Mostly working with giraffes:

The importance of peers and role models for adolescent girls.

Juli Simon Thomas

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Advisor: Dr. Chris Weiss

Abstract

This paper explores the importance of role models and peer support and the relationship of these to the gender gap that continues to exist in the pursuing of Science, Technology, Engineering, and Mathematics (STEM) fields. In looking at survey data from two Expanding Your Horizons Network (EYHN) conferences, in San Jose, CA and Murfreesboro, TN, I find that peers play a lesser role than expected, whereas parents and teachers figure more prominently. Given positive feedback and a relatively large percentage of respondents in STEM-related college majors years later, I conclude that the EYHN format is useful in informing and motivating interested adolescent girls to continue in math and science disciplines. Applications of these findings and ideas for future research are discussed.

Introduction

In 1975, Gary Becker asserted that, rationally speaking, parents should invest more in their sons' schooling than their daughters', since the return to education was quite a bit higher for men. Though the gender gap in wages persists still, despite gradual improvement (Goldin, 1990), beliefs have also shifted, and the number of women studying for Bachelor's degrees has actually overtaken the number of men doing so (Jacobs, 1996). In fact, this number is projected to grow so that 60 percent of enrolled undergraduate students will be women by 2016 (National Center for Education Statistics, 2007). There is no longer a pressing need for women to seek employment that will lead to early high rewards, as Polachek hypothesized in 1978, since many women remain in the workforce throughout their life course. However, it still remains true that female students "are more likely to graduate from education, arts, humanities, social sciences, and law" while male students "are more likely to graduate from natural sciences, mathematics, and engineering" (Bradley, 2000, p. 1).

Some universities are taking measures to encourage women to choose Science, Technology, Engineering, or Mathematics (STEM) majors, such as the University of Twente in the Netherlands; there, administrators are starting a special program in which women can make up missing prerequisite courses the summer before the school year begins (VK.tv, 2007). However, this is a stopgap measure to prevent their current situation: they have one woman studying Mechanical Engineering, out of one-hundred total students in this college major. It would be preferable to make sure that women come to college prepared in the first place, which means tackling the issue of STEM course enrollment by women in high school or even middle school, in some cases. Iowa State University also believes that women are missing out on the gathering of some pieces of knowledge, though they focus exclusively on the lack of hands-on

work, often laboratory experience; to remedy this, they offer a summer internship in which female undergraduates can do such work in their labs[1].

Another asset of Iowa State's internship program is the fact that the students also can spend time with women who work in the field as professors or researchers, who can potentially serve as role models for future study or career goals. The importance of role models is often touted by non-profit mentoring organizations such as *Big Brothers Big Sisters*[2]; research certainly backs this claim (Brooks-Gunn, Duncan, Klebanov, & Sealand, 1993; Dryler, 1998; Fiedler-Brand, Lange, & Winebrenner, 1992; Riegle-Crumb, Farkas, & Muller, 2006). Peer support is also thought to be vital to adolescent development, especially for girls (Cohen, 1983; Hanushek, Kain, Markman, & Rivkin, 2003; Lee & Bryk, 1988; Stake & Mares, 2001). The trouble is, then, if there is only one woman in a class of one-hundred students, who is her role model and who serves as peer support? Recent data from the National Center of Education Statistics (2007) shows that 44.7% of Mathematics and Statistics undergraduates are women, but this number is 22.2% for Computer and Information Systems and only 18.3 percent for Engineering and Engineering Technology (p. 60).

As the international non-profit organization Expanding Your Horizons Network, or EYHN, sees it, the way to connect high school girls and women in STEM fields is to bring them all together at conferences. EYHN has combined the idea of role models and peer support into one conference model. By providing a blueprint and support for conferences which are currently held across world, EYHN hopes to educate high school girls about the possibilities within STEM fields. These conferences allow girls a glimpse at women who work in such careers and at content that may be involved in their jobs. To elucidate the importance of support by similar

1 See http://www.pwse.iastate.edu/about/mission.html for more information.
2 See http://www.bbbs.org for more information.

others, this paper explores survey data from two such conferences, one in San Jose, CA, and one in Murfreesboro, TN (a town about 20 miles outside of Nashville, TN).

The survey data gives a glimpse into the importance of connecting middle and high school girls with women in various careers, including those in STEM-related areas. As the pre-conference surveys from Murfreesboro, TN show, career plans for the attendees include "dolphin trainer", "CSI", and "mostly working with giraffes". Yet many of these same girls are not planning to take math or science courses in high school. Whether they are in fourth or ninth grade, the very least guidance to which these girls should have access is information about which science courses they must take in order to fulfill their current career dreams, even if these entail African mammals.

The importance of peer support

In a 2003 study, Hanushek, Kain, Markman, and Rivkin found that students' academic achievement is positively affected by their peers' achievement; in fact, they found that just a 0.1 standard deviation increase in peer math achievement (as measured by various tests) is linked to a 0.02 increase in math score for that student (p. 542). Talton and Simpson (1985) report similar results, which become particularly pronounced past the sixth grade: "As peer attitude toward science increases, so does individual student attitude toward science." (p. 21) In fourth grade, parents maintain their position as the highest social authority for their children, but by the time these children are in tenth grade, their peers have taken over this influential role (Stake & Nickens, 2005). Indeed, researchers involved in the study of deviance in adolescents are well-aware of the threat that deviant peers pose (Aseltine, 1995). This raises the idea of curriculum tracking: placing students in classes by ability or achievement level, or specifically not doing so,

becomes an interesting subject when viewed through the lens of influential peer support. If students are in the same classes, they are more likely to meet than if they did not share classes. Added to the general high school social spectrum is homophilous nature of social networks, a well-accepted phenomenon that quantifies the tendency of the proverbial birds of a feather to flock together. For all students, social life in high school becomes a whole world of issues and challenges; the final part of this section will focus on the particular difficulties that girls face during this transitional time.

Curriculum tracking: general information and contentions

Curriculum tracking, or ability grouping, is a controversial practice; though many studies exist and various opinions are held, it is still unclear what the best possible approach is to educate an entire school system full of children. Slavin defines ability grouping as "some means of grouping students for instruction by ability or achievement so as to reduce their heterogeneity" (1987, p. 294); he underscores that the way in which this is accomplished can vary quite a bit, with options ranging from having completely different classes, to grouping within one classroom, to students within a class being taken out for lessons outside of their "home base" class. As Hanushek and Wößmann (2005) explain, this allows teachers to focus and pace the curriculum in the most appropriate way for as many members of the classroom as possible. The fundamental issue with the division of students into classrooms aimed at different levels of ability seems to be mostly that if there is a higher level course, there must be a lower level counterpart. Though students assigned to the former usually appear to flourish, the latter often causes problems of varying degrees of severity (Hoffer, 1992). Ability grouping creates an obvious hierarchy; as this structure persists, students are increasingly likely to believe that they

belong on certain rung of the ability ladder. They have become an entrenched group with their peers. Since this implies that students phase out the idea of this ladder being scalable, upward mobility becomes hidden to them (Hoffer, 1992; Oakes, 1985). Hence, the groups stagnate as they were established. Lee and Bryk indicate in a 1988 study that students assigned to college preparatory classes do indeed end up more likely to attend college versus their counterparts who were not assigned to preparatory course work; whether this result is due to an initial propensity for college attendance or is related to the instruction in a classroom that is deemed to be college-bound, remains unanswered.

Even if one looks past the issue of social cohesion within groups in the classroom, the issue becomes how students are assigned to groups in the first place, and this is where a large part of the controversy within tracking happens to lie. Returning to Slavin's definition, students are grouped by "ability or achievement". The questions that spawn from that conception of grouping are how these two items are measured, and consequently how one divides up a grade level of students to accommodate all of these measured levels. If the placement in college preparatory courses is as powerful an indicator of college attendance as Lee and Bryk would have us believe, whomever assigns students to their classes is powerful indeed. Many school systems use prior achievement as an indicator of courses to which students should subsequently be assigned (Kubitschek & Hallinan, 1998); this becomes problematic if one assumes that inequality in early achievement is linked to family background, since then track placement becomes nothing more than a reflection of family background (Hanushek & Wöβmann, 2005). Disadvantaged students are much less likely to be in academic courses than their advantaged counterparts (Lee & Bryk, 1988; Oakes, 1985). Once placed, students develop social ties with others in their classes, as mentioned previously, and thus they become increasingly entrenched in

whichever level of coursework they were initially assigned. Talton and Simpson (1986) found that the classroom environment was the best predictor for how girls felt about science; this environment included the classroom climate, the curriculum, and also their friends taking the same class.

Curriculum tracking: special cases

For two particular types of students, the ability group division is arguably easier: gifted children and children with physical, mental, or educational special needs. In the US, many states actually allow both of these two groups to fall under the heading of special education.[3] Gifted children are usually given an IQ test such as the Stanford-Binet or Woodcock-Johnson assessments as identification. Despite the fact that even these tests elicit controversy, combining a child's scores with observed behaviors does pave a slightly more acceptable path in general than the more minute divisions such as "on-level" versus "honors" coursework. Upon identification, there are varying theories on where gifted students should be placed. Some maintain that having gifted students in a classroom with non-gifted students is of great benefit to the other students and also bolsters the gifted child's social abilities (Schack, 1993); others emphasize that gifted students need an accelerated pace to remain engaged in the material and avoid boredom, which can lead to a rejection of education as a whole (Fiedler-Brand, Lange, & Winebrenner, 1992). Students with disabilities are often taken out of the regular classroom for at least part of their instructional day, but sometimes they are reintegrated into a regular classroom; Fuchs, Fuchs, and Fernstrom (1992) highlight the necessity of doing so on an informed, case-by-case basis. Ultimately, it seems that this would be the best manner of dealing with every single student in the school system in order to ensure that they attend the best possible combination of

3 For example, see http://www.louisianaschools.net/lde/eia/486.html for more information.

educational experiences for them personally. The question remains, however, of exactly what this best educational experience entails in practice.

Curriculum tracking and friendship

Since the assignment of students to tracked classes can lead to friendships within those classes (Field, n.d.; Riegle-Crumb, Farkas, & Muller, 2006), schools which do engage in the practice of curriculum grouping of some sort are likely to have students with friends whose general characteristics are quite similar. As Kubitschek and Hallinan state: "In general, any school policy or practice that affects students' social organization is likely to influence their social relationships, whether students participate voluntarily or involuntarily." (1998, p. 14) Regardless of class placement, social network theory argues that there is a tendency towards homophily in social networks anyway, so this adds another dimension of sameness in high school friendships. Homophily is "the principle that a contact between similar people occurs at a higher rate than among dissimilar people" (McPherson, Smith-Lovin, & Cook, 2001, p. 416). This occurs yet more in larger groups (Hallinan & Sørensen, 1985); as these smaller tangents of a larger group become steadily closer friends, that group becomes increasingly coveted by others and thus closer again themselves. Since people are more likely to connect with those who are geographically (physically) close to themselves, being in the same classes exacerbates the homophily that already exists as a natural tendency (McPherson, Smith-Lovin, & Cook, 2001). However, even when controlling for the initial homophily that was bound to exist between peers, Cohen (1983) found that students' aspirations of college attendance were still significantly influenced by their peers.

Adolescent girls and peer support

The world of high school girls provides a particularly interesting case of peer influences. The social lives of girls have recently become a subject of much discussion, with movies such as *Mean Girls* and *Cruel Intentions* feeding into the concepts initially popularized by *Heathers*. Wiseman's book *Queen Bees and Wannabes* (2002) and Simmons' *Odd Girl Out* (2002) provided a window into the carefully hidden social mazes which girls are often forced to navigate as they progress through adolescence. Social lives are important to all teenagers, but to girls, they become crucial and defining; Stake and Mares (2001) found that when they were given the opportunity to attend a science enrichment program, girls were much more likely to make social ties to other girls in the program than boys were to connect with other boys or girls. Mastekaasa and Smeby (2006) also find that girls are more likely to be influenced by their peers than boys are. Thus, I view the previously discussed effects of sharing the same classes and homophily in social networks as being intensified for high school girls versus these effects for high school boys. As discussed in more detail in the sections *Women in Higher Education* and *Gender Segregation in Science, Technology, Engineering, and Mathematics (STEM) Fields*, this magnification of effects can be detrimental to girls in STEM fields if few other girls attend such courses and if the boys in those courses have completely different interests than the girls. In the science enrichment program mentioned previously, Stake and Mares found that girls were less likely than boys to continue into the next level of the program, which required more commitment, time, and required a project to be completed at the end; the girls put more effort into making social connections with the other girls in the program. This should not be viewed as a negative result, but rather, as an indicator of what girls see as having significance versus what boys find important. This can be used to shape how future programs are structured in order to

better accommodate varying priorities of participants.

The importance of role models

The concept of role models overlaps with that of peers, though a role model can be any other person who inspires the subject while a peer is someone of similar age or at least similar current standing in the life course (e.g. also a student). Role models in a high school student's life can be parents, other kin, teachers, others in the same neighborhood, or peers. Just as with ability grouping in classrooms, some students' choices of role models are beneficial while others are not. And just as many other life course factors, socio-economic status (SES) often enters the discourse on role model choices and opportunities. Role models can influence children's choices for future education, careers, general behavior, and can support or condemn gender-biased opinions, which becomes especially important for adolescent girls. As Riegle-Crumb, Farkas, and Muller (2006) assert: “From teachers to professors to mothers or other relatives who are employed in science, technology, engineering, and math (STEM) fields, these women offer a tangible representation of what is possible for adolescent girls in their own lives.” (p. 208-9)

Though Stake and Mares (2001) found no effects on female students from solely their parents' levels of education, they did find a significant effect of parental support: family encouragement highly influenced the impact that the enrichment program had on the girls. Looking at parental influence from a slightly different angle, Dryler (1998) found that children were more likely to choose gender-atypical educational programs if their parents were highly educated. She did not find that girls imitate their mothers and boys their fathers; rather, she found that gender-stereotyping can come as an influence from either parent. The discourse surrounding parental influence within socio-economic classes varies quite a bit: Correll claims

that SES does not need to be taken into consideration in her study of self-assessments as men and women are equally distributed across socio-economic classes. Since this contradicts Dryler's results, I conclude that the role that SES plays remains ambiguous and can be altered by many other environmental factors (such as parental attitudes, school-related factors, and resources within geographical reach of the student, e.g. libraries, state-sponsored after-school programs).

Brooks-Gunn, Duncan, Klebanov, and Sealand (1993) went beyond the parents and looked at neighborhood effects. The number of affluent neighbors with high occupational status, and perhaps also how many of these neighbors were part of two-parent families, did prove to be "key dimensions of neighborhood economic and social structure most likely to affect children and adolescent behavior over and above family resources" (p. 377). Their results also indicate having affluent people living next to low-income neighbors will result in the former having worse outcomes rather than the proximity aiding the latter in improving their outcomes (p. 384).

Teachers can serve as such proximate role models as well. Carrington and Skelton (2003) discuss recent policies in England and Wales to encourage minorities and men to apply for teaching positions. The U.K. administration is hoping that providing such role models will counter the issue of male and black under-achievement that these countries are facing. Thus, they are basing their policy on the idea that students will better relate to someone from a similar race/ethnic background and the same gender; the authors present arguments to the contrary, underscoring that students do not per sé choose to select teachers as their role models (p.255).

Of course, other students can provide role models for a student as well. Thus, the role as peer can be extended to being a model as well. This was touched upon in the prior discussion of gifted students: some feel that gifted students provide excellent classroom role models for the non-gifted students in the room (Schack, 1993), though it is debatable if this is fair to the gifted

student and, more importantly, if it affects their educational wellbeing or not (Fiedler-Brand, Lange, & Winebrenner, 1992). With regard to girls specifically, Riegle-Crumb, Farkas, and Muller did find that high-performing girls bolster each other, especially in male-dominated fields. Thus, they essentially become each other's role models. This is discussed in more detail in the section titled *Gender Segregation in Science, Technology, Engineering, and Mathematics (STEM) Fields*.

Women in higher education

As women gained access to higher education – in some cases, improved access, and in some cases, access at all – both their participation in and their completion of it began to increase quickly. The number of women graduating with a Bachelor's degree officially surpassed the number of men gaining the same level of education by 1982 (Jacobs, 1996); this trend is also seen in other countries, such as the Netherlands ("Steeds meer," 2007). To explain this trend, several authors have argued the role of girls' behavior in school before college, as it tends to be better than boys' behavior (Jacob, 2002); thus, girls are more likely to want to continue pursuing educational goals. Others have stated the possibility of women wanting access to more educated husbands (Mickelson, 1989); Goldin (1995, as referenced by Jacobs, 1996) is careful to only emphasize the idea of "the Mrs. degree" as a planned outcome for women attending colleges in the 1950s. Another explanation is that women are more motivated, since their returns to higher education are often beyond men's returns. (DiPrete & Buchmann, 2006) However, women still face unequal returns to education, despite the increases in these returns. This means that women know that they must surpass men in order to ultimately reach the same level as men do in the work force, which could partially explain the fact that women overtook men in terms of college

completion rates. At the same time, men are losing faith in the pay-offs of education; additionally, fewer of them have fatherly role models, a fact which has been linked to a lower participation rate in higher education. With highly motivated women who are aware they must surpass men in rank and perhaps education in order to equal them in salary and with the lowering rate of men completing a higher degree, this leads to the situation that can be now seen in many countries: female rates of college completion are higher than men's rates.

Using data from the National Educational Longitudinal Study of 1988, Jacob examines eighth-graders' behavior and finds that girls generally score higher in relevant categories as compared to boys. Specifically, boys tend to display "the inability to pay attention in class, to work with others, to organize and keep track of homework or class materials and to seek help from others." (p. 590) Boys get lower grades, are more often in remedial classes, and work less on homework assignments. Girls' success with such non-cognitive traits, he argues, lead to a comfort level in educational settings that persists when deciding to go to college and in eventual college completion.

This seems to explain why women do not shy away from higher education; it can even address why they are flocking to it at higher rates, since it is a place where, on the whole, they succeed. However, these are difficult measures to disentangle from the elusive measure of motivation. One could argue the converse: that women are more motivated to succeed at school for other reasons and understand that good behavior, completing homework assignments, and aiming for high grades is simply a part of attaining their educational goals.

Though motivation itself remains fairly ambiguous, there are studies that touch on ideas that relate to such a measure. DiPrete and Buchmann point out that women see higher returns to education than men do – this realization could certainly play into a motivation factor for women.

Jacob quantifies this trend at 55% higher wages for women versus 40% for men when examining the difference between having just a high school diploma and earning a college degree. He also mentions that more men than women do not see the use of a college degree. Presumably, women are well aware of the barriers they face; they want to be as prepared as they can be to tackle them. Mickelson takes a more depressing stance: she believes that women see education as a way to attain status and are blinded by this outcome, to the the point of longer realizing that their ultimate wage level will still be lower than that for men.

This ubiquitous blindness seems far-fetched. The majority of women must be aware that, per dollar earned by men, they earn quite a bit less for the same job. Yet women have access to many careers, at least in most westernized countries. If they know that they will earn less for the same job, the only solution to finding equal wages, beyond continuing a political fight for such equality, is to surpass men in education and later in the workplace. For the same job, men and women may not earn the same salary, but a woman ranked higher than a man in the same industry will most likely out-earn him.

While women are caught in this psychological cycle, education looks increasingly less useful and interesting to men, as mentioned previously from Jacob's findings. As the family structure alters, fewer men have fathers in the home as role models; absentee fathers have been linked to lower college completion rates for their sons. (Buchmann & DiPrete, 2006) Thus, women continue to charge onward, hoping to reach eventual parity with men.

Gender segregation in Science, Technology, Engineering, and Mathematics (STEM) fields

In a volume edited by England, Ridgeway (1993) asserted that "gender, once activated, shapes performance expectations that in turn drive verbal and nonverbal interaction" (p. 184).

Combined with the idea that by the time they reach preschool ages, children have learned how to act within the cultural scope of their genders (Farenga & Joyce, 1999), it becomes crucial what this scope defines for a world full of preschool-age children. To explore the conceptions which play into the plans adolescent girls see for their futures, one must examine traditions and social constructions as the backbone of their cultural experiences, their own resulting perceptions of ability and appropriateness of STEM coursework, Kanter's idea of tokenism and its consequences, and the environment which girls must traverse to succeed in STEM subjects.

Tradition holds that there are fields of work which are gendered as male and others as female. Thus, people can choose careers in a gender-traditional or in a gender non-traditional manner and are often steered towards fields (by guidance counselors, parents, teachers, or others) that are deemed gender-appropriate, as discussed in *The Importance of Peer Support* and *The Importance of Role Models*. Sax and Harper (2007) note that "the source of gender differences extends back into the pre-college years, where women and men develop different values, confidences, aspirations, and patterns of behavior." (p. 22) According to the authors, these differences not only persist through college but usually increase as well. Farenga and Joyce (1999) find that, by the time they are nine years old, children believe that science is more appropriate for boys than girls. Cultural norms alienate women from studying STEM subjects while widespread beliefs that men are better at these subjects marginalizes women, state Mastekaasa and Smeby (2006; also see Correl, 2001 and Wagner & Berger, 1997); after their study of educational choices, they determined that one should not ask why women drop out of male-dominated fields but rather why they choose female-dominated fields instead. Women drop out of female-dominated fields to a much lesser extent (Mastekaasa & Smeby, 2005). Polachek (1978) also cautions against neglecting the gender bias within personal choices of

college majors, as opposed to simply relying on explanations of discriminatory hiring practices to explain the occupational gender gap. As discussed in the section *The Importance of Role Models*, girls are more likely to choose gender non-traditionally if their parents are highly educated (Dryler, 1998), so this could provide one explanation for girls' choices. Indeed, Halaby (2003) agrees that parents are the top influence in choosing a career. However, a crucial motivating factor in choosing a course of study is whether or not one enjoys that field; enjoyment is, in turn, directly related to whether one finds that subject to be gender-appropriate (Jacobs, Finken, Griffin, & Wright, 1998).

Males are more likely to believe that they are competent in math (Correll, 2001) and attribute their successes in the field to their ability much more than women do (Hyde, Fennema, Ryan, Frost, & Hopp, 1990), despite the fact that male and female test scores in math are often largely the same (Jacob, 2002). In fact, it has been seen that girls' performance exceeds that of boys in all subjects, for a variety of reasons discussed further in the section *Women in Higher Education*. Holding these beliefs rather than understanding the reality of the situation has been shown to undermine the confidence girls have in their own performance in STEM subjects (Science Daily, 2007). Hyde et al. (1990) found few differences in affect for math between boys and girls, but when differences did exist, it was always that the girls felt more negatively towards the subject. A recent study shows that the sheer idea of math makes girls perform at a lower level than they might without thinking of math, as compared to male test-takers, in evaluations that are themselves not math-related at all (Science Daily, 2007). Thus, according to those results, the way in which the sections of the SAT are ordered can influence a female test-taker's performance through her own feelings of inadequacy in math.

For the girls who do choose to pursue education in a STEM field, Kanter (1977) suggests

they can be victims of the effects of tokenism. As the token woman in the room, she says, you stand out, which means that people are more likely to remember what you do and how you perform (also see Mastekaasa & Smeby, 2006). Additionally, since this means you are different than others in the same environment, the homophily of their social networks is challenged (Smith-Lovin & McPherson, 1993), which can make it harder to build a social support network.

Ridgeway (in England, 1993) goes as far as to say that "a woman must perform better in a mixed-sex environment to be perceived as having equal ability to him." (p. 185) Whether or not learning environments are appropriately structured for both men and women to succeed is an ongoing concern. In the U.K., a constant focus on establishing an aura of independence for the learner can be counterproductive specifically for women; dependence on any aid in their studies is seen as a weakness, whereas it may simply be a learning strategy that many women tend to employ (Leathwood, 2006). However, Jacobs (1996) finds that women have adequate access to education and decent college experiences, yet there remains a large gender gap in final career outcomes.

As previously discussed in the section *The Importance of Peer Support*, peers play a large role in the lives of all adolescents, especially adolescent girls. Girls benefit hugely from each other's support in STEM classes (Riegle-Crumb, Farkas, & Muller, 2006), but the transitory and influential nature of their friendships can also jeopardize their choices (Smith-Lovin & McPherson, 1993). With social ties being so essential to high school girls, if there are few girls in STEM courses, these few may leave for lack of support. Girls perceive less support for being in science courses, Stake and Nickens (2005) find, and furthermore, boys express reservations about girls being in those courses. This is an issue, the authors find, because it is exactly that peer support which allows students to imagine themselves as future scientists, thus making it a

crucial element of girls' choices.

The Expanding Your Horizons Network

The Expanding Your Horizons Network, or EYHN, is an international nonprofit organization based on the campus of Mills College, an all-women's college in Oakland, CA[4]. The goal of EYHN is to run conferences for female high school students in order to inform them of opportunities within science- and mathematics-related fields. The Oakland-based headquarters licenses the conferences; various places around the world that are part of EYHN (usually colleges and universities) ultimately organize and run these conferences. There are currently 90 different places which house conferences; more than 725,000 girls have participated in one or more conferences (S. Roberts-Ohr, personal communication, May 22, 2007).

By providing these girls with access to female professionals as well as information about the interesting projects in such fields, EYHN hopes to encourage more girls to choose science, technology, engineering, and math (STEM) studies[5]. Given that high school is a time to become academically ready to handle college studies, the goal is then to ensure that girls are adequately preparing themselves with the correct courses in order to study what they want to once they reach college. The EYHN web site provides an overview (including interactive content, such as video footage and recorded speech) of several women and their chosen careers, so girls can get started becoming acquainted with some career options.[6]

It is important to note that participation in the conferences is voluntary. Teachers at middle and high schools or leaders of after-school organizations or activities (such as *Girl Scouts*

4 See www.expandingyourhorizons.org for more information.
5 See http://www.expandingyourhorizons.org/AboutUs/Mission.html for a description of the Mission and Goals for the EYH Network.
6 See http://www.expandingyourhorizons.org/Pathways/mentors.html for this section of the web site.

of America) in the area of a conference encourage girls to attend; usually conferences are held at a college or university close to where most of the attendees reside. According to EYHN's latest Annual Report (2006), 87% of conference participants are in sixth, seventh, or eighth grade.

Research questions

In this paper, I am interested in further elucidating the level of influence that others, specifically female others, have on female high school students. I believe that past research does not fully underscore the immense influence that the social environment has on high school girls. As mentioned previously in the section *Gender Segregation in Science, Technology, Engineering, and Mathematics (STEM) Fields*, since social ties are often crucial to girls' high school experiences, if there are fewer girls in STEM courses, it may influence those few to leave the classes. Additionally, as friendships are broken, girls may leave certain classes in order to be in the classes their friends chose instead. It is essential to examine girls' choices of coursework at the high school level, since their choices during that time can preclude them from certain college majors (Sax & Harper, 2007; VK.tv, 2007); for example, a student who did not enroll in Trigonometry and Calculus in high school can probably not choose to study Engineering at the college level unless those courses completed elsewhere prior to enrollment. Even if they do take the correct courses, as mentioned in the *Introduction*, the majority of women do not choose to earn a Bachelor's degree in most STEM fields, and those who do earn such a degree often do not ultimately enter the workforce in those fields.

I am interested in seeing the effects that the EYHN conferences had on high school girls, since these conferences allow them a chance to be with other girls in their situation as well as giving them access to women in gender non-traditional careers. Offering peer support and role

models should be quite beneficial to girls who are at a crucial time in their educational development. The survey data allows me to look at several aspects of the conference effects.

This leads me to the following hypotheses:

- H1a: *Most conference attendees will not initially be excited about STEM courses and will not be planning to take many STEM courses beyond what is required.*
- H1b: *After attending the conference, the attendees will feel more positively about taking STEM courses and will plan to take more courses beyond what is required.*

I believe that girls are socialized to be unexcited about STEM courses; I believe that the first-time conference attendees chose to attend the conference because there are obeying their teachers, their parents, or they decided to attend as a group of friends. (Those who chose to attend a second or third time are likely more interested in the content of the conference.) However, seeing women who work in STEM fields will challenge their previous assumptions about what is appropriate for females to study. Additionally, access to information about what courses to take and towards what sort of tasks this can lead in a workplace will instill confidence in attendees' thoughts on their own abilities. Thus, specifically, I will initially examine how the girls feel about STEM courses and which courses they plan to take; then, I will compare these results to the courses that the girls plan to take after the conference.

- H2: *The number of math and science courses taken by the presenters at the conference will be larger than most of the attendees suspected.*

When planning their schedules in high school, students are often unaware of the consequences lacking courses can have; many do not take the time to contemplate how their choices at the moment can affect their eventual choices of college majors or even college admission (Farenga & Joyce, 1999; Kubitschek & Hallinan, 1998; Riegle-Crumb, Farkas, & Muller, 2006; Sax &

Harper, 2007; Stake & Mares, 2001; Stake & Nickens, 2005). I predict that attendees will be rather surprised at the number of STEM courses needed to reach certain career goals.

- H3a: *Peers will play a large role in the lives of the conference attendees.*
- H3b: *Following peers, parents will play the second most important role in offering advice and aiding in decision-making.*

Given the research surrounding the influential role that peers play in the lives of adolescents (see the section *The Importance of Peer Support*), I predict that conference attendees will list their friends as the most important sounding board for their issues and as the main reference point for their queries. However, since research shows that peers overtake parents as most influential players in adolescence (Stake & Nickens, 2005), I believe that, after going to their peers, attendees will reach out to their parents.

- H4: *The majority of conference attendees will choose STEM-related college majors or careers.*

Since the conference attendees are presumably not forced to be there, I believe that they will already have a budding interest in STEM fields. This allows the conference to play a confirmatory role in their choices of college majors or careers.

Data

For this project, I was generously given access to data from a EYHN conference in Murfreesboro, TN[7] and data from a follow-up survey to participants from various EYHN conferences from 1999 to 2001in San Jose, CA. For the former site, attendees were given a pre-conference and a post-conference survey *(n*=236 and *n*=235, respectively*)* with various questions

7 I would like to thank Judith Iriarte-Gross and Rebecca Zijlstra for gathering this data. See http://mtsu32.mtsu.edu:11094/ for Middle Tennessee State University's web site for its Expanding Your Horizons conferences.

regarding opinions and thoughts about their career plans, courses taken, and attitudes towards women in math and science. (See *Appendix A* for copies of these two surveys.) For the latter site, attendees were given a post-conference survey only with questions in a similar vein to the TN surveys. However, this particular survey was sent out several years after the conferences (it was sent in 2006 to reflect upon conferences held in 1999 through 2001). It therefore has the benefit of containing information on the girls' choices of college majors and jobs but the downside of having a weaker response rate (n=93). (See *Appendix B* for a copy of this survey.)

Murfreesboro, TN

The town of Murfreesboro, TN is about 20 miles south-east of Nashville, TN. In 2006, it was ranked as one of the *Top 100 Best Places To Live* by *Money magazine*[8]. Once the capital of Tennessee (from 1818 until 1826), Murfreesboro is now the sixth largest city in that state with an area of 35 mi^2 (*Visiting Murfreesboro*, n.d.). The population is 86,793 (see Figure 1 for a graphical representation of the race/ethnic distribution), and the median household income is $39,705, according to the U.S. Census Bureau (2007).

San Jose, CA

San Jose, CA is about 50 miles south of San Francisco and 390 miles north of Los Angeles. The city encompasses 177.7 mi^2 (City of San José, 2006), making it the third largest city in California (after Los Angeles and San Diego) and the tenth largest city in the US. The population is 974,000 (see Figure 2 for a graphical representation of the race/ethnic distribution), and the median household income is $70,921 (U.S. Census Bureau, 2007), making it the city

8 See http://money.cnn.com/magazines/moneymag/bplive/2006/snapshots/PL4751560.html for the complete article.

with the highest median income in the U.S. (City of San José, 2006).

Figure 1. Race/ethnic distribution in Murfreesboro, TN.

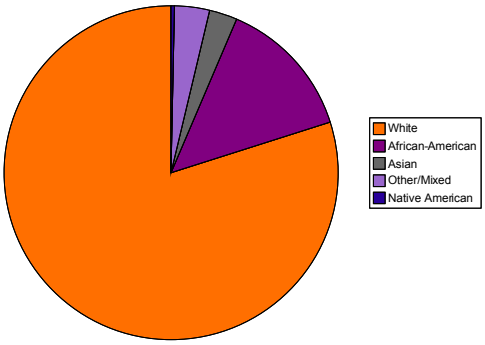
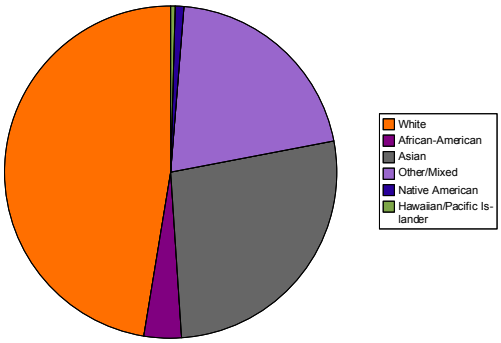


Figure 2. Race/ethnic distribution in San José, CA.



Methods

I used STATA to examine all the data;for qualitative answers from the Murfreesboro, TN surveys, I obtained the physical survey forms and read through each of those as well. The initial data analysis was done by examining the data itself and then looking at the results of several bivariate comparisons. It is perhaps relevant to note that gender never needed to be added as a predictor, since all conferences attendees were female.

For the follow-up survey for the women who attended San José, CA, EYHN conferences between 1999 and 2001, I used logistic regression to see how certain factors affect the choice of a STEM-related college major. Logistic regression allows for a calculation of the probability that an outcome *y* will occur given predictors *x* (Wooldridge, 2006). Namely, I calculated the probability of choosing such a major with the following predictors: the number of EYHN conferences attended, whether or not the participant personally believed that the conference affected her choice of career, and whether or not the EYHN conference affected the math and science electives taken in high school. The logistic regression was restricted to the respondents

who identified themselves as current college students. Thus, I eliminated three respondents who had already graduated from college and twelve respondents who were still in high school as seniors.

Using the format from Wooldridge (2007), I ran a logistic regression without predictors to set a benchmark:

$$P(y = 1|\boldsymbol{x}) = P(sciences = 1) \quad (1a)$$

where *sciences* is a binary variable indicating if the respondent chose a college major in a STEM field (if yes, *sciences* = 1, else *sciences* = 0).

Then, I ran a logistic regression including a predictor for having attended one EYHN conference, which allows me to see how attending one conference compares to attending two or three conferences (the other two choices of responses to this question):

$$P(y = 1|\boldsymbol{x}) = P(sciences = 1|eyhconf1) \quad (2a)$$

where *sciences* is again the variable explained above and *eyhconf1* is a binary variable indicating whether the respondent attended one EYHN conference (*eyhconf1* = 1) or attended two or three conferences (*eyhconf1* = 0 for both cases).

Then, I ran a logistic regression including several other predictors as explained earlier:

$$P(y = 1|\boldsymbol{x}) = P(sciences = 1|eyhconf1, eyhcareer, electmath, electsci) \quad (3a)$$

where *sciences* and *eyhconf1* are the same as explained for the prior equations, *eyhcareer* is a binary predictor which indicates if the respondent thinks that attending the EYHN conference(s) affected her choice of career, and *electmath* and *electsci* are binary predictors which indicate if the respondent thinks the EYHN affected her choice of math and science electives (respectively) in high school.

This leads to the following equations:

$$P(sciences = 1) = \Lambda(\beta_0) \quad (1b)$$

$$P(sciences = 1|eyhconf1) = \Lambda(\beta_0 + \beta_1 eyhconf1) \quad (2b)$$

$$P(sciences = 1|eyhconf1, eyhcareer, electmath, electsci) =$$

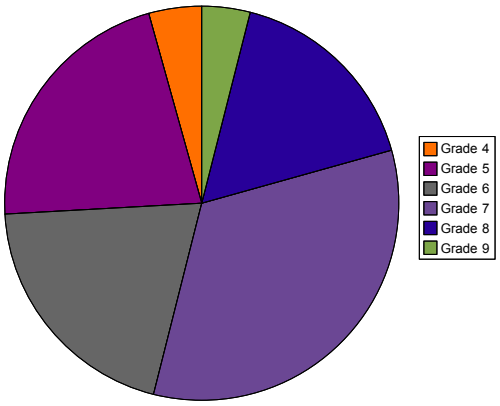
$$\Lambda(\beta_0 + \beta_1 eyhconf1 + \beta_2 eyhcareer + \beta_3 electmath + \beta_4 electsci) \quad (3b)$$

Analysis

Pre-conference survey, Murfreesboro, TN

This was the first conference for 85.8% of the survey respondents of the pre-conference survey in Murfreesboro, TN (*n*=236). Though this is a high percentage, that does mean that 14.2% of the respondents had attended previously, which is fairly impressive in its own right. The distribution of respondents across grade levels is shown in Figure 3.

Figure 3. Pre-conference survey respondents' grade levels (Murfreesboro, TN).



The majority of the attendees were, at least at this point, quite unsure of their plans for the future: 53.9% do not know their educational path upon graduating from high school. Though there are mild fluctuations, there are no specific trends by grade on this factor. Thus, the

explanation that a fourth-grader may be justifiably unsure of her plans for the future does not hold, since equally as many seventh- and eighth-graders feel that way. From the qualitative responses to a question asking about their intended careers, a popular response for fourth-graders was teacher while sixth- and seventh-graders mostly wanted to be veterinarians. Those same two choices shared the lead with fifth-graders. Eighth- and ninth-graders showed a much more varied range of possible choices, from cosmetic surgeon to real estate agent. Over all grades, all respondents, 13.2% wanted to be doctors, 20.6% veterinarians, and 18.4% teachers in various disciplines.

Surprisingly, not all attendees took math or science classes in the school year prior to the conference: 90.9% reported taking a math class that year while 87.7% reported taking science. The students who did not take a math class in that year were all fourth-, fifth-, sixth-, and seventh-graders at the time of the survey, so all eighth- and ninth-graders in the sample did take a math class while they were seventh- and eighth-graders. The students who did not take a science class in that year were spread across fourth- through eighth-grades; only the ninth-graders all took science the previous year (their eighth-grade year). Given that elementary and middle school years are generally used to instill the basics of various subjects, I find it distressing that nearly 10% of these students are missing a year (or perhaps more) of math and more than 12% are missing a year of science. It is possible that students may not realize a particular subject as being a science course, such as the situation of fourth graders who spend all day with one teacher and may not necessarily distinguish all subjects, or seventh graders who are taking geology and may not realize this is a science course.

When examining the data for current math and science courses, the results are more positive. Out of 229 respondents on the question, 223 attendees report to be currently enrolled in

math classes, usually in a basic third-, fourth-, fifth-, or sixth-grade math class. Though it is tough to draw conclusions from the data for ninth-graders, since there are only nine of them, most are taking Algebra, which is a normal level of math for that grade. All eighth- and ninth-graders report being currently enrolled in a math class. Only two respondents are not currently enrolled in a science class, one in sixth-grade and one in seventh-grade. The largest percentage of respondents (39.6%) are enrolled in basic third-, fourth-, fifth-, or sixth-grade Science or Earth Science courses.

In terms of future plans of course-taking, the numbers are disconcerting once more (though these are pre-conference surveys values, so nothing has yet been done to discuss the options with these students): only 7.8% of respondents plan to take a math class in twelfth grade; this number is 6.7% for eleventh grade and 3.1% for eighth grade. Since, in a stark contrast, 24.4% of respondents intend to take a math class in college, they are clearly unaware of the consequences of missing years of math in high school. The results for eighth grade are especially alarming, since this is supposed to be a year which provides a basis with which students will go into high school courses. Oddly, all the girls who do not plan to take math in eighth grade also stated that math is either “awesome” or “ok”, so their choice of not taking math seems unrelated to their views of the subject per sé.

The numbers are similar for students planning to take science courses: only 8.0% plan to take a science class in twelfth grade, 6.9% in eleventh grade, and 7.5% in eighth grade. Though their opinion of the subject seems to have more bearing on their plans in this case – all those stated “Science? Ugh!” plan to only take the subject in sixth and seventh grades – even many of the students who claim to enjoy science do not plan to take a science class in eighth, ninth, or tenth grade.

In conjunction with the numbers mentioned in the previous paragraph, it is wholly unsurprising to find that 88.4% of respondents do not know which math classes they need to enter a college major or vocational program of their choice. This majority percentage is spread evenly across grades four through eight; in other words, for example, a similar percentage of fourth-graders and eighth-graders are unfamiliar with necessary courses. Interestingly, the only grade which stands out is the ninth grade: none of the ninth-graders know which math courses they must take. Arguably, however, this particular result could be due to the apparent ease of course choices to fourth- and fifth-graders (more feel that they know what to take because they have to be truly exposed to the choice of classes), or due to the small sample of ninth-graders. Unfortunately, this question was not asked about science, so it is impossible to tell if students feel more comfortable with their choices of science education.

When turning to more specifics of the course choice dynamic, it is seen that 50.3% of the girls in the sample have been encouraged to take more STEM courses than are required. Of those, 34.6% report being coaxed to do so by parents, 35.5% by teachers, 18.7% by school counselors, 8.4% by other family members, and 2.8% by friends. (It is necessary to mention that this was a question in which respondents could select all which apply, so various combinations of these answer choices may have been selected by the same respondent. I make no distinction between answers selected as lone responses versus those who checked all the boxes for the purposes of this analysis.) This shows that these respondents feel that the motivating factors for them are not peers but, in fact, teachers and parents. The small percentage of school counselors is worrisome; this seems to reflect a hesitation on the part of counselors to push students to go beyond the basic requirements from the school or school district. It must also be considered that most students have not discussed their college or career plans with a school counselor; since this

is not necessarily relevant yet for fourth-, fifth-, and sixth-graders, restricting the analysis to seventh-, eighth-, and ninth-graders shows that 91.3% say that they have not spoken with a counselor regarding such matters or their grade does not do that.

Finally, an interesting response concerns a question about skills which respondents are hopeful to learn; one such choice is computer programming. Overall, 54.3% plan to take computer programming prior to college enrollment. However, upon closer examination, it appears that 69.7% sixth-graders plan to take such a course, capping a growth from fourth and fifth grade, whereas only 44.8% of seventh-graders plan the same, and this percentage does not recover for eighth- and ninth-graders. This could be a sign of girls realizing what fits into an appropriate gender stereotype as they hit the true throes of adolescence; I am hesitant to conclude this, though, since research shows that girls are well-aware of such trends by preschool ages (Farenga & Joyce, 1999).

Post-conference survey, Murfreesboro, TN

An impressive 90.6% of respondents (*n*=235) found the EYHN conference to be as helpful or more helpful than they expected in informing them of science and engineering careers; 85.5% found the same of math and computer science careers. The latter number is somewhat tempered by 9.8% who said the information was less helpful than expected. From the information gathered, 46.5% concluded that taking math was more important than they expected for a successful career and 53.9% concluded this about science coursework. This is likely an effect of the "role models", as the women in STEM fields who discuss their careers with conference participants are referred to by EYHN: these women took more math classes than they expected, say 51.1%, and more science classes, say 52.0% of respondents. A fairly size-able

46.1% of respondents feel that they have more clarity on which courses to choose in the future. When asked about their future careers, 9.4% wanted to be doctors at this point, 19.2% veterinarians, and 11.9% teachers, which provides a nice juxtaposition to these number from the pre-conference surveys; this is discussed in more detail in the *Conclusion*.

Though 31.2% say they are "way more" interested in STEM careers after the conference and 35.9% are "sort of more" interested, none of the respondents plan to take AP Calculus and two respondents plan to take AP Physics, making the percentage for this future choice a measly 1.3%. For future assistance in planning their careers, the numbers are quite different from what what planned prior to the conference: 45.9% say they will consult teachers, 21.7% will go to guidance counselors, a much lower 19.8% defer to parents, and 12.1% mentioned family friends. Unfortunately, peers were not an option included in this question, so it is difficult to tell if the proximity of other participants in the conference provided a sense of encouragement.

Post-conference follow-up survey, San Jose CA

Women who attended conferences in 1999 through 2001 responded with a variety of reactions in this 2006 survey (n=93). The response rate for this survey was 11.6%. Table 1 below shows a sample of the initial recalled reactions to the conference given, split into positive and neutral/negative. It is important to mention that the positive reactions by far outnumber the negative or neutral reactions (73 positive versus 13 neutral/negative reactions). Several respondents remember simply being impressed by being able to physically be on a college campus, which could be interpreted as positive feedback (if college campuses are impressive, perhaps the respondent is likely to attend college) or negative feedback (if all the respondent remembers is the physical location, this does not say much about the effect of the conference on

that participant).

Table 1. A sample of reactions by conference participants, five to seven years after attending.

Positive reactions:

- "I loved meeting so many women interested in the sciences and mathematics. . . . I was surprised so many young girls (all my age) were there."
- "I was impressed by how many successful women there were in the professional world of science and math, etc."
- "...it was interesting to see women going against their stereotypical image."
- "I was more influenced to take chemistry and physiology as classes at my own high school."
- "Interested [*sic*] to learn that women who worked in these areas were real, normal people!"

Neutral/Negative reactions:

- "[I recall n]othing really, just that we talked about quarks in the big auditorium room."
- "...since I was a high school student at the time, I'm not sure how informative it was for me."
- "I don't remember much about the conference."
- "Not a damn thing."
- "Boring."

To characterize the respondents, 11 (11.8%) were still in high school at the time of the survey (all were seniors), 78 (87.8%) were college students, and 3 (less than 0.1%) were college graduates. Of the 78 college students, 21 were freshmen, 30 were sophomores, 11 were juniors, 14 were seniors, and there was 1 in between sophomore and junior year and one non-response. Between 1999 and 2001, respondents attended at least one EYHN conference to end up in this sample; 15.4% actually attended two conference and the same number attended three conferences.

A disappointing 45.2% say that the conference did not influence their choice of career; 33.3% say it influenced their choice a little, 17.2% say it moderately influenced their choice, and

4.3% say it strongly influenced their choice. However, viewing the college majors chosen by survey respondents in Table 2, the respondents who chose a STEM-related major only (thus not including those with a combination of STEM and Arts majors) account for 39.4% of those currently enrolled in college (*n*=66). The respondents with an Arts-only major are 34.9% of the total sample. Even combining Arts and Business majors gives 42.4%, only slightly above the number of STEM majors. For an all-female sample, this is a high percentage of STEM concentrators. It could be argued that self-selection plays a role, since the response rate was low and perhaps those with an already budding interest in STEM fields were encouraged or self-motivated to attend the EYHN conference in the first place. However, there are also responses within the free-form fields of the survey which indicate that the Arts were the respondent's interest all along[9], so this would provide a slight counter-argument to such claims. When discussing future career plans, these results are mostly echoed by 46.2% planning to not pursue a career that requires math and/or science, 21.5% being unsure of this, 17.2% thinking about pursuing a career that necessitates such skills, and 15.1% definitely pursuing such a career.

It must also be kept in mind at this point that EYHN does not set out to try to recruit women into STEM fields. Rather, their goal is to close the gap of knowledge and refute gender stereotypes that may have been instilled through prior educational experiences. Thus, perhaps this is not such bad news, since the goal was not to change everyone's career goals to STEM-related selections, but to inform the attendees of choices they could make and show them that it is societally acceptable to make such choices. Of course, other effects can also be seen: one respondent mentions, "I knew that I wanted to go to college because of it. It didn't make me go

9 As related to the question *If you are **not** interested in a career in math, science, and/or engineering, what do you think might have helped you, while still in school, to become more interested in these fields?*, examples of such responses include: "Nothing – I love the humanities. I am glad to have had information about math/science but I never had a passion for it." and "Nothing really, I decided it was not for me. You have to go with what's in your heart."

into math or sciences." This can hardly be viewed as negative, though it surely feeds into the the above percentages.

Table 2. College majors for respondents who were attending college at the time of the San José, CA, follow-up survey. Five responses of Undeclared, Undecided, N/A, and General Education are not shown in this table, thus, *n*=66.

STEM*	Arts**	Business ***	Combination****
26	23	5	7

*includes responses: Accounting, Pre-Biology, Biology, Biology(integrated), Biology: sciences, Human Biology, Molecular Cell Biology, Neurobiology/Physiology, Biology or Chemistry Aeronautical Engineering, Chemical Engineering, Computer Engineering, Environmental Engineering, Engineering (subfield not yet chosen), Materials Science & Engineering, Mathematics, Dental, Dietetics, Nursing, Psychology
**includes responses: Art History, Art and Design, Digital Arts, Film, Criminal Justice, Culinary Arts, Anthropology, Cultural Anthropology, Social Work, Sociology, Sociology & Spanish, English: Writing & Theater, Literature, History, International Political Economy, International Relations, Political Science, Political Studies, Politics & Government, Liberal Studies/Early Childhood Education, Child & Adolescent Development, Special Education, Mass Communications/Russian, Spanish/Public Health, Kinesiology
***includes responses: Agriculture & Business, Business/Marketing, Business Administration, Hospitality, Administration, Marketing, Paralegal Studies
****includes responses: Biology & Psychology, Biology & Theater, Biopsychology, Culinary Arts/Business/Accounting, History & Environmental Science, Math & Education, Psychology/Communications, Psychology/Dramatic Arts

Though the largest percentage of respondents claims that the EYHN conference did not influence their decisions in taking elective math and science courses (46.7% for the former, 34.4% for the latter), 21.7% and 32.3%, respectively, indicate a moderate influence and 7.6% and 12.9% indicate a strong influence. In terms of career information, only 16.3% of respondents found the conference not helpful at all in providing information about science and engineering careers; 13.2% said the same for math, computer science, and/or technology-related careers. Given this relatively positive feedback to the role that the conference played in their lives and adding this to the fairly large number of respondents in STEM-related majors, it is interesting to note that only 7.5% of respondents find it to be "very important" or "important" to have female role models. Though 23.7% find this to be "slightly important", by far the largest

percentage, 68.8% think this is "not important at all".

Table 3. Logistic regression results for all three specified models.

Dependent Variable: *sciences*			
Independent Variable	Logit Model 1	Logit Model 2	Logit Model 3
eyhconf1	N/A	.916 (.558)	.903 (.566)
eyhcareer	N/A	N/A	-.034 (.309)
electmath	N/A	N/A	-.041 (.381)
electsci	N/A	N/A	-.080 (.359)
constant	-.947 (.231)	-1.609 (.490)	-1.267 (.808)
Log-Likelihood Value	-55.107	-53.617	-53.051
Pseudo *R*-Squared	0.000	0.027	0.0315

To further investigate the respondents who did choose a STEM-related college major, I ran logistic regressions as outlined in the *Methods* section using Stata™[10]. The results of these logistic regressions are listed in Table 3. Though the Pseudo *R*-Squared values and the *p*-statistics are not particularly interesting to examine since the former is high and the latter quite low, the variable *eyhconf1* does have a useful result. The *p*-value for this variable is 0.101 in Model 2 and 0.111 in Model 3, which is quite close to significance at $p<.01$ and is significant at $p<.05$. This means that attending one EYHN conference significantly affects the probability of majoring in a STEM field at $p<.05$, though, by comparison, attending more than one conference is not significantly useful in making this choice at any commonly accepted *p*-statistic threshold[11].

10 I used Intercooled Stata version 9.2 for Macintosh.

11 I also ran two other logistic regressions including variables indicating if the respondent had attended two or three conferences, instead of one. I ran various configurations of these models and found that variables of attending two or three conferences were never near significance (always with *p*-values over 0.5) and therefore decided to only use *eyhconf1*, the predictor indicating that the respondent attended one conference, in my analyses.

Comparisons: similar studies

Though several programs aimed at getting high school girls involved in STEM fields exist across the U.S., usually in universities, very few studies have been done on any of these programs. Though it would be most relevant to provide exact comparisons and counterfactuals to the results and analysis presented in this paper, this proved to be quite difficult. However, there are three studies that are useful in providing a framework in which to place the information contained in this paper: one is a program that took place at a high school in Hawaii (Sodersten & Wilkins, 2005), another is a study conducted at the New Jersey Institute of Technology (NJIT) during its girls-only Women in Engineering and Technology program called FEMME (Koppel, Cano, Heyman, & Kimmel, 2003), and the third is a study of science enrichment programs at a Midwestern university (Stake & Mares, 2001). It is perhaps relevant to point out that the results of the first two of these studies were presented at conferences held by organizations who promote women's participation in STEM fields[12]; neither of those studies were published in peer-reviewed journals. The third study mentioned was published in a peer-reviewed journal.

The first study discusses a program at a high school in Hawaii, which was created to teach students how to compete in robotics competitions; one of the main goals of the program was to involve girls, requiring that 50% of a team entering the competition be female. Before the program began, all participants rated their interest and knowledge in STEM fields (on a scale from 1 to 10), which led to interesting results: "The largest difference between the responses of the females and males was in their view of their abilities in engineering (female average 5.8,

12 The results from the program at the high school in Hawaii were presented at a conference held by the Women in Engineering Programs & Advocates Network (WEPAN) and the National Association of Minority Engineering Program Administrators, Inc. (NAMEPA); the results from the program at the New Jersey Institute of Technology were presented at the 33rd American Society for Engineering Education (ASEE) / Institute of Electrical and Electronics Engineers, Inc. (IEEE) Frontiers in Education Conference.

male 7)." (Sodersten & Wilkins, 2005, p. 4) After the competition, these numbers were 7.6 for female respondents and 7.8 for male respondents (p. 5). This increase in self-confidence can be seen as consistent with the decision by the Murfreesboro, TN post-conference survey respondents to take more STEM courses and the spike in interest in pursuing a STEM-related career.

The second study, conducted at NJIT, varies from the study in Hawaii in that it compares the FEMME program, a program for high school girls to encourage them to take STEM-related courses, to the Pre-Engineering Program (PrEP), an identical program to FEMME in every way except that it was open to high school girls and boys. The study found that there was no particular advantage to FEMME versus PrEP, thus concluding that the benefits for girls were seen whether boys were present during the program or not (Koppel, Cano, Heyman, & Kimmel, 2003, p. 5). After attending either program, students were more aware of what an engineering job entails and the percentage of students who voiced that they did not want to be engineers decreased; however, the percentage of participants who said that they did want to be engineers increased for FEMME participants and decreased for PrEP participants (p. 4). Again, the overall awareness of STEM fields (for FEMME and PrEP) and the STEM career interest increase (for FEMME) echo the results from all three EYHN surveys.

The final study mentioned reports pre-post comparisons for a science enrichment program for gifted high school students. (It is important to note that, as previously mentioned in the section *The Importance of Peer Support*, gifted students are often considered to be a special case for educational purposes.) This program was specifically limited to students who displayed high academic aptitude. In attitude measures, no significant positive changes were found from the pre-test to the post-test (Stake & Mares, 2001, p. 1080). However, the authors argue that this

precisely proves their point that a different methodology must be employed to measure the changes that take place in the program's participants. By utilizing follow-up surveys, which did show an increase in science interest and positive attitude toward the discipline, and surveys of parents, who also reported the same increases, the authors showed that evaluation of the program was more positive when evaluated in retrospect, as opposed to when it was evaluated right after but on the same day as the program's occurrence. This argument can also be used to explain the lower ratings of EYHN in the follow-up surveys from the San José, CA conferences versus the post-conference ratings from the Murfreesboro, TN conference, though these results show the opposite effect. Students at the Murfreesboro, TN conference were quite positive in their post-conference feedback, whereas the respondents from the San José, CA follow-up surveys appeared more critical, judging the program as having less of an effect on their career choices. Of course, differences between sites, the fact that the conferences being compared were held in different years, and the age of the Murfreesboro, TN respondents versus the age of the San José, CA respondents[13] must be considered.

Conclusion

In this paper, I have addressed the literature that surrounds the importance of peers and role models for female students, especially during adolescence. To explore my hypotheses on this subject, I examined data from Expanding Your Horizons Network, or EYHN. I was given access to three set of survey results, a pre-conference survey from a conference in Murfreesboro, TN, a post-conference survey at the same conference, and a post-conference survey sent to girls who attended San José, CA, conferences between 1999 and 2001.

13 By my estimates, the youngest participants at the Murfreesboro, TN conference were likely around ten years old and the oldest around fourteen, whereas the San José, CA survey was sent to respondents who were probably between sixteen and twenty-one years old.

My first hypothesis was broken into two parts:

- H1a: *Most conference attendees will not initially be excited about STEM courses and will not be planning to take many STEM courses beyond what is required.*
- H1b: *After attending the conference, the attendees will feel more positively about taking STEM courses and will plan to take more courses beyond what is required.*

The pre-conference survey showed that 9.1% of respondents did not take a math class their previous school year; 12.3% did not take a science class their previous school year. However, at the time of survey, only 2.6% were not enrolled in a math class and 0.9% were not enrolled in a science class. Since the percentage of students who intend to take math and science classes in higher grades in high school is quite low (below 10% for both subjects, for eighth, eleventh, and twelfth grades), yet 24.4% intend to take math in college, and 21.8% intend to take science there, this proves that H1a is true for this sample. The responses from the Murfreesboro, TN, post-conference survey show that the participants were surprised by the number of math courses needed for the careers discussed by the "role models", the women volunteering to present information about their careers. Combining the responses "way more" interested in STEM careers and "sort of more" interested gives an overall percentage of 67.1%, which is a large number. To confirm these results, the San José, CA, post-conference follow-up survey gives information about the influence of EYHN on their choices of elective math and science courses. For both subject areas, the majority of respondents report "a little influence", "moderate influence", or "strong influence" (for math, 53.3%, and for science, 65.6%). Though the "strong influence" was not a particularly popular choice, with 7.6% for elective math classes and 12.9% for elective science classes, the fact that the majority of respondents felt that the conference had some influence on them, even five to seven years after attending, proves that H1b is true as well.

However, looking at the college majors chosen by the women who attended the San José EYHN conferences displays an interesting picture. Nearly 40% of the enrolled college students had chosen a STEM field as their college major, and this number does not take into account the women who have a major that is a combination of a STEM-related field and an Arts or Business field. Though 40% is not the majority, statistically speaking, it is a larger number than is usually seen for a sample of women: based on numbers from 2003-2004, 26.5% of Bachelor's degrees went to women in STEM fields, compared to 30.6% of men who concentrated in one of those fields[14] (U.S. Department of Education, 2004). Thus, I can say that the women in this sample are out-pacing men overall when it comes to choosing to concentrate in a STEM-related field for their Bachelor's degrees.

On another note relevant to the topic of choosing courses, I can compare the career hopes for the attendees of the Murfreesboro, TN, conference before and after the conference took place. As mentioned previously in the *Analysis* section, the juxtaposition of the numbers is interesting. Prior to the conference, 13.2% of the respondents wanted to be doctors; after the conference, this number was 9.4%. The girls with hopes of being a veterinarian went from 20.6% pre-conference to 19.2% post-conference, and the percentage of those who planned to become teachers went from 18.4% to 11.9%. By examining the rest of the data, I can see that the drop in percentage is mostly due to the fact that the list of careers overall has expanded post-conference. In other words, respondents listed more generic professions before the conference (e.g. doctor, lawyer, designer), whereas after the conference, responses became more specific and varied (e.g. pediatrician, patent/copyright lawyer, robotics engineer, cosmetic chemist). Though certainly some of these may be directly procured from the presenters at the conference (e.g. robotics

14 I used the same segmentation of STEM, Arts, and Business to calculate these percentages as I used with the EYHN data.

engineer, cosmetic chemist), I believe that this shows that career choices have begun to take more shape in the minds of these girls.

My second hypothesis concerned the course load taken by the "role models" at the conference:

- H2: *The number of math and science courses taken by the presenters at the conference will be larger than most of the attendees suspected.*

As mentioned in the previous paragraph, respondents were indeed surprised at the number of math and science courses taken by the presenters: 51.1% found they took "way more" math courses and 52.0% found they took "way more" science courses. Though this clearly provided useful information to these participants, ironically, 68.8% of the respondents from the San José, CA, survey did not find having female role models to be important in preparing for their futures. Perhaps this illustrates the difference between college students and high school students, or perhaps these college students actually have already found mentors or role models of some sort and are underestimating their worth or forgetting their impact if the main impact was felt in previous years.

My third hypothesis dealt with the importance of peers and parents to the survey respondents:

- H3a: *Peers will play a large role in the lives of the conference attendees.*
- H3b: *Following peers, parents will play the second most important role in offering advice and aiding in decision-making.*

Some qualitative responses to what would best increase girls' interest in math or science, posed to the San José, CA conference attendees, indicate a spectrum of likely targets for advice:

- "Teachers who . . . are willing to step in to prevent other students from making girls

who excel in these areas feel like they don't belong!!"

- "Meeting successful women in high-level rewarding careers (career panel)."
- "Meeting with other women with status in the math/science world."
- "Hook the girls up w/ [*sic*] mentors early on."

Interestingly, according to the survey responses, peers do not play a particularly large role in in the participants' decision-making. Though it is unclear from the Murfreesboro. TN, post-conference survey what role the respondents assign to their peers (or friends), as this is not an option for them to select, the same site's pre-conference survey does show that the motivation to take STEM-related courses comes mostly from teachers (35.5%) and parents (34.6%). Only 2.8% of respondents who report being coaxed to take more STEM-related coursework (50.33%) say that their friends played a role in this encouragement.

My fourth hypothesis addressed the choice of college majors for respondents, thus making this hypothesis only relevant to the San José, CA, follow-up survey:

- H4: *The majority of conference attendees will choose STEM-related college majors or careers.*

As discussed earlier in this section, nearly 40% of the women surveyed who had attended San José, CA, conferences did choose a STEM-related college major. This is not a majority, so I cannot say that H4 is true; however, it is a high percentage and must be taken as a good sign of the use of early exposure to STEM fields for these women.

Finally, the logistic regression shows that attending one EYHN conference is particularly useful in motivating girls to choose STEM-related careers but future conferences do not have a large effect. Though this is largely unsurprising, since likely these girls have gone through a transitional phase to believing that STEM-related careers are appropriate for them, if they needed

to learn this, during their first experience with the conference, this could be taken under advisement by EYHN. Perhaps the repeat attendees could have access to a higher level of career counseling, beyond the information that the first conference provided them.

In my opinion, the ultimate goal is choice equality, so that women feel they can come to a decision of what career choice is best for them, regardless of gender stereotypes or other environmental or social pressures. The issue is, when do we "catch" girls to prevent them turning away from math and science in an effort to fulfill a stereotypical feminine ideal? The results presented in this paper underscore the need for connections between women in STEM-related careers and the girls who may choose to follow in their footsteps.

As EYHN conferences continue across the world, each hosting entity (university or other organization) should consider the merit of pre-conference and post-conference surveys as well as follow-up surveys several years later for all participants. These conferences are part of many events being created and run in many countries in order to allow girls to make informed career choices. Currently, the thorough evaluation of such events is often conspicuously absent. Judging from the results presented in this paper, there are certainly benefits to attending these conference. However, cross-site comparisons would improve evaluations greatly, and a comparison of various similar studies could also be quite constructive. As more entities embark upon the organization of EYHN conferences, perhaps the convenience of web site-based surveys would coerce more participants to complete them, allowing researchers to fully understand the use of informing adolescent girls about their future choices – many of which require preparatory courses right now.

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Appendix A: Surveys from the EYHN conference in Murfreesboro, TN

Pre-conference survey

Hello. On behalf of the National Office of Expanding Your Horizons (EYH), I want to thank you for agreeing to participate in this short survey. We're so excited that you are participating in an EYH conference!

We know that EYH is a great program. After EYH conferences we hear stories from people like you. We hear how much fun young women had at the conferences, and we know that we are helping more and more young women learn about new and exciting careers that are math and science based. But, we need more information from young women like you so we can improve our conferences. We also want to demonstrate that EYH has a long-standing impact on thousands of young women. Please take a few minutes to fill out this pre-conference survey and pass it to an usher **before** the session begins.

PLEASE PRINT CLEARLY

Name _____
Home Address _____
City _____
State, Zip _____
E-Mail (optional) _____
Phone (optional) _____

Is this your first EYH conference? Yes No

May we contact you by mail and ask you to participate in some follow-up surveys about EYH?
Yes No

What is your current grade? 3rd 4th 5th 6th 7th 8th 9th 10th 11th 12th

1) How much thought have you given to the question of what you'll do when you finish your high school education?
A Lot Some A little Not Much None at all

2) What career(s) seem interesting to you? _____

3) Please check the box that best describes your attitude towards math.
Math? It's awesome! Math? It's OK Math? I can take it or leave it Math? Ugh!

4) Please check the box that best describes your attitude towards science.
Science? It's awesome ! Science? It's OK Science? I can take it or leave it Science? Ugh!

5) Which one of these statements most accurately describes your opinion about what you know about women scientists and about their jobs? Please check one

Women scientists have no trouble obtaining excellent science jobs.

Women scientists sometimes encounter difficulty getting jobs in science.

Women scientists often face major problems getting jobs in science.

Women scientists almost never find employment.

I do not know enough about women scientists to have an opinion.

6) Have you discussed your college or career plans with your school counselor?

Yes No My grade does not talk to the school counselor about college or career plans.

7) At this time, what kind of educational path do you plan on after high school?

None Junior College Apprenticeship Bachelor's Degree Master's Degree Doctorate

Other_____ I do not know yet.

The next three questions are about what you did in school last year.

8) Did you take any math classes last year?

Yes No

Which ones did you take? (please check the ones you took)

Basic 3rd, 4th, 5th or 6th grade math

Integrated math Pre Algebra Algebra Geometry Calculus

Advanced Placement Calculus Other _____

9) Did you take any science classes last year?

Yes No

Which ones? (please check the ones you took)

Basic 3rd, 4th, 5th or 6th grade science

Earth Science Biology Advanced Placement Biology Marine Biology

Chemistry Advanced Placement Chemistry Environmental Science Physics

Advanced Placement Physics Other_____

The next two questions are about what you are doing in school this year.

10) Check the box that is closest to the name of your **current** math class:

Basic 3rd, 4th, 5th or 6th grade Math Pre Algebra Algebra Advanced Algebra

Geometry Calculus Advanced Placement Calculus I am not taking any math

Other_____

11) Check the box that is closest to the name of your **current** science class:

Basic 3rd, 4th, 5th or 6th grade Science Earth Science Biology Advanced Placement Biology

Marine Biology Chemistry Advanced Placement Chemistry Environmental Science

Physics Advanced Placement Physics I am not taking science at this time.

Other_____

12) Please indicate all of the grades in which you plan to take at least one math class.

6th 7th 8th 9th 10th 11th 12th College math courses while in college

I do not know

13) Please indicate all of the grades in which you plan to take at least one science class.

6th 7th 8th 9th 10th 11th 12th College science courses while in college

I do not know

14) Which of these skills do you plan to have by the time you graduate from high school?

Typing		Computer Programming		Graphic Design		Drafting		Keyboarding	
Yes	No	Yes	No	Yes	No	Yes	No	Yes	No

15) Do you know which math classes you may need to enter a college major or vocational program of your choice?

Yes No

16) Have you been encouraged to take more math, science or technology courses than your school requires you to take?

Yes No

If yes, who has encouraged you? Parents Teachers School Counselor Family Friend

Other

Post-conference survey

We hope that you had a terrific time at the conference! Now that you have participated, we have a few more questions we would like you to answer. Once again, thank you so much for taking a few short minutes to do this. With your help, we can bring EYH conferences to more and more young women all over the USA.

Please Print: (We realize we have asked you before, but we need this information again)

Name: _____

Home Address: _____

City: _____

State, Zip: _____

Phone: (optional) ( ) _____

E-mail: (optional) _____

May we contact you by mail to participate in other surveys like this one? Yes No

1) How helpful was the conference in providing you with new information about science and engineering careers?

More helpful than I thought it would be. As helpful as I thought it would be.

Somewhat less helpful than I thought it would be. Way less helpful than I thought it would be.

2) How helpful was the conference in providing you with new information about math and computer science careers?

More helpful than I thought it would be. As helpful as I thought it would be.

Somewhat less helpful than I thought it would be. Way less helpful than I thought it would be.

3) Please check the statement that best describes your attitude towards math after this conference.

For a successful career taking math is more important than I thought. For a successful career taking math is just as important as I thought. For a successful career taking math is not as important as I previously thought.

4) Please check the statement that best describes your attitude towards science after the conference.

For a successful career taking science is more important than I thought. For a successful career taking science is just as important as I thought. For a successful career taking science is not as important as I previously thought.

5) Based on what you learned and heard at the conference, how much more interested are you in math, science and engineering careers than you were before the conference?

Way more interested. Sort of more interested Not at all more interested Don't Know

6) In the pre-conference survey you indicated which years you plan on taking math in junior high or high school. Which math courses are you now thinking about taking that are NOT required by your school. Please check all the math courses you plan to take.

Integrated Math Pre- Algebra Algebra Advanced Placement Algebra Geometry

Calculus Advanced Placement Calculus Not Sure Other _____

7) In the pre-conference survey you indicated which years you plan on taking science in middle school and high school. Which science classes are you now thinking about taking that are NOT required by your school. Please check all the science courses you plan to take.

Basic Science Biology Advanced Placement Biology Marine Biology Earth Science

Environmental Science Chemistry Advanced Placement Chemistry

Physics Advanced Placement Physics Not Sure Other _____

8) How has your understanding of what math and science courses are required to enter a particular college major or vocational career changed because of this conference?

Much clearer A little bit clearer Not clearer at all I am not sure

9) After attending the workshops and meeting the professional women who ran them (we call them role models), please check the statement that best describes your perceptions.

The role models took way more math courses than I thought their careers required them to take.

The role models took way less math courses than I thought their careers required them to take.

The role models took the same amount of math I thought their careers required them to take.

The role models did not say how much math they took to do their job.

10) After attending the workshops and meeting the professional women who ran them (we call them role models), please check the statement that best describes your perceptions.

The role models took way more science courses than I thought their careers required them to take.

The role models took way less science courses than I thought their careers required them to take.

The role models took the same amount of science courses I thought their careers required them to take.

The role models did not talk about how many science courses they took to do their job.

11) What career(s) do you think you would like to pursue?

_____

12) If you desire future career counseling or career guidance, where would you go? Check all that apply

. Teacher Guidance Counselor Parent Family Friend Other

13) Would you attend another Expanding Your Horizons Conference next year?

Yes No Not Sure

14) Would you tell a friend that they should attend an EYH conference next year?

Yes No Not Sure

15) Please respond to the following statements:

How useful was the conference in...

A) Helping you plan your future high school and college courses?

Very useful Useful A little useful Not useful No opinion

B) Introducing you to careers that you had previously thought about for yourself?

Very useful Useful A little useful Not useful No opinion

C) Introducing you to careers you knew nothing about?
Very useful Useful A little useful Not useful No opinion

D) Providing specific information about where you can go if you have further questions about math and science careers.
Very useful Useful A little useful Not useful No opinion

E) Helping you understand what a professional does in a normal day?
Very useful Useful A little useful Not useful No opinion

Please respond to the following statements:

In the workshops I learned more about what professionals do in a normal day. Yes No

Based on what I learned today, I feel a science career is possible for me. Yes No

Based on what I learned today, I feel a science career would be rewarding to me. Yes No

At the conference I learned how much money I would make in certain fields. Yes No

At the conference I learned what I need to do to pursue a career in the sciences. Yes No

At the conference I learned about careers that require a vocational education. Yes No

The most interesting thing I learned today was:

The most important thing I learned today was:

Because of what I heard/did today, I'm now wondering about:

Appendix B: Follow-up survey from 1999-2001 EYHN conferences in San Jose, CA

1. What do you recall about your reactions to the San Jose EYH conference?

2. Where are you now? **(choose one)**

•If you are currently a **high school** student, what year are you in? _____

•If you are currently a **college** student, name of college?_____

What year are you in?_____

What is your major field of study? _____

•If you are a **college graduate**, name of college_____

Year that you graduated_____

What was your major? _____

•What kind of work are you currently doing? _____

3. How many EYH Conferences have you attended?

[ ] 1 [ ] 2 [ ] 3 or more

4. What is your first choice of a career that you are currently thinking about pursuing?

5. Did your participation in a San Jose EYH Conference influence this career choice? (check one)

[ ] No influence [ ] A little influence [ ] Moderate influence [ ] Strong influence

6. How did participating in the San Jose EYH Conference influence your career choice?

7. What other factors and/or people influenced your choice of a future career?

8. Did the San Jose EYH Conference influence your decision to take any ELECTIVE math courses in high school?

a) No influence b) A little influence c) Moderate influence d) Strong influence

9. Did the San Jose EYH Conference influence your decision to take any ELECTIVE science courses in high school?

[ ] No influence [ ] A little influence [ ] Moderate influence [ ] Strong influence

10. How helpful was the San Jose EYH Conference in providing you with information about science and engineering careers?

[ ] Very helpful [ ] Helpful [ ] A little bit helpful [ ] Not helpful at all

11. How helpful was the San Jose EYH Conference in providing you with information about careers involving math, computer science, and/or technology?

[ ] Very helpful [ ] Helpful [ ] A little bit helpful [ ] Not helpful at all

12. What resources or opportunities do you think would be helpful to interest girls in careers involving math and/or science? *(check all that apply)*

[ ] taking additional math and/or science courses [ ] visiting a job site/company

[ ] attending college or vocation school [ ] interning at a company/office

[ ] having a mentor [ ] talking to a career counselor

[ ] having knowledge of job descriptions and responsibilities

[ ] spending a day with a mathematician, engineer, or scientist

[ ] participating in additional math and science activities offered by the EYH Network

[ ] Other, Please Specify: _____

_____

13. Which statement most accurately describes your future career plans?

[ ] I will definitely pursue a career that requires math and/or science knowledge and skills.

[ ] I am thinking of pursuing a career that requires math and/or science knowledge and skills.

[ ] I am not sure if I will pursue a career that requires math and/or science knowledge and skills.

[ ] I do not plan to pursue a career that requires math and/or science knowledge and skills.

14. As you prepare for your future, how important do you feel it is for you to have female role models?

[ ] Very important [ ] Important [ ] Slightly important [ ] Not important at all

15. Please write any suggestions you may have for improving the EYH conferences.

16. If you are **not** interested in a career in math, science and/or engineering, what do you think might have helped you, while still in school, to become more interested in these fields?

•More interesting math courses •More interesting science courses

•More enthusiastic teachers in these areas •More field trips related to math/science careers

•More mentors •More information about these careers

•Anything else? _____

17. May we contact you in the future if we need more feedback from you? [ ] Yes [ ] No

If yes, please write your name, address (including zip code), and e-mail address.

Name:_____

Address:_____
Number and Street

_____
City State Zip

E-mail:_____