiety about computers.

In addition, Oakes submits that "considerable work suggests that girls and minorities show a greater interest in people, whereas White boys show more interest in things" (1990, p. 171). This leads many to assume that it makes sense that women and people of color are underrepresented in the more abstract sciences.

At this point it is important to note that, although it is telling that student perceptions, attitudes, interests, and experience tend to favor White boys in the scientific pipeline, "almost none of this work has attempted to establish a direction of causality between liking and *achievement*" (Oakes, 1990, p. 172). There seems to be a relationship between interest and career aspirations, however. Ware and Lee found that young women who reported a "positive attitude toward mathematics in high school were more likely than other women to major in a scientific field in college" (Ware & Lee, 1988, p. 600). Similarly, the American Association of University Women points out that:

> Students who like math and science are more likely to aspire to careers as professionals. On an open-ended measure of career preference, students who like math and science are more likely to name professional occupations as their first career choice. The impact is stronger for girls than for boys. (1994, p. 12)

Student Aspirations

Trends in females' course taking may show females to be gaining on males, but gender differences in scientific career aspirations remain great. For the most part, young women are not choosing to pursue scientific careers (AAUW, 1992).

Scott and McCollum suggest that the lack of female role models contributes to aspirations. "Subtle, unconscious stereotypes convey what is appropriate for boys and girls and thus contribute to the formation of career and course taking aspirations" (1993, p. 175; see also, Eccles, 1987). By six years of age, children already associate careers with gender. And by high school, students are making career-related decisions based upon these stereotypes (Farmer et al., 1985). In a Michigan study, 90% of students believed in male- and female-typed jobs. "Scientist" was among the "male" jobs (Michigan Department of Education, 1990). As one girl in the study commented, "before you know it, this stuff [gender stereotypes] is in your head" (Michigan Department of Education, 1990, p. 4).

There is much evidence that females believe a career in a scientific field makes it difficult or impossible to raise a family (Eccles, 1987, 1994; Gaskell, 1984; Oakes, 1990; Ware & Lee, 1988). In 1978, a nationwide survey indicated that high school girls consider the "perceived incompatibility between scientific careers and family life" as the most significant barrier to the pursuit of science and technology (Ware & Lee, 1988, p. 595). Now, almost twenty years later, this factor continues to play an important role in women's career aspirations, and the effect seems even greater for Hispanic women (Oakes, 1990). Similarly, a ten-year ethnographic study found that many college women put relationships with men above their career goals and, therefore, had high levels of attrition from science related fields (Holland & Eisenhart, 1990).

Students of lower SES face different barriers to the pipeline. One of these may be that college educated parents expect their children to of to college. Therefore, they make sure that their children continue in the pipeline (Oakes, 1990). Parents with higher SES seem to have more access to the resources and knowledge needed to negotiate their children's educational experiences. As a result, they may recognize the importance of keeping their students in the pipeline that allows for wider options for students' educational futures.

The Context of Choice

Two kinds of factors can be distinguished from the above review that serve to squeeze girls and others out of the pipeline: (1) various sorting mechanisms--counseling, testing, and talent tracking, for instance--and (2) students' own choices. We are particularly interested in the second factor. For as sorting falls more into disfavor, the notion that students freely choose to exclude themselves from the pipeline by their curricular choices is increasingly used to justify unequal patterns. This justification (apology) is one that we have encountered in our work in public schools and is to be found in the current political backlash against the goal of equity (Sommers, 1996). In our survey, we sought to challenge and undermine it.

The gender and SES differences we found partially confirmed the current research. In our study, girls and students of lower SES had more negative attitudes about math, science, and computer courses; and they took fewer pipeline courses. Nevertheless, our female participants had higher educational aspirations than the males. Our findings thus present a challenge to the assumption that it is merely students' free choices that lead to the unequal pipeline course taking patterns. The systematic differences point instead to something else at work in the students' context of choice, which seems to have an impact on their attitudes and course taking.

In order to make thoughtful, informed choices, students, particularly females and students with lower SES, must have knowledge and understanding about the possible effects of such factors as bias and course selection on their later educational and occupational opportunities. Indeed, as Howe (1997) asserts, "the mere fact than an individual affirms a choice does not mean that freedom and opportunities worth wanting exist" (p. 22).

Making meaningful course choices requires that students comprehend the importance of their schooling decisions. They must also understand the social and educational contexts that may be limiting their perceptions and desires. Kymlicka (1989) maintains that a social context of choice is framed by a person's cultural membership in conjunction with the social and political environment. The concept of a context of choice can be applied to gender, racial, or SES "membership" within education. Often, because of students' context of choice, students' knowledge and understanding about their real choices and opportunities are severely limited.

What Kymlicka (1989) means by a social context of choice is that when a person makes choices in her or his life, these choices are influenced by the social, cultural, and political conditions under which she or he learns about life's possibilities. In order to make meaningful choices, in Kymlicka's words, "individuals must have the cultural conditions conducive to acquiring an awareness of different views about the good life, and to acquiring an ability to intelligently examine and re-examine these views" (Kymlicka, 1989).

For an opportunity, and the choices leading to that opportunity, to carry meaning, the person facing a choice needs to be aware that the choices and opportunities are in existence. Howe maintains that:

> In order for someone to possess a real opportunity, she or he must also possess certain relevant information, including, of course, the information that the opportunity exists. Furthermore, deliberation on the part of the person possessing a given opportunity must be effective in determining which among several possible outcomes is pursued. (1997, p. 18)

In addition, Howe (1997) points out that in determining whether or not an opportunity really exists, it is essential to know the context in which the choice is made.

In further illustration that inequality of opportunity can be produced when girls and young women do not have a context in which they can make meaningful choices, Rosser explains that by dropping out of math and science, women prohibit themselves from 75% of all college majors, which are the ones that invariably lead to the highest paying, most technical jobs (Rosser, 1990). Thus they restrict their possible future earning capability and career options, and play into the current gender-stratified job market and pay scale.

We set out in this survey to dig more deeply into certain factors discussed above -- students' aspirations for future education and careers and course taking attitudes and patterns

-- that define the "context of choice" (Kymlicka, 1989) associated with the gender and SES of students. If systematic differences exist here, then one can infer that unequal patterns cannot be justified solely by the appeal to the rhetoric of free choice.

The Survey

Data and Methods

Procedure. The survey was administered in the 1995-1996 school year to 13 high schools and middle schools. It focused primarily on the students' plans and perceptions with respect to math, science, technology, and vocational education, and the relationships among these and students' gender. This emphasis was dictated by the focus of the gender equity project that funded the survey. However, we combined the analysis of gender differences with analyses about students' socioeconomic status (SES) and race/ethnicity, in light of the inextricable connection between gender, SES, and race/ethnicity. Here we focus on the gender and SES differences found in the responses of the high school students.

We chose survey as the research method in order to gain a broad perspective on student perceptions and attitudes. Separate versions of a survey instrument were developed for high schools and middle schools, in both English and Spanish. Each had approximately 90 fixed-response items divided into sections on demographic information; attitudes toward math, science, computers, and vocational education; and perceptions of fairness of the treatment of various groups. Each also had approximately five fill-in items. These items asked students to name the job they would like to have and the job they think they probably will have, the groups that were most picked on in their school, and the groups of students with which they felt most comfortable.

Of the eight high schools surveyed, the sample analyzed here was drawn from five schools (three of the schools were excluded from the analyses reported here because of sampling and/or administration problems). In all but one school, which sampled from among different sections of the same course offerings, all students were surveyed.

The survey was administered by individual teachers who were instructed how to administer the surveys in a consistent manner. Four of the five schools administered the survey on one day of their choice, three schools gave the survey in a non-academic homeroom/advisement period, one administered it during the period of the day when all students have a scheduled class, and the one school that surveyed a sample gave it to students in all their different foreign language classes, over a two-week period.

Participants. We surveyed students in five high schools (3 four-year, grades 9-12; 2 three-year, grades 10-12) in a southwestern state. The schools ranged in size from 470 to under 1,800 students. They included one affluent suburban school, a large comprehensive urban school, an urban alternative school, a suburban/rural school, and one school set in an agricultural community.

The resulting sample had the following characteristics: N = 2,842; response rate = 68.4% ; males = 47.8%, females = 52.2%; Whites = 74.8%, Hispanics/Latinos = 13%, Asians = 5.1%, African Americans = 4.6%, and Native Americans = 2.5%; Mother's level of education (the variable used as a proxy for socioeconomic status):[4] High school graduation or less = 32.9%; Vocational, trade, or business school = 14.7%; Bachelor's degree = 24.6%; and post BA/BS = 13.9% (13.9% responded "don't know" to their mother's level of education).

A sequence of one-way and two-way ANOVAs were performed on the high school data. Because the schools served different grade levels, to ensure consistency, we focused on students in grades 10 through 12 in our analyses. In addition, when analyzing SES, we omitted those students who did not know their mother's education level.

Results

Several findings have emerged from the analyses thus far that appear quite robust. (We use as our criterion the customary $p < .05$. In most cases the p-value is well below .05). In light of our desire to examine the pipeline phenomena highlighted in the literature, we centered our analysis on four variables: educational aspirations, pipeline course taking, advanced pipeline course taking, and attitudes toward pipeline courses. We also documented students' career aspirations by gender and SES.

Educational Aspirations

Students were asked to indicate the level of education they would like to attain: 1, High school or less; 2, Vocational, trade, or business school; 3, Bachelor's degree; and 4, Education beyond a bachelor's degree (the same scale associated with mother's level of education described above). Gender was significant (p = .000), and it was females who had higher aspirations (See Figure 1). Females had a mean aspiration of 3.51, closer to the "Post BA/BS" level, whereas males had a mean aspiration of 3.34. SES was also significant (p = .000). Higher aspirations were associated with higher SES (See Figure 2); students with the lowest SES had a mean aspiration of 3.23, closest to the "Bachelor's degree" level, whereas students with the highest SES had a mean aspiration of 3.67, closest to the "Post BA/BS" level.

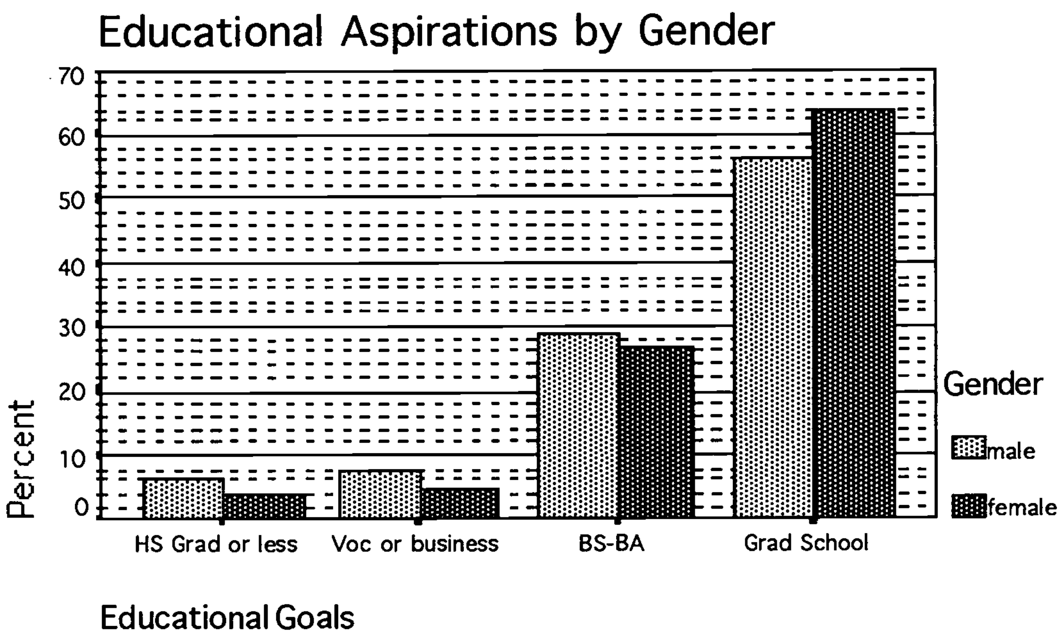

Figure 1

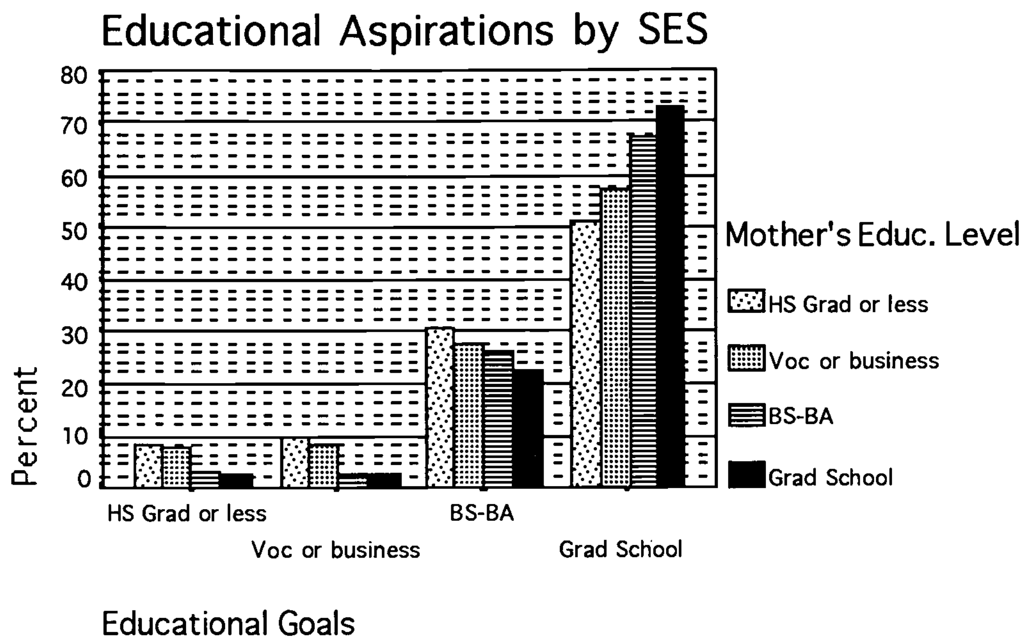

Figure 2

<u>Pipeline Course Taking</u>

The variable "pipeline course taking" was created by summing five items that asked respondents to indicate whether they had taken or planned to take trigonometry, calculus, chemistry, physics, and computer programming (1 = plan to take or have taken; 0 = do not plan to take). The gender difference was significant ($p = .001$), with males having taken or planning to take more pipeline courses (See Figure 3). On average, males had taken or planned to take more than three of the five pipeline courses; girls had taken or planned to take fewer than three. The results were also significant for SES ($p = .000$), with higher levels of SES tracking higher levels of pipeline course taking (See Figure 4).

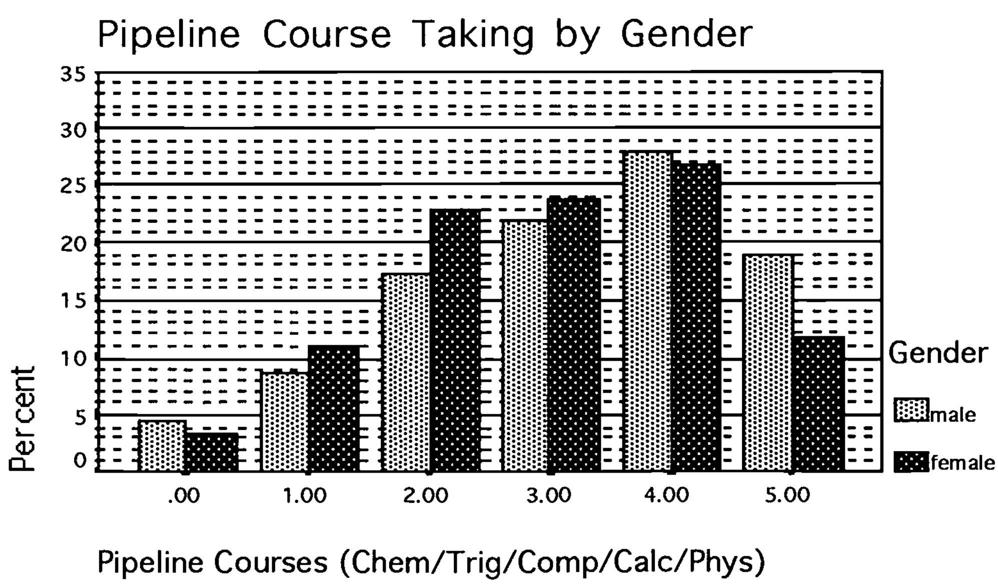

Figure 3

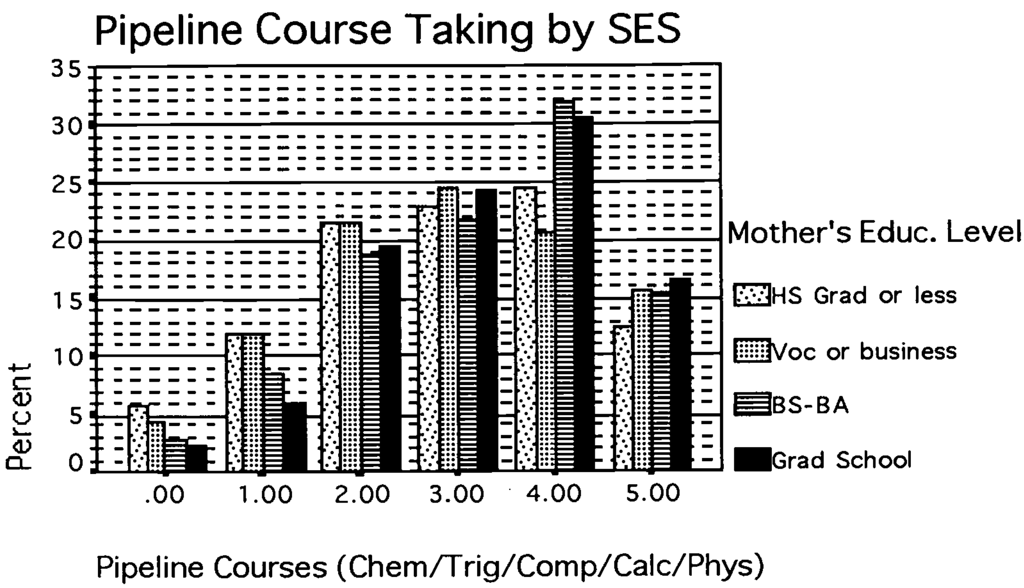

Figure 4

Advanced Pipeline Course Taking

The variable "advanced pipeline course taking" was created by summing the three most advanced courses on the course list. The respondents indicated whether they had taken or planned to take, or did not plan to take computer programming, calculus, and physics. Like the "pipeline course taking" variable, the gender difference was significant ($p = .005$), with males having taken or planning to take more advanced pipeline courses (See Figure 5). On average, males had taken or planned to take 1.54 advanced pipeline courses, whereas females had taken or planned to take 1.25. And students with higher SES had taken or planned to take more advanced pipeline courses (See Figure 6).

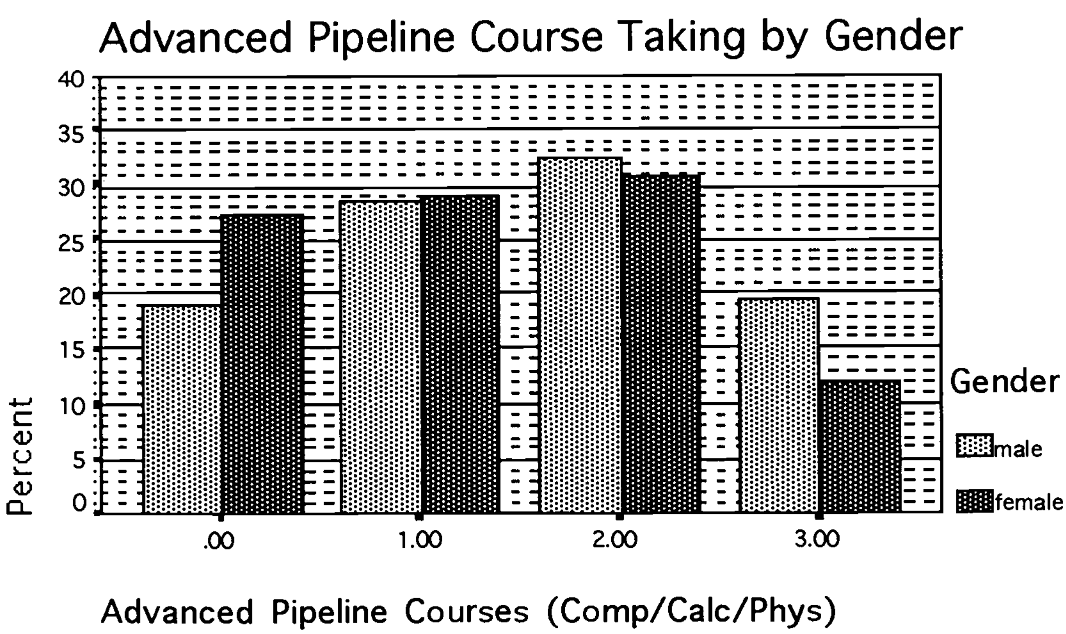

Figure 5

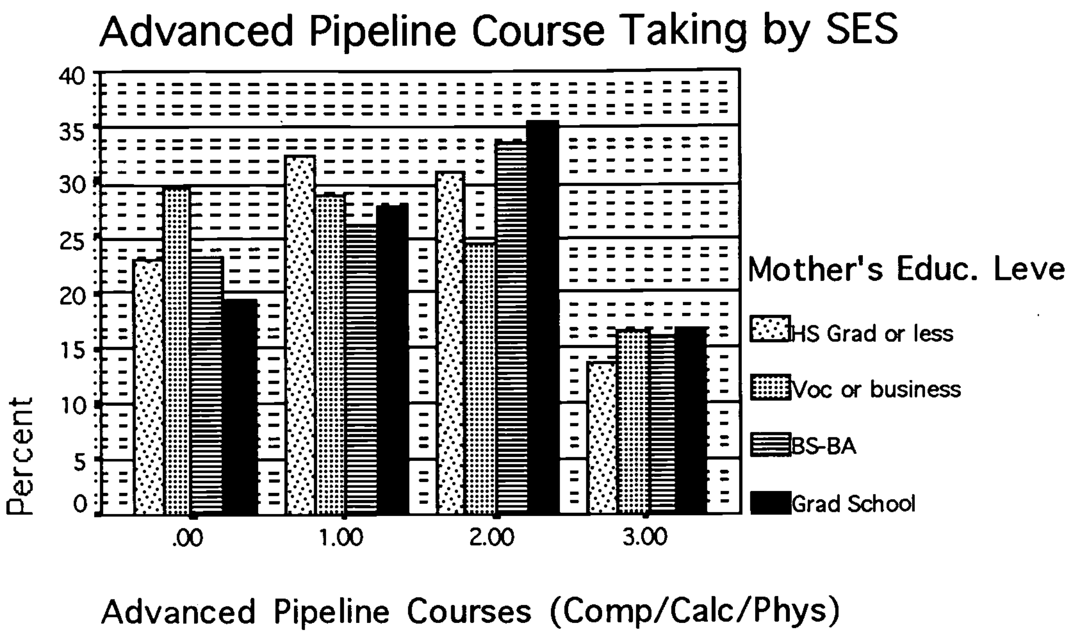

Figure 6

Attitudes Toward Pipeline Courses

The variable "attitudes toward pipeline courses" combined 12 items that asked respondents to indicate their attitudes toward their math, science, and computer courses. The items included whether students like those courses, understand what is being done in class, think they will use those courses as an adult, and perceive that doing well in those subjects as important for their future. Results were significant for gender (p = .011), with males having more positive attitudes, especially in the 12th grade (See Figure 7). Results were also significant for SES (p = .009), with higher SES corresponding to more positive attitudes (See Figure 8).

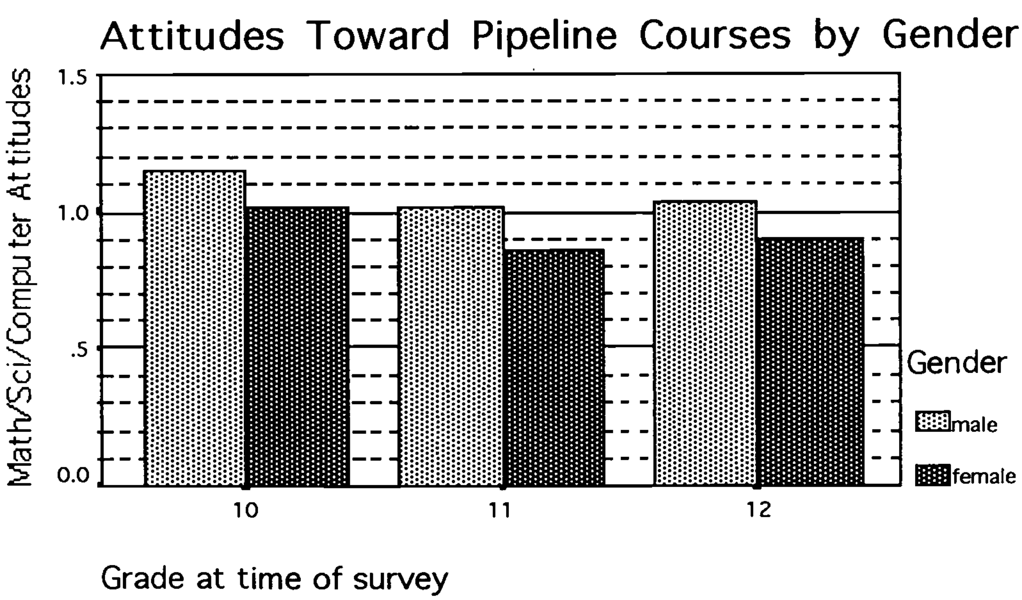

Figure 7

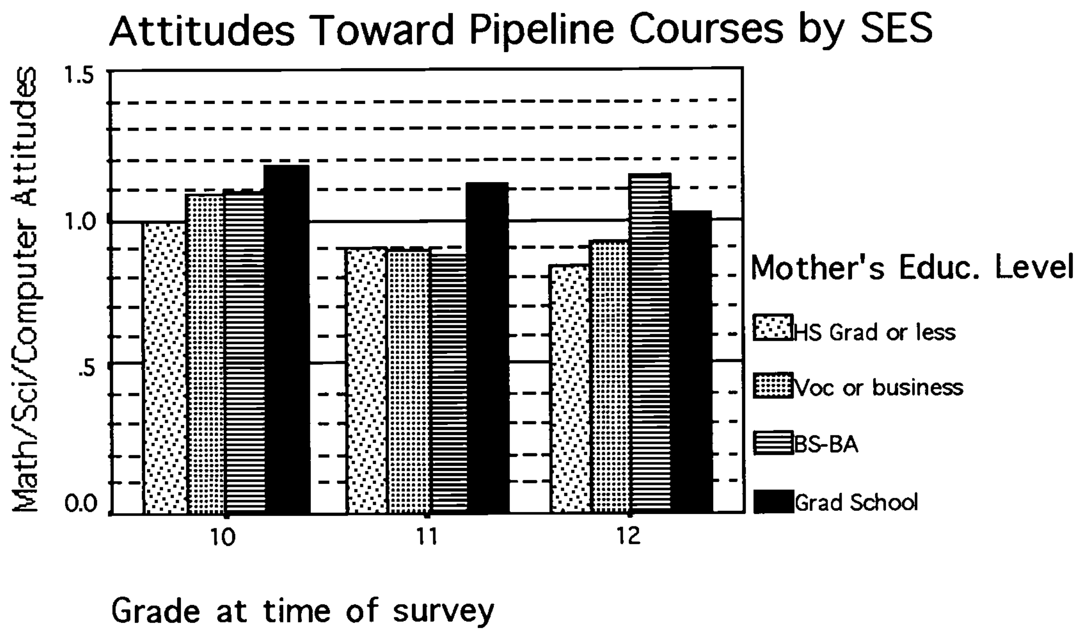

Figure 8

Career Aspirations Students were asked to write in their first and second choice of job that they would like to have as an adult. This resulted in over 140 different job choices written in by the students. We placed each job choice into an overall career category including Air & Space Flight (e.g., pilot, astronaut); Science/Math (e.g., all types of scientist, mathematician); Law (e.g., attorney, judge); Financial Services (e.g., accountant); Athletics (e.g., athlete, coach); Architecture (e.g., architect, draftsperson); Business (e.g., owner, executive); Teaching (e.g., all types of teacher); the Arts (e.g., actor, photographer); Skilled Help/Health Services (e.g., medical technician, physical therapist); Medicine/Physician (e.g., doctor, dentist); Literary Fields (e.g., writer, editor); Protective Services (e.g., police officer, firefighter); Animal Care (e.g., veterinarian); Skilled Services (e.g., cosmetologist, hair stylist); Computer Programming; and Engineering. This way, we were able to obtain a percentage of students in each career category, both by gender and by SES (See Figures 9 and 10).

We see a lower percentage of females in some scientific and technical fields such as Air & Space Flight, Computer Programming, and Engineering, and in the more stereotypically male fields such as Athletics, Business, and Protective Services. Accordingly, we see a higher percentage of females in the helping professions and other more stereotypically female careers such as Teaching, the Arts, Medicine, Literary Fields, Animal Care, and Skilled Services. Our findings here mirror trends in doctoral degrees awarded in 1995 (The Chronicle of Higher Education, 1996). Whereas women received 39.3% of all PhD degrees, they received only 28.4% of the PhDs in Business and Management, and only 11.6% of the PhDs in Engineering.

There are similar, but not identical, trends by SES. We see lower percentages of students with lower SES aspiring to careers in Science/Math, Medicine, Computer Programming, and Engineering. And there are higher percentages of students with lower SES choosing careers in the Arts, Skilled Help/Health Services, and Protective Services.

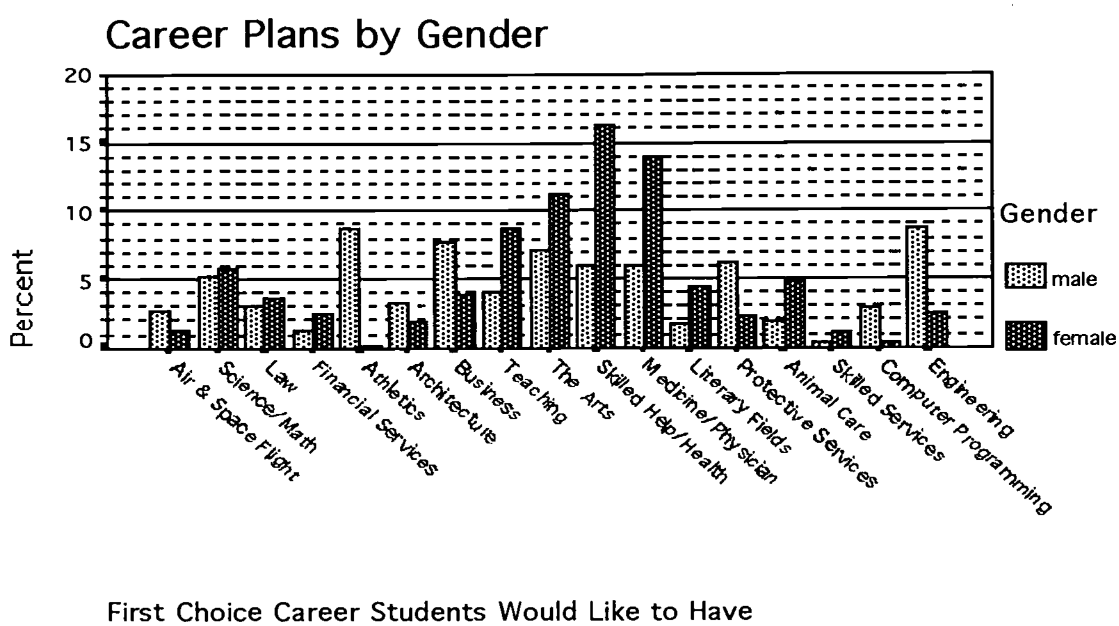

Figure 9

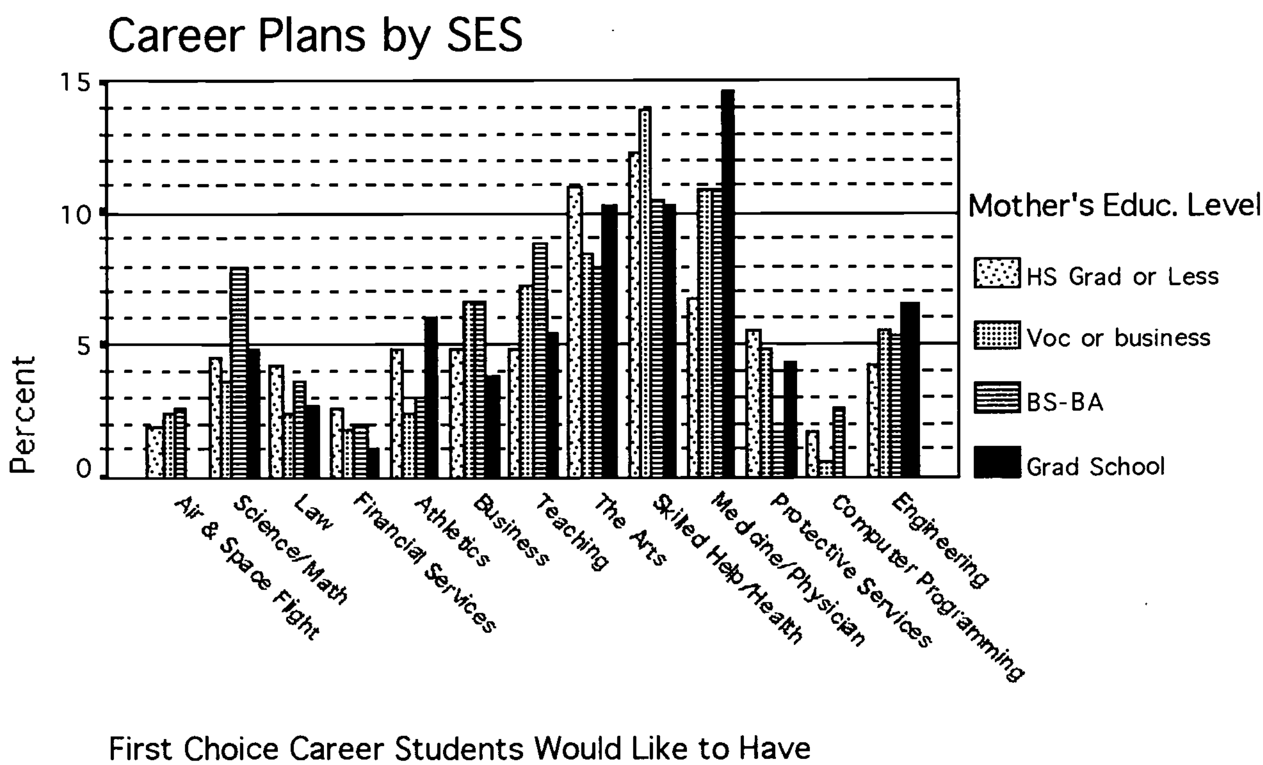

Figure 10

Discussion

There is some good news here, most of which is to be found in the absence of significant differences: there were no significant differences according to race/ethnicity for educational aspirations, pipeline course taking, or attitudes toward pipeline courses. The differences that existed for gender in aspirations for future education were in favor of females, who reported slightly higher educational aspirations than males. Finally, the significant gender differences for pipeline course taking appeared in the very highest level courses (e.g., computer programming, calculus, and physics), not across the board in math and science courses.

Numerous studies indicate that significant course taking differences appear in the most advanced levels of math, science and computing. Although some researchers suggest that the various 'gaps' start earlier (e.g., the computer gap in 3rd or 4th grade), it seems clear that if course taking differences appear at all, they do so in the most advanced courses -- courses which lead to high-status scientific careers (Nelson & Watson, 1990-91). Our study confirmed these findings, as 19.5% of male students had taken or planned to take calculus, physics, and computer programming, as compared to only 12% of females.

In addition, the students reported career aspirations that, in some cases, defied traditional role stereotypes. For example, just as many, if not more, young women aspired toward careers in medicine, science/math, financial services (e.g., accounting), and law; and just as many, if not more, students with lower SES aspired toward careers in law, business, and financial services.

There is also some bad news. In the case of SES, its levels (lower to higher) perfectly tracks lower (or worse) to higher (or better) values on each variable: educational aspirations, pipeline course taking, advanced pipeline course taking, and attitudes toward pipeline courses. Despite high aspirations, females continue to find pipeline coursework less desirable than males, and (perhaps for this reason) to opt out of the pipeline in larger numbers, as well as the careers to which they lead. Young women may be opting out of the very pipeline courses that they would need to take in order to fulfill their career aspirations. And they are not even aspiring towards the most scientific and technical fields. Female students and students with lower SES aspire to careers in engineering, air and space flight, and computer programming in much lower numbers than males and students of higher SES (See Figures 9 and 10).

One of the most intriguing and consistently reported findings about gender differences in math, science, technology and vocational education, is that they grow stronger as students get older. Rather than gaining on boys in scientific achievement, course taking, confidence and career aspiration, female students fall further and further behind males as they get older (AAUW, 1992; Oakes, 1990; Schmuck & Schmuck, 1994). Researchers overwhelmingly agree that the gender differences we have discussed increase through the end of middle school and, substantially, throughout high school.

We found that, indeed, female and lower SES students' attitudes about pipeline courses became more negative after the 10th grade. While males and some higher SES groups' attitudes decreased also, they nevertheless remained higher than females and students of lower SES.

Conclusion

In light of these findings, it is all too facile to suggest that, irrespective of gender and SES, students are equally situated regarding whether to choose to leave the educational pipeline. Factors are at work that create inequalities in the context of choice. Interestingly, substantial inequalities do not exist with regards to students' educational goals. The inequalities seem to surface most strikingly within students' actions. Something is compelling students, mainly young women and poor students, to opt out of advanced math, science, and computer courses, <u>even though</u> they have high educational and career aspirations that may well require those advanced courses.

The Shopping Mall High School documented that high schools work hard to provide students with plenty of course choice. However, schools "will press themselves to offer great variety, but will not press students to choose wisely or engage deeply" (Powell, Farrar, & Cohen, 1985, p. 3). It is as if the message is: "opportunities are there,...but only if you take them" (Powell et al., 1985, p. 3). As has been documented before and reinforced by the findings of our study, too many students are not taking the pipeline courses that lead to genuine educational and, consequently, career opportunities. And it is primarily students with lower SES and female students of all kinds who lose opportunities due to their course taking patterns. Educational reform involving communication among researchers, teachers, and students must address this if it is to lead students to achieve genuine choice and genuine equality of educational opportunity (Howe, 1997).

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[1] The following table is also telling:
Percentage of parents who believe these courses are important for children

Course	Important for boys	Important for girls
Literature	46%	52%
Reading	44%	56%
Social Studies	45%	55%
Physics	59%	41%
Math	79%	41%
Computer Science	67%	22%

Source: Shashaani, "Socio-economic status, parents' sex-role stereotypes," p. 446.

[2] However, Deboer found that a one-semester course difference still exists (1984).
[3] For a comprehensive review of "affective factors" related to women and minorities participation in math and science, see Oakes, 1990, p. 171+.
[4] The most accurate measure of socioeconomic status includes behavioral data such as academic environment in the home, and demographic data such as parents' level of education, family income, parents' occupation, and number of educational possessions in the home. Unfortunately, we were unable (due to school district restrictions) to ask questions related to parents' occupation or income on the survey. Since it is highly correlated with the more accurate measure of SES, we chose to use the variable, mother's level of education as a proxy for SES. (See White, 1981).

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