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Encouraging Girls in Math and Science (Part 1)

Diane Halpern, Ph.D. • November 2007

Topic: Encouraging Girls in Math and Science

Highlights

- At the doctoral level in math and science, only about 25 percent of students are female; many smart girls are not choosing a path in these fields.
- Students should be told that abilities are expandable—with enough hard work, you get better. Giving students specific feedback lets them know what they need to focus on to advance.
- Role models are effective because they send girls the message that, "someone like me can do this."
- Live experimentation in the classroom helps spark students' interest and connect math and science to their everyday lives.
- Girls, and students in general, can also benefit considerably from training in visual spatial skills.

About the Interviewee

Diane F. Halpern is Professor of Psychology at Claremont McKenna College. She has won many awards for her teaching and research, including the 2002 Outstanding Professor Award from the Western Psychological

Association, the 1999 American Psychological Foundation Award for Distinguished Teaching, 1996 Distinguished Career Award for Contributions to Education given by the American Psychological Association, the California State University's State-Wide Outstanding Professor Award, the Outstanding Alumna Award from the University of Cincinnati, the Silver Medal Award from the Council for the Advancement and Support of Education, the Wang Family Excellence Award, and the G. Stanley Hall Lecture Award from the American Psychological Association. Diane was president of the American Psychological Association in 2004.

Diane is the author of several books: *Thought and Knowledge: An Introduction to Critical Thinking* (4th ed., 2003), *Thinking Critically About Critical Thinking* (with Heidi Riggio, 2003), *Sex Differences in Cognitive Abilities* (3rd ed., 2000), *Enhancing Thinking Skills in the Sciences and Mathematics* (1992), *Changing College Classrooms* (1994), *Student Outcomes Assessment* (1987), and *States of Mind: American and Post-Soviet Perspectives on Contemporary Issues in Psychology* (co-edited with Alexander Voiskounsky). Her most recent book is coauthored with Fanny Cheung at Chinese University, entitled *Women at the Top: Powerful Leaders Tell Us How to Combine Work and Family* (Wiley/Blackwell Publishers, 2008). This book is based on interviews with 62 women who made it to the top of their profession with children and other family responsibilities. It combines practical advice from these highly successful women with the research literature on work and family.

Full Transcript

The purpose of the practice guide is to develop guidelines about what we know works in encouraging more girls—and more women—to go into careers that use math and science. There are a number of reasons why we need to encourage more girls and more women to go into math and science. One of the reasons is that we're facing a serious shortage in the coming years in the United States in the number of mathematicians and scientists that we have. Increasing number of jobs require math and science, and we have a real shortage. In addition, we know that there are a number of areas where girls and women are underrepresented. So we're missing out on an awful lot of talented people who really could be advancing these areas and be critical for our workforce and critical for our ability to stay competitive and cooperative in a global economy.

One of the things the guide wants to convey to educators, to parents, to the whole general public is that there are, in fact, things that we can do that will encourage more girls and more women to go into areas of math and science. And if we do these things, we definitely should be increasing—changing girls' and women's lives, changing their options and really increasing our preparedness for the workforce.

We're often asked, "where are the differences between girls and boys and how they perform in math and science?" And in fact we find that on some of the measures, girls are doing way better. On some of the

measures boys are doing way better. Different kinds of measures of the same sorts of skills, but that's why we say that on average we're not looking at real differences in abilities. We know that girls tend to get better grades in school, for example, in math and science courses and in all their courses. And, in fact, right now, they're taking slightly more math and science courses as they get through high school. So those are one of the measures where we know girls are doing particularly well. The other measures where they're doing less well is they do slightly less well than boys on some of the standardized exams. On average we count—there's no evidence that it's naturally better for boys to go into math and sciences.

What we are concerned with is the low participation rate of girls in a number of the sciences and in mathematics. So, for example, what's the evidence that we have a problem? About almost half of all undergraduates in math majors are female, so very close to 50 percent numbers—46 percent, 45 percent, depending on what you're measuring. But when you look at the doctorates, they're only about 25 percent. So we're losing an awful lot of very talented women who are getting good grades who are then not pursuing careers in mathematics.

If you looks at their participation rates in medical school—in medical school graduation rates are now 50 percent female; veterinary school, 75 percent female. And those are certainly areas that are very heavily scientific. But if you look at other areas like physics, like engineering, like certain areas of mathematics, the rates are much lower. So it's certainly not a matter of, "can girls do math, can girls do science?" Obviously they can. They're already doing it. But there are certain fields within math and science where they're not participating. Why is that important? It's important because we know, first, of the talent that we're losing. And secondly, when girls and women go into an area, they sometimes study somewhat different topics within an area.

Girls are more likely—and women—are more likely to be more concerned with environmental issues, environmental engineering. In biology, they're more likely to be concerned with some reproductive biological issues. By cutting out a portion of the population, we're also cutting the full range of diversity in our interests and where we make our advances.

It isn't until you start getting to puberty—where lots of things are changing—that you find some of the differences in people's interests and in their choices when they have some choice of courses and some choice of activities. People say, "Well where does it come from?" They certainly come from our expectations. They may come from differences in our development and in our hormone levels. But none of it implies that we can't be encouraging more girls to get into math and science and that they can't all be achieving at equally high rate.

People always ask the "why" question about why are girls and boys not, on average, exactly the same? And those answers are really complicated. There are certainly differences in developmental processes between girls and boys, but none of it puts a limit on anyone's intellectual growth or ability to study or excel in any academic area.

We have five recommendations in our practice guide. Let me just briefly give you an overview of them. Our first is sort of interesting—and you know these are true for boys and girls. They may be particularly true for girls, but these will help everybody improve in science and math. And one is to really convey the idea to students that, in fact, abilities are expandable. I used to be a dean of undergraduate studies at a state university, and when I was dean sometimes students would come in to talk to me and they would say, "I can't do math." Or, "I can't do science." And this was their way of saying "I need to get out of that requirement." And I would say, "What does it mean you can't do it? Is it like an allergy? Is it like, you know, you're allergic to it?" And when you listen to what people are saying, what they're saying is, "I find it hard." And, in fact, somewhere along the line they never learned that it's supposed to be hard. And it is hard, but with the appropriate work, with enough hard work, in fact, you get better. And then it gets easier. And we really need to teach people that it's not that: "You're good in math. You're not good in math. You're good in science. You can't do science." In fact, we can all get better. And with hard work, what is hard now becomes easy.

Most teachers know that they need to provide feedback to students—Information about how well they're doing. But there's two kinds of feedback and they don't have the same results. One is a global, generalized feedback. So if, for example, you take a standardized exam, you get a number, and that number says you did well, you didn't do well. But it doesn't give you any more specific information to tell you what you know and more importantly what you don't know. And we really need to be sure that when we're giving people feedback—one, that it's real feedback. So it's not the sort of thing that regardless of what you do we tell everyone, "that's great." Because that's really not helpful, and that's misleading. But, in fact, we know what you do well, what you don't do well, and how you can use that feedback to improve. And those are just very good practices. They'll help girls and boys know what they need to focus on to advance. Learning math and science for most people is different from learning literature, for example. And they need a different kind of feedback because there's certain skills they may be missing, and then they can really work on developing those skills—filling in holes.

Another one of our recommendations is to provide role models. And this comes out of an old psychological literature. I bet some of our teachers are familiar with the work of Albert Bandura, who talked about motivation. And one of the things with a role model is you're able to say, "Someone like me can do this." So if, for example, I'm a young, Hispanic girl growing up in a neighborhood where there's little English and I've never seen a scientist that looks like me grown up, what you're implicitly telling me is people like me don't become scientists. And even if that's not the message you mean to put across, that is the message that gets conveyed in a thousand small ways. And by showing you some Hispanic woman who grew up in a house where they didn't speak much English, who went on and made scientific and mathematical contributions, what you're really saying is people just like you, in fact, do do these things. And that turns out to be incredibly important. We have really new respect for how all of those implicit messages get put across without even meaning to—what we're telling people about their abilities.

Our fourth recommendation is really to encourage more live experimentation in the classroom—things that involve people's own curiosity, that sparks their interest. We also found—and a lot of this work has been done by people looking at girls' expectancies of success—that even when girls value math and science, they don't see its value in their every day lives. They don't see how they're going to use it. They don't see it as something worth knowing. And if it's not something worth knowing, why should I work so hard at it? There is an old movie you may recall, I'll bet some of our teachers do, when – *Peggy Sue Got Married*. And she gets to come back from the future, and she's in her high school class, and she tells everyone, "Trust me, you're never going to use algebra." And, you know, everyone in the theater just breaks out laughing. And in fact, a lot of that are the messages that we have. So that if we could see the use for this in our lives and in our future careers, then in fact, it will increase motivation and time on task and all those other things that are important for learning that's really going to last.

The last recommendation, the fifth one, is one that I've particularly done a lot of work in, and it's the area of visual spatial skills training. And what that means is training people how to think spatially. We have remedial reading, for example, for kids who have trouble with reading. We have remedial math. But we have nothing in our curriculum, typically, that teaches people about spatial thinking. And there are a number of areas of mathematics—particularly geometry for example, or topology, certain areas in the sciences—that tend to be more spatial. And if you look at some of the cognitive differences literature, this is one of the areas where you find some of the biggest differences between boys and girls, with the advantage going to boys. Everyone will benefit if we have a visual spatial skills training, so I know how to translate a word problem to a picture. And often that will make a very big difference in visualizing what you're solving for and understanding the problem.