Academic Proficiency & Spatial Visualization

LCTCS PIPESTEM Training

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www.napequity.org

A little TRUE or FALSE Quiz!

1. When **boys** are successful in school, their parents and teachers are more likely to **attribute their success to hard work**; when **girls** are successful, adults are likelier to **attribute it to innate talent**.

2. Rising levels of **estrogen** at puberty enhance **girls' verbal skills** while rising levels of **testosterone** at puberty **elevate boys' spatial and math ability**.

3. Parents discourage risk-taking more in daughters than sons.

4. Mothers talk more to their young daughters than to their young sons.

Goal

To understand some of the components of Academic Proficiency and learn new strategies as well as written and online resources.

Objectives

- Understand some of the many factors that contribute to Academic Proficiency
  - Spatial Visualization
  - Stereotype Threat
  - Attribution Theory
  - Growth/Fixed Mindset
  - Self Efficacy

Theory

- When women [and other underrepresented students] are academically proficient, they are more likely to persist in choosing nontraditional careers.

- Stereotype Threat and lack of visual/spatial skills may erect barriers to achievement.

Spatial Visualization

- Studies show a strong correlation between spatial skills and aptitude in math, science, and engineering.

- Innate aptitude plus experience and practice impact spatial skills.

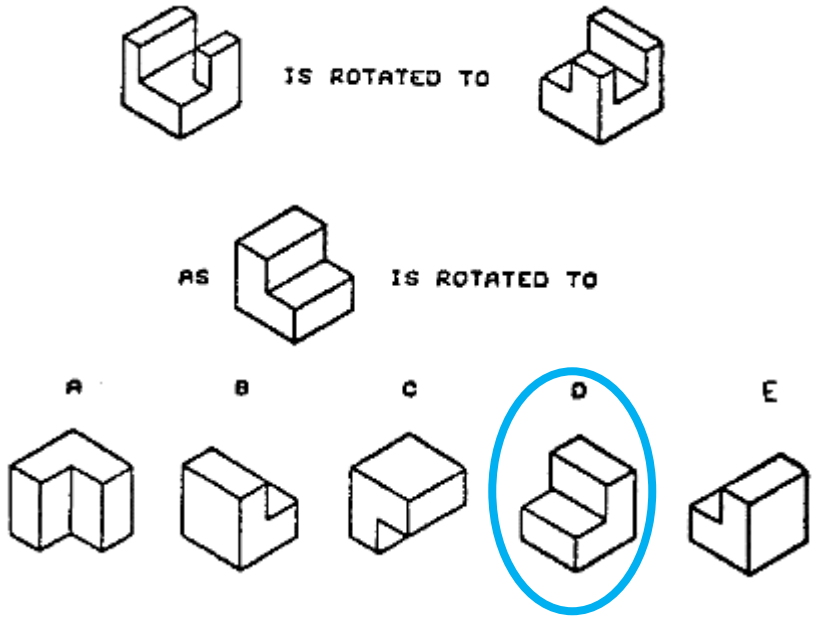
For more information: Sorby, Wysocki, and Baartmans. *Introduction to 3D Spatial Visualization: An Active Approach* (Book & CD).

Activity: Dr. Marshall's Patented (not really) Test of Spatial Visualization

Draw the 2-D pattern piece(s) from which the sleeve of a man's suit coat is made.

Did yours look like this?

Spatial Skills Are *Not* Innate and Can Be Improved with Training!



This is a sample question on mental rotation.

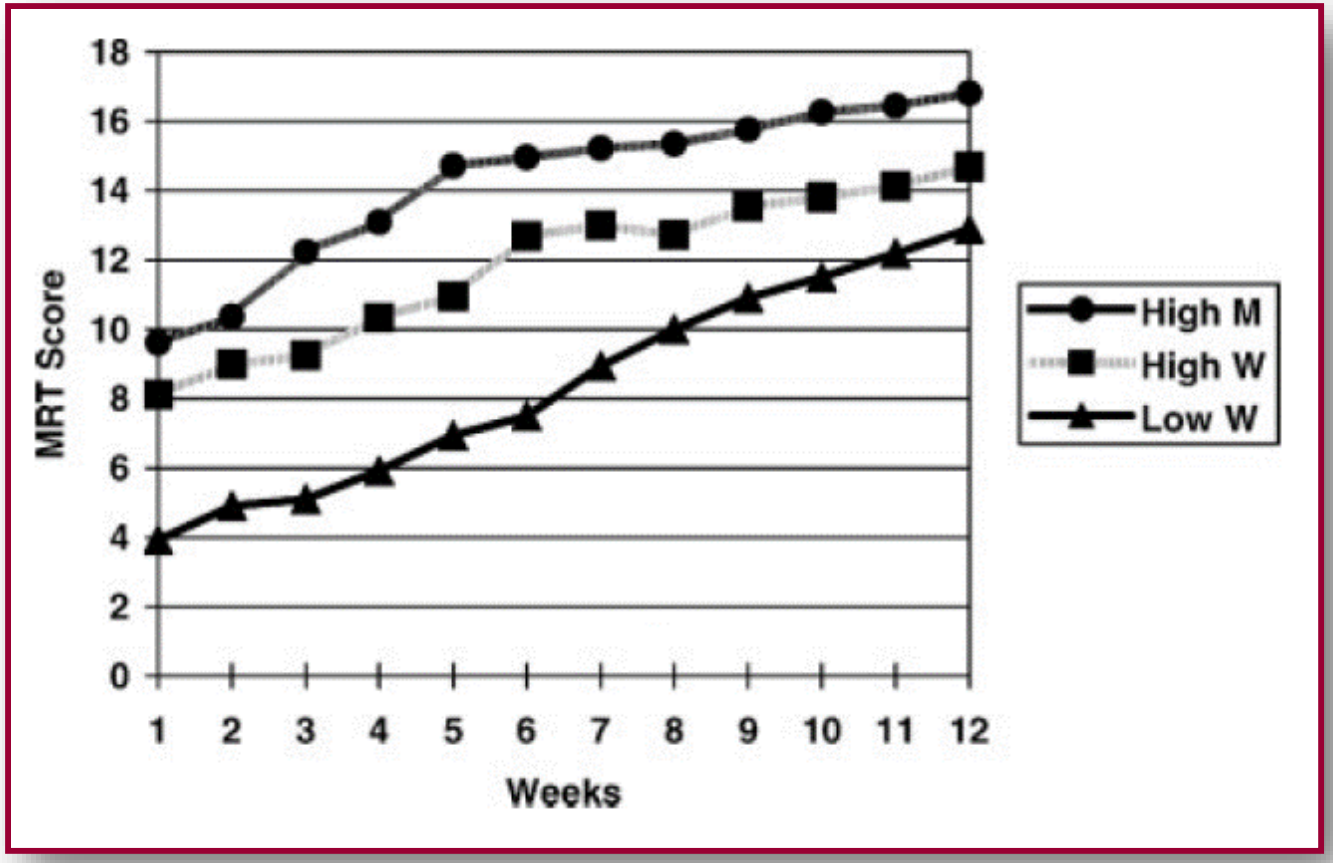
Do you know the right answer?

Playing with building toys as well as drawing can help children develop spatial skills.

Activity: Block by Block

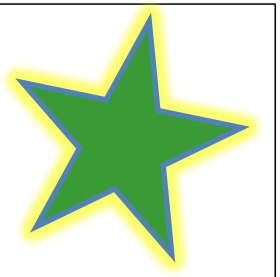
Effect of Spatial Experience

Terlecki, Newcombe & Little. (2007) *Applied Cognitive Psychology, 22*:996



Study shows improvement in mental rotation performance with practice. All subjects improve, but women who were least able ("Low W") showed the greatest improvement.

Super Strategies

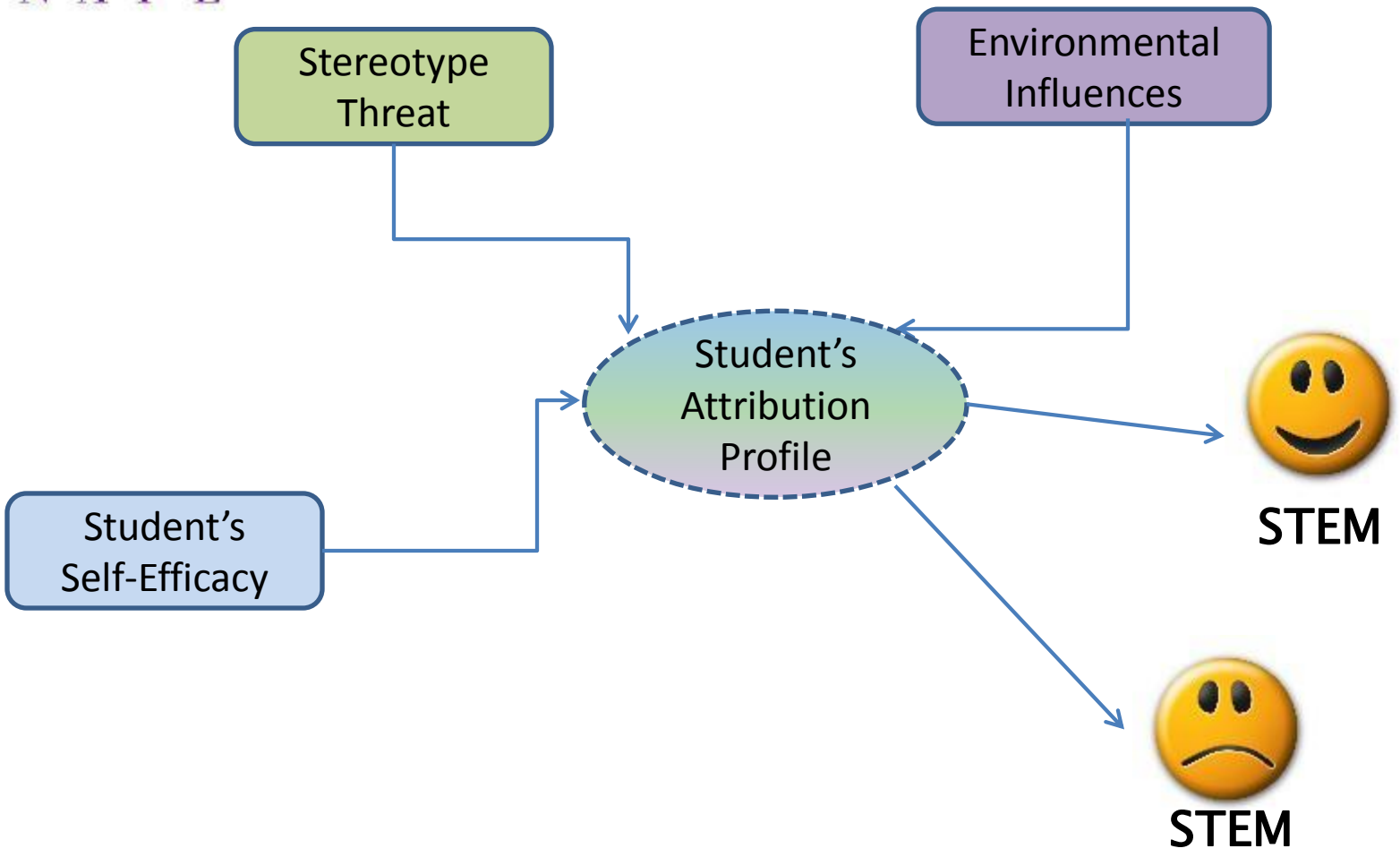


- Teach visual-spatial skills by integrating activities in your classroom that build student skills such as:
  - Lego sets
  - Suitcase packing or kitchen cabinet organizing
  - Block building exercises
  - 3D puzzles
  - Sims computer programs and games
- Teach visual-spatial skills to girls so that they understand that with proper training, they can do it too.

"Boys do not pursue mathematical activities at a higher rate than girls do because they are better at math. They do so, at least partially, because they *think* they are better."

—Shelley Correll, professor

The Big Picture



Stereotype Threat

Stereotype threat refers to being at risk of confirming, as self-characteristic, a negative stereotype about one's group (Steele & Aronson, 1995).

Gendered Stereotype Threat

- You need not believe in the stereotype for it to be threatening!
- Results in perception of ability of girls being reduced to gender stereotype.
- May impact student performance.

- Gender stereotypes may be as subtle as assigning children a gender and accompanying color at birth.

Girls and Stereotype Threat

- Stereotype threat happens in situations where the stereotype is **relevant**
- Threat most affects girls who **care about performance**
- When a gender stereotype becomes salient, **girls often underperform**
- Gender stereotyping results in **decreased interest & dis-identification**
- Often girls who perform above average, successfully dis-identify with stereotypes and do extremely well

Effects of Gender Stereotype Threat

- Lower test performance
- Disengagement, devaluing, and dis-identification
- Reduced sense of belonging
- Lower behavioral intentions for math-related activities
- Lower representation of women and ethnic minorities
- Self-handicapping strategies, such as reduced practice time for a task

All Shapes and Sizes

Anyone who can identify with some group is vulnerable to stereotype threat.

Gender-based	Race-based	Age-based	Socioeconomic-based
Sexual orientation	Religion	(Dis)ability	Intersection
	Undocumented	ELL	

Super Strategies

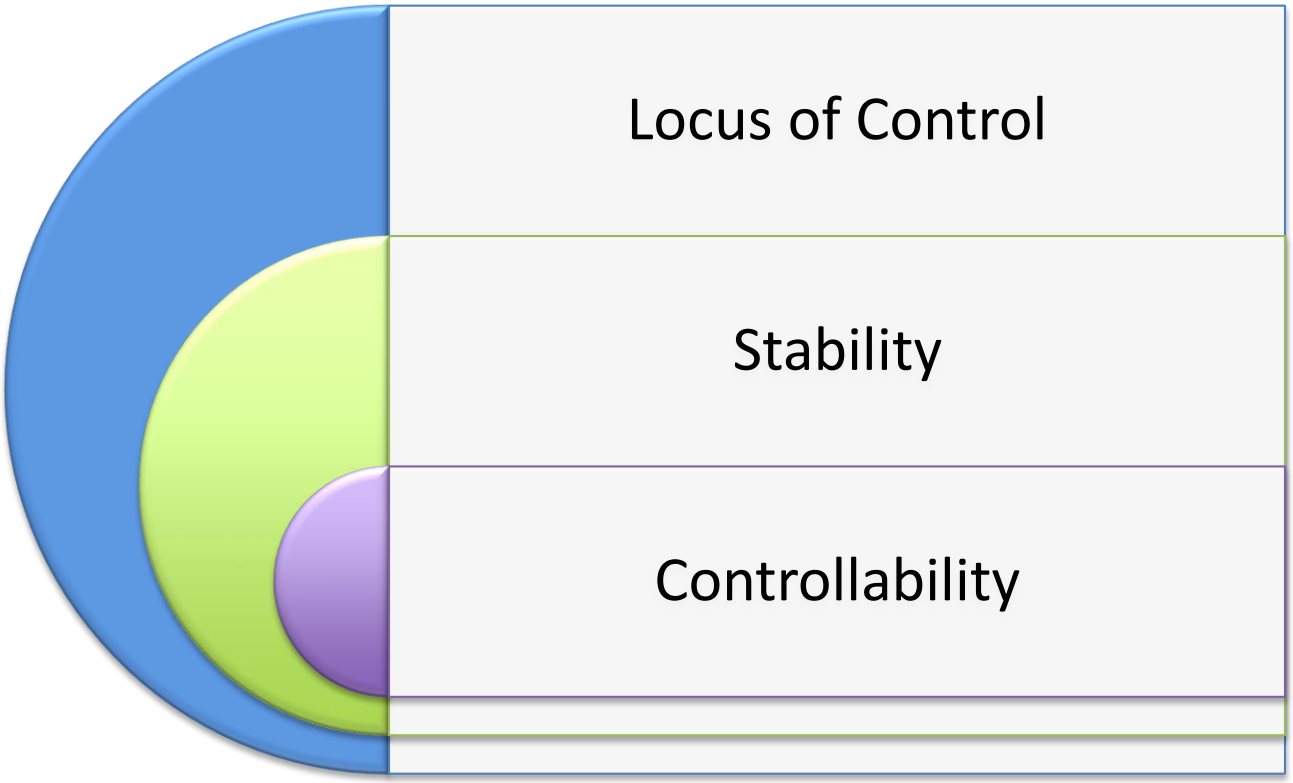
- Challenge stereotypes
- Directly address and discuss potential implicit bias
- Minimize bias in assessments
- Create counter-stereotypic imaging
- Tell your students when tests show no gender differences
- Provide micro-affirmations and encourage self-affirmations
- Provide role models/mentors to balance stereotypes
- Adapt and encourage a growth mindset focus
- See www.reducingstereotypethreat.org
- Read: *Whistling Vivaldi* by Claude Steele

What is Attribution?

Attribution refers to how we explain causes of behavior and events.

- Rationale used to attribute causes to things that happen in our lives.
- How we make sense about our own and others' behavior.
- Used to make predictions about future outcomes of similar actions.

Causal Dimensions of Behavior



Self-Handicapping Attribution Trends

What is the reasoning?

1. A student who believes she will fail a difficult test may be inclined to refrain from studying for that test.

2. A student doesn't want others to think she *had* to study to do well.

Learned helplessness is typically an outcome of students *repeatedly attributing failure* to forces beyond their control.

(Internal/Stable-Unstable/Uncontrollable)

Gendered Attribution Trends (Female)

Luck or chance played a role.

I'm not smart enough, or I'm not good enough.

Failure is taken personally.

Both fear of failure AND fear of success.

Internalization detrimental to self-confidence.

Decreased in risk-taking behavior.

Success = Externally Attributed

Failure = Internally Attributed

Gendered Attribution Trends (Male)

I'm inherently smart and therefore successful.

This was out of my control.

I had bad luck.

Others were jealous of me.

That teacher grades really hard.

Success = Internally Attributed

Failure = Externally Attributed

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.

Read: MindSet by Carol Dweck. Visit: mindsetonline.com

Super Strategies
Attribution Theory

- Provide feedback that is **most useful to each student**.
- Identify **difficult concepts**.
- Attribute success to **hard work**
  - "This was a difficult concept; I can tell you studied/practiced."
- **Assess and retrain** attribution style.
- Encourage students toward i**nternal/stable** Attribution Profile.
- Remind females that they are **as good as males in math**.
- Remind males that **literacy skills are important for all students** to be successful.
- Repeatedly **highlight successes** that counteract the students' inaccurate attributions.

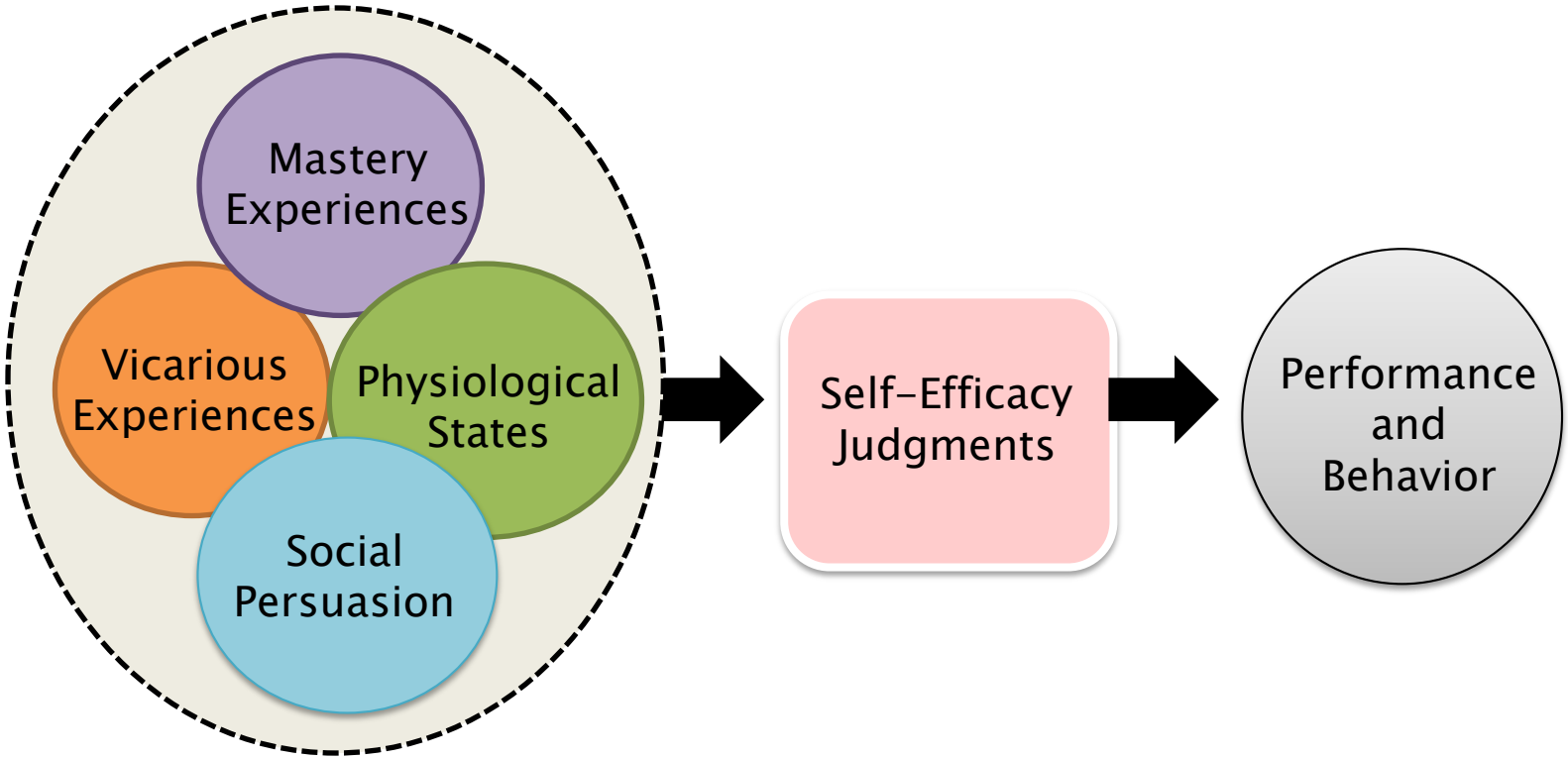
Efficacy and Self-Efficacy

The capacity to produce a desired result or effect.	The belief one holds in her ability to be successful.
Efficacy	**Self-Efficacy**

Self-Efficacy

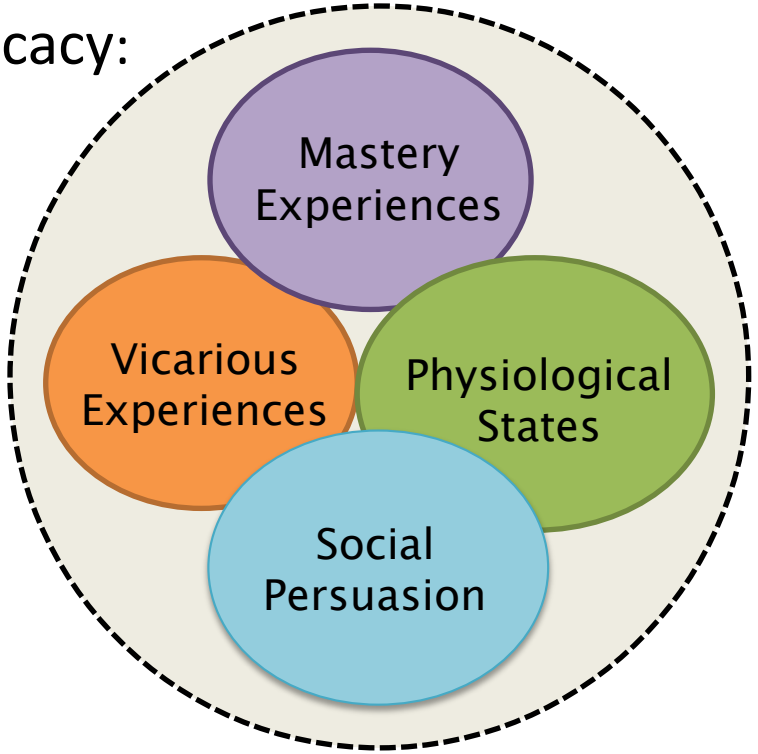
Self-confidence does not equal self-efficacy!

Sources of Self-Efficacy



Activity: Efficacy Brainstorm

Brainstorm about a strategy/action to try with girls in the classroom that might enhance **one** of the sources of CTE/NT self-efficacy:

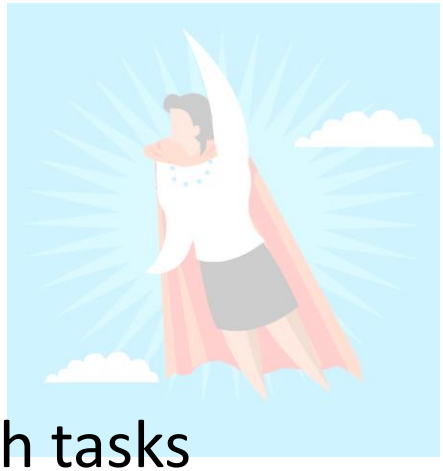


Girls, Self-Efficacy, and STEM

There is a direct correlation between self-efficacy and career choices.

Super Strategies
Self-efficacy

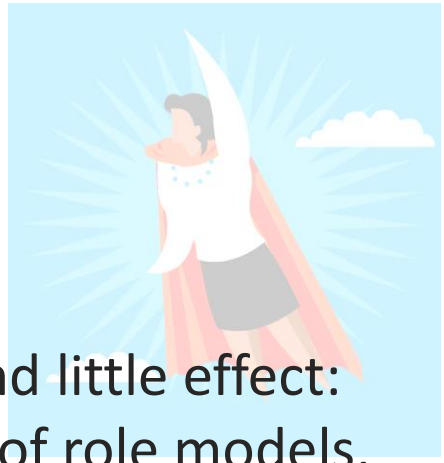
- Look for ways to incorporate the **four sources of self-efficacy**
- **Provide training** about self-efficacy.
- Teach females to **self-affirm**.
- Remind women of **other women's** achievements (role models) to reduce stereotype threat.
- Structure opportunities for success with tasks that may appear not possible to students.



Super Strategies

Academic Proficiency

- Teach visual/spatial skills
- Intervene to revise underestimation
- Teach students that ability can be enlarged
- Provide math camps for girls
- Incentivize AP courses
- Develop video games that appeal to girls
- Be mindful of stereotype threat:
  - Circumstances in which researchers found little effect: small educational institutions, presence of role models, equal [subgroup] representation, testing in groups of three similar students, have students read about role-models



What is one thing **You Will** do to Change The Big Picture