Take Action:
Encouraging Females to Excel in Mathematics

Christy Gillespie **NCTM New Orleans Session 568**

Stereotype Threat

"merely the notion that one might 'live up to' a negative stereotype – will undermine someone's ability to perform at their highest capability. The fear of proving a negative stereotype true actually causes someone to underperform – and this can account for girls' underperformance in math and science."

- Jon Aronson, NYU Associate Professor of Applied Psychology

Why Stereotype Threat Keeps Girls Out of Math and Science, and What to Do About It

Our Session Goals

1) Discuss Research
2) Share Strategies

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Stereotype Threat

"When one views oneself in terms of a salient group membership (e.g., "I am a woman, women are not expected to be good at math, and this is a difficult math test"), performance can be undermined because of concerns about possibly confirming negative stereotypes about one's group. "

Reducing Stereotype Threat.org

What are the Math Stereotypes?

Stereotype threat refers to being at risk of confirming, as self-characteristic, a negative stereotype about one's group

(Steele & Aronson, 1995). *www.reducingstereotypethreat.org*

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The Impact of Stereotype Threat

Over 300 experiments have documented a marked decrease in female scores and performance when girls are asked to indicate their gender before taking a math assessment.

Stereotype Threat has also been linked to female's underperformance in

- Engineering Assessments
- Leadership
- Negotiation
- Chess Skills

(e.g., Davies et al.2005; Kray et al.2001; Logel et al.2009; Maass et al.2008; McGlone et al.2006)

The Children's Place

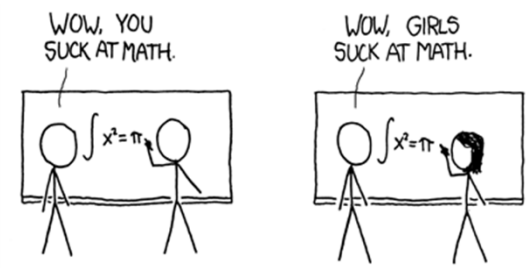
Forever 21

David & Goliath

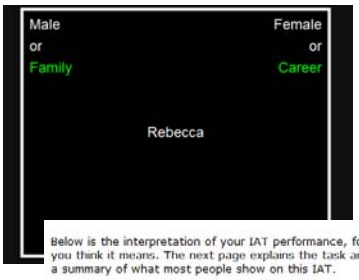
Are We Gender-Biased Teachers?

- "Classroom interactions between teachers and students put males in the spotlight, and relegate females to the sidelines." (Sadker, www.sadker.org)
- In the classroom, girls are
  - three times less likely to receive praise than boys
  - half as likely to be called on by the teacher
  - five times less likely to call out

(Sadker, 1994)



Courtesy of xkcd.com



Harvard University's Project Implicit

Below is the interpretation of your IAT performance, followed by questions about what you think it means. The next page explains the task and has more information such as a summary of what most people show on this IAT.

Your Result

Your data suggest a slight association of Female with Career and Male with Family compared to Male with Career and Female with Family.

What Can We Do?

- Teach girls about the phenomenon of stereotype threat
- Have student perform a self-affirming task before engaging in stereotype threat task
- For older students, read biographies of successful women in STEM fields before taking high-stakes test

The Role of Stereotype Threats in Undermining Girls and Women's Performance and Interest in STEM Fields. (Shapiro, Williams, 2011)

How Do We Learn?

- Learning causes the growth of brain cells. In particular, we build new dendrites. (Willis, 2006)
- The brain can reshape and re-organize its networks of dendrite-neuron connections . (Giedd, 1999)
- The brain also removes connecting dendrites when they are no longer in use (called pruning).
- Laughter and emotions build stronger connections which helps us later recall information taught

How Do We Learn?

- During periods of stress, the amygdala prevents new information from gaining access to the memory circuits needed for learning.
- The brain needs periodic short rest breaks (one-two minutes) to allow neurotransmitters to be replenished so that new material can be processed.
- The brain needs adequate sleep to transfer learning from short-term to long-term memory

Research-Based Strategies to Ignite Student Learning
Dr. Judy Willis

Differences found through Neuroscience

- Females use more areas of the brain simultaneously to solve math problem than males
  Newsweek 1995, "The Science of the Brain"
- With MRI scans, researchers notice distinct differences between men and women in which parts of the brain are used to complete tasks
  http://www.webmd.com/brain/news/20060719/men-women-use-brain-differently
- Girls have larger right Temporal Parietal Junction (rTPJ)
  - Sole function is in understanding others
  - May explain why girls tend to be more social than boys

The Myth of Multitasking

Neurologists indicate, we are not multitasking, but rather, quickly switching from task to task using brain pathways. (Higher-operating procedures)

Attempting to multitask can reduce productivity by approximately 40-percent according to some researchers.

Multiple studies indicate that people who consider themselves good at multitasking frequently spend more time on tasks than non-"multitasking individuals"

Photo Credit:
depositphotos.com

Differences found through Neuroscience

- Researchers from the National Institute of Health (NIH) participated in a five-year study of brain development in children. Their conclusion: "The different regions of the brain develop in a different sequence, and different tempo, in girls compared with boys"
  Gender Differences in the Sequence of Development by Leonard Sax, M.D. Ph.D.

"The right hemisphere of the brain is considered the center for spatial skills. Studies have shown that, as early as 3-6 months, boys have more responsivity in the right hemisphere." J.L. Shucard & D.W. Shucard (1990)

Are There Differences in How Our Brains Learn?

Girls & Self-Esteem

- Girl's self-esteem has a more controlling impact on her decisions and behavior than boys
- In 1991, AAUW self-esteem study, girls rated self-esteem significantly lower than boys
- In 2008, Dove funded self-esteem study
  - 70% of girls did not believe they were good enough
  - 75% of girls identifying with low self-esteem reported negative activities such as cutting, drinking, eating disorders

How Girls Thrive, by JoAnn Deak
American Association of University Women (AAUW)

In math and science, a growth mindset benefits girls.

Fixed Mindset	Growth Mindset
Intelligence is static.	**Intelligence can be developed.**
Leads to a desire to *look smart* and therefore a tendency to	Leads to a desire to *learn* and therefore a tendency to
• **avoid challenges**	• **embrace challenges**
• **give up easily due to obstacles**	• **persist despite obstacles**
• **see effort as fruitless**	• **see effort as path to mastery**
• **ignore useful feedback**	• **learn from criticism**
• **be threatened by others' success**	• **be inspired by others' success**

- Teach children that intellectual skills can be acquired.
- Praise children for effort.
- Highlight the struggle.
- Gifted and talented programs should send the message that they value growth and learning.

Slide provided by AAUW "Why So Few? Women in Science, Technology, Engineering, and Mathematics"

Talking & Thinking Differently About Math

Have Conversations About Learning Math

Key Points

- Math is a Skill (not an innate talent)
- Discuss mistakes as learning opportunities
- Tell students that brain cells grow as they are learning
- Ask parents (especially Moms) not to say they were bad at math

When teachers tell girls they can increase their intelligence by learning, they do better on math tests and are more likely to study math in the future. (AAUW Executive Study)

HOW THIS TRANSLATES INTO CLASSROOM STRATEGIES

Talking & Thinking Differently About Math

- Ensure your classroom is an engaging space.
- Consider a quote wall created by students.

Image courtesy of PaulGooddy/FreeDigitalPhotos.net

What Are Our Goals?

Communication
Collaboration
Confidence
Cooperation

What can I do in the classroom?

- Teach concepts in multiple ways
  - Builds more memory pathways in the brain
  - More pathways = easier recall
  - Assist with long-term retention
- Allow for adequate Repetition
  - Embeds working memory into long-term memory
  - Does not mean rote repetition or busy work
- Praise the effort (not the score or intelligence)
- Provide opportunities for girls to take chances and make mistakes without big consequences.

Reflecting over Work (Communication)

- Reflections after assessments encourage learning from mistakes
- Alter homework to incorporate reflection

Name: _____ Assessment Name: _____

Problem # Missed	Describe your error(s) and/or why points were deducted	Reason for this error?	Rework the problem trying to correct your error	How can you prevent this type of error in the future?

Communication Collaboration Confidence Cooperation

The Four "C"s in Action

Students Working Together to Learn

Consider the structure of the classroom to maximize opportunities for collaboration & cooperation

- Desk Arrangement
- Interactive Projects
- Time during lessons to Compare and Share

WHAT IS GEMS?

Girls Eliminating Math Stereotypes (GEMS) is an organization dedicated to removing the "gender gap" in mathematics. GEMS is a collaboration of high school women and math faculty working together to find and discuss published research concerning possible gender-differences that impact learning, maximizing one's learning potential, and the impact of math stereotypes upon female students' achievement.

Student members have presented their work at two state-level conferences, and participated in a poster session at the collegeboard regional forum in New York City .

Students Working Together to Learn

- For older students, organize student-led study sessions and/or assign study partners
- Create opportunities for girls to collaborate

Image courtesy of stockimages/FreeDigitalPhotos.net

Communication Collaboration Confidence Cooperation

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