

HIGH ACHIEVING GIRLS IN MATHEMATICS: WHAT'S WRONG WITH WORKING HARD?¹

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The participation of women in graduate studies and mathematics-related careers remains a social and economic problem in the United States. Part of a larger study to understand this lack of participation, here we present preliminary findings of girls who are high achievers in middle grades mathematics. This interpretive study documents girls' voices from feminist perspectives and reports their perceptions of what it takes for them to be successful in advanced math classes. Girls attribute their success to a) strong family support, b) desire to understand mathematics, c) assertiveness, and d) belief in hard work.

FOCUS, BACKGROUND, AND FRAMEWORKS

An excellent math student tries hard. They don't give up. They ask for extra help if they know they need it. They, um, no matter what grade they get, if they're trying hard and they know they need help then they're doing really good. I think if you try your best and a B is all you can do and you just can't quite get it then ... you're doing good.

Jolee, Rising 8th Grade Girl

The focus of this study is to identify factors that high achieving adolescent girls associate with their success in mathematics. A synthesis of the mathematics achievement literature no longer supports the common notion that boys consistently outperform girls in mathematics. Gender differences in achievement still persist in secondary schools, on college entrance exams, and among middle grades talented youth. Achievement differences are generally not significant at the elementary and middle school levels (Beaton, Mullis, Martin, Gonzalez, Kelly, & Smith, 1996; Chipman, 1996). In terms of female participation in mathematics, Chipman (1996) believes that representation of the number of undergraduate mathematics degrees granted to women is equal to that of men, and that women's under-representation in physics, engineering, and computer science may be unrelated to their attitudes toward mathematics. She reports that women are under-represented in mathematics graduate studies, and that this may be attributable to a gender difference in confidence that, in turn, may reflect the failure of the culture to recognize women's mathematical contributions. In other words, when the mathematician's culture does not value women's contributions, women's self-confidence is shaken and goals of advanced mathematical study are judged unattainable. There is conflicting evidence in the literature concerning the relationship between attitudes, such as confidence, and achievement (Ma & Kishnor, 1997; Ruffell, Mason, & Allen, 1998).

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While earlier studies (Fennema & Sherman, 1977) report high correlation between these factors, a recent meta-analysis of studies of attitude and achievement found only weak relationships and Fennema (1996) herself questions assumptions that guided her earlier work on gender differences. "Perhaps," she writes "our belief about the [gender] neutrality of mathematics as a discipline may be wrong" (p.22). In stating her new position, she expresses concern as to whether we have asked the right questions in previous gender studies. Fennema has opened the door to new directions of inquiry along with the need for another set of assumptions and frameworks for studying gender and promoting equity in mathematics education. This view is also espoused by Damarin (1995), who recognizes the empirical research accomplishments of Fennema and others, but urges the adoption of frameworks that incorporate feminist perspectives. She suggests that these perspectives "must be actively pursued and constructed as a way of knowing, which begins with the lives of (particular) women in the world" (p.247).

Our study adopts a perspective that begins with the individual rather than a socially constructed theoretical perspective or world-view. If, as Damarin suggests, knowledge resides with the individual, then we assume that learning begins with the individual's prior experiences and beliefs. This perspective leads us to ask how we can change the culture to value and use the contributions of young women. Rather than an approach that seeks to change girls, we seek to discover their strengths by listening to their voices so that their strengths can be incorporated into mathematics education as it is enacted in the classroom. As Shultz and Cook-Sather (2001) advise, we seek to gain new insight as to how high achieving girls approach their study of mathematics by listening as they speak to their experiences.

MODE OF INQUIRY AND DATA SOURCES

Data were gathered from interviews of participants in the *Girls on Track* project, a program designed for middle school girls who have demonstrated their ability to pursue upper level math courses. The girls were rising seventh or eighth graders and on the "fast track" in math leading to the study of calculus by their junior or senior years in high school. All girls who made application for this free camp were accepted into the *Girls on Track* program.

These are daughters of baby-boomers who are economically secure and ambitious for their children. All but two girls live in intact two-parent families where the father is the main breadwinner and works as a computer scientist or engineer, an accountant, or in some other position at one of the large technology or scientific companies in the area. Most of their mothers are also employed but they hold a wider range of jobs, including computer engineer, pharmacist, teacher, nurse, business manager and others. One girl, whose mother died, lives with her grandmother; another, whose parents are separated, lives with her father but these girls, as well as all the others, have stable, caring families.

Girls on Track provides a two-week summer camp for 80 girls with team-building activities to investigate community problems, build computer skills, strengthen proportional reasoning, learn about careers and gender issues while engaging in math-related sports algebra. Camp counselors were asked to select 1-2 girls from their teams who they anticipated would continue in their studies of advanced mathematics. From this

list, 16 girls were interviewed at or near the end of the two-week summer math camp. All but two of the girls were rising 8th graders; 3 were Asian Americans, 6 were African American and nine were Caucasian. The prompts in these semi-structured interviews were: (a) What was math like for you last [school] year? (b) What grade would make you unhappy? (c) Where did you go when you wanted help? (d) What is your favorite subject? and (e) What careers interest you? The interviews were videotaped, the videotapes were transcribed and analyzed. Content analysis was used to develop categories that were then used to code the transcripts.

RESULTS

Four factors emerged as dominant in these high achieving students' minds as they talked about their experiences in math class and what they had to do to achieve success. These factors are explained below.

High Expectations

The girls have high expectations that are encouraged and supported by their families and, often, by their teachers. They are confident that they will experience success in mathematics and they define success as achieving high grades. The following excerpts from interviews are typical.

Interviewer: What was math like for you last year?

Elizabeth: I didn't take pre-algebra last year and I struggled a little bit at the beginning but now I love math. It is one of my favorite subjects. My teacher told me algebra would be a challenge but to just keep my head screwed on right and I could do it. The first quarter I made a C and my mom was like "No, you can do better than that" so ever since then I've made an A.

Interviewer: What algebra grade would make you unhappy?

Brandy: A (grade of) C would make me unhappy because my mother really expects a lot out of me because I'm supposed to be going into 7th grade and I'm going into 8th. She expects a lot out of me and I don't want to disappoint her.

The one element present in each of the girl's lives, without exception, is unquestioning, constant family support and help when needed. This takes different forms and may come from siblings or other relatives as well as from mom and dad but is there for all of these girls. Girls report that one or both parents help them regularly when they have trouble doing homework. Some examples of what the girls say about the kind of help they receive:

Ann: When I couldn't do some of the problems in homework I told my mom and she said "okay we will work on them", because she buys workbooks like the teachers use. She buys them from everywhere and she makes me work on the weekends and over the summer.

Keisha: If I have a problem I can't solve and I go to my mom and she can't figure it out then my dad will sit down with me after dinner and we will go through it step by step until we figure out the answer. Basically he helps me along but I do most of it.

- Interviewer: What would your parents do if you got a bad grade?
- Brandy: They wouldn't get mad at me, they would ask me why I got the bad grade and then help me to improve. I don't think they would get mad at me, I think they would help me. They would probably hire a tutor.
- None of the girls seemed to feel that their parents put excessive pressure on them to succeed; they seemed to have adopted or internalized their parents expectations and made them their own.
- Melissa: My mom and dad brought me up as a straight A students and I am used to getting straight A's and if I get a B I am really disappointed.
- Interviewer: Do they[parents] put pressure on you?
- Melissa: No, really they just like me to do my work and try to get better grades if I get bad ones.

Desire to Understand Math

These girls all want to understand what they are doing in math. One said she wants to know *if I'm really learning and not just memorizing*.

- Gail: I didn't just look at [my returned test or homework papers] and go "Oh, yeah, this is right or this is wrong". If I found something wrong and the teacher gave me the right answer I would go back and try to figure out what I did wrong and how to solve it.
- Alice: I like a challenge and not just something I can zip through. Something I really have to think about and work hard to get the answer. You have to know how you got the answer. You have to know all kinds of math, not just one type. You have to be good at all the steps, not just knowing the answer.

The desire to understand, and their opinions of their teachers, came out in response to the question "How was math for you this year?" They were not asked directly about their teachers but all gave an opinion which, in almost every case, depended on whether the teacher helped them understand the topic or concept being studied. Six girls said they had good teachers; *She really helped me understand it or she did a lot of activities with us and it wasn't just out of the book*.

- Angel: We had a really good teacher. She made it a lot of fun and she made it easier so if we didn't understand she explained it really well and went over it until everybody got it.

Four girls had both positive and negative things to say about their teachers while six were critical of teachers who *really didn't want anybody to do anything well*.

- Fran: [She] let the boys get her off track and then she confused everybody when she tried to explain [in the time remaining].

Several complained about teachers who wanted students to do problems only one way.

- Sitna: Sometimes I felt like the teacher wouldn't spend enough time on one thing. Sometimes I wouldn't understand things the way she was going through it and some of the times she wanted us to do the problems her way and that was harder for me because I knew my own simple way.

Then there was Kelly who only said that her teacher was *grumpy all year long* and made her feel that she wasn't doing her best.

Assertiveness

These are not the "good girls" who are passive in class, remaining quietly in the background while the teacher asks the boys the hard questions. Their desire to understand, as well as their desire to get a good grade, prompts them to ask questions in class and to seek help offered by teachers before and after class. One girl explained that she had to "take the lead" in asking questions.

Lisa: Nobody would ask questions rarely [if] ever because they'd be embarrassed or something.

Interviewer: Did you ask questions?

Lisa: Yes. And then other people would ask a question after I did. So they'd not feel so embarrassed if somebody [else] started out asking questions.

Another said, *If I don't get it, I don't get it and I'm just going to raise my hand*. When these girls get lower grades than they want they go to the teacher and ask why they got the low grade and what they can do to bring it up.

Interviewer: What would you do if you got a C?

Marlene: I would ask the teacher how I got it and ask her to tell us the percentage of the grade and stuff like that. And I would go to her and ask how did I get this [grade] and sometimes if she had problems with it she might raise your grade a couple of points

Interviewer: Would you mind going in after school for help?

Marlene: We did that. The math teacher had a whole bunch of kids after school.

Belief in Hard Work

What they all do to bring up a grade or maintain an A, is to work hard or harder and what makes them happy when they get the grade they want is *I know I worked for it*. When they get the A that they all work for and expect, they feel good *because I know I worked for it* or *because I really pushed myself* or *because I worked so hard for that grade*. When they don't get the grade they want or expect, they don't blame the teacher; they put the onus on themselves. *I go back and try to figure out what I did wrong* or *I ask for extra help and study more and make sure I understand the topic*. *If I got a C, said Sitna, I'd just work more and ask the teacher for stuff to review*.

For these high achievers, a good math student is *someone who tries hard and does their best*. One of the questions posed to all the girls was "What is your definition of an excellent math student? The responses given below are representative of the group.

Sitna: Somebody who always tries their hardest and not necessarily a great, you know, a highly great person. [One] who asks questions in class, who's always participating, never half asleep or anything and always trying their best to do what they can.

Marlene: One that is working and tries the hardest but then also asks questions and actually understands it and keeps working.

And what did Kelly, who said her teacher was grumpy all year and not very helpful, do? This is what she said:

Kelly: I went back into the books and I had taken Sylvan Learning Center and I asked them for help and they went over it with me. I took notes in class and we had a student teacher that helped us. I wrote down notes and did extra problems so I would do my best. And that worked.

EDUCATIONAL IMPORTANCE

These interviews present a picture of girls who like math, who are almost desperately serious about their schoolwork. They want to live up to the expectations of their parents but also want to live up to their expectations for themselves. They worry about alienating their friends by making good grades but are not deterred. The interviews confirm what we have long known, that girls, unlike boys, believe that success comes from hard work rather than ability (Wolleat, Pedro, Fennema and Becker, 1990). This theme ran through all the interviews; girls returned to it over and over. A survey of teachers involved in *Girls on Track* found that teachers think that girls who make As work harder than boys who make As. But these are not the girls referred to by Johnston and Nichols (1995) who "work hard absorbing cut and dried knowledge" (p. 97). All 16 girls, without prompting said that they want to understand what they are studying in mathematics. The want to know how problems work not just how to work problems and get the right answers.

A number of researchers report that teachers in their studies believe that boys have more ability in mathematics than girls (Li, 1999). In a study of the gender beliefs of Finish teachers, Soro (2002) states that teachers believe boys think more deeply about mathematics than girls. These studies find that teachers, including the *Girls on Track* teachers, believe that girls work hard or put more effort into their studies than boys. We question if these stereotypical beliefs about boys and girls reflect a devaluation of effort and hard work on the part of teachers.

Cook-Sather (2002) advocates conversations with students as an important step towards educational reform and the need to incorporate students' perspectives in policy and practice issues. Rather than examining girls' deficits in relation to the culture, here we reported on girls' beliefs about the strengths they bring to the study of mathematics. As a consequence of this perspective, we must examine our world-views about girls' beliefs. We question the education culture's lack of value of hard work for adolescents in mathematics. Despite evidence to the contrary, many continue to believe in the "math gene," especially for boys (Soro, 2002). Recall that we are not studying gifted youth, but those who achieve in the top 20-30%. These attitudes send messages to boys and girls that if you just use your innate ability to understand mathematics, without studying, then you have more value than someone who has ability and works hard to understand mathematics. Certainly as adults, and especially as women, we know the value of hard work to attain life goals. Girls learn from us about hard work, only to be disappointed when their efforts are not valued in an educational setting. We ask, *What's wrong with working hard in math class?*

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