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# A Longitudinal Study of the Educational and Career Trajectories of Female Participants of an Urban Informal Science Education Program

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Abstract: The purpose of this longitudinal case study is to describe the educational trajectories of a sample of 152 young women from urban, low-income, single-parent families who participated in the Women in Natural Sciences (WINS) program during high school. Utilizing data drawn from program records, surveys, and interviews, this study also attempts to determine how the program affected the participants' educational and career choices to provide insight into the role informal science education programs play in increasing the participation of women and minorities in science, math, engineering, and technology (SMET)-related fields. Findings revealed 109 participants (93.16%) enrolled in a college program following high school completion. Careers in medical or health-related fields followed by careers in SMET emerged as the highest ranking career paths with 24 students (23.76%) and 21 students (20.79%), respectively, employed in or pursuing careers in these areas. The majority of participants perceived having staff to talk to, the job skills learned, and having the museum as a safe place to go as having influenced their educational and career decisions. These findings reflect the need for continued support of informal science education programs for urban girls and at-risk youth. © 2004 Wiley Periodicals, Inc. J Res Sci Teach 41: 835–860, 2004

Percentages remain low despite efforts over the past several decades to achieve more equitable numbers of women and minorities in the science, math, engineering, and technology (SMET) careers. The discrepancy in SMET careers has been attributed to numerous issues relating to education, psychology, and society. It is impossible to identify one single cause since all issues affecting women's choices whether to participate in SMET careers are complex and interrelated. It is likely that a combination of factors is still deterring young women from choosing a profession that involves science.

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Although there are no simple solutions, there have been and still continue to be efforts to narrow the gender gap. In science education, a large number of single-sex schools and classes, after-school programs, mentoring programs, and summer science programs attempt to increase girls and women's participation in SMET. How effective these programs are in the long term is still not fully understood. The purpose of the present study is to describe the educational and career trajectories of a sample of young women from urban, low-income, single-parent families who participated in single-sex, informal, science education, enrichment programs during Grades 9 and/or 10 of high school. This study also attempts to determine which program elements affected the participants' educational and career choices from their own perspectives to provide insight into the role informal science education programs play in increasing the participation of women and minorities in SMET-related fields.

## Rationale

### *Underrepresentation of Females in SMET*

Women have a long history of underrepresentation in SMET careers that continue to this day. According to the National Science Board (2000), ''women were slightly more than one-fifth (23 percent) of the S&E [science & engineering] workforce, but close to half (46 percent) of the U.S. labor force in 1997.'' When these numbers are broken down by discipline, the situation looks even less promising. To understand the situation more completely, one must break down the blanket category of SMET into smaller components. The aforementioned numbers include all types of SMET fields including life and physical sciences, social sciences, computer science, mathematics, and various engineering occupations. Looking at the individual SMET categories from 1993 to 1997, the NSF reported increases in the percentage of women in all categories except computer and mathematical sciences, where a decline in the number of women was seen. Despite increases, the degree of representation of women varies across individual disciplines and proves most inequitable in the so-called hard sciences. For example, women constituted 63% of psychologists and 55% of sociologists, but only 10% of physicists and 9% of engineers (National Science Foundation, 2000).

Similar trends exist in higher education. Although women make up the majority of the current enrollment figures at most U.S. colleges and universities, women are still the minority when it comes to obtaining degrees in science. In 1997, women represented only 23% of the scientists and engineers holding doctoral degrees (National Science Foundation, 2000).

As a group, women are minorities in SMET. Women and girls are at risk of not being equally represented in these fields in school or in the workforce. When compounded with other risk factors such as being labeled as a racial or ethnic minority, low socioeconomic status, and nontraditional family structure, women are placed in a position which does not favor their success in traditionally White, male-dominated fields. As shown through the figures mentioned earlier, still too few women have been resilient enough to overcome the odds placed against their success in the sciences.

Long before entering college and choosing a major, young women are being turned off to SMET. As Sadker and Sadker (1994) highlighted, males and females are treated quite differently from the time they are infants on up through high school and beyond. Science textbooks and curricula often fail to equally represent females in photos, illustrations, and text. Science content when traditionally presented in schools, especially in the physical sciences, does not have as great a relevancy to real-life experiences for girls as it does for boys. For instance, concepts are frequently presented using male-oriented examples such as guns, sports, and automobiles.

In the classroom, girls tend to have fewer opportunities than boys to use tools and equipment. According to Jones et al. (2000), boys often do not hesitate to begin to manipulate science equipment that is placed in the classroom whereas girls are more likely to wait for specific instructions from the teacher. As is the case in many classrooms, there is frequently not enough science equipment for each individual student. When this situation occurs, boys are more likely to dominate the allotted time available for using the equipment, thus in the long term accruing more experience. Outside of school, girls engage in fewer science- and technology-related activities than their male counterparts (Catsambis, 1995). The overall impact of the difference between these out-of-school-time science experiences between boys and girls on their participation in science is still not fully understood (Clewell & Campbell, 2002), although results of a recent study conducted by Lottero-Perdue and Brickhouse (2002) suggested that increased opportunities for ''tinkering'' with science equipment during childhood would likely benefit girls.

As students progress through the elementary grades into middle and high school, the gender gap in science widens. In a meta-analysis of the literature from 1970 to 1991, Weinburgh (1995) concluded that boys have a more positive attitude than girls towards all types of science, and that as attitudes become more positive, achievement increases. Gender differences in attitude are well established by Grade 8, with White girls having more negative attitudes than Black girls (Catsambis, 1995). Kahle and Meece (1994) suggested that ''girls generally develop a set of attitudes and beliefs that do not promote high levels of achievement and participation in science'' (p. 545). Wyer's (2003) study of female undergraduate science majors suggested that positive attitudes toward science along with positive perceptions of the images of scientists contributes to one's persistence in SMET participation.

Negative perceptions of scientists can emerge as early as Grade 2, as evidenced in the Draw-a-Scientist Test (Chambers, 1983), and increase with age (Baker & Leary, 1995; Chambers, 1983; Schibeci & Sorensen, 1983). The majority of both female and male students are unlikely to draw pictures of female scientists or scientists of color (Bodzin & Gehringer, 2001; Chambers, 1983; Finson, Beaver, & Cramond, 1995; Fort & Varney, 1989; Mason & Kahle, 1988; Parsons, 1997). It is not that male scientists should be considered negatively, but that girls are not seeing themselves as scientists in these Draw-a-Scientist exercises. Girls' negative stereotypes of science and scientists established in the early grades continue to persist throughout high school (Parsons, 1997).

The courses students take in high school can have a significant impact on the opportunities that will be available to them later in life. Taking a greater number of math and science classes than the minimum number required by state law can positively influence standardized test scores, scholarships and awards, college acceptance, and access to careers (American Association of University Women, 1999; Farmer, Wardrop, & Rotella, 1999; O'Sullivan, Weiss, & Askew, 1998; U.S. Department of Education, 2000). Often unaware of the long-term consequences, girls take fewer advanced-level math and science courses than boys. This puts young women at a disadvantage when they reach college. The already exceptionally low numbers of females interested in a SMET field lack the required course work to pursue a SMET major. Changing girls' course-taking behavior has proved to be a difficult challenge for many educators focusing on this particular goal (Darke, Clewell, & Sevo, 2002).

Even if girls do aspire to and meet the prerequisites for a SMET career during high school, they often change their minds once they reach college. Some women find the large, impersonal structure of university science lectures uncomfortable and difficult (Shmurak, 1998). Some students discover that other fields are more interesting or suitable for them. Other negative factors deterring women from participating in SMET careers include low salaries, inequitable distribution of career rewards, and the stress inherent in balancing career and family (Clewell & Campbell,

2002). Regardless of the reasons, only a small percentage of the women who initially aspire to a SMET career are achieving their goals.

### *Educational and Career Aspirations of Girls and Young Women*

There is a small, but growing, body of research describing many of the factors influencing the educational trajectories of women and girls. In the midst of this research, a well-developed theoretical framework has emerged from the work of Jacquelynne Eccles (1994). Influenced by Bandura's social learning theory, Eccles' theory focuses on a set of social and psychological factors, linking ''educational, vocational, and other achievement-related choices most directly to two sets of beliefs: the individual's expectations for success and the importance or value the individual attaches to the various options perceived by the individual as available'' (p. 587).

Eccles' (1994) theory is based on the assumption that individuals are frequently faced with achievement-related choices, which are ''made within the context of a complex social reality that presents each individual with a wide variety of choices, each of which has both long-range and immediate consequences'' (p. 591). An individual's choices are limited by the knowledge one possesses about the existing possible options. An individual may partially or entirely lack information or may have acquired inaccurate information about particular options. In addition, gender-role schema may influence decision making. Socialization experiences serve to shape either the reinforcement or the deconstruction of gendered stereotypes. Clewell and Campbell (2002) provided a detailed summary of the social-psychological research on girls' and women's participation in SMET, including the influence of science and mathematics instruction, attitudes, and parents and society.

Girls may not see some choices as feasible based upon beliefs associated with negative stereotypes (American Association of University Women, 1999, p. 108). In a review of the literature on African American women's career development, Hackett and Byars (1996) found that African American women aspired to male-dominated careers more often than White women. Hackett and Byars attributed the difference to a less sex-typed gender-role socialization during childhood and to exposure to more traditionally masculine experiences, thus enhancing self-efficacy.

Applying the Eccles (1994) model to careers in SMET, expectations for success relate directly to a student's self-concept and ability to do science and math. Children who perceive themselves as having high academic efficacy perform well academically and, in turn, have high educational aspirations and feel they are capable of pursuing careers in the sciences (Bandura, Barbaranelli, Caprara, & Pastorelli, 2001). The more positive a student feels about herself and her abilities, the more likely she is to take more higher level science courses (American Association of University Women, 1999; Baker, 1987).

The second component of the Eccles (1994) model stresses that the individual will make choices based upon the perceived importance or value of their options. If students do not see science as important or valuable to their own lives, they will not be likely to consider taking additional science courses or pursuing a career in a SMET field (Farmer et al., 1999). If girls are currently not as likely as boys to see science as relevant to their future (Catsambis, 1995), then it is not as likely that they will pursue careers in SMET.

Madill et al. (2000) found that a group of over 100 urban young women enrolled in a science-related major favored career-related values with relevancy to their own lives. They ranked a set of career-related values during Grade 11 and then again 3 years later as college students in the following order of importance: personal development, ability utilization, achievement, social relations, altruism, economics, prestige, and autonomy. The order remained the same over time.

In many cases, students are not aware of their full range of options. ''Too many students make career choices in an information vacuum'' (American Association of University Women, 1999, p. 115). They lack information and knowledge about pursuing higher education or careers in science (Kao & Tienda, 1998; Madill et al., 2000). Often, students do not know what scientists and engineers actually do on a day-to-day basis (Baker & Leary, 1995; Gottfredson, 1981; Lewis & Collins, 2001). Madill et al. (2000) found that young women studying in science-related majors had little work experience in fields related to their areas of study. Many students do not personally know a male or a female scientist. Girls in elementary and secondary school have few women-scientist role models available to them (Baker & Leary, 1995). This is especially true for girls of color (Hackett & Byars, 1996).

Level of social support is positively related to higher expectations of future success in students (Dubow, Arnett, Smith, & Ippolito, 2001). The students who do choose science frequently have positive role models to assist with their decisions. Counselors, teachers, and parents have a great potential to influence girls to enter into or opt out of SMET careers through their attitudes, encouragement, resources, teaching methods, and classroom materials (American Association of University Women, 1999; Bandura et al., 2001; Campbell & Beaudry, 1998; Hackett & Byars, 1996; Jones et al., 2000; Kahle & Meece, 1994; Paa & McWhirter, 2000; Sadker & Sadker, 1994).

### *Extracurricular Activities and Informal Science Education*

As a means to broaden girls' participation in science, numerous intervention strategies have been implemented throughout the United States. Based upon a recent study of the NSF's Program for Women and Girls, Darke et al. (2002) identified mentoring and role modeling, extracurricular SMET activities, and summer camps as efforts that positively affected girls and women in SMET.

Although students spend a great deal of time learning in the classroom during regular school hours, a large amount of learning also occurs during nonschool hours. Learning can take place in a variety of environments including schools, homes, museums, and community centers, to name just a few. Participation in extracurricular activities may help students to improve academically, learn the values of teamwork, competition, and responsibility, and enhance their self-concept (American Association of University Women, 1999; Eccles & Barber, 1999; Nettles, Mucherah, & Jones, 2000; Shmurak, 1998; U.S. Department of Education, 2000). The growing literature on neighborhood youth programs suggests that after-school activities provide adolescents with places where they can feel safe from the pressures of their families, schools, and their sometimes dangerous neighborhoods (Halpern, Barker, & Mollard, 2000; McLaughlin, Irby, & Langman, 1994; U.S. Department of Education, 2000).

When these voluntary educational activities are intentionally designed not to be a part of a school's curriculum and they incorporate a SMET-related topic, they are collectively referred to as ''informal science education.'' A better understanding of and comfort with science provided by informal science experiences can lead students toward considering careers in SMET. ''Many people with science-related careers credit their initial interest in SMET to informal rather than formal exposure, identifying museum and science centers as the most important stimulants to their childhood interest'' (COSMOS Corporation, 1998, p. 4). Informal science education programs conducted by museums and science centers frequently provide opportunities for mentoring, improving science and job skills, and counteracting science stereotypes. Science programs designed specifically for girls increase their understanding and perceived value of science (American Association of University Women, 1998) as well as offer opportunities to develop skills they might have otherwise missed out on, such as utilizing science equipment or acquiring job skills (Eccleston, 1999; Pierce & Kite, 1999) and increased feelings of self-concept and

empowerment (Baker, 2002). The single-sex setting, although controversial in its actual effects, seems to be preferred by girls, helping them build confidence, try new things, and explore career possibilities (American Association of University Women, 1998).

On the downside, students from low socioeconomic backgrounds are less likely to participate in extracurricular activities (American Association of University Women, 1999; U.S. Department of Education, 1995). In addition, these same students do not participate in the same types of extracurricular activities. Mirroring course-enrollment patterns, students from less affluent families are more likely to join vocational and professional organizations at their schools, and less likely to join academic clubs and honor societies (U.S. Department of Education, 1995).

## Program of Study

The Women in Natural Sciences Program (WINS) is a yearlong natural science enrichment program offered for academically talented females. To be eligible, participants must be entering Grade 9 or 10, be enrolled in public school, maintain a *C* or better average in all major subjects, live in households where one or both parents are absent, and demonstrate financial need (be eligible for reduced school lunch). Since 1982, the WINS program has been offered free of charge to all participants and includes materials, admission fees, field-trip transportation, bus tokens for travel to and from the museum, and family memberships to the science museum. Approximately 30 young women are selected each year. The ultimate goal of the WINS program is to provide participants with the information, encouragement, and confidence they need to consider pursuing careers in the natural sciences, to make informed decisions, and to shape their own futures.

In the fall of each year, the museum solicits student nominations from all public schools with eighth- and ninth-grade classes. Teachers, principals, and counselors submit the names and addresses of as many students as they see qualified. Over 150 students are nominated each fall. An application packet is directly sent to each nominee. Nominees must then submit application forms, with complete school transcripts for the current and previous grade levels, proof of family financial need, and a minimum of two recommendation forms, and attend an interview. Participants are selected based upon their interest in academics and science as well as their overall attitude, motivation to learn, and family financial status.

The first of four WINS sessions begins in July. During the 7-week summer session, students attend classes at the museum 3 mornings per week. In addition to environmental-science-themed classes at the museum, students take field trips to local parks, spend an entire night in the museum, and stay at an environmental education center for 5 days and 4 nights where students hike, canoe, star gaze, swim, and complete ropes courses.

During the academic year, students meet at the museum 1 afternoon per week and attend monthly Saturday field trips. The academic-year unit themes include terrestrial ecology, taxonomy, and aquatic ecology. Throughout the year, students meet scientists, play science-related games, do arts and crafts, and tour behind the scenes of the museum. Students also travel to other educational places such as laboratories, zoos, aquariums, gardens, and seashores.

After completion of the yearlong program, approximately 15 to 20 of the WINS students remain involved in the program through participation in a second-year extension of the program known as WINS II. WINS II includes opportunities for paid laboratory or museum positions, travel, and involvement in other established informal science education programs. Other WINS II girls sometimes acquire volunteer or paid positions in other programs and departments within the museum. Acceptance into the second year of the program is based on first-year performance as well as available funding.

Over the years, the WINS program has accumulated information about the backgrounds and the desired educational and career goals of its participants. To determine whether the participants pursued their original educational and career goals and if elements of the WINS program influenced their decision making, the following research questions were investigated:

1a. What were the desired (preparticipation) educational and career trajectories of 1992 to 1997 WINS participants prior to their acceptance into the WINS program as obtained from their program application forms?
1b. What were the actual (postparticipation) educational and career trajectories of 1992 to 1997 WINS participants from the time they left high school to the present as obtained from program records and survey?
2. What differences exist between the 1992 to 1997 WINS participants' desired (preparticipation) educational and career trajectories and their present (postparticipation) educational and career trajectories?
3. Which program elements do the 1992 to 1997 WINS participants perceive as having affected their educational and career trajectories as obtained from survey and semistructured interviews?

## Method

### *Research Design/Rationale*

The investigation of the previous research questions takes the form of a longitudinal, descriptive case study. The case itself is comprised of those individuals who completed at least 1 year of the WINS program between 1992 and 1997. The case-study method was selected due to its appropriateness for studying contemporary events, for understanding highly contextual topics, and for its advantage when the process is just as important as the product (Merriam, 1998; Yin, 1994). The study is considered longitudinal because it describes (a) the desired (preprogram) educational and career trajectories of students as they were reported between 1992 and 1997 during their eighth-grade year of schooling, prior to their acceptance into the WINS program, and (b) the present (postprogram) educational and career trajectories as reported during adulthood 4 to 9 years later. The study also is considered descriptive since it details the educational trajectories of participants and their perceived influence of the WINS program on their educational- and career-related decision making.

This case study utilizes qualitative methodology for the data collection (documents, open-ended survey questions, and interviews). The study also contains elements of quantitative data embedded within the qualitative methods (closed-ended survey questions and frequency counts).

### *Sample*

A purposive sample was used for this study. The sample consists of former WINS participants who applied for, were accepted into, and completed at least 1 year of the program between 1992 and 1997. Between 1992 and 1997, 152 young women attended the program for at least 1 year. These young women represent a highly specific portion of the general population. All of these women have several factors in common, making them a unique group about which little prior research has been conducted.

All of the young women in this study (a) come from single-parent homes, (b) come from low-income households, (c) are mostly minorities (89.47%), (d) attended an urban public high school,

(e) expressed an interest in science during their eighth- or ninth-grade year of school, and (f) participated in a yearlong science enrichment program at a natural science museum. All young women who completed at least 1 full year in the WINS program were invited to participate in the study. All former students ($n = 152$) were contacted by mail; 51% ($n = 78$) of them completed and returned a survey. Of the 78 women who returned a completed survey, a subsample of 12 survey respondents was asked to participate in an interview. The subsample was selected purposively as well. An attempt was made to select a group that included diversity in racial background (9 African Americans, 1 Latina, 1 Asian American, 1 White), age (2 from each of the 6 years of study), and educational trajectories (magnet, neighborhood, and vocational high schools).

### *Validity*

The researcher used multiple sources of data and methods to strengthen the study. Data came from documents produced several years ago by the participants when they were children and from current surveys and interviews with the participants who are now adults. Participants were periodically asked to perform member checks to ensure that the researcher's interpretations of the interview transcripts and survey data were accurate. Other former WINS students and staff were involved in piloting the survey and interview guide. Several former WINS staff members and university colleagues provided feedback during all stages of the research.

External validity in the traditional sense is very limited in this study. The study describes only a particular group of students who attended a specific program, and the sample was not randomly selected. In particular, research Question 3 reports participants' perceptions of a program they attended many years prior to the study. The generalizability of the results from a single case to a larger population is questionable (Merriam, 1998). So long as the context of this case is considered, educators, policy makers, and youth program coordinators may find the entire case or portions of it relative to their own programs.

The purpose of the research and its voluntary nature was explained to all potential participants in a cover letter sent with the survey. Those invited to complete an interview were asked to read the transcript of their individual session to ensure their voice was being transmitted in a manner fully reflecting their experiences (Poland, 2002). In dissemination of results, participants' true identities are protected through the use of pseudonyms.

### *Procedure*

The three main data-collection strategies for this study include personal program documents, self-administered surveys, and semistructured interviews. Original WINS student application forms provide first-person accounts of the participants' desired educational trajectories. The desired trajectories were taken verbatim from the original application forms and entered into a database. Utilizing program mailing lists, former participants were sent a survey inquiring about educational and career decisions made since their completion of the program. The survey questions were aimed at collecting descriptive information such as basic demographics, information related to participants' high school careers such as schools attended, math and science courses taken, and SAT scores, and details regarding their level of involvement in the WINS program. A portion of the survey attempts to gain explicit details regarding the educational trajectories of the participants. They were asked to map their route from their senior year of high school to their current location along their individual trajectory. Data analysis took place concurrently with the data collection. The survey results were analyzed and compared to original program records, with open coding leading to category formation.

Following the initial analysis, semistructured interviews were conducted with a representative subsample of the survey respondents ($n = 12$) to gain a deeper understanding of the information they provided on the written survey. The interviews employed an interview guide to ensure coverage of major themes and issues, but allowed enough room for participants to fully contribute their perspectives about the WINS program and their educational trajectories. Each interview session lasted anywhere from 10 to 22 min. Six guiding questions were included: (a) What is (was) your major area of study? (b) What is it about *(area of study given in Question 1)* that attracted you to that area? (c) Did you ever have any experience with (*area of study given in Question 1*) prior to your decision to study that area? Explain. (d) Thinking back to the WINS program, did your involvement in the program influence your decision to study (*area of study given in Question 1*). Explain. (e) On your survey you indicated that (*an aspect of the WINS program listed in survey Question 28*) influenced your educational or career decision. Explain. (f) What other aspects about the WINS program do you feel influenced your education or career decision making? Explain.

## Results

### *Research Question 1a: What were the Desired (Preparticipation) Educational and Career Trajectories of 1992 to 1997 WINS Participants Prior to their Acceptance into the WINS Program as Obtained from their Program Application Forms?*

Program records were used as the main data source for answering this question. As part of the original application form, participants completed the following question: ''What are your current education and career plans once you graduate from high school?'' Participants' responses to this question provided the data for Research Question 1a.

A total of 152 young women completed at least 1 full, yearlong session of the WINS program between 1992 and 1997. The majority of participants (89%) were in the middle of their eighth-grade year when they completed the WINS application; the remaining 17 girls (11%) were in the Grade 9 or 10. The majority of the participants described their race or ethnicity as African American or Black (83%). Table 1 summarizes participants' racial/ethnic backgrounds. A total of 151 participants (99%) completed Question 1a on their original WINS application. Coding and analysis of research Questions 1a and 1b were divided into two stages. The first stage examined participants' education plans while the second stage concentrated on their career plans.

*Desired Educational Trajectories.* During the first stage of analysis for this research Question 1a, the researcher assigned codes to the responses using five general categories: (a) responses indicating the participant planned to attend a college or a university; (b) responses indicating the participant planned to acquire a position of employment requiring a college degree, but with no mention of any postsecondary education; (c) responses indicating the participant

Table 1
*Participants' race/ethnicity*

| Race/Ethnicity | Total ($n = 152$) | % |
|---|---|---|
| African American/Black | 126 | 83 |
| Caucasian | 13 | 8 |
| Latina | 6 | 4 |
| Mixed/Other | 4 | 3 |
| Asian | 3 | 2 |

planned to attend a trade or vocational school after high school; (d) responses indicating the participant planned to enter into the military; and (e) responses indicating the participant was undecided about her future career. The majority of participants (92%) indicated a desire to enroll in a college or university, as shown in Table 2.

*Desired Career Trajectories.* The second stage of coding focused on the types of careers respondents indicated they planned to have in the future. Only 144 participants provided this information on their application forms. Several students listed more than one career choice, thus the analysis included a total of 208 responses. The researcher placed each career choice into one of 22 possible categories, as illustrated in Table 3. Medicine and health-related career choices were most popular (42%) followed by choices falling into the SMET category (25%). Law and education were the third and fourth most popular desired careers. Table 3 presents a breakdown of participants' desired career types.

A more detailed coding of the medicine/health-related choices reveals that the job of doctor was overwhelmingly the most desirable occupation among preprogram participants. Although 37 of the young women answering this question did not specify exactly what type of doctor they would like to become, 22 respondents specifically expressed an interest in working with women (obstetrician/gynecologist) and children (pediatrician). Table 4 provides a detailed breakdown of the types of desired medicine/health-related careers the young women reported.

A separate analysis of the individual fields within the SMET category reveals 19 participants (37%) did not specify the type of science field they desired to work in. This suggests that participants may not have been completely familiar with the range of science careers or what exactly a scientist does in her or his occupation (Baker & Leary, 1995). Biology (19%) ranked high on the list while physics and chemistry were entirely absent, supporting previous research that women are more likely to choose life science over the physical sciences (National Science Foundation, 2000). Table 5 provides a detailed breakdown of the types of desired SMET careers reported by participants. Interestingly, computers ranked third (17%) among the SMET careers desired by students. This is in contrast to a report of a decline in women's interest in the field of technology (National Science Foundation, 2000).

*Research Question 1b: What were the Actual (Postparticipation) Educational and Career Trajectories of 1992 to 1997 WINS Participants from the Time they Left High School to the Present as Obtained from Program Records and Surveys?*

*Actual Educational Trajectories.* Educational trajectory data were available for a total of 117 of the 152 original participants. Data for 78 participants were obtained from the survey, and data

Table 2
*Participants' desired educational trajectories prior to acceptance into the women in natural sciences program*

| Desired Educational Trajectory | Total ($n$=151) | % |
|---|---|---|
| College | 139 | 92 |
| College-level job (no mention of obtaining degree) | 5 | 3 |
| Trade school | 3 | 2 |
| Undecided | 3 | 2 |
| Military | 1 | 1 |

Table 3
*Participants' desired career types prior to acceptance into the women in natural sciences program*

| Desired Career Type | Total | % |
|---|---|---|
| Medicine/Health | 87 | 41.83 |
| SMET (science, math, engineering, & technology) | 52 | 25.00 |
| Law | 18 | 8.65 |
| Education | 10 | 4.81 |
| Entertainment/Arts | 9 | 4.33 |
| Business (establish their own) | 5 | 2.40 |
| Psychology | 5 | 2.40 |
| Military/Government/Law Enforcement | 4 | 1.92 |
| Business (accounting, marketing, etc.) | 3 | 1.44 |
| Cosmetology | 3 | 1.44 |
| Undecided | 3 | 1.44 |
| Media (radio, television, film) | 2 | 0.96 |
| Archaeology | 1 | 0.48 |
| Architecture | 1 | 0.48 |
| Religion/missionary | 1 | 0.48 |
| Restaurant/Culinary/Tourism/Hospitality | 1 | 0.48 |
| Social Work | 1 | 0.48 |
| Sports/recreation | 1 | 0.48 |

*Note*. $n = 144$. Participants were free to list multiple responses. The total number of responses given is 208. Categories are based upon program records and survey responses.

for the remaining 39 participants were provided by program tracking records, for a total response rate of 77%. All 117 respondents earned a high school diploma. A total of 109 participants (93%) enrolled in some type of college program following high school completion. Table 6 summarizes the participants' actual educational trajectories as of December 2001.

As of December 2001, of the 75 participants completing the second portion of the survey, 21 of the young women (28%) had been out of high school for over 4 years—enough time to complete an undergraduate degree. Eighteen of the 21 women (86%) earned their bachelor's degrees during this period.

Table 4
*Participants' desired medicine/health career type by discipline prior to acceptance into the women in natural sciences program*

| Medicine/Health Career Type | Total ($n = 87$) | % |
|---|---|---|
| Doctor (did not specify) | 37 | 42 |
| Pediatrics | 17 | 19 |
| Nursing | 12 | 14 |
| Surgeon | 6 | 7 |
| Obstetrics/Gynecology | 5 | 6 |
| Veterinary | 3 | 3 |
| Physical Therapy | 2 | 2 |
| Psychiatry | 2 | 2 |
| Anesthesiology | 2 | 2 |
| Dentistry | 1 | 1 |
| Optometry | 1 | 1 |
| Podiatry | 1 | 1 |

Table 5
*Participants' desired science, math, engineering, and technology (SMET) career type by discipline prior to acceptance into the women in natural sciences program*

| SMET Career Type | Total ($n = 52$) | % |
|---|---|---|
| General (did not specify) | 19 | 37 |
| Biology | 10 | 19 |
| Computers | 9 | 17 |
| Engineering | 6 | 11 |
| Math | 3 | 6 |
| Environmental/Ecology | 2 | 4 |
| Meteorology | 2 | 4 |
| Agriculture | 1 | 2 |

*Actual Career Trajectories.* Data were available for 100 participants, 75 from survey and 25 from program tracking records, providing a response rate of 66%. Table 7 presents the participants' actual career trajectories as of December 2001, based upon their current employment or major area of study in a postsecondary education program. Careers in medicine/health-related fields rank highest, with 25 students (25%) employed in or pursuing a career in this area. Careers in SMET fields rank second, with 20 students (20%) working or studying in these areas.

A closer inspection of the participants' choices in the medicine/health-related fields reveals premed/biology (36%) as the highest ranking career path among members of the group, followed by nursing (28%). Table 8 provides a breakdown of the actual types of medicine/health-related careers pursued by participants.

In the SMET category, a more detailed analysis shows an equal number of participants are pursuing biology (6) and computer (6) careers. One woman selected chemistry as her major. None of the women in this study are pursuing physics or math. The underrepresentation of these women in the physical sciences is similar to that reported by the National Science Foundation (2000). Table 9 presents all of the SMET areas participants are presently studying or working in. It also is worthwhile to note that 2 participants who selected careers in education are concentrating on science education.

Of the 13 participants who are pursuing graduate studies, 6 are pursuing an advanced degree in a SMET discipline. Two are pursuing a master's degree plus certification in secondary science education. The other graduate-level participants are studying in the fields of business, elementary education, law, psychology, and rehabilitative counseling.

### *Description of the Context of Participant's Educational and Career Trajectories*

The WINS selection criteria provided a starting point for contextualizing the educational and career trajectories of the participants. All of the women in this study were selected to be a part of

Table 6
*Participants' actual educational trajectories as of december 2001*

| Actual Educational Trajectory | Total ($n = 117$) | % |
|---|---|---|
| Enrolled in College | 109 | 93 |
| Working | 4 | 3 |
| Enrolled in Trade School | 2 | 2 |
| Military | 2 | 2 |

Table 7
*Participants' actual career trajectories as of december 2001*

| Actual Career Type | Total ($n = 100$) | % |
|---|---|---|
| Medicine/Health | 25 | 25 |
| SMET (science, math, engineering, & technology) | 21 | 21 |
| Business (accounting, marketing, etc.) | 14 | 14 |
| Education | 10 | 10 |
| Psychology | 9 | 9 |
| Media (radio, television, film) | 5 | 5 |
| Social Work | 3 | 3 |
| Cosmetology | 2 | 2 |
| Law | 2 | 2 |
| Architecture | 1 | 1 |
| Entertainment/Arts | 1 | 1 |
| History | 1 | 1 |
| Language, English, Speech | 1 | 1 |
| Liberal Arts | 1 | 1 |
| Military/Government/Law Enforcement | 1 | 1 |
| Real Estate | 1 | 1 |
| Restaurant/Culinary/Tourism/Hospitality | 1 | 1 |
| Sports/Recreation | 1 | 1 |
| Undecided | 1 | 1 |

*Note*. Categories are based upon survey responses.

the WINS program because of their high level of interest in and motivation to learn science. While attending high school, all participants in this study resided in low-income households in which at least one biological parent was absent. To be eligible for the WINS program, participants must have been eligible for the school district's free or reduced-rate lunch program. In addition, all women in this study attended inner city public high schools.

During adolescence, the majority of participants (85%) attended academic magnet high schools. Of the 78 participants completing the WINS survey, 54 (69%) took four or more science classes, and 55 (71%) took four or more math classes. Thirty-six surveyed participants (46%) took advanced placement or honors-level courses in science, math, or computers. Thirty-six surveyed participants (58%) also earned a combined SAT score of at least 1000. Sixty-two survey respondents (79%) indicated that they were involved in three or more out-of-school-time activities while in high school. Seventy-one participants (91%) joined at least one non-sport-related

Table 8
*Participants' actual medicine/health career type by discipline*

| Medicine/Health Career Type | Total ($n$=25) | % |
|---|---|---|
| Premedicine (biology major) | 9 | 36 |
| Nursing | 7 | 28 |
| Pharmacy | 2 | 8 |
| Physical Therapy | 2 | 8 |
| Biobehavioral Health | 1 | 4 |
| Health Information Management | 1 | 4 |
| Laboratory Technology | 1 | 4 |
| Nutrition/Public Health | 1 | 4 |
| Veterinary | 1 | 4 |

Table 9
*Participants' actual science, math, engineering, and technology (SMET) career type by discipline*

| SMET Career Type | Total ($n$=20) | % |
|---|---|---|
| Biology | 6 | 30 |
| Computers | 6 | 30 |
| Environmental/Ecology | 3 | 15 |
| Engineering | 2 | 10 |
| Agriculture | 1 | 5 |
| Biochemistry/Forensics | 1 | 5 |
| Chemistry | 1 | 5 |

extracurricular activity. Thirty-nine participants (50%) played at least one sport. Fifty-five (71%) participants took part in one or more community- or church-related activities.

All of the women in this study participated in the WINS program for a minimum of 1 year. Of the 78 survey respondents, 68 (87%) indicated that they had participated in 2 or more years of the program. During their initial year in the WINS program, 74 of the young women (95%) attended the 5-day field trip to the PEEC, and 65 participants (83%) camped overnight at Assateague Island. Twenty-eight surveyed participants (36%) indicated that a family member had accompanied them on at least one WINS field trip.

In the fall semester immediately following high school completion, 54 of the 75 participants completing the second portion of the survey (72%) were enrolled full time at a 4-year college or university, and 1 student was enrolled part time. Seven women (9%) attended a 2-year college or community college, 6 full time and 1 part time. One woman was enrolled full time in a cosmetology program at a trade school. Another woman enlisted in the U.S. Navy. Six women (8%) did not begin taking postsecondary education courses until the spring semester following high school graduation.

While in college, 10 participants (13%) transferred from one college or university to another. Of the 48 students who had completed at least 1 full year of full-time undergraduate studies by December 2001, 11 (23%) did not work during their first year of college. Of those completing 4 years of college, only 3 did not work during the school year. As of December 2001, 70 of the 78 surveyed participants (90%) were unmarried and had no children.

### *Research Question 2: What Differences Exist between the 1992 to 1997 WINS Participants' Desired (Preparticipation) Educational and Career Trajectories and their Present (Postparticipation) Educational and Career Trajectories?*

Research Question 2 identified differences between the participants' present educational and career trajectories and their desired educational and career trajectories recorded between 1992 and 1997 prior to their involvement in the WINS program. Originally, 67% of the careers listed by participants on their application forms were SMET-related (including medicine and health). Based upon program records and the survey, 45% of the participants actually pursued a career in a SMET-related field.

Of the 75 students who, in their early adolescence, originally desired a SMET career, 40 (53%) young women actually pursued a SMET-related field after high school. Of the 28 participants who originally desired a non-SMET-related career, 6 (21%) switched into a SMET-related field after high school.

Of the 40 participants who maintained their childhood SMET-related trajectory, 20 (50%) switched from one SMET area to another. In switching from one SMET field to another, 10 of these women relinquished their desire to become doctors for a less prestigious, more traditional health-related career such as a nurse or a lab technician. Two women reorganized their plans in the opposite direction, aspiring to become doctors rather than nurses.

Nineteen of the 32 women who switched from a SMET-related to a non-SMET-related field had originally listed "doctor" as their desired career choice. Instead of medicine, 5 of these women pursued careers in other helping fields such as psychology, social work, and education. Eleven of the 21 participants maintaining their desire to pursue a non-SMET-related area of study switched from their original choice to a different non-SMET-related field. Only 30 women (29%) remained true to their original career plans (10 in the non-SMET category and 20 in the SMET category).

In a comparison of the participants who actually pursued a SMET-related career with the participants who did not pursue a SMET-related career, the number of advanced placement and honors-level courses taken in high school was significantly related to pursuing a SMET-related career, $\chi^2$ (3, $n = 78$) = 10.69, $p < .05$. Years involved in the WINS program, number of out-of-school-time activities, high school type, number of science courses, number of math courses, and self-reported combined SAT score did not significantly relate to the career path selected.

### *Research Question 3: Which Program Elements do the 1992 to 1997 WINS Participants Perceive as Having Affected their Educational and Career Trajectories as Obtained from Surveys and Semistructured Interviews?*

Research Question 3 aims to describe the 1992 to 1997 WINS participants' perceptions of which program elements affected their educational and career trajectories. Question 28 of the WINS survey directly addresses the aforementioned research question. In this particular question, respondents were asked to "[p]lace an X next to as many aspects of the WINS program that you feel in any way influenced your educational or career decisions." The question lists 18 different program components participants could respond to. The results of this survey question and the semistructured interviews provide insight into the ways in which the participants perceive the WINS program as having affected their lives. Semistructured interviews with 12 participants were used to further explore participants' perceptions of each program component they identified as influential.

During the interview sessions, the researcher asked the interviewees to explain why they had selected specific aspects of the WINS program. Participants sometimes spoke of various program components together. For instance, they sometimes did not differentiate between the summer classes and the academic-year classes. Based on this occurrence, the results presented cluster similar program components; the original 18 program elements presented on the survey were reorganized into 11 categories.

*Summer and Academic-Year Classes.* Forty-three of the 78 survey respondents (55%) indicated WINS summer classes had an influence on their educational or career decisions. Forty-one survey respondents (53%) indicated that the WINS classes during the school year influenced their education or career decisions. Nine of the 12 participants interviewed indicated on their surveys that the WINS classes influenced their education or career decisions. Interviews revealed that the structure of the WINS classes—the hands-on nature of activities, the frequent opportunity for discussion and debate, the guest speakers, and the number of different scientific fields and topics covered—were important to these participants.

Interviewees mentioned that the format of the WINS classes aided their career explorations. Maureen, currently a premed student, stated, ''when we were in WINS we definitely got a taste of everything, which was very good as far as helping us figure out what we want to do with our lives.'' Holly remembered the classes as helping the girls with ''kind of figuring out which science you wanted to go to, if you wanted to do science.'' Just because a person likes learning about science does not mean the person should pursue a career in the sciences, as indicated by Maureen's comment:

> I know some people, when they were in WINS, they figured out they didn't want to do science at all, and certainly not for the rest of their lives, but at least they have the knowledge they didn't want to do that—sometimes that's more important to know.

*Science Information Learned in WINS.* Forty-six of the 78 respondents (59%) indicated that the science information learned in WINS influenced their educational or career decisions. Five interviewees spoke positively of the science information they learned in WINS. They indicated that the science information they acquired in the WINS program aided them with high school or college science courses. Seana felt she had an advantage in her schoolwork ''because when I took biology and everything I understood what was going on.'' Fatimah shared similar thoughts, exclaiming, ''It was good that I went to WINS because I actually learned it before I got to high school.''

*Field Trips.* Forty of the 78 respondents (51%) indicated that Saturday field trips during the school year had an influence on their educational or career decisions. Forty-six of the 78 participants (59%) indicated that the 5-day trip to the PEEC had an influence on their educational or career decisions. Thirty-nine of the 78 participants (50%) rated the overnight camping trip to Assateague Island as having had an influence on their educational and career decisions. All 12 interviewees indicated that these trips influenced their educational or career decisions. These women remembered the trips as fun, educational opportunities to escape the fast pace of life in the city. Maureen recalled her experience, noting, ''I hadn't really been out of the city, as far as going out to the middle of nowhere and just experiencing nature and the beauty of nature.''

*A WINS II Opportunity to Travel or Attend Another Program.* Over the years, WINS II participants have traveled to many parts of the world. Thirty-seven of the 78 survey respondents (47%) indicated a WINS II opportunity to travel influenced their educational or career decisions. Many WINS II students participated in other science enrichment programs, attended youth summits, hosted an American Association of University Women symposium for local girls, and shadowed teens from other science institutions. Twenty-eight of the 78 survey respondents (36%) indicated a WINS II opportunity to go to another program or school influenced their educational or career decisions. The interviewees discussed how travel provided focus and direction for participants. Holly discussed the effects of her trip to a paleontology dig in Montana:

> Well, I decided that if there was a way to do paleontology as a hobby, I would definitely do it . . . I mean, I have no problem with teaching at a University. That would be great because I think that would even be fun. You know being in the field is fun, and doing research and actually getting your hands dirty is fun, but it is not something I would want to do all year long.

*Careers and Scientists.* Thirty-seven of the 78 respondents (47%) indicated that career information learned while in the program influenced their education or career decisions. Thirty of the 78 respondents (38%) indicated meeting scientists at the museum influenced their educational or career decisions. Seven interviewees spoke of careers they learned about or scientists they met while in WINS, claiming that outside of the WINS program they did not have many opportunities to meet scientists. Bobbi summed this up by saying, ''Well, beside your science teacher, who do you know that you can actually meet that knows that much about science?''

*The Friends Made in WINS.* In the WINS program, students met girls from all parts of the city with whom they shared many commonalities, one of which being their enjoyment of learning science. Forty-three of the 78 survey respondents (55%) indicated that the friends they made in WINS influenced their educational or career decisions. For interviewees, it was important to have friends with whom they shared similar interests in science. Arlene stated, ''it was nice to find somebody that shared some of the same interests as me so I didn't feel like the outcast in school.'' She added, ''Since I had all these high interests in science, it's nice to find people that were just as determined as I was to make their goals and their dreams come true.'' Maureen articulated her perception of the importance of the friends she made in WINS by saying:

> They have similar interests, so when I start talking about something science related they don't look it me like I'm speaking another language. They understand. A lot of them came from similar socio-economic backgrounds that I did, similar parts of the city that I did where the crime rate tends to be up, violence tends to be a big factor there, single-parent homes. To be able to have people that understand you in that way and to connect with you in that way tends to be very helpful, tends to kind of provide a safety net for you to lean back on. To have somebody there encouraging you when you kind of get discouraged by what you see around you.

*College Information Acquired.* WINS staff encouraged participants to pursue postsecondary education by planning activities to assist in preparing students for selecting, visiting, applying to, financing, and succeeding in college. Thirty-eight of the 78 respondents (49%) indicated the college information they learned in WINS influenced their educational or career decisions. Three participants mentioned the lack of resources available at their high schools. They mentioned the heavy workload of the few counselors prevented any intense or personalized attention to their needs. Maureen noted about the counselors, ''They have so many other applications to go over that you don't really get a chance to sit down and talk with them intensely about your future.'' Holly also stated, ''at school, even though we got help from our counselors, it was still, I guess, a little bit easier to talk to somebody that was closer to or more familiar with, who kind of knew me a little bit better personally.''

*Job Skills and Paid Positions.* Teamwork, leadership, responsibility, cooperation, punctuality, and communication are skills stressed during the first year of the program. Forty-seven of the 78 survey respondents (60%) indicated the job skills they learned in WINS influenced their educational or career decisions. Each summer, 4 to 6 WINS II students worked alongside a research scientist in the laboratory and in the field. On the survey, 16 participants (21%) indicated that holding a WINS II position in a laboratory influenced their education or career decisions. Note that of the 62 participants who did not indicate that having a WINS II position in a laboratory had an influence on their education or career decisions, only 2 had held such a position in a research

laboratory. The WINS II program offered a greater number of employment opportunities in the museum division than in the laboratories. On the survey, 39 young women (50%) indicated that having a paid job in the museum influenced their educational or career decisions.

Nine interviewees discussed the job skills they acquired through their participation in the program. These young women most frequently spoke about the development of their communication skills. Being part of the WINS program instilled a positive work ethic in the participants, as evidenced by Bobbi's description of how working in the museum influenced her decisions. She stated:

> I think it made me more responsible and understand my mother's position, of her working, and just money, and you know it's just so many things that I could say, but definitely being responsible and knowing how to manage money kind of thing. So, I think that played a part in my career move and my education.

*Volunteering.* Although volunteering in the museum is not officially a part of the WINS program, program staff encouraged the participants to volunteer their time in other museum programs. Twenty-nine young women (35%) responding to the survey indicated that volunteering in the museum influenced their educational or career decisions. Four participants discussed their volunteering experiences during their interview sessions. They noted that volunteering assisted with the development of time-management skills, and reinforced their feelings of competence in their knowledge and skills. Salina's volunteer work in the museum's live animal center "kind of helped me out a lot, too, with knowing that I was definitely going to be in the science field." Brandi carried the value of volunteering into adulthood, saying, "it taught me at an early age that not everything is about getting paid for, and if you've been blessed with opportunities, it's nice to turn around and give someone else a hand that may not have that opportunity you had."

*Having the Museum as a Safe Place to Go.* Forty-one of the 78 survey respondents (53%) indicated that having the museum as a safe place to go influenced their education or career decisions. Ten interviewees described the museum as a fun place where you always could learn something new, hang out with friends, or just take time out to sit and think. Interviewees perceived the museum as providing an opportunity to escape their sometimes-dangerous neighborhoods or family or emotional problems. Maureen stated, "it was definitely really helpful in helping me to put myself in an ambitious mind set, to know that there's a lot more for me out there than just living in North Philly dodging bullets." Similarly, Arlene commented, "I don't have to worry about a drive-by. That's always good."

Four interviewees extended the importance of having the museum as a safe place to go into their adult lives. They spoke about the museum as being a place to which they could always return. They described the feeling of fitting in, even after having been away for extended periods of time. Two interviewees, now working in the field of education, expressed a desire to one day be able to coordinate an outreach program similar to the WINS program. Bobbi described her vision:

> I would like to start a program like this. You know, as time goes on, as you know, my education builds beyond my bachelor's degree, I would like to start a nonprofit organization for boys and girls, you know, from in cities and outside so they can come together and see that they're not so different just because we're in different areas or we're different colors or whatever.

*Having Staff to Talk to.* Fifty of the 78 survey respondents (64%) indicated that having staff available to talk to influenced their educational or career decisions. Eleven of the 12 interviewees described the WINS staff as approachable role models who took time out to answer their questions, offer advice, and help out with homework. They said they felt as though they were treated as individuals and as young adults rather than children. Fatimah described the staff as:

> . . . more like friends instead of just mentors or adults that are there telling you what to do. They were sitting there right beside you, and even if they already knew the things you were learning, they were still interested in it, and they were like learning new things as they went along, working with us. So it was like, they weren't really adults. They were just older kids.

Some participants described the staff as being like an extended family to them. Sereeta commented, ''if we were having a problem we all knew that we could go and talk to somebody about it. So, it made it a little bit, it was more of like a kind of a friendly, familylike atmosphere.'' Bobbi also described the program as being ''like a new family to me.'' The women often felt that they could easily relate to the staff, especially when it came to their interest in science. Salina exclaimed, ''I never really met anyone who was a science nerd like I wanted to be and it was really cool having someone that was knowledgeable.'' Several women also talked about the lasting effects of their relationships with staff members. They acknowledged that they are still able to rely on the staff for advice. Bobbi considered the relationships to be ''lifelong.''

## Discussion

### *Research Question 1a*

The findings indicate prior to their WINS experience, this group of young women held rather high educational and career aspirations leaning towards SMET-related careers. Although this finding comes as no surprise within this sample since having a high level of motivation is one of the many criteria for selection into the program, it does sharply contrast with the negative stereotype frequently associated with urban girls from poor, single-parent households. In Brunious' (1998) case study of poor, inner city Chicago youth, the troubled seventh- and eighth-graders' ''low expectations, unrealistic, and unassuming goals,'' and ''voices echo[ing] the defeat and poverty that pervade the ghetto'' (p. 103) do not accurately depict the aspirations of WINS participants. WINS participants set high, yet realistic goals similar to the African American and Hispanic women in Farmer et al.'s (1999) longitudinal study, which examined differences between men and women in SMET and non-SMET careers. Farmer et al. found that both men and women in their study who pursued science careers compared to those in nonscience careers had held higher aspirations for prestigious careers and high levels of education during high school.

The majority of the WINS participants desired high prestige, medicine/health- and SMET-related careers in which minorities and women are severely underrepresented. Compounded with the risk factors of low socioeconomic status and attending underfunded, inner city public schools, the chances for attaining a career in a SMET area could potentially have been limited for the population of this study. Although, Kao and Tienda (1998) suggested that prior to high school, girls from single-parent families tend to exhibit high career aspirations based upon the fact that female-headed households demonstrate the need for daughters to be financially independent.

Even though a high number of students desired SMET-related careers, their choices were not always specific. Many girls listed general careers such as ''scientist'' or ''doctor.'' This may hint that in early adolescence, girls are uncertain of their career plans. This assertion may be incorrect;

rather, girls may be lacking adequate career information (American Association of University Women, 1999). They often have not yet had substantial opportunities to explore their options (Madill et al., 2000) and know very little about what people employed in SMET-related fields regularly do at their jobs (Baker & Leary, 1995; Gottfredson, 1981; Hackett & Byars, 1996; Lewis & Collins, 2001). If girls knew more about SMET careers before high school, a crucial drop-off point for many, they may have a better chance of staying in the SMET pipeline.

It also is important to note that the top four career-choice categories, medicine and health, SMET, law, and education, can be identified as careers that enable the individual to help others. This finding is consistent with the work of Baker and Leary (1995) and Shmurak (1998), who found that girls in each of their studies selected science-related careers based upon a desire to help people, animals, plants, and the earth. When students value helping others, they are not likely to aspire to careers in physical science (Eccles, 1994).

### *Research Question 1b*

Not only did all 117 participants in this case study graduate from high school but 93% of the women also enrolled in some type of college program after high school. This is not what one would typically expect to find in a school district in which less than 50% of ninth-graders graduate in 4 years and in which more than 2,400 adolescents give birth to babies each year (School District of Philadelphia, 1998). The National Science Foundation (2000) reported that in 1998 among Black high school graduates, 57% had completed some college. WINS participants have clearly surpassed this statistic. These participants have grown into persistent women on a path leading them away from the poverty they have known for most of their lives, empowering them to break from a cycle that continues to trap far too many youth growing up in urban environments.

Almost half of the participants in this case study (45%) have extended their childhood interest and motivation in science into adulthood through their choice of occupation. This figure contrasts with the National Science Foundation's (2000) report that in 1998 about one third of Black students (both males and females combined) intended on majoring in science or engineering. Black women were even less likely to pursue a SMET major. Although the issue was not addressed directly by the participants in the survey or the interviews, the affects of the single-sex atmosphere may to some degree partially explain the above-average enrollment in SMET majors (Schoon, 2001).

### *Research Question 2*

In a 17-year longitudinal study of youth from the United Kingdom, Schoon (2001) determined that career aspirations developed by youth at age 16 were key factors in predicting a career in the natural sciences at age 33. Over half of the women (53%) who at age 13 to 14 originally planned to pursue a SMET-related career did so, but even within this category many women changed their plans to some extent, indicating that prior to the program, participants' plans were not fully materialized. Kao and Tienda (1998) argued that minority and low socioeconomic status contributes to less concrete career aspirations. At that age, girls' knowledge of different careers is frequently limited (American Association of University Women, 1999). This may partially explain why some of the participants relinquished their desire to become doctors for a less prestigious, more traditional health-related career such as a nurse or a lab technician. Participants also may have perceived high-prestige career paths blocked, as is frequently the case for women and minorities (Gottfredson, 1981; McWhirter, 1997; Perrone, Sedlacek, & Alexander, 2001; Rojewski & Hill, 1998; Schnorr & Ware, 2001). Some participants who altered their career paths

may perceive their more recent choices as more relevant to their lives and their long-term goals, having a more direct application or relevance, or as being more interesting (Lewis & Collins, 2001; Madill et al., 2000).

Career choice is extremely complex, and involves the interactions of multiple variables. In support of recent literature (American Association of University Women, 1999; Farmer et al., 1999), the only high school experience significantly related to a SMET career path in this study is the number of advanced placement or honors SMET classes taken. It has been well established that taking a greater number of math and science classes can positively influence standardized test scores, scholarships and awards, college acceptance, and access to SMET careers (American Association of University Women, 1999; Farmer et al., 1999; O'Sullivan et al., 1998; U.S. Department of Education, 2000). The results of the WINS study may imply that not only is the number of science and math classes important but also that the level and quality of courses is crucial. Perhaps participants' completion of advanced placement or honors status SMET courses is related to their feelings of competence in these subject areas, adding to a student's confidence in her ability to pursue a SMET-related career.

Although not found to be significant in this study, other variables may have influenced the educational and career trajectories of individual students such as belief in one's own science ability (Bandura et al., 2001; Eccles, 1994; Hackett & Byars, 1996; Paa & McWhirter, 2000; Schoon, 2001), an intrinsic interest in SMET (Perrone et al., 2001), valuing math and science (Eccles, 1994; Farmer et al., 1999), positive peer influences (Dubow et al., 2001), and access to role models (Baker & Leary, 1995; Paa & McWhirter, 2000).

*Research Question 3*

Five to 10 years after their involvement in the WINS program, the majority of participants perceived the science content they learned in WINS as having an influence on their education and career decisions. Research has proven that informal science education programs for girls (and boys) can affect students' attitudes toward science, their achievement in science (Lee-Pearce, Plowman, & Touchstone, 1998), and their perceptions of scientists, but the literature has not yet indicated these programs directly affect students' education and career decision making. In this case study, less than half of the participants surveyed indicated that the scientists they met in WINS and the career information they learned influenced their educational and career decisions. Several different scientists usually came to speak with the WINS classes or invited the classes to visit their labs. The majority of scientists working at the museum during the period covered by the study were White males. Few WINS participants actually had the opportunity to work closely on a regular basis and develop mentoring relationships with these scientists. These factors may help explain why participants' did not perceive meeting scientists as influencing their career decisions.

The WINS program provided participants with an assortment of positive experiences. According to the participants, WINS offered mentoring relationships with adult staff, a safe and stable place to call their own, job skills, and socialization experiences with like-minded peers. Social opportunities to participate in science similar to those afforded by informal science education programs may lead to feelings of greater competency in SMET as evidenced by Brickhouse and Potter's (2001) in-depth examination of two young urban girls' science-identity formation. The WINS participants' perceptions parallel the perceptions of former participants in the Exploratorium's Explainer program, which shares several similar program elements. A longitudinal study of the Exploratorium's program revealed its former participants perceive it to have been a "major influence on the development of their curiosity, interest, and confidence in learning science," (Diamond, St. John, Cleary, & Librero, 1987, p. 648). Programs serving

students for only short periods of time are most likely unable to offer the three aforementioned program aspects, pointing to the need for a greater number of programs that serve students for extended periods of time.

Considering participants' low-income and single-parent family status, their perception of the WINS program as providing a secure, stable environment is worth further attention. Several years after the program, the museum remains a safe and comfortable place for these young women. This finding reinforces the need for more out-of-school-time programming for high school aged teens, especially when those who live in low-income, single-parent families are likely to live in blighted and dangerous neighborhoods (U.S. Bureau of the Census, 1997). The interaction of program staff, a safe environment, and job skills also may have served to enhance participants' resilience (Frieman, 2001; Furstenberg, Cook, Eccles, Elder, & Sameroff, 1999; Hebert & Reis, 1999; Newman, Myers, Newman, Lohman, & Smith, 2000; Wong, 1997), identity development (Shoffner & Newsome, 2001), and sense of self-efficacy (Hackett & Byars, 1996), which is associated with pursuing a SMET-related career (Eccles, 1994; Paa & McWhirter, 2000; Schoon, 2001).

The exploratory nature of this case study and the participants' positive perceptions of the aforementioned program elements raise the question of what type of role middle/upper class informal science institutions such as museums, zoos, and aquariums can serve in narrowing the gap for women and minorities in SMET-related fields. Immersion and inclusion in a traditionally upper class institution may offer program participants an opportunity to become adept at crossing borders, allowing students to become experienced in utilizing the dominant language and culture (Chinn, 1999). Unfortunately, this aspect was not directly addressed in the study, but interviewees' indications of the museum being a comfortable place in adulthood may suggest that over time participants of programs at such institutions may develop a sense of ownership and a potential to improve the diversity of science museums.

## Implications for Practice

In the area of career education, especially within the SMET-related fields, it appears that students need to be exposed to the variety of different potential careers long before they reach high school. Students need opportunities to explore their options and learn more about the training requirements and the day-to-day responsibilities associated with SMET-related careers. For instance, students need to discover the rigorous requirements for a career as a doctor early on in their education so that they make take the necessary course work in high school.

In addition, careers in the physical sciences continue to be dominated by men more so than careers in life sciences. Based upon WINS participants' interests in careers in which they are able to help people, perhaps women do not perceive physical science careers as having that characteristic. Career educators and science teachers can present these fields to girls in a new light, allowing them to see the dual possibility of both studying physical science *and* helping others.

## Conclusion

In summary, the participants in this case study initially held high educational and career aspirations. Although interested in science, few girls aspired to the extremely male-dominated fields of physical science and engineering (National Science Foundation, 2000). In early adolescence, the majority of participants displayed a high-level interest in SMET-related fields valuing human interaction and opportunities to help others. In adulthood, over half of the participants in this study maintained their aspirations for SMET-related careers. Their interest in

occupations stressing human interaction and opportunities to offer assistance to others persisted as well, evident in both their choice of SMET-related and non-SMET-related career paths such as psychology and education.

Although enrolling in advanced placement or honors-level SMET high schools courses emerged as a predictor of actually pursuing a SMET-related career for women in this study, the majority of participants perceived several aspects of the WINS program as impacting their educational and career decisions. Having program staff to talk to, having the museum as a safe place to go, learning job skills, learning science content, attending WINS classes and field trips, and making friends with like-minded peers from the same background played a positive role in participants' educational and career development.

Although not every participant's trajectory has led to career in science, these women, each in her own individual way, have achieved success and overcome barriers associated with the risk factors of gender, race, and low socioeconomic status.

Informal science education programs can play an immense role in the lives of young women and low-income students. When the duration of intervention is long enough so that participants form relationships with staff, feel they are in a safe, stable environment, and acquire skills for adulthood, participants benefit by gaining the confidence and support needed to succeed in science careers. Informal science-education programs of at least 1 year in duration should be given precedent by funders and the educational organizations conducting the programs. In addition, efforts to provide youth with a safe and supportive environment are crucial. This does not mean merely providing youth with a physical space. Youth need to be treated with respect and made to feel they belong. Studies comparing SMET-based and non-SMET-based out-of-school-time programs are much needed to narrow in on the most effective program elements.

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