

How “Social Vaccines” Can Diversify STEM: Effect of Peers, Mentors, & Experts

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A riddle

A man and his son are in a terrible car accident. The man dies instantly; the boy is critically wounded. The ambulance rushes the boy to the ER on the slim chance he can be saved. The surgeon enters the operating room, takes one look at the boy and says: "I can't operate on this boy...he is my son!"

Who is the surgeon?

Why didn't the answer pop into mind easily?

- Because we automatically associate men and women with different types of professional roles.
- Men = technical professions; women = caretaking professions.
- *Implicit stereotypes*: inaccurate assumptions that overlook talent when it is embodied in a person who doesn't fit a narrow profile.
- Consequence: Girls and women who don't fit this narrow profile feel they don't belong in STEM classes, majors, and careers, even if they have the ability.

How to effectively increase girls' and women's participation in STEM

“Social vaccines”

Just as biomedical vaccines protect and inoculate individuals' body against noxious bacteria and viruses

so too...

Contact with female experts and peers act as “social vaccines” that protect and inoculate individuals' mind against noxious stereotypes

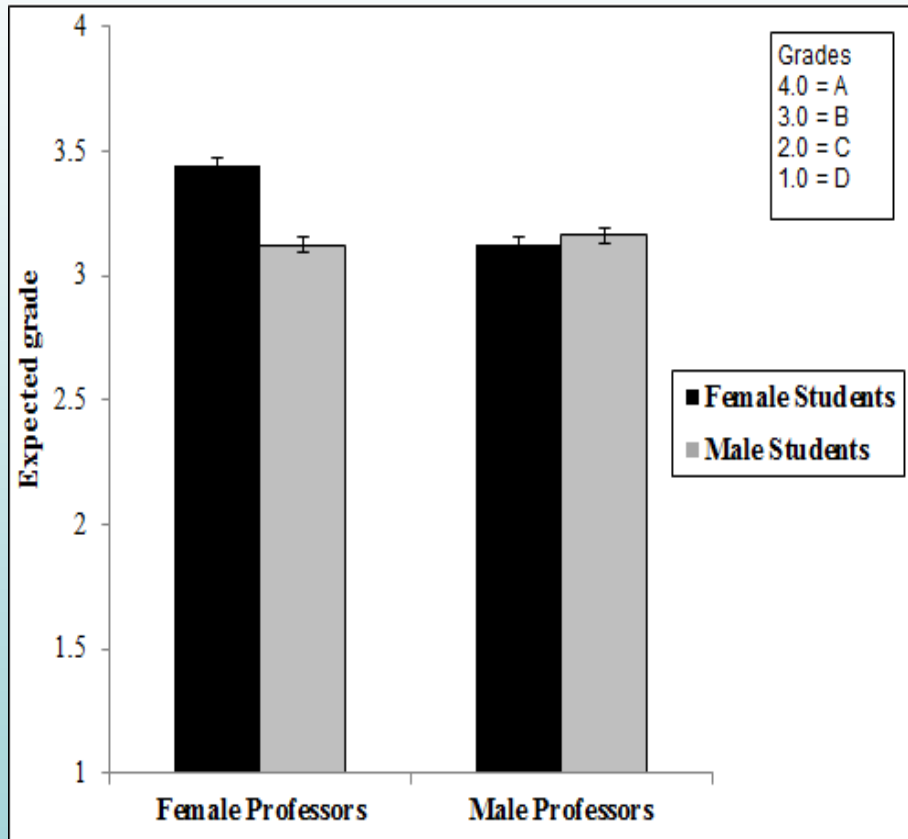
Four examples of social vaccines based on my research

Female teachers and professors in STEM are social vaccines

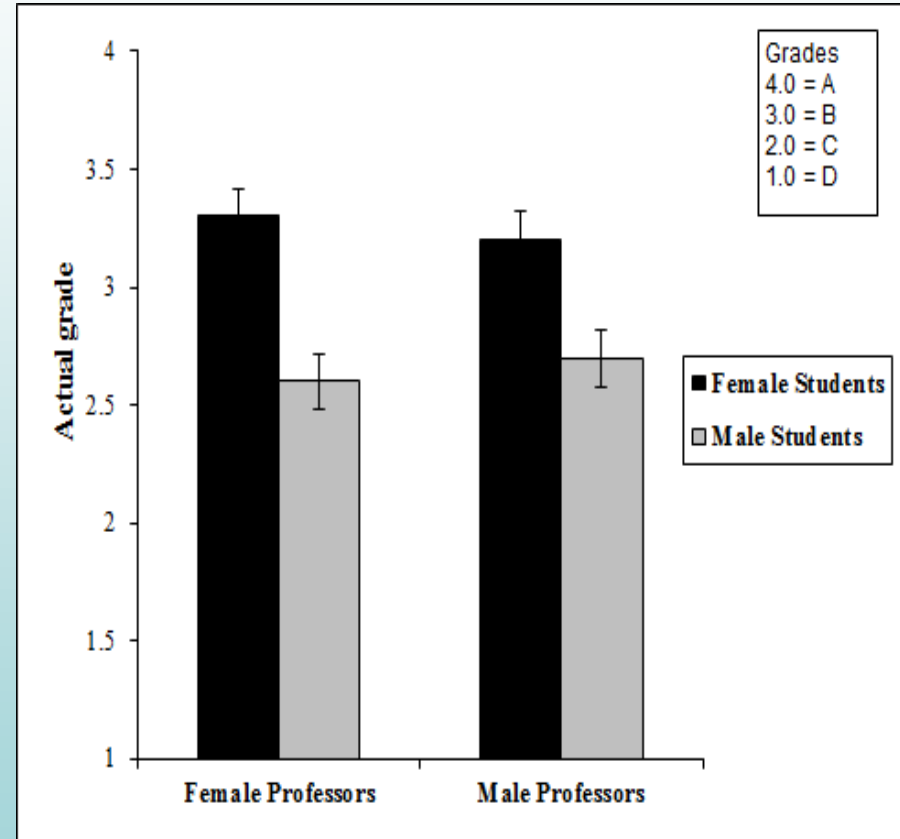
- When women start college and take STEM courses with female instructors, contact with same-sex experts increases confidence and belonging
- A study in calculus courses: Recruited 1st year college students from calculus classes taught by female professors or male professors.
- Everything else about these classes was identical: syllabus, exams, grading
- Does the professor's gender affect female students' confidence in their calculus ability, grades in calculus, etc.?

Expected final grade and actual final grade

Expected calculus grade (confidence)



Actual calculus grade (ability)



**Media stories of successful women in STEM
are also social vaccines**

Media stories of female engineers



Ayanna Howard received her B.S. in electrical engineering at Brown University and her M.S. and Ph.D. in electrical engineering from the University of Southern California. Ayanna was first inspired by the TV show “The Bionic Woman,” in which a severely injured woman attains extraordinary powers through artificial (bionic) limbs. Ayanna decided at age 11 that she wanted to create artificial limbs for people. She planned to go to medical school, but discovered she hated biology—especially dissecting frogs. She then heard about robotics and realized that if she became an engineer she could do exactly what she wanted to do. She currently teaches and conducts research at the Georgia Institute of Technology where she is working to discover new ways that robots can help both in space exploration and in assisting people on Earth. One project that she is very proud of is her work at NASA’s Jet Propulsion Laboratory, where she helped develop the next generation of the Mars rover—a robot that will be independent-minded enough to explore the Martian terrain on its own, without having its every move programmed by a human.

Media stories of male engineers



Samuel Howard received his B.S. in electrical engineering at Brown University and his M.S. and Ph.D. in electrical engineering from the University of Southern California. Samuel was first inspired by the movie “The Six Million Dollar Man” in which a severely injured man attains extraordinary powers through artificial (bionic) limbs. Samuel decided at age 11 that he wanted to create artificial limbs for people. He planned to go to medical school, but discovered he hated biology—especially dissecting frogs. He then heard about robotics and realized that if he became an engineer he could do exactly what he wanted to do. He currently teaches and conducts research at the Georgia Institute of Technology where he is working to discover new ways that robots can help both in space exploration and in assisting people on Earth. One project that he is very proud of is his work at NASA’s Jet Propulsion Laboratory, where he helped develop the next generation of the Mars rover—a robot that will be independent-minded enough to explore the Martian terrain on its own, without having its every move programmed by a human.

Media stories of engineering innovations (no gender information)



Electrical engineering started with the discovery of electricity and involves the study and application of electricity, electronics, and electromagnetism. In addition to working on improving electronics, electrical engineers also work on ways to use electronics to improve people's lives and information collection. For example, electrical engineers at the Georgia Institute of Technology are currently working to discover new ways that robots can help both in space exploration and in assisting people on Earth. One such project is being conducted at NASA's Jet Propulsion Laboratory, where they are helping NASA develop the next generation of the Mars rover—a robot that will be independent-minded enough to explore the Martian terrain on its own, without having its every move programmed by a human.

Media stories of female engineers

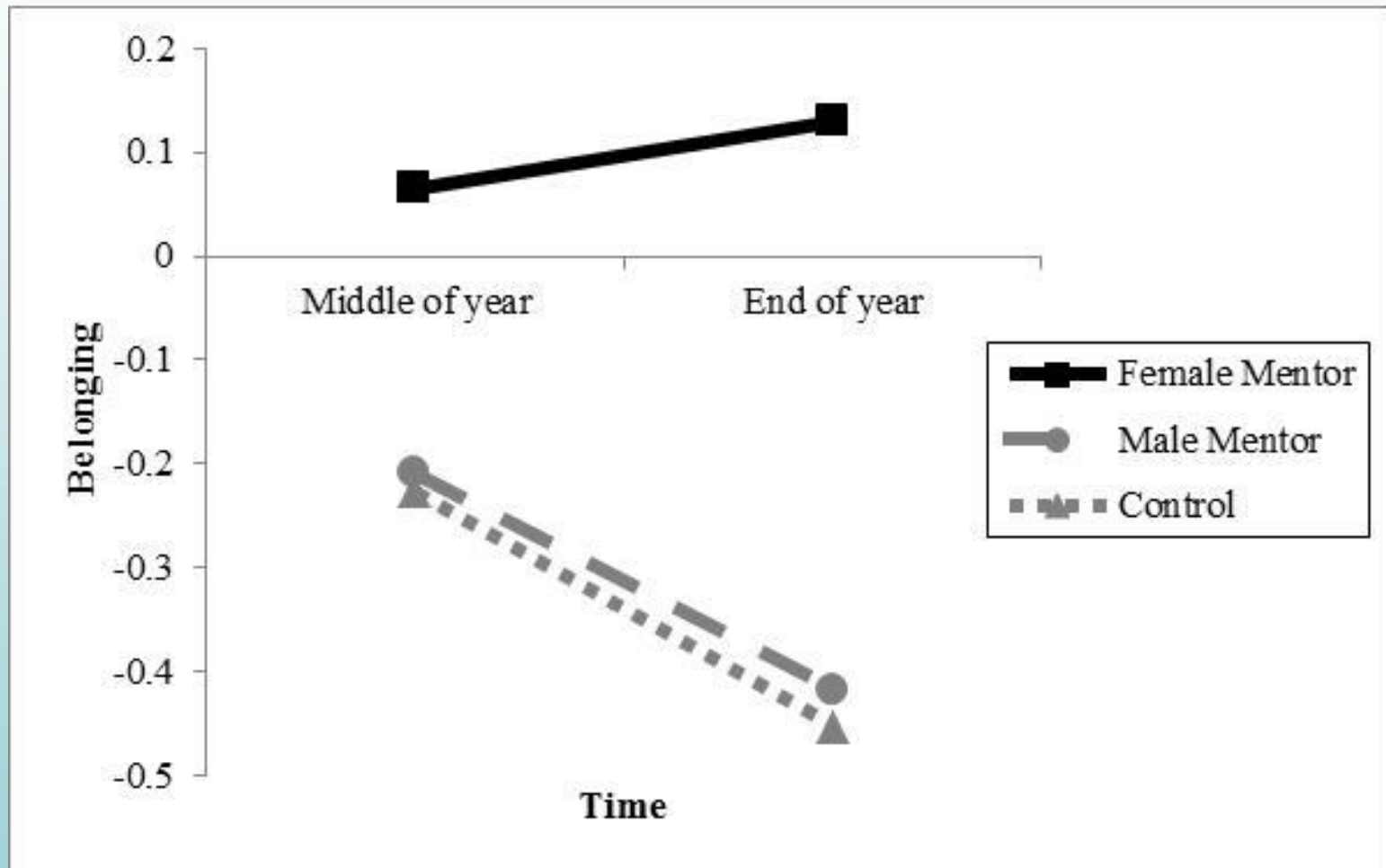


- Greater liking for engineering
- Felt more connected to female than male engineers
- Greater connection with female engineers led women students to be more interested in pursuing engineering careers

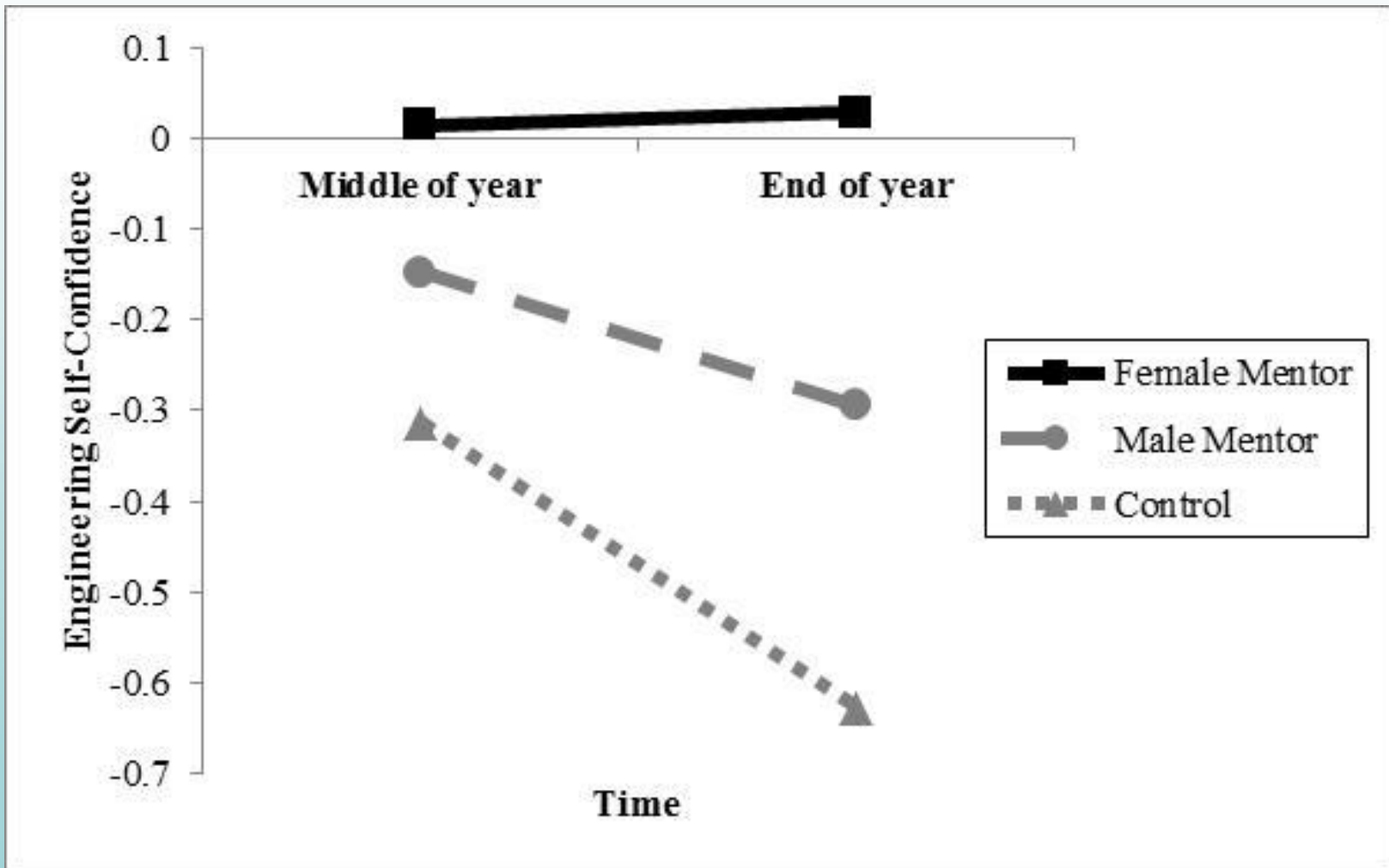
Peer mentors at transition points

- When students transition from one academic stage to another (e.g., transition from high school to college), they are vulnerable to self-doubt and attrition from STEM majors.
- Peer mentors can be effective social vaccines during transitions.
- A study on peer mentoring in college with 1st year women students in engineering
- Gave students a female mentor, male mentor, or no mentor for 1 year
- Tracked mentees' progress until graduation

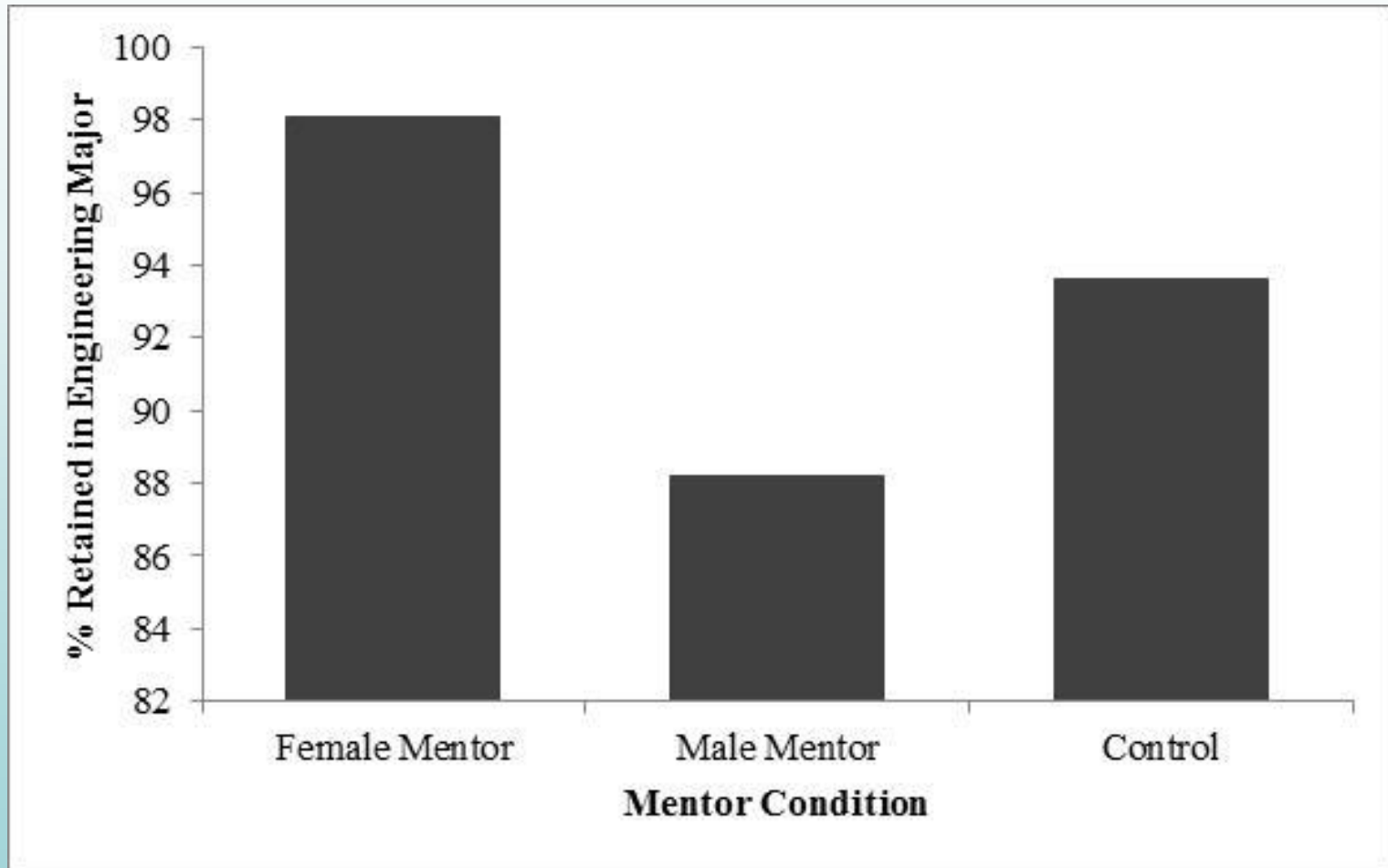
Female peer mentors preserve feelings of belonging in engineering



Female peer mentors protect self-confidence in engineering



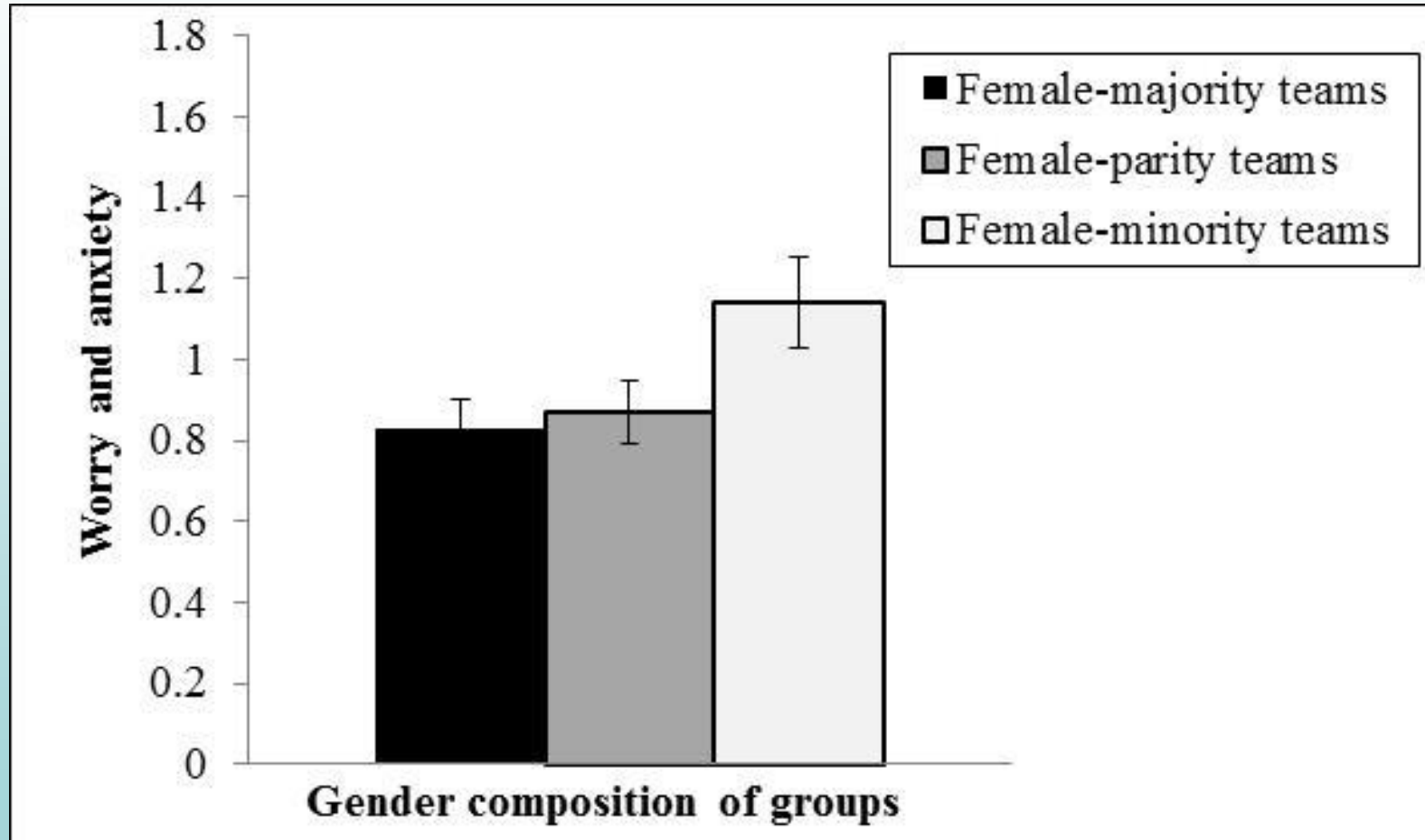
Female peer mentors increase retention of women in engineering majors



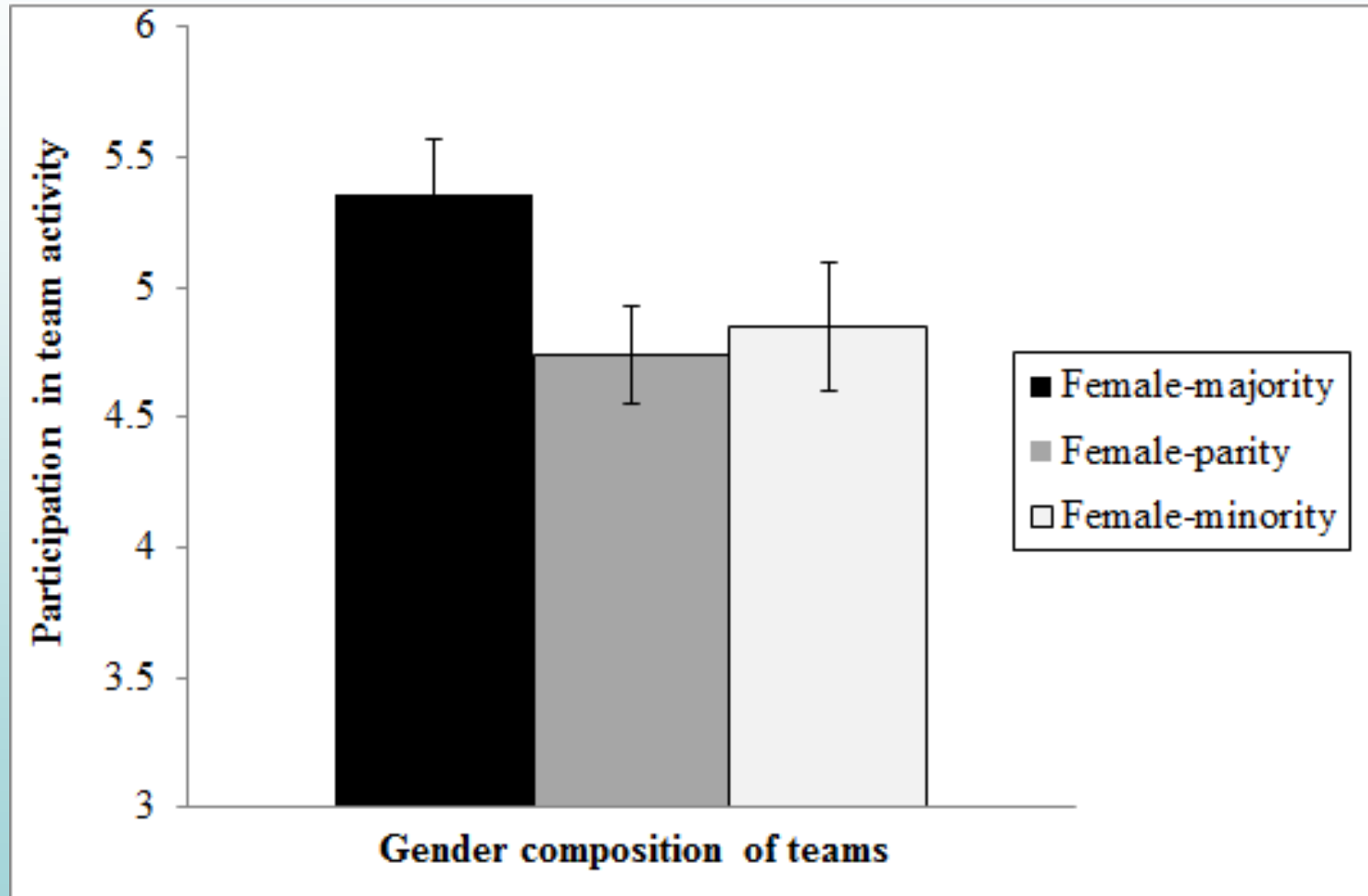
Success in STEM often depends on teamwork

**Teams with a critical mass of women serve
as social vaccines**

Women felt more anxious in teams where they were a solo but less anxious with a critical mass of women



Women spoke up more in teams that had a majority of women



Five solutions that increase gender diversity in STEM

1. Increase contact w/ female STEM professors and teachers so that girls and women in their classes can imagine achieving similar success
2. Encourage mentoring relationships between beginning students in STEM who are girls and women w/ advanced peers of the same sex
3. Showcase success of technical women through media stories and guest speakers in STEM classes
4. For team-based learning classes, pay attention to gender composition of teams. Avoid teams with a solo girl or woman.
5. Timing matters: Some solutions are most effective if implemented at transition points in life (transition to high school; transition to college).

Thanks!

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