High School Preparation for College Calculus: Is the Story the Same for Males and Females?

Carol H. Wade, Ph.D. & Christian P. Wilkens, Ed.D.
The College at Brockport (SUNY)
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Why is it important to study Gender and Mathematics?

- US needs well prepared STEM professionals
- Substantiate, or not, single gender schools or single gender classrooms
- Dispel or confirm stereotypes concerning gender and mathematics

Single gender schools & classrooms

Why?

- *Claims* about biological and developmental differences, behavior differences, classroom and school climate impacts, pedagogy, etc.
- *E.g.* The charter application for the Franklin Academy for Boys (Tampa, FL): "*...the typical teenage girl has a sense of hearing seven times more acute than a teenage boy,*" and "*...[s]tress enhances learning in males. The same stress impairs learning in females.*" (L.A. Times, 6/4/12)

Monroe County (NY) single gender schools

Public (*allowed under ESSA – then NCLB – since 2002*)

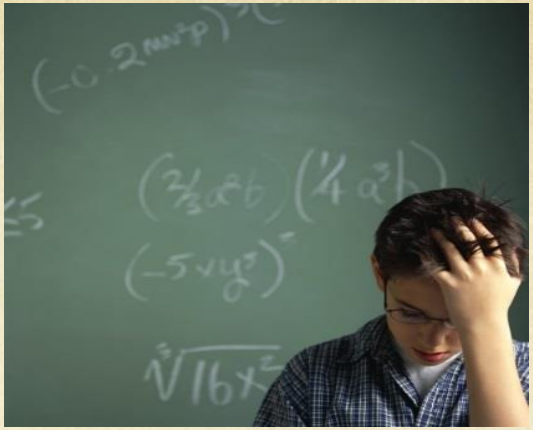
- RCSD – Leadership Academy for Young Men (7-12th grade)
- RCSD – MLK Academy for Boys (3-6th grade)
- Young Women's College Preparatory Charter School (7-12th grade)
- Vertus Charter School (all male, 9-12th grade)
- University Prep Charter School (all male, 7-12th grade)

Private

- McQuaid Jesuit High School (all male, 7-12th grade)
- Ora Academy (all female, 9-12th grade)
- Our Lady of Mercy High School (all female, 7-12th grade)
- Talmudical Institute (all male, 9-12th grade)

How about instructional practices in co-gendered schools and classrooms?

Boys are doing far worse than girls.



- Girls & boys perform **identically** on virtually all IQ & achievement tests.

- YET outcomes are different across gender.

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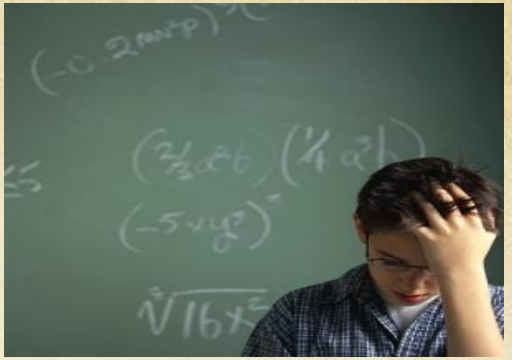
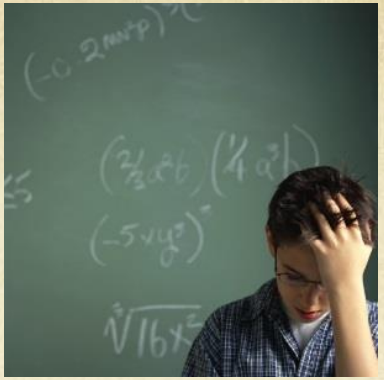


- Compared to girls, boys of all races and ethnicities are **more likely to be retained** in any grade (Ross et al., 2012, Fig. 3), are **more likely to be suspended or expelled** from school (National Center for Education Statistics [NCES], 2012a, Table 14), are **more likely to struggle with reading and writing** (NCES, National Assessment of Education Progress [NAEP], Reading 2013; NCES, NAEP Writing 2011), are **more likely to take easier courses** and **get lower grades** (Nord et al., 2011, Figs. 18 & 22), and are **twice as likely to be in special education programs** (Ross et al., 2012, Fig. 1).

Boys are doing far worse than girls.



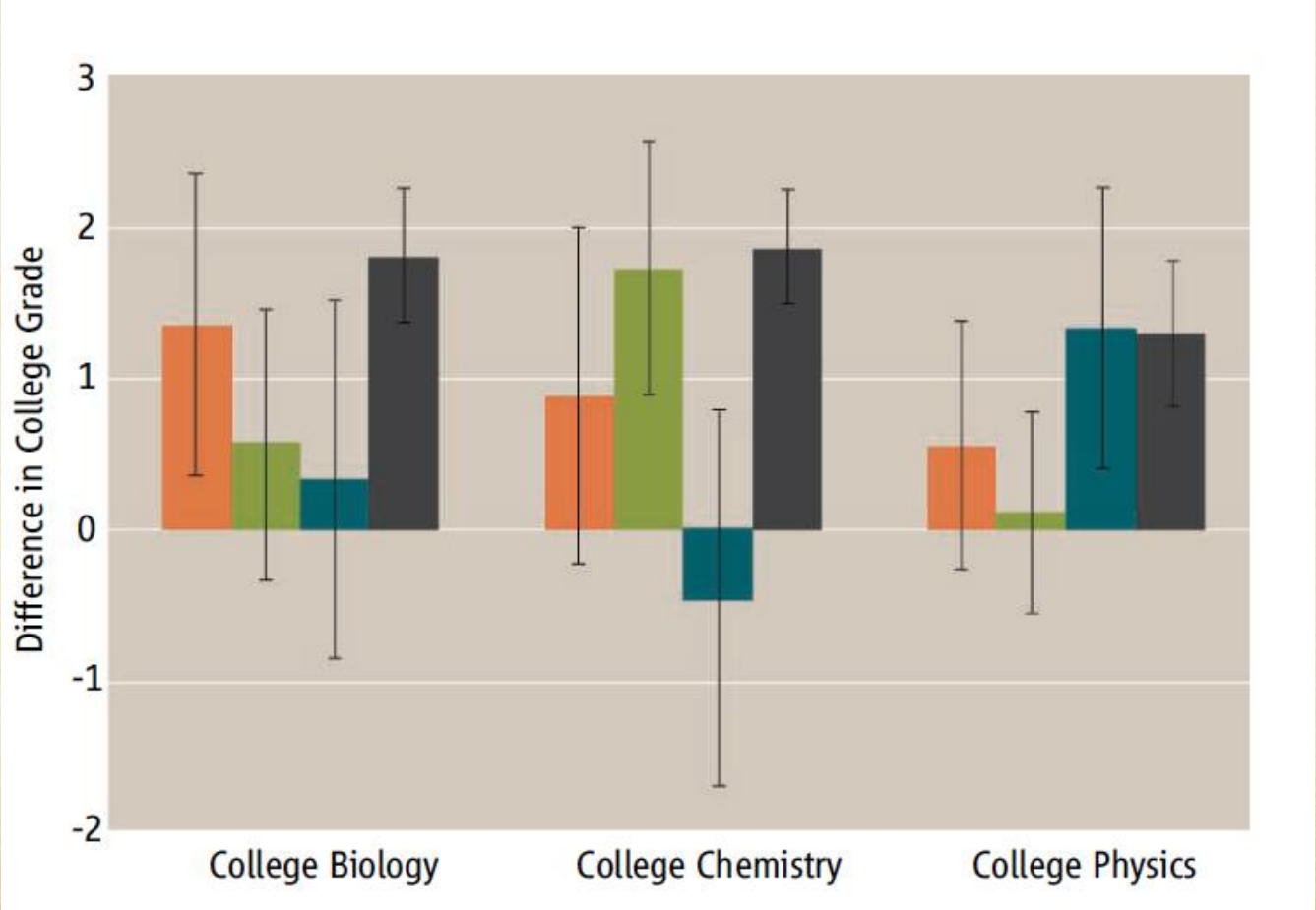
- These struggles yield poor school outcomes:

- Boys are **less likely to graduate from high school** than girls (Stetser & Stillwell, 2014, Table 4), are **less likely to matriculate to college** (NCES, 2013, Table 302.60), are **less likely to stay in college** when there (Ross et al., 2012, Figure 6), and are ultimately **less likely than girls to earn associate's, bachelor's, master's, or doctoral degrees** (NCES, 2012b, Indicator 47).

What about females?

- Take the same math courses as males in high schools (Bressoud, 2014).
- Get similar or better grades than males (Bressoud, 2014).
- Account for less than half of the students in college calculus (Ellis Fosdick and Rasmussen, 2016)
- Twice as likely as males not to continue to Calculus II (Ellis Fosdick and Rasmussen, 2016)
- Under represented in many STEM fields (Ellis Fosdick and Rasmussen, 2016)

How did we get to the national study on high school preparation for college calculus?



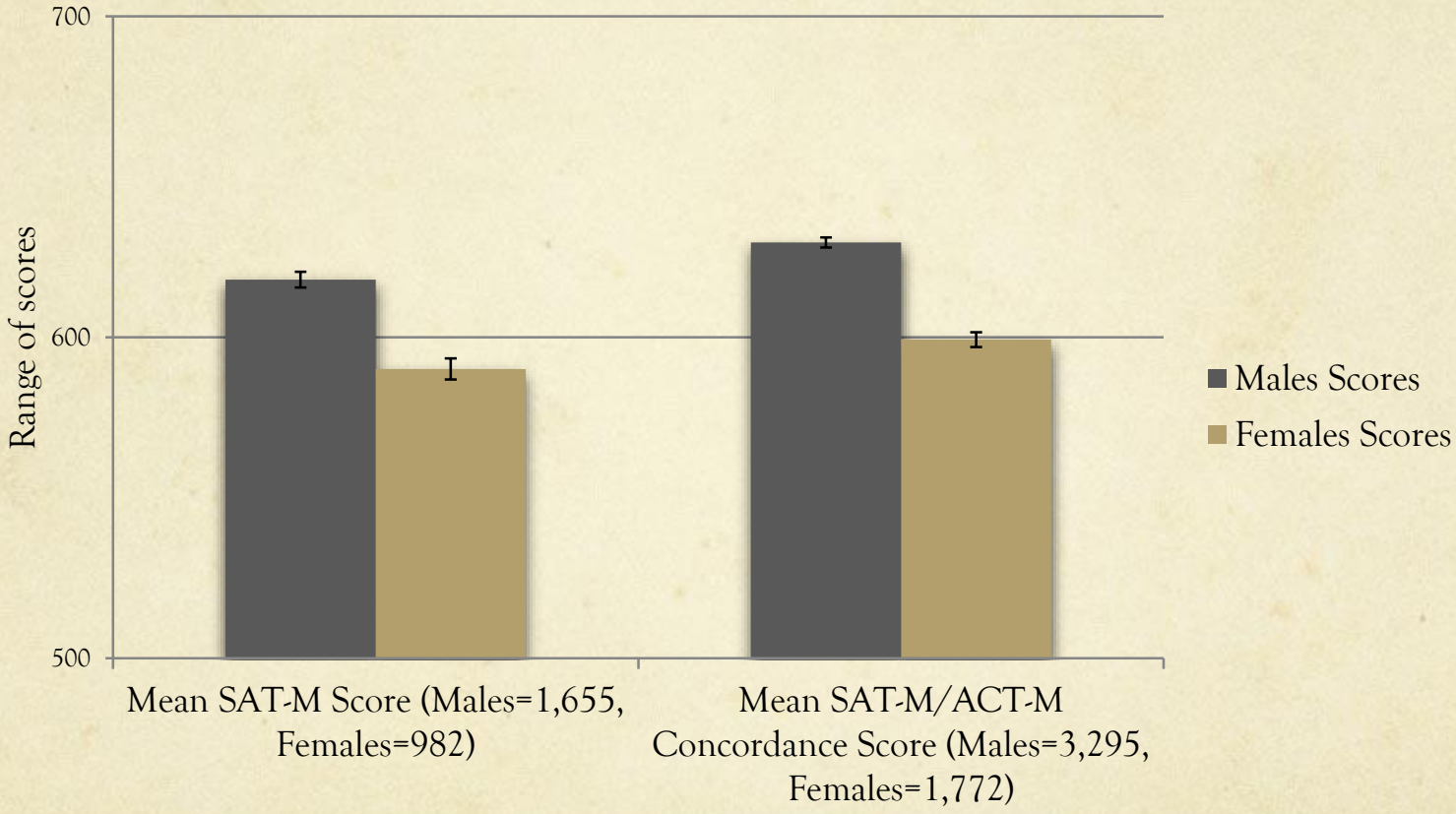
FICSMath Study

- ***10,492 total respondents from across the US***
- For this study:
  - Precalculus or calculus senior year in high school
  - 5,985 in single variable college calculus following semester
  - 5,681 reported gender in dichotomous fashion
  - If the gender question had been broader there may have been less missing data

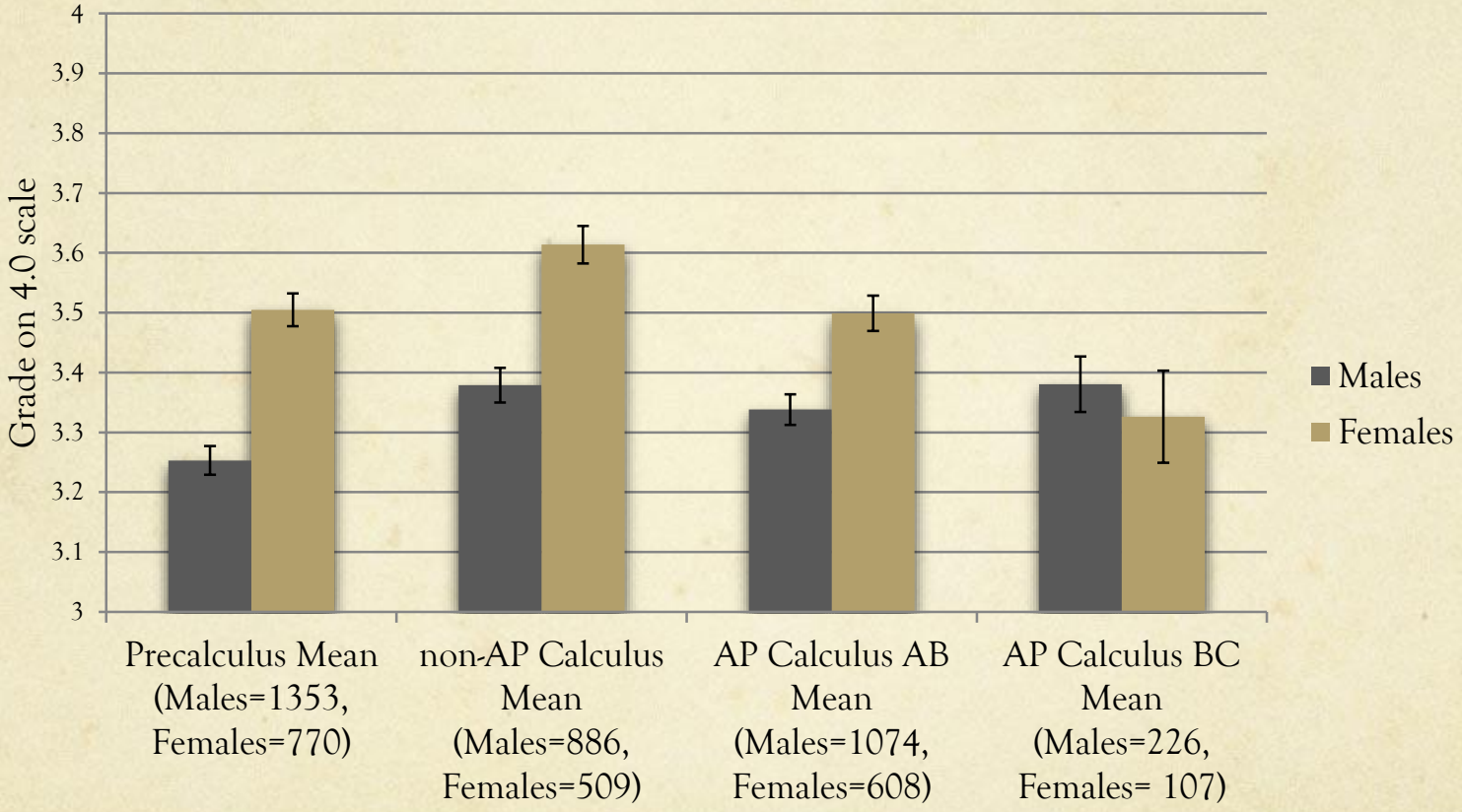
In this Study
3,648 males; 2,033 females:

- Precalculus to College Calculus:
  - males=1,416; females=788
- Non AP Calculus to College Calculus:
  - Males=920; females = 110
- AP Calculus AB to College Calculus:
  - Males=1,078, females= 609
- AP Calculus BC to College Calculus:
  - Males=234, females=118

Comparison of Males and Females average scores on the SAT-M and the SAT-ACT Mathematics Concordance Score.



Mean performance grades in students' last high school mathematics class (precalculus or any level of calculus) with the number of males and females who self reported their grades on the FICSMath survey.



Control Variables in HLM

Variable	Parameter Estimate	Standardized Coefficient	Minimum Value	Maximum Value	Mean
Precalc or Calc Grade	3.78***	0.21	0	4.33	3.391
Calc Dummy	5.71***	0.19	0	1	----------
SAT/ACT Math	0.02***	0.11	200	800	631.86
Grade in Algebra 2	1.45***	0.06	0	4.33	3.65
Grade in Geometry	1.34***	0.06	0	4.33	3.65

*p<0.05; **p<0.01; ***p<0.001

Gender Item
Males=1; Females=0

Variable	Parameter Estimate	Standardized Coefficient	Minimum Value	Maximum Value	Mean
Gender	-1.70	0.57	0.00	0.00	--------

*p<0.05; **p<0.01; ***p<0.001

Variable	Parameter Estimate	Standardized Coefficient	Minimum Value	Maximum Value	Mean
Required new insight and creativity	1.92***	0.06	0.00	1.00	--------
Extent of conceptual understanding	0.62***	0.05	0.00	5.00	3.68
Emphasis on Functions	0.57**	0.04	0.00	5.00	3.93
Emphasis on Vocabulary	0.40**	0.04	0.00	5.00	2.34
Frequency of problems with proofs	-0.01***	-0.06	0.00	7.00	4.94
Teacher highlighted more than one way to solve problems	-0.48**	-0.05	0.00	5.00	3.66
Emphasis on hands on activities	-0.43**	-0.05	0.00	5.00	1.74
Whole class discussions	-0.28***	-0.04	0.10	5.00	2.29
Connected math to real life applications	-3.23***	-0.03	0.10	5.00	1.55
STEM or non-STEM calculus course	-3.61***	-0.06	0.00	0.00	-------

*p<0.05; **p<0.01; ***p<0.001

Important take away:

There were no interaction variables between gender and pedagogical practices used in high school level precalculus or calculus (non-AP, APAB, or APBC).

What does this mean?

- Teachers do not need to teach differently for different genders in the transition phase to college calculus.
- This calls into question the money spent on single gender schools (based on performance in mathematics and preparation for future learning)
- This calls into question the practices of single gender mathematics classes.

Questions?