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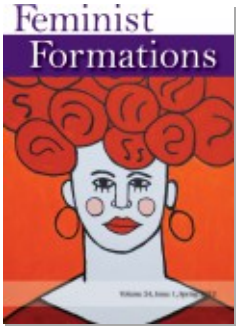

NWSA Journal, Volume 16, Number 1, Spring 2004, pp. 96-115 (Article)

Published by The Johns Hopkins University Press
DOI: 10.1353/nwsa.2004.0033

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African American Women in Science: Experiences from High School through the Post-Secondary Years and Beyond[1]

SANDRA L. HANSON

This essay uses data from the National Education Longitudinal Survey (NELS) to provide information on the science achievement, access (course-taking), and attitudes of young African American women at various points in the science education system. In addition, it uses recent data from the NELS 2000 panel to examine these young women's entry into science occupations in the early adult years. This essay also examines the extent to which their experiences differ from those of young white women. There is a growing—but limited—body of research that suggests that in spite of barriers the science system sets up for women, minorities, and minority women, it cannot be assumed that members of these groups will be equally disinterested in science. Using a multicultural gender framework, I argue that gender systems in the African American community provide young women with a unique set of resources that might be important for generating interest and success in science. In one of the most extensive studies of young African American women's science experiences from the early high school years to the early adult years, findings show that there is a continued interest and involvement in science, often more so than that for young white women.

Keywords: African American women / science / education / occupations / NELS

In the United States, young women's participation in many aspects of science education continues to be lower than that of young men. As a result, women remain underrepresented in science and science-related occupations—one of the most elite and influential sectors of the U.S. labor force (Hanson et al. 1999; National Center for Education Statistics 2000a, 2000b; National Science Board 2000; National Science Foundation 2000). This shortage of women is a reflection of the continuing bias and gender inequity in science. A focus on the science experiences of women, as an undifferentiated group, has been typical of researchers and federal data collection agencies and policymakers. It has limited the amount of information available on subgroups of women. However, researchers increasingly have come to the conclusion that not all women have the same experiences in science education and occupations and that our understanding of the unique talents, interests, and experiences of subgroups of women is heightened when we consider their experiences through a multicultural lens (Hanson and Palmer-Johnson 2000; Mau et al. 1995).

Preliminary research has found that young African American women are particularly interested in and engaged in science—at least during the high school years (Hanson and Palmer-Johnson 2000; Mau et al. 1995; National Center for Education Statistics 2000a). In spite of this interest, African American women encounter racism and sexism in the science domain and remain underrepresented in science programs and science occupations (Kenschaft 1991; Malcolm et al. 1998; National Science Board 2000; National Science Foundation 2000; Vining-Brown 1994).

The goal of this research is to provide information on a wide array of science experiences for young African American women at various points in the science education system. Entry into science occupations in the early adult years is also examined. Reports by the National Science Foundation (2000) and the National Science Board (2000) have gone a long way in providing increasing amounts of information on diverse populations in science education and occupations. However, the data are often provided for race groups and gender groups, but not for race/gender subgroups. Even when subgroups are mentioned, the information provided is often minimal. The focus is usually on objective measures of science experience such as standardized achievement tests, course-taking (or major), and type of occupation with few insights into young women's attitudes about and perceptions of their abilities and future experiences in science. In addition, longitudinal data are seldom included, and information tends to be presented only for certain sectors of the science pipeline (e.g., secondary school vs. post-secondary school vs. occupations).

Questions about the level of young African American women's involvement in various areas of science (access, achievement, attitudes) at multiple points in time and the extent to which these experiences differ from those of young white women are of interest here. Research questions are answered using data from the National Educational Longitudinal Study (NELS) (National Center for Education Statistics 2002). These data provide a detailed map of the science experiences of a cohort of young African American women as they move from the 8th grade (surveyed in 1988) through high school (surveyed in 1990 and 1992) to post-secondary education (surveyed in 1994) and beyond (surveyed in 2000). This research is one of the first to look at the science experiences of women in the newest (2000) NELS panel.

Background

A Multicultural Lens

The multicultural approach to understanding gender comes out of recent work by women of color who have attempted to correct past biases in the social sciences (Collins 1990; Zinn and Dill 1996). An awareness of the

white, middle-class bias of much work on gender led to a focus on the intersection of race, class, and gender (Andersen and Collins 1995; Glenn 1985; Rothenberg 1992; West and Fenstermaker 1995). This work posits that it is the combination of statuses that make for a particular group's attitudes, position, and opportunities (Lorber 2001). Collins (1990) has been particularly effective in describing this approach. She suggests that people can be simultaneously oppressed and oppressor, privileged and penalized; no one form of oppression is primary. Rather there are layers of oppression, within individual, community, and institutional contexts. Collins also argues that each of these locations is a potential site of resistance. This approach emphasizes the unique subcultures of minority women and the role of these cultures in affecting both the structures that limit and direct women's lives as well as the agency that allows them to retain some control and influence within these structures (Hanson and Kraus 1998, 1999). The unique subculture of African American gender systems is important background for understanding the science experiences of young African American women.

Research has suggested that gender systems in African American subcultures might provide young women a unique set of resources—resources that might be important for generating interest and success in science. The cultural context of the African American community is one that historically saw women working and heading families (Andersen 1997). African American women continue to have high rates of labor force participation and do not perceive work and family roles as conflicting (Collins 1987). Instead of work being in opposition to motherhood, it is seen as an important dimension of motherhood. And it is the perceived incompatibility between science careers and family pursuits that keeps many women from entering and pursuing science degrees and occupations (Matyas 1986; Ware and Lee 1988).

Historical analyses have suggested that the tradition of male dominance in white families in the United States has not been replicated in African American families. In part because of the legacy of slavery, the African American family has been typified by greater equality in family decision making and division of labor (Gutman 1976; Hill 1971; Kane 2000). As a result of these arrangements it has been suggested that gender roles are more egalitarian here than in white families (Wade 1993). Wilcox (1990) found that African American women are more dissatisfied than white women with the amount of power women have in society and Dugger (1988) found that they were also more aware of gender discrimination. These patterns contribute to greater self-esteem, independence, and assertiveness as well as high educational and occupational expectations among young African American women (and their parents) relative to other women (Andersen 1997; Hanson and Palmer-Johnson 2000; Hill and Sprague 1999; National Center for Education Statistics 2000a). All

of these characteristics have been shown to be related to success in science (Hanson 1996). In my earlier examination of the high school science achievement process (Hanson and Palmer-Johnson 2000), my colleague and I found that African American families compensate for disadvantages on some resources (e.g., socioeconomic status) by providing young women with an excess of other resources (e.g., unique gender ideologies, work expectations, and maternal expectations). And unlike white parents, they sometimes provide more of these resources to their daughters than their sons. Similarly, Higginbotham and Weber (1992) found that African American families put a greater stress on education and occupation as sources of mobility for their daughters (relative to white families) since they do not see marriage as a source of mobility (as white families are more likely to).

African American Women in Science

Although the last few decades have seen progress for women in science, the sciences continue to be a male domain (Hanson et al. 1999; National Center for Education Statistics 2000a, 2000b; National Science Board 2000; National Science Foundation 2000). The culture of science was historically, and is currently, a male culture that is often hostile to women and minorities (Harding 1986; National Science Foundation 2000; Rossiter 1982). The tendency in science research has been to talk about "women's" experiences and focus on women (or minorities) and not acknowledge variation within these groups. Hence there is relatively little research on minority women in science (Burbridge 1991; Catsambis 1995; Clewell and Anderson 1991). Does the science system equally discourage all women from entering the sciences? There is little evidence available to answer this question. However, the literature discussed here suggests a construction of gender in the African American community which does not mirror that in the white community. The confluence of a science system that is hostile to women, minorities, and most likely minority women, with an African American gender system that might provide unique resources in science, is of interest here.

Some have argued that since women do less well in science than men and minority group members do less well in science than members of the majority, there will be a double disadvantage for young African American women in science (Clewell and Anderson 1991; Vining-Brown 1994). The argument is one of double jeopardy that assumes an additive effect of the two statuses—female and African American. It is true that members of non-Asian minorities and women do less well in science when compared to whites and men respectively (National Science Foundation 1999), and there is some evidence that young African American women experience

special barriers in science (Carwell 1997; Clewell and Anderson 1991; Hueftle et al. 1983; Malcolm 1976; Vining-Brown 1994). However, there is a growing (although still limited) body of research that suggests that in spite of the barriers which the science system sets up for women, minorities, and minority women, we cannot assume that members of these groups will be equally disinterested in science. Some research shows that African American youth in general hold more positive attitudes about science than any other subgroup (Hueftle et al. 1983) and that African American girls in particular are very positive about science (Creswell and Exezidis 1982), sometimes more so than their white counterparts (Mau et al. 1995). Interestingly, African American women are more likely than other women of color to hope to become mathematicians (a male domain related to science) (Duran 1987; Kenschaft 1991).

My earlier research on African American women's science experiences during the high school years, revealed that African American women do as well as (and sometimes better than) white women on a majority of science measures (Hanson and Palmer-Johnson 2000). Recent data from the National Science Foundation (2000) suggest that experiences in science from post-secondary school through occupations are distinctly different for women from different race/ethnic groups. The data suggest that, African American females are increasingly present in science. For example, African American women earned more than half of the bachelor's degrees in science and engineering awarded to their race/ethnic group in 1997. And (during the same year) African Americans were the only race group where women earned over half of the master's degrees in science and engineering. African American women earned 46 percent of the Ph.D.s awarded to African Americans in science and engineering in 1997 while white women earned 38 percent of the degrees awarded to whites. Finally, data from the National Science Foundation (2000) suggest that African American women make up a much larger portion of African American scientists (36%) than is the case for white women (22%). It should be noted that many of these percentages were not presented in the body of the National Science Foundation report (2000) but rather were calculated from figures in Appendix A. When these figures are examined with a focus on percentages of women within race groups that are pursuing science degrees and occupations, the results often suggest a distinctly higher representation among African American women relative to white women. It is important to keep in mind, however, that although the percentages are sometimes higher for African American women than for white women, the raw numbers are often very small. For example, although (within race/ethnic groups) African American women earned a higher percentage of science and engineering Ph.D.s than did white women in 1997, the actual number of African American women and white women earning these degrees was 280 and 5,180 (National Science Foundation 2000).

Although it cannot be assumed that African American women will be more discouraged in science than white women, this is not to say that these young women are able avoid racism and sexism in their pursuit of science. Existing studies of African American women in science document considerable barriers that these women face (Kenschaft 1991; Malcolm 1976; Ovelton Sammons 1990; Vining-Brown 1994). However, the potential for continued interest in and engagement with science in the white male science domain is what my research examined. In later phases of the project, the dynamics and sources of support and discouragement will be explored in greater depth.

Research Questions

A number of questions are addressed in this research. First, what are the science experiences (access, achievement, and attitudes) of young African American women in the 8th grade? A review of the reports on science education leads to the hypothesis that young African American women will start out with a high level of interest and course-taking in science. Race comparisons may show a level playing field, or maybe even an advantage of young African American women over young white women. Young African American women will not, however, experience high levels of science achievement (as measured by standardized test scores) relative to white women.

Another question of interest is, how do the science experiences of young African American women change as they pass through the high school, post-secondary, and early years in the labor force? How do these experiences compare to those of young white women? It is expected that as the young women progress through the white, male-dominated education system, their interest and course-taking (or likelihood of majoring or getting a degree or eventually a job) in science will lessen but, as a group, they may still be more likely than young white women to pursue science.

Data and Methods

The first goal of the study is to chronicle the science education experiences of a nationally representative group of young African American women. The National Educational Longitudinal Survey (NELS) provides an excellent data source for this activity. NELS is a nationally representative, longitudinal data set collected under the auspices of the National Center for Education Statistics (2002). The base year data for NELS were collected in 1987–88 on a nationally representative sample of 24,599 eighth graders (approximately aged 13) from 1,000 schools. They were

interviewed again in 1990 when they were in the 10th grade, in 1992 when they were high school seniors, and in 1994 when they were two years out of high school. The fourth follow-up was conducted in 2000 (approximately aged 25). The data include extensive information on a wide variety of science education experiences. Analyses are based on those who participated in all three survey years. Those who dropped out of high school are not included. All analyses include weights that control for sample attrition and nonresponse. Since NELS weights were created to project to the total U.S. high school youth population, I adjusted the weights back to sample size. The sample I used consists of 581 young African American women and 3,365 young white women.

The NELS data are a valuable tool for showing the science experiences of representative samples of U.S. youth. The longitudinal nature makes them an excellent source of insight for transitions in the science educational pipeline and thus the development (and loss) of youth who exhibit talent in science. The data are frequently used to guide educators and policymakers. No one has used this data set to focus specifically and in detail on the experiences of young African American women. With the most recent (2000) panel of information on the NELS cohort, the NELS provides the richest source of information available on the science experiences of young people from age 13 (middle school) through the high school, undergraduate, and post-college years.

Measures of Science Experiences (NELS)

NELS has excellent longitudinal data (over a 12-year period) on the science experiences of a cohort of young people who were in 8th grade in 1988. In this research I did not include the social sciences in the definition of science. Majors and occupations involving physical science, mathematics, medical science, computer science, engineering, and technology were included. Three of the most important aspects of science experience encompass science access, science achievement, and science attitudes (Hanson 1996). NELS includes extensive measures of each (see Table A.1 for a full list of these measures within each survey year). For example, measures of access include enrollment in accelerated science (8th grade), chemistry (10th grade), university/college physics classes (2 years out of high school), and science major or degree (including those in math, engineering or technology) since leaving high school (2 years out of high school and 8 years out of high school). Measures of achievement include (among others) grades in science and standardized science test scores during the high school years as well as science occupations in the post-high school years. Measures of attitudes include (among others) responses to questions about looking forward to science classes, feeling challenged in these classes, being interested and doing well in science, as well as others which ask about the importance of science in the respondent's

future (measured during the high school years). A question about the occupation that the respondent plans to have at age 30 (coded here as science or not science) is also included in the attitudinal questions.

Analyses

I use descriptive statistics to detail the science experiences of a cohort of young African American women (and the young white women in the comparison group) in the 1988 through 2000 NELS panels. T-tests are used to determine whether the experiences of the two groups of women are significantly different at each point in time. In order to take full advantage of the longitudinal data, odds ratios for continuing in science given earlier course-taking, achievement, or interest are calculated for the young African American women and for the young white women. Odds for continuing in an area of science given earlier success in that area (access, achievement, attitudes) as well as odds for doing well on other science indicators given success in one (e.g., odds of taking chemistry in 10th grade given positive attitudes in 8th grade) are also calculated for the two groups.[2] This analysis will provide insight about the effect of early success and interest in science (e.g., in the 8th grade) on later science experiences. Researchers are increasingly documenting the early course-taking and positive science attitudes of young African American women. The unique longitudinal data provided in the NELS are important for their ability to connect these early science experiences to later ones, aiding the attempt to chronicle and explain the science experiences of these minority women from the early high school years to the post-secondary years and beyond. Later analyses will use the NELS data on families, schools, and peers as well as qualitative data being collected in a web survey to help explain the trends found here.

Findings

Science Access. Means showing young women's access to science, by race, are reported in Table A.1. As expected, there are a number of variables on which there are no race differences and a number on which there is an African American advantage. There are fewer comparisons showing a white advantage than an African American advantage. Results suggest that in 8th grade, young African American women are much more likely to be in advanced, enriched, or accelerated science courses than is the case for young white women (40% vs. 24%). In 10th grade there are no differences in the amount of course work in chemistry. Similarly, in 12th grade there are no race differences in the young women's enrollment in science classes over the past two years, although young white women were more likely to be taking a science class at the time of the survey. When those attending college were asked (2 years out of high school) about course-taking and majors, there were no differences in chemistry course-taking.

However, young white women were more likely to have taken a physics course (12% vs. 8%). But it was young African American women who were more likely (almost twice as likely) to report a science major (at their first college/university attended, 25% vs. 14%). By the time the young women were eight years out of high school there were no race differences in their report of whether or not their first or second degree was in science. But the African American women were considerably more likely to report that they would like a degree in science by age 30 (26% vs. 15%).

Science Achievement. Means showing young women's achievement in science, by race, are also reported in Table A.1. As expected, there is considerable white advantage here. But when it is occupational achievement (not school achievement as measured by grades or standardized test scores) that is examined, this white advantage disappears. Starting in 8th grade, the young white women were more likely to get higher grades in science (in 10th grade as well) and to score higher on standardized science exams (in all 3 high school years). The race difference in science exam scores was consistent across the three measurement periods. However, eight years out of high school (2000) it is young African American women who were more likely to report a current/most recent job that was in science (22% vs. 17%). And all other job reports (measured 2 years out of high school) show no race difference.

Science Attitudes. Means for variables measuring science attitudes presented in Table A.1 reveal a distinctly positive attitude toward science on the part of African American women in the early years of high school. These young women, when asked in the 8th grade (1988), were more likely than young white women to look forward to science class (59% vs. 55%). In the same year, they were more likely than young white women to feel that science would be useful in their future (70% vs. 65%). Two years later (1990), in 10th grade, they were more likely than young white women to say that they often work hard in science class (64% vs. 55%). However, by the last year of high school (1992) these patterns shift and it is young white women who claim more interest in science (49% vs. 42%). In the same year, there are no race differences in respondent reports on how well they do in science. But the trends reverse again in the early adult years (2000) when the young women have been out of high school for eight years. Almost one-third (31%) of the young African American women reported that the occupation that they plan to have at age 30 will be in science. Less than one-quarter of young white women reported such plans (24%).

Odds of Continuing in Science. Tables A.2 and A.3 show the odds for young African American and young white women of continuing in science given earlier engagement in science. Table A.2 shows the odds of continuing within areas of science (e.g., earlier access leading to later access) and Table A.3 shows the odds of continuing within one area given

engagement in another (e.g., earlier attitudes leading to later access). Findings in Table A.2 indicate that within science access, the odds of a young woman (African American or white) continuing in science courses and programs given earlier course-taking are significantly higher than for young women who did not have earlier access to science. For example, the odds of a young woman who was in 8th grade advanced science going on to take chemistry in 10th grade were .36 for African American women and .44 for white women. For young women who had not been in the 8th grade advanced science class the odds of being in 10th grade chemistry were considerably lower (.12 for African American women and .17 for white women). However, in two of the three sequences examined, the odds for continuing on were higher for African American women than for white women.

Table A.2 also shows that in two of the three science achievement sequences, earlier achievement was significantly related to later achievement for both African American and white women. The connection between high science grades at earlier and later points was higher for young white women than for young African American women. However, the connection between having a science occupation two years out of high school and having a science occupation eight years out of high school was higher for the African American women than for the white women.

Finally, Table A.2 shows the odds of earlier positive attitudes leading to later positive attitudes toward science. Here, for the young African American women (but not the white women), earlier experiences are not as strongly related to later experiences as they were in the areas of science access and achievement. Although the odds of having positive attitudes in 10th grade were higher for those who had positive attitudes in 8th grade than for those who did not, later sequences did not show this trend. These findings suggest that young African American women with positive attitudes about science early on may not continue to be as positive about science in later years. But they also suggest that an absence of positive attitudes earlier does not preclude the chance of having positive attitudes later. It makes sense that early and later engagement is less highly correlated in science attitudes than it is in access and achievement where course-taking and knowledge tend to be cumulative along a set curriculum.

Table A.3 shows the sequences for which the odds of having success in one area of science were significantly related to the odds of success in another area for the sample of African American women. A consideration of all possible sequences revealed significant associations in only two areas. These involved the influence of earlier positive attitudes on later access and the influence of earlier access on later achievement. In some, but not all of the cases, the relation between earlier success and later success was also significant for young white women. The findings add important detail to my earlier findings that show significant

science course-taking and positive science attitudes among young African American women in the early high school years. These early experiences in science are setting the stage for success in other areas of science as well. Interestingly, it is the early course-taking that seems to increase the odds of being in science occupations in later years—the area of science achievement where young African American women sometimes have an advantage over young white women.

Discussion and Conclusions

In the research presented here, a multicultural gender framework was used to gain insight into the aspirations and characteristics encouraged among young women in the African American community. This examination suggested that simple assumptions about the mismatch between women and science are often based on experiences of white women. In fact, in the African American community, gender is constructed in a very different way and many of the characteristics that are considered appropriate for females (e.g., high self-esteem, independence, and assertiveness, as well as high educational and occupational expectations) are not inconsistent with characteristics that contribute to success in science. It is this push into the sciences in the context of the white, male science culture that is often hostile to those who are not white or not male, which makes young African women's experiences an important area of study.

This examination of young African American women's science experiences from 8th grade through the early adult years (12 years later) in three areas of science (access, achievement, and attitudes) revealed considerable interest in and access to science for young African American women. However, it is attitudes, even more than access, where young African American women distinguish themselves. Starting in 8th grade, and continuing into the early adult years, young African American women are often more positive about science than their white counterparts.

Findings from the NELS survey also show considerable access (course-taking) to science among young African American women. As with the findings on attitudes, this greater access continued through the post-high school years. One of the largest race differences revealed by the NELS data involved the percentage of women taking advanced, enriched, or accelerated science courses in 8th grade—40 percent of young African American women but only 23 percent of young white women. Although the percentages were smaller in the post-high school years, young African American women still outpaced young white women on some indicators of science access. For example, the young African American women were more likely to report (2 years out of high school) that they had majored in science at a post-secondary institution and (8 years out of high school) that they expected a degree in science by age 30. Notably, a consideration

of the relationship between science success in the early years, and success in later years, revealed that this early access to science courses and programs is critical in increasing the odds that young African American women will have science jobs in their early adult years.

It was in the area of science achievement where young African American women in the NELS sample fared the least well. When achievement in science education (as measured by grades and standardized exams) was considered, young white women in the sample always scored higher. These findings are corroborated by other research showing that young African American women score lower on standardized science exams than do young white women (Clewell and Andersen 1991; Hanson 1996). Testing biases that favor middle-class white students are most likely part of the explanation for this trend (Lomax et al. 1995). It should be noted, however, that one of the most unexpected results from the NELS survey came in achievement and it revealed an advantage for the young African American women. When they were asked as young adults (8 years out of high school) about their current or most recent job, African American women were more likely than white women to report a job in science. This finding should not come as a surprise given some of the recent data available on minority women in science occupations (National Science Foundation 2000).

Although young African American women often express more interest in science than their white counterparts, there is nevertheless a lessening of interest over time. For example, in 8th grade, 59 percent of the young women looked forward to science class and 70 percent said science will be useful in their future. But by the time they had been out of high school for two years only 42 percent were interested in science (this is less than for white women) and 48 percent said they do well in science. And finally, in their eighth year out of high school, only 31 percent of the young African women planned to have a job in science by the age of 30. This "cooling out" was expected given the fact that these young women face not just sexism, but also racism in their pursuit of science. Malcom's (1976) research on African American women scientists reveals considerable barriers, including low expectations of teachers, especially of white teachers in integrated school systems. Other reports on African American women scientists support these claims of racism (Kenschaft 1991). Another important factor in the chilly climate that young African American women experience is that students are seldom made aware of the contributions of African Americans (much less African American women) in science (Ovalton Sammons 1990; Von Sentima 1985). This invisibility, together with the small number of minority women available as teachers and mentors (Jordan 1999), work to create obstacles for young African American women. Colleges that have been the most successful in encouraging minority women scientists are women's colleges and historically black colleges and universities (HBCUs), especially women's

HBCUs, which have diverse faculties and give confidence to women in science (Jordan 1999).

This research revealed a large science talent base among young African American women. It constitutes one of the most careful examinations, to date, of the science experiences of these young women in both science education and occupations over time. One of the most unexpected findings revealed here was African American women's continued interest and presence in science, beyond the high school years. It is important to note, however, that the number of young African women who are interested and involved in science in the early adult years is much lower than the number who are interested and involved in the early high school years. The concern is that educational and occupational institutions are not fully developing all science talent. When gender and skin color are major factors determining who will do science, a considerable amount of science talent will be lost. The implications of this loss for scientific discovery and advance is considerable. The implications are also great for the young people who are denied access to science since they will not be involved in the creation of policies and technologies that will guide us through the next century.

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Notes

1. This research was funded by grant REC-0208146 from the Division of Research, Evaluation, and Communication of the National Science Foundation. The opinions expressed do not necessarily reflect the position of the National Science Foundation. The author thanks Michelle Jiles for her analytic support.

2. Odds for continuing within an area of science were calculated for each sequence within each area of science, e.g., from 8th to 10th grade, 10th to 12th, etc. These odds are shown in Table A.2. In the case of the odds of continuing on in one area given earlier engagement in another area, the number of combinations was large and not all could be shown. I limited those shown in the table to the ones that were significant for the African American sample.

Table A.1.
Means (and Standard Deviations)
for Science Variables for Young Women by Race: NELS

Variables	African-American Females	White Females
Science access		
1988 (8th grade)		
In advanced, enriched, or accelerated science courses		
(1=yes; 0=no)	.40 (.49)**	.23 (.42)**
1990 (10th grade)		
Coursework in chemistry		
(1=one half to two years; 0=none)	.18 (.38)	.18 (.38)
1992 (12th grade)		
Enrolled in science classes in the last two years		
(1=yes; 0=no)	.89 (.32)	.89 (.31)
Taking a science class this term		
(1=yes; 0=no)	.43 (.49)**	.51 (.50)**
1994		
Taking/taken courses in physics last 2 years[a]		
(1=yes; 0=no)	.08 (.27)**	.12 (.32)**
Taking/taken courses in chemistry last 2 years[a]		
(1=yes; 0=no)	.29 (.45)	.29 (.46)
Science major at post-secondary institution[a]		
(1=yes; 0=no)	.25 (.43)**	.14 (.34)**
2000		
First post-secondary degree—science[b]		
(1=yes; 0=no)	.14 (.35)	.14 (.34)
Second post-secondary degree—science[b]		
(1=yes; 0=no)	.08 (.27)	.09 (.29)
Science degree expected by age 30		
(1=yes; 0=no)	.26 (.43)**	.15 (.36)**
Science achievement		
1988 (8th grade)		
Science grades from 6th grade until now		
(1=mostly A's; 0=B's or less)	.34 (.47)**	.38 (.49)**
Science standardized score	45.12 (7.91)**	52.73 (9.11)**
1990 (10th grade)		
Science grades		
(1=mostly A's; 0=B's or less)	.38 (.48)**	.43 (.50)**
Science standardized score	43.96 (7.09)**	52.06 (8.98)**

Table A.1., continued

Variables	African-American Females	White Females
1992 (12th grade)		
Science standardized score	43.02 (8.12)**	52.10 (8.87)**
1994		
First occupation—science		
(1=yes; 0=no)	.02 (.15)	.02 (.13)
Most recent occupation—science		
(1=yes; 0=no)	.03 (.17)	.02 (.15)
Occupation 1992—science		
(1=yes; 0=no)	.02 (.15)	.02 (.13)
Occupation 1993—science		
(1=yes; 0=no)	.02 (.16)	.02 (.13)
Occupation 1994—science		
(1=yes; 0=no)	.04 (.19)	.02 (.14)
2000		
Current/most recent occupation—science		
(1=yes; 0=no)	.22 (.42)**	.17 (.37)**
Science attitudes		
1988 (8th grade)		
Usually look forward to science class		
(1=strongly agree or agree;		
0= disagree or strongly disagree)	.59 (.49)*	.55 (.50)*
Science will be useful in my future		
(1=strongly agree or agree;		
0= disagree or strongly disagree)	.70 (.46)**	.65 (.48)**
1990 (10th grade)		
Often work hard in science class[c]		
(1=almost everyday; 0=less than everyday)	.64 (.48)**	.55 (.50)**
1994		
Interested in science[c]		
(1=important; 0=not as important)	.42 (.50)*	.49 (.50)*
Does well in science[c]		
(1=important; 0=not as important)	.48 (.50)	.50 (.50)
2000		
Planned occupation by age 30—science		
(1=yes; 0=no)	.31 (.46)**	.24 (.43)**

*significant at .10 level

**significant at .05 level

[a]questions only asked of those in college at time of interview

[b]questions only asked of those who had attended or were attending college at time of interview

[c]questions only asked of those taking science

Table A.2.
Odds for Young African American Woman Having High Access (Achievement, Attitudes) to Science Given Earlier Access (Odds for Young White Woman are in Parentheses): NELS

Access	*Odds*+	*Achievement*	*Odds*+	*Attitudes*	*Odds*+
8th Grade Advanced Science 10th Grade Chemistry	.36/.12*** (.44/.17)***	8th Grade Science Grades 10th Grade Science Grades	.64/.49* (2.23/.38)***	8th Grade: Sciences Useful 10th Grade: Work Hard in Science	2.66/1.07*** (1.33/1.09)***
10th Grade Chemistry Science Major, 2 Years Post-HS	.45/.33* (.20/.15)***	10th Grade Science Grades Science Occupation 2 Years Post-HS	.01/.03 (.02/.02)	10th Grade: Work Hard in Science Interested in Science 2 Years Post-HS	.64/.70 (1.24/.68)***
Science Major, 2 Years Post-HS Expect Science Degree by age 30, 8 Years Post-HS	.91/.21*** (.84/.11)***	Science Occupation 2 Years Post-HS Science Occupation 8 Years Post-HS	1.3/.17*** (.50/.14)***	Interested in Science 2 Years Post-HS Plan Science Occupation by Age 30	.58/.55 (.66/.26)***

***Chi-Square for association between earlier and later science experience is significant at .05 level
**Chi-Square for association between earlier and later science experience is significant at .10 level (African American Women Only)
*Chi-Square for association between earlier and later science experience is significant at .20 level (African American Women Only)
+Odds of later success given earlier success/odds of later success without earlier success

Table A.3.
Odds for Young African American Women Having Success in One Area of Science Given Success in Other Areas (odds for young white women are in parentheses): NELS

Attitudes	*Access*	*Odds*[+]	*Access*	*Achievement*	*Odds*[+]
8th Grade: Science Useful	Science Major 2 Years Post-HS	.45/.20*** (.20/.01)***	10th Grade Chemistry	Science Occupation 8 Years Post-HS	.58/.25*** (.26/.19)***
8th Grade: Look Forward to Science	Taken Physics Course 2 Years Post-HS	.14/.05*** (.15/.13)	10–12th Grade Science Enrollment	Science Occupation 8 Years Post-HS	.32/.13*** (.22/.12)***
10th Grade: Work Hard in Science	Taken Chemistry Course 2 Years Post-HS	.50/.29*** (.44/.37)***	Taken Physics Courses 2 Years Post-HS	Science Occupation 8 Years Post-HS	.77/.35** (.53/.19)***
10th Grade: Work Hard in Science	Science Major 2 Years Post-HS	.44/.22*** (.15/.18)	Taken Chemistry Course 2 Years Post-HS	First Occupation was in Science	.07/.00* (.03/.01)
10th Grade: Work Hard in Science	Expect Science Degree by Age 30, 8 Years Post-HS	.37/.22** (.17//.19)	Taken Chemistry Course 2 Years Post-HS	Science Occupation 8 Years Post-HS	.60/.30** (.56/.13)***

***Chi-Square for association between earlier and later science experience is significant at .05 level
**Chi-Square for association between earlier and later science experience is significant at .10 level (African American Women Only)
*Chi-Square for association between earlier and later science experience is significant at .20 level (African American Women Only)
[+]Odds of later success given earlier success/odds of later success without earlier success

References

Andersen, Margaret L. 1997. *Thinking About Women: Sociological Perspectives on Sex and Gender*. Boston: Allyn and Bacon.

Andersen, Margaret L. and Patricia Hill Collins. 1995. *Race, Class, and Gender: An Anthology*. Belmont, CA: Wadsworth.

Burbridge, Lynn B. 1991. The Interaction of Race, Gender, and Socioeconomic Status in Education Outcomes. Working paper NO 246. Wellesley, MA: Center for Research on Women, Wellesley College.

Carwell, Hattie. 1977. *Blacks in Science: Astrophysicist to Zoologist*. Hicksville, NY: Exposition Press.

Catsambis, Sophia. 1995. "Gender, Race, Ethnicity, and Science Education in the Middle Grades." *Journal of Research in Science Teaching* 32(3):243–57.

Clewell, Beatriz C. and Bernice Anderson. 1991. *Women of Color in Mathematics, Science, and Engineering: A Review of the Literature.* Washington, D.C.: Center for Women Policy Studies.

Collins, Patricia Hill. 1990. *Black Feminist Thought*. Boston: Unwin Hyman.

———. 1987. "The Meaning of Motherhood in Black Culture." *Sage* 4 (Fall): 3–10.

Creswell, John L. and Roxane H. Exezidis. 1982. "Research Brief—Sex and Ethnic Differences Mathematics Achievement of Black and Mexican American Adolescents." *Texas Tech Journal of Education* 9(3):219–22.

Dugger, Karen. 1988. "Social Location and Gender-Role Attitudes: A Comparison of Black and White Women." *Gender and Society* 2(4):425–48.

Duran, Richard P. 1987. "Hispanics' Pre-college and Undergraduate Education: Implications for Science and Engineering Studies." In *Minorities: Their Under-representation and Career Differentials in Science and Engineering*, edited by L.S. Dix, 73–128. Washington, D.C.: National Academy Press.

Glenn, Evelyn N. 1985. "Racial Ethnic Women's Labor: The Intersection of Race, Gender, and Class Oppression." *Review of Radical Political Economics* 17:8–108.

Gutman, Herbert G. 1976. *The Black Family in Slavery and Freedom*. New York: Vintage.

Hanson, Sandra L. 1996. *Lost Talent: Women in the Sciences*. Philadelphia: Temple University Press.

Hanson, Sandra L., Stefan Fuchs, Silke Aisenbrey and Nataliya Kravets. 1999. "A Comparative Study of Female Elites: Gender Attitudes Among Women Scientists in Germany and the U.S." Paper Presented at the annual meetings of the American Sociological Association, Chicago, IL, August.

Hanson, Sandra L. and Rebecca S. Kraus. 1998. "Women, Sport, and Science: Do Female Athletes Have an Advantage?" *Sociology of Education* 71(2):93–110.

Hanson, Sandra L. and Elizabeth Palmer-Johnson. 2000. "Expecting the Unexpected: A Comparative Study of African American Women's Experiences in Science During the High School Years." *Journal of Women and Minorities in Science and Engineering* 6(4):265–294.

Harding, Sandra. 1986. *The Science Question in Feminism*. Ithaca: Cornell University Press.

Higginbotham, Elizabeth and Lynn Weber. 1992. "Moving Up with Kin and Community: Upward Social Mobility for Black and White Women." *Gender and Society* 6(3): 416–40.

Hill, Robert B. 1971. *The Strengths of Black Families*. NY: Emerson Hall.

Hill, Shirley A. and Joey Sprague. 1999. "Parenting in Black and White Families: The Interaction of Gender and Class and Race." *Gender and Society* 13(4):480–502.

Hueftle, Stacy J., Steven J. Rakow, and Wayne W. Welch. 1983. *Images of Science.* Minneapolis: University of Minnesota, Science Assessment and Research Project.

Jordan, Diann 1999. "Black Women in Agronomic Science: Factors Affecting Career Development." *Journal of Women and Minorities in Science and Engineering* 5(2):113–28.

Kane, Emily W. "Racial and Ethnic Variations in Gender-Related Attitudes." *Annual Review of Sociology* 26:419–39.

Kenschaft, Patricia C. 1991. *Winning Women into Mathematics*. Washington, D.C.: Mathematical Association of America.

Lomax, Richard G., Mary M. West, Maryellen C. Harmon, Katherine A. Viator, and George F. Madaus. 1995. "The Impact of Standardized Testing on Minority Students." *The Journal of Negro Education* 64(2):171–85.

Lorber, Judith. 2001. *Gender Inequality: Feminist Theories and Politics*. Los Angeles: Roxbury.

Malcolm, Shirley M. 1976. *The Double Bind: The Price of Being a Minority Woman in Science*. Washington, D.C.: American Association for Advancement of Science.

Malcolm, Shirley M. et al. 1998. "Equity and Excellence: Compatible Goals: An Assessment of Programs with Increased Access and Achievement of Females and Minorities in K–12 Mathematics Education." Report for the American Association for the Advancement of Science (AAAS-84-14).

Matyas, Marsha Lakes. 1986. "Persistence in Science-Oriented Majors: Factors Related to Attrition among Male and Female Students." Paper presented at the annual meetings of the American Educational Research Association, San Francisco.

Mau, Wei-Cheng, Margaret Domnick, and Randolph A. Ellsworth. 1995. "Characteristics of Female Students who Aspire to Science and Engineering or Homemaking Occupations." *The Career Development Quarterly* 43:323–37.

National Center for Education Statistics. 2000a. *Entry and Persistence of Women and Minorities in College Science and Engineering Education.* NCES 2000–601, by Gary Huang, Nebiyu Taddese, and Elizabeth Walter. Washington, DC: U.S. Department of Education.

———. 2000b. *Trends in Educational Equity of Girls and Women.* NCES 2000–030, by Yupin Bae, Susan Choy, Claire Geddes, Jennifer Sable, and Thomas Snyder. Washington, DC: U.S. Department of Education.

———. 2002. *National Educational Longitudinal Study: 1988–2000.* Data files and Electronic Codebook System—Base year through fourth follow-up ECB/CD-ROM, Public Use (NCES 2002–322 CD ROM). Washington, DC: U.S. Department of Education, National Center for Education Statistics.

National Science Board. 2000. *Science and Engineering Indicators—2000*. Arlington, VA: National Science Foundation.
National Science Foundation. 2000. *Women, minorities, and persons with disabilities in science and engineering: 2000*. Washington, D.C.: NSF.
Ovelton Sammons, Vivian. 1990. *Blacks in Science and Medicine: A Biographical Directory of Black Scientists* (91–111). Washington, D.C.: Hemisphere Publishing.
Rossiter, Margaret S. 1982. *Women Scientists in America: Struggles and Strategies to 1940*. Baltimore: Johns Hopkins University Press.
Rothenberg, Paula S. 1992. *Race, Class and Gender in the United States*. New York: St. Martin's Press.
Vining-Brown, S. 1994. *Minority Women in Science and Engineering Education*. Final Report. Princeton, NJ: Educational Testing Service.
Van Sertima, Ivan. 1985. *Blacks in Science: Ancient and Modern*. New Brunswick, NJ: Transition Books.
Wade, Bruce H. 1993. "The Gender Role and Contraceptive Attitudes of Young Men: Implications for future African American Families." *Urban League Review* 16(2):57–65.
Ware, Norma C. and Valerie E. Lee. 1988. "Sex differences in choice of college majors." *American Educational Research Journal* 25:593–614.
West, Candace and Sarah Fenstermaker. 1995. "Doing Difference." *Gender and Society* 9:8–37.
Wilcox, Clyde. 1989. "Race, Gender Role Attitudes, and Support for Feminism." *Western Political Quarterly* 43(1):113–21.
Zinn, Maxine B. and Bonnie T. Dill. 1996. "Theorizing Difference from Multiracial Feminism." *Feminist Studies* 22(2):321–31.