

Gender and mathematics research

How do the attitudes of boys and girls differ?

- Differences exist between genders in confidence around learning mathematics: males provided evidence that they were more confident about learning mathematics than were females;
- While young men did not strongly stereotype mathematics as a male domain, they did believe much more strongly than did young women that mathematics was more appropriate for males than for females.
- Males believed that mathematics would be more useful to them than females did.

Gender Equity for Mathematics and Science

Invited Faculty Presentation

Elizabeth Fennema

<http://www.woodrow.org/teachers/math/gender/02fennema.html>

- Girls attitudes to maths in US are becoming more negative. Recent research is looking at the cultural influences to explain why: such as early experiences with practical and scientific equipment (boys often given access, girls less so) and stereotyping in society of mathematicians.

MATH, SCIENCE, AND GIRLS: CAN WE CLOSE THE GENDER GAP?

National Network for childcare

http://www.nncc.org/Curriculum/sac52_math.science.girls.html

Article explores perceived difference in attainment in maths for boys and girls and states that in the US now, that difference has been eroded. However, there is still a difference in attitudes. University of Michigan study showed that women see maths and science as being isolating and not of so much use to society as more verbal subjects/areas. Women frequently saw themselves as 'people oriented' and did not see maths as contributing to this. Vanderbilt University researchers tracked students who scored well on the math part of the SAT at age 13. Found that mathematically gifted girls had broader talents, whereas boys had strong maths bias. Students with strong verbal skills are less likely to pursue maths and science.

What math gender gap?

By Laura Vanderkam

USA Today 2005

http://www.usatoday.com/news/opinion/2005-04-11-girls-math-forum_x.htm

Beliefs that were uncovered in research exploring the beliefs and behaviour of females were:

- Math and science disciplines are male domains.
- One has to be a genius in math and science; you have to have a math/science mind.
- You are either good in math/science **or** good in language arts. You can not be good in both. Tobias labeled this the "zero sum" theory. Girls receive positive reinforcement in the language arts because they tend to be more verbal.
- Math/science work is done instantly if at all.
- There is only one right way to do a problem.

Sheila Tobias

<http://www.woodrow.org/teachers/math/gender/03b-tobias.html>

At what age are negative opinions formed and what are factors?

Boys and girls have similar mathematics and science proficiency scores on tests at the age of 9, but a gap begins to appear at around age 13, or at least this has been the pattern from 1973 to 1994 on the National Assessment of Educational Progress (NAEP).

According to the Third International Math and Science Study (TIMSS) results, among participating countries, girls and boys had similar average mathematics achievement scores (U.S. National Research Center, 1996). However, on the NAEP, 17-year-old females have consistently scored lower, on average, than 17-year-old males, and in 1994, they were 5 scale-score points lower than males (Campbell et al., 1996)

The Relationship of Math Anxiety and Gender

Martha Tapia, Berry College

George E. Marsh II, The University of Alabama

<http://www.rapidintellect.com/AEQweb/5may269014.htm>

There is a common belief that females are less mathematically capable than males. This belief is fairly constant across populations (see e.g. Eccles, 1987). Classroom studies have shown that this belief is in place by the time children enter the third grade (Crawford, Herrmann, Holdsworth, Randall & Robbins, 1989). This belief is mirrored by students' parents. By the time children enter kindergarten, parents expect girls to do better at verbal tasks and boys to do better at math (Lummiss & Stevenson, 1990). This belief continues through elementary school (Entwistle & Baker, 1983) and on throughout the academic process (Hyde & Linn, 1988; Yee & Eccles, 1988).

How Negative Expectancies and Attitudes Undermine Females'

Math Confidence and Performance: A Review of the Literature

by

Jennifer Gutbezahl

<http://www.inform.umd.edu/UMS+State/UMD-Projects/MCTP/Essays/WomenAndMath.txt>

New research by a team that includes vocational psychologists at the University of Wisconsin-Milwaukee (UWM) indicates that the self-confidence instilled by parents and teachers is more important for young girls learning math and science than their initial interest.

<http://www.sciencedaily.com/releases/2008/09/080905153807.htm>

There is evidence of difference in the way that teachers respond to male and female students in mathematics (and more generally?) 'teachers interact more with boys than with girls, praise and scold boys more than girls, and call on boys more than girls. However, the impact of this differential treatment is unclear and difficult to ascertain.' (Fennema & Leder, 1990)

'...girls' self-esteem, confidence in their abilities, expectations for life, interest in challenging courses and rewarding careers, and pursuits in math and science decline as they get older'

American association of University Women, Washington, DC, "Shortchanging Girls, Shortchanging America: A Call to Action." AAUW Initiative for Educational Equity, American Association of University Women, Washington, DC, 1992.

According to this paper, parents' and teachers' expectations for girls in math have an enormous impact on girls performance in math. Girls internalize their teachers' and parents' negative expectations, which become self-fulfilling prophecies.

Gutbezahl, Jennifer, "How Negative Expectancies and Attitudes Undermine Females' Math Confidence and Performance: A Review of the Literature," Information Analysis -General, 1995. (To order by mail, write to: ERIC Document Service, 7420 Fullerton Rd., Suite 110, Springfield, VA. 22153-2852.)

Do girls' attitudes differ if there is more use and application? Are particular approaches more appropriate for girls?

Competitive activities encouraged boys' learning and had a negative influence on girls' learning, while the opposite was true with cooperative learning. Since competitive activities were much more prevalent than cooperative activities, it appeared that classrooms we studied were more often favorable to boys' learning than to girls' learning.

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Classroom Strategies for promoting effective maths and science work for girls

- ask students to state concepts out loud (this helps students to learn the vocabulary of the subject).
- cultivate bonding around an intellectual challenge (this provides students with an opportunity to feel like a team).
- use the human body as a vehicle for interesting girls in physics, etc. (girls often find the human body fascinating and will identify with phenomena related to the body).
- encourage girls to participate in extracurricular math and science activities.
- stress safety precautions instead of dangers (girls will sometimes be reluctant to participate in lab activities if they seem too dangerous).
- use computer and lab partners (most girls work better in teams).
- introduce lessons with an overview (girls learn more readily from the "big picture" rather than from disconnected details).
- incorporate students' comments into lectures (this technique validates the students' understanding of concepts).
- acknowledge the contributions of both men and women to mathematics and science via posters, reports, examples, story problems, etc.
- use cooperative activities and some single-sex small groups.
- provide female role models.
- provide opportunities for girls to develop spatial visualization skills.
- use writing to help students express and clarify their feelings and thoughts (e.g., math autobiographies, science journals).
- create an attractive classroom environment (research shows that girls learn better in an aesthetically pleasing environment).
- wait 4 or 5 seconds before calling on a student to answer the question (girls often wait until they have formulated an answer before they raise their hands; boys often raise their hands immediately and then formulate an answer).
- don't grade on a curve (encourage all students to realize their potential rather than to compete against one another).
- solve problems by multiple methods (this appeals to students with different learning styles).

Classroom Attitudes

- encourage a "can do" attitude; teach students to give themselves credit. (Girls tend to credit their achievements to luck rather than to their ability.)
- encourage all students to take additional math and science courses (teacher encouragement has been shown to be a major factor in students' decision-making processes).
- encourage girls to take risks.
- judge *what* girls say, not *how* they say it (don't assume that if they hesitate or apologize, they don't know the answer).
- help girl students value themselves (girls often have a severe drop in self esteem during the middle school years. Women teachers need to model a healthy self respect and male teachers need to have respect for both girl students and female colleagues).

Kathie Anderson, Rhonda Brooks, and Sr. Mollie Reavis, SNJM
<http://www.woodrow.org/teachers/math/gender/11strategies.html>

Research ending with 15 practical recommendations for the improvement of math education for girls. (couldn't get access to this – it would need to be sent for)

Hanson, Katherine, "Teaching Mathematics Effectively and Equitably to Females." *Trends and Issues No. 17, Columbia University, New York, N.Y. Teachers College; Education Development Center, Inc., Newton, MA. Center for Equity and Cultural Diversity. 1992.*

(To order by mail, write to ERIC Clearinghouse on Urban Education, Institute for Urban and Minority Education, Box 40, Teachers College, Columbia University, New York, N.Y. 10027.)

Research argues that girls would enjoy math, increase their time on math tasks, and have positive emotional reactions to math if math were taught in a cooperative setting.

Bono, Deborah, "The Impact of Cooperative Learning on Suzy and Janie's Attitudes about Math," *Research Report in Virginia, 1991.*

(To order by mail, write to: ERIC Document Service, 7420 Fullerton Rd., Suite 110, Springfield, VA. 22153-2852.)

Recent research:

5/29/2008 - The gender gap in math perceived to exist between girls and boys has long been contested. New research published in the journal *Science* adds clarity to the debate and demonstrates that girls perform better in mathematics in more gender equal societies, in some cases besting male peers.

The research, led in part by Kellogg School of Management Professor Paola Sapienza, sought to address the issue of whether social and cultural factors influence women's success in math and science. Sapienza and her colleagues Luigi Guiso (Istituto Universitario Europeo) and Ferdinando Monte and Luigi Zingales (University of Chicago), empirically investigated whether a global gender gap exists in math to understand the relative importance of biology and culture on the development of basic mental attributes that are valuable for conducting math and science.

"The so-called gender gap in math skills seems to be at least partially correlated to environmental factors," says Sapienza. "The gap doesn't exist in countries in which men and women have access to similar resources and opportunities."

http://www.kellogg.northwestern.edu/News_Articles/2008/sapienza-research.aspx

New report gap has narrowed between boys and girls in US

A new report by researchers at University of Wisconsin and University of California, Berkeley, aims to overturn the long-held belief that girls aren't as good at math as boys. According to new data, the researchers say, that gender gap has become a myth — a finding they hope will help shift the very real gender gap in math, science and technology professions, which are currently dominated by men.

<http://www.time.com/time/health/article/0,8599,1826399,00.html>