A History of Perceptions of Girls’ Aptitudes in Science and Math

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Questions

How have perceptions of girls’ aptitudes in math and science changed from the early 19th century to the early 21st century?

How did demographics affect these perceptions?

What were periods of change? Why?
Questions

What were perceptions of girls’ aptitudes in which subjects?
How did these perceptions compare to those of boys?
What are some reasons for the changes?
Did perceptions affect achievement?
What are some implications for today?
Caveat

There have been complex underlying changes in the constructions of math and science as fields of knowledge and study. This is the perspective of a historian of education not a historian of science, and more on perceptions about science than math.
Demographics

White educators’ perceptions (female and male) of girls who were:

- White
- Middle class and above
- Native born, not immigrants
- Attending “higher schools,” private co-ed and single sex academies
- Later, public high schools.
Late 18th and Early 19th Century

What were perceptions of girls’ aptitudes in science in the late 18th and early 19th century?

Girls were thought to have a good aptitude for science.
Guess which science was first thought appropriate for girls? In which girls could and should succeed? Why?

Geography!

Morse’s *Geography Made Easy*, 1784, dedicated to “The Young Masters and Misses Throughout the United States”
From Thomas Smith, *The Scientific Library*, 1815
American Antiquarian Society
In Kim Tolley, *The Science Education of American Girls*
New York: Routledge/Falmer, 2003
Most illustrations and charts are from Tolley
Why was geography the first science thought appropriate for girls?

- Mothers as educators of new generation of American citizens
  - Needed to know new geography of new nation
  - Nationalism
  - Pride in new nation
- Create support for scientific expeditions
  - Lewis and Clark, 1804, and others
- Expansive definition of geography, natural history, material culture, collections of objects, “wonders”
- Religious, to better understand the works of the “Creator”
### Table 1.1  Percentage of Pennsylvania Higher Schools Offering Geography, 1750–1889

<table>
<thead>
<tr>
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<th>1750–1829</th>
<th>1750–1889</th>
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<tbody>
<tr>
<td>Female schools</td>
<td>67% (n=36)</td>
<td>83% (n=90)</td>
</tr>
<tr>
<td>Male and coeducational schools</td>
<td>74% (n=47)</td>
<td>77% (n=116)</td>
</tr>
</tbody>
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*Source: Compiled from James Mulhern, *A History of Secondary Education in Pennsylvania* (New York: Arno Press, 1969), 328 and 428. Mulhern’s data are based on the courses of study offered in school catalogs. Sample sizes are indicated in parentheses.*

### Table 1.2  Percentage of North Carolina Male and Female Higher Schools Offering Geography, 1794–1839

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<table>
<thead>
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<tbody>
<tr>
<td>Female schools</td>
<td>94% (n=47)</td>
</tr>
<tr>
<td>Male schools</td>
<td>86% (n=56)</td>
</tr>
</tbody>
</table>

*Source: Data compiled from newspaper advertisements included in Charles L. Coon’s *North Carolina Schools and Academies 1790–1840: A Documentary History* (Raleigh, N.C.: Edwards & Broughton, 1915).*
Why were girls thought to be good at sciences compared to boys?

- Expectations of career and life roles
  - Ministry for men: motherhood for women
  - Classical languages for boys: sciences for girls
- Social construction of perception
  - Men were supposed to be good at languages so girls could not be (reverse of today!!)
  - Latin and Greek were markers of men’s education: No latin offered at Mt. Holyoke in 1837; Latin was offered at Wellesley in 1875 to demonstrate that it would offer education equal to that of men
- Other reasons
  - Low status for sciences-Job market not good for sciences: Women were not in the job market
  - High status of classical languages-male teachers knew classical languages; many were also ministers
Spread from private academies and in private teacher education seminaries, Emma Willard’s Troy Female Seminary, founded in 1821, was one of the main centers of dissemination.
Uses of Science Education for Girls and How Taught

• Practical Uses
  • Domestic science, home chemistry, cooking…

• Taught hands on, with experiments
  • Beginning and higher level textbooks such as:
    • Emma Willard's sister Almira Hart Lincoln Phelps's much-used textbooks, Botany for Beginners, 1833; Geology for Beginners, 1834; Chemistry for Beginners, 1834; Lectures on Chemistry, 1837, and others
If the formula in the note below be applied to the third example in numbers, the loss of weight will be equal to

\[
\frac{2000(2 \times 4000 \times 500 + 250,000)}{16,000,000 + 2 \times 4000 \times 500 + 25,000} = \frac{8,500,000,000}{20,250,000} = 419.41 \text{ lbs.}
\]

If the height is not more than half a mile, \(x^2\) may be neglected, and then the formula will be

\[
W - W' = \frac{W \times 2x}{r + 2x}.
\]

Fig. 17.

* Let \(A\), Fig. 17, be the earth, \(C\) its center, \(x\) the height from the surface, then will the weight at \(s\) be to the weight at \(x\) as the squares of the distances \(Cx\) and \(Cs\). Now, to find the loss of weight, we must subtract the weight at \(x\) from the weight at \(s\), and then, if we represent the weight at \(s\) by \(W\), and at \(x\) by \(W'\); also, \(Cs\) by \(r\), and \(sx\) by \(x\), we shall have the proportion

\[
W : W' = (r + x)^2 : 2rx + x^2, \text{ or } W : W' = r^2 + 2rx + x^2 : 2rx + x^2.
\]

The loss of weight, then, will be

\[
W - W' = \frac{W(2rx + x^2)}{r^2 + 2rx + x^2}.
\]

Plate 3.2 The Formula for Newton's Law of Gravitational Force, in Alonzo Gray's *Elements of Natural Philosophy*, 1850.
Later 19th Century Post Civil War

- Growth of higher math education for girls
- By 1880s equal number of boys’ and girls’ academies offered algebra and geometry
- More girls than boys in public high schools and more graduate. Why? Gender segregated jobs and careers: few careers for girls so stay in high school; for women’s occupations, girls need math and science to become teachers, nurses need science, bookkeepers need math
Early 20th century, Progressive Era

- Subject differentiation begins in sciences, not math.
- Until 1920 equal number of male and female algebra teachers, but more male science teachers.
- Demographics of high schools change, more stratified, immigration peaks, racial, ethnic, and social class stereotypes and prejudice about aptitude, vocational education for immigrants, Native Americans, African Americans, Latinos, Asians and Asian Americans, and children from low-income families, content level declines in “comprehensive high schools,” resistance.
In 1893

Committee of Ten, Harvard president Charles W. Eliot recommends classical subjects for all high school students, with sciences and modern languages, but only about 5% of school-age students in urban North attending public high schools in 1880s, curriculum for elites
In 1918

Cardinal Principles of Secondary Education, high school educators recommend seven curricular guidelines for high school curriculum, in order:

1. health
2. command of fundamental processes (basics not higher level)
3. worthy home membership
4. vocation
5. civic education
6. worthy use of leisure
7. ethical character
After 1918

Vocational education takes up more time, home economics for girls, shop for boys

Change in gender of teachers by subject, by 1927-28 (based on sample of 38 Wisconsin high schools), English teachers 100% female, physics teachers 92% male
Girls begin choosing different subjects within sciences, natural history, nature study, botany, horticulture, gardening, and zoology, not other sciences, and take up Latin and other languages, reversal of earlier stereotypes, gendered curriculum differentiation a legacy of the Progressive Era
Public discourse of gender changes, eugenics, essentialism. Psychologist G. Stanley Hall “invents” gendered adolescence in 1904, girls thought to be innately different from boys in their thinking and abilities, based on new sciences of psychology, genetics, IQ testing.
Depression era, World War II, Cold War

Backlash against girls in science, Cold War science for men

Media ignores women in sciences and math, “Marie Curie syndrome,” a few rare “heroines,” women at Los Alamos and elsewhere and importance to war effort in science and math not discussed in media
1950s

- Myth of “perfect” wife, mother, and children
- How to get a husband
- Not work in the job market
- Not be perceived as good in math and science
- Brown v Board of Education 1954, but growth of suburbia and segregation continues, lower standards and fewer science and math course offerings in segregated schools
1960s and 1970s

- President Lyndon Baines Johnson’s War on Poverty
- Elementary and Secondary Education Act of 1965-most new federal $ goes to remedial “compensatory education” to poor children in elementary schools, not to high schools science and math education
- With escalation of Vietnam War education funding becomes limited
1980s and Beyond

- Standards and accountability movement begins-attempt to raise curriculum standards
- No Child Left Behind-focus on literacy and arithmetic, less on science,
  - gender NOT a category for closing achievement gaps
  - Common Core State Standards attempt to raise science and math curricular expectations nationally, resistance to Core and excessive testing
- public perceptions of girls’ lower aptitude in math and sciences harden
- growth of technology as career for men-Silicon Valley gender imbalance
- STEM movement for global economic competition begins-concern about girls not in STEM fields
Possible effects of perceptions of aptitude on achievement?

In 1923, E. L. Thorndike, father of educational psychology and standardized achievement tests, found NO statistically significant differences in girls’ and boys’ achievement on arithmetic tests.
Possible effects of perceptions of aptitude on achievement?

In 2011, Trends in International Mathematics and Science Study (TIMSS) reports, based on 2007 data, differences in girls’ and boys’ performance by grade level and subject.

In math, American boys outperformed girls in grade 4 but girls outperformed boys in math at grade 8.

In science, girls outperform boys in grade 4 but boys outperform girls in science in grade 8.
Possible effects of perceptions of aptitude on achievement?

In 2015, Organization for Economic Cooperation and Development study found large performance differences between 15-year-old girls and boys on PISA tests (Program for International Student Assessment) with boys scoring higher in math, OECD attributes in part to perceptions of parents, teachers, and girls, math anxiety, low confidence, and stereotype threat.
From executive summary of *The ABC of Gender Equality: Aptitude, Behavior, and Confidence*, OECD, 2015

“In the large majority of countries and economies that participate in PISA, among high performing students, girls do worse than boys in mathematics; in no country do they outperform boys at this level. In general, girls have less self-confidence than boys in their ability to solve mathematics or science problems. Girls – even high-achieving girls – are also more likely to express strong feelings of anxiety towards mathematics. **On average across OECD countries, the score-point difference in mathematics performance between high-achieving girls and boys is 19 score points. However, when comparing boys and girls who reported similar levels of self-confidence in mathematics and of anxiety towards mathematics, the gender gap in performance disappears.**

Today? What can we do?
References


References


Thank you!