

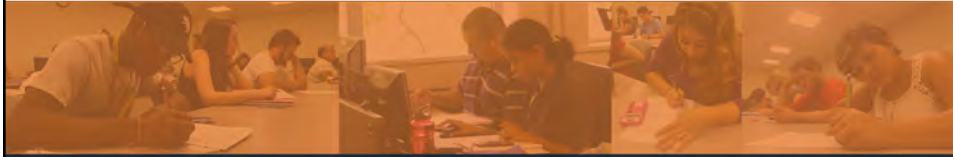


Rigor and Character: How an Understanding of the Social-Emotional Dimensions of Learning Mathematics Can Accelerate Learning

Doug Sovde, Director, K-12 Education Strategy, Policy, and Services
Charles A. Dana Center

Catherine Good, Associate Professor, Psychology, Baruch College and the Graduate Center
City University of New York

April 23, 2018, NCSM Annual Conference



About the Dana Center

— Equity — Access — Excellence —

2018



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Dana Center by the Numbers



We supported **60,500 K–12 students** attending school on U.S. military bases through our work with the **Department of Defense Education Activity**.

Dana Center by the Numbers



We engaged with **118 districts in 23 states** to provide middle and high school math courses of the **highest quality** as recognized by rigorous state and national reviews, including EdReports.org.

Dana Center by the Numbers

At the close of 2017, the Dana Center has contributed to the **implementation of math pathways** in higher ed systems, institutions, and campuses in **29 states**.



“In the perception of society my athletic talents are genetic; I am a likely mugger-rapist; my academic failures are expected; and my academic successes are attributed to others.

To spend most of my life fighting these attitudes levies an **emotional tax** that is a form of **intellectual emasculation.**”

DR. NEIL
DeGRASSE TYSON

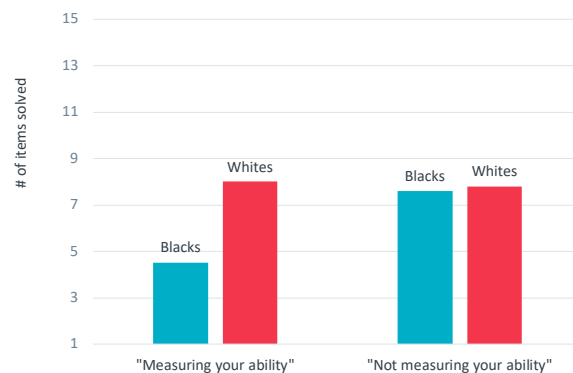


Stereotype Threat

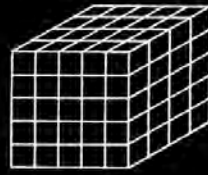
Unpleasant apprehension arising from the awareness of a negative ability stereotype in a situation where the stereotype is relevant, and thus confirmable

Steele & Aronson, 1995

Cultural Stereotypes Contribute to Gaps in Learning and Achievement



Steele & Aronson, 1995



If the figure above is a rectangular solid composed of cubes, each with edge of length 4 centimeters, what is the volume of the rectangular solid in cubic centimeters?

- (A) 100
- (B) 256
- (C) 400
- (D) 5120
- (E) 6400

**A****B****C****D****E**

Performance Feedback



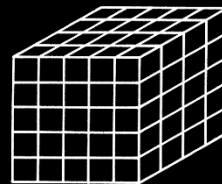
Correct Answer

(E) 6,400

Math Tutor

Answer: (E) 6,400

Step 1:



Step 2:

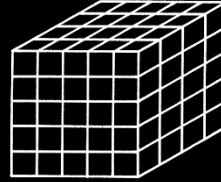
Step 3:



Math Tutor

Answer: (E) 6,400

Step 1: Label figure with edge length of each cube and length, width, and height. [\(more\)](#)



Step 2:

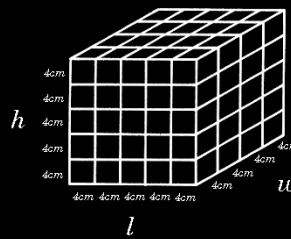
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Math Tutor

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Step 2:

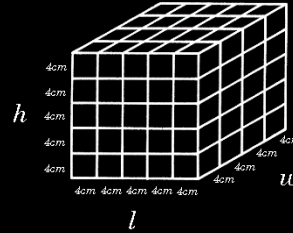
Step 3:



Math Tutor

Answer: (E) 6,400

Step 1: Label figure with edge length of each cube and length, width, and height. (more)



Step 2: Find the values of the length, height, and width of the solid. (more)

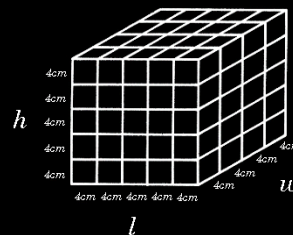
Step 3:



Math Tutor

Answer: (E) 6,400

Step 1: Label figure with edge length of each cube and length, width, and height. (more)



Step 2: Find the values of the length, height, and width of the solid. (more)

Step 3:

$$\text{Length} = 4 + 4 + 4 + 4 = 16$$

$$\text{Width} = 4 + 4 + 4 + 4 + 4 = 20$$

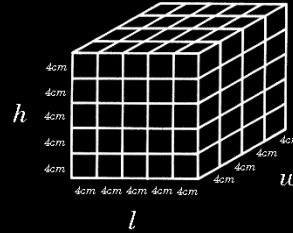
$$\text{Height} = 4 + 4 + 4 + 4 + 4 = 20$$



Math Tutor

Answer: (E) 6,400

Step 1: Label figure with edge length of each cube and length, width, and height. (more)



Step 2: Find the values of the length, height, and width of the solid. (more)

Step 3: Find the volume of the solid. (more)

$$\text{Length} = 4 + 4 + 4 + 4 = 16$$

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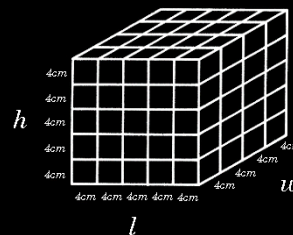
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Math Tutor

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Step 1: Label figure with edge length of each cube and length, width, and height. (more)



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Volume of a Rectangular Solid:

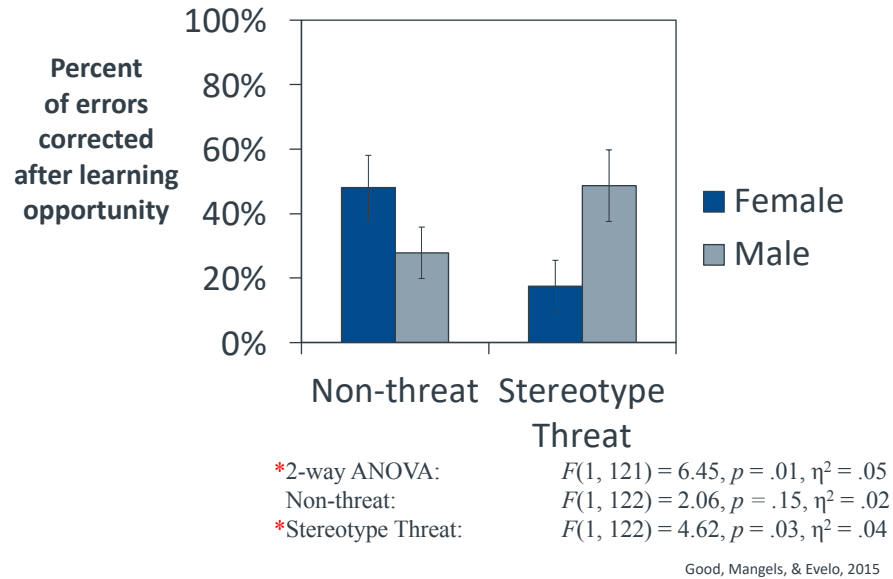
$$l \times w \times h$$

$$\text{Volume} = 20 \times 16 \times 20$$

$$= 6,400$$



Stereotype Threat Undermines Learning



Turn and Talk

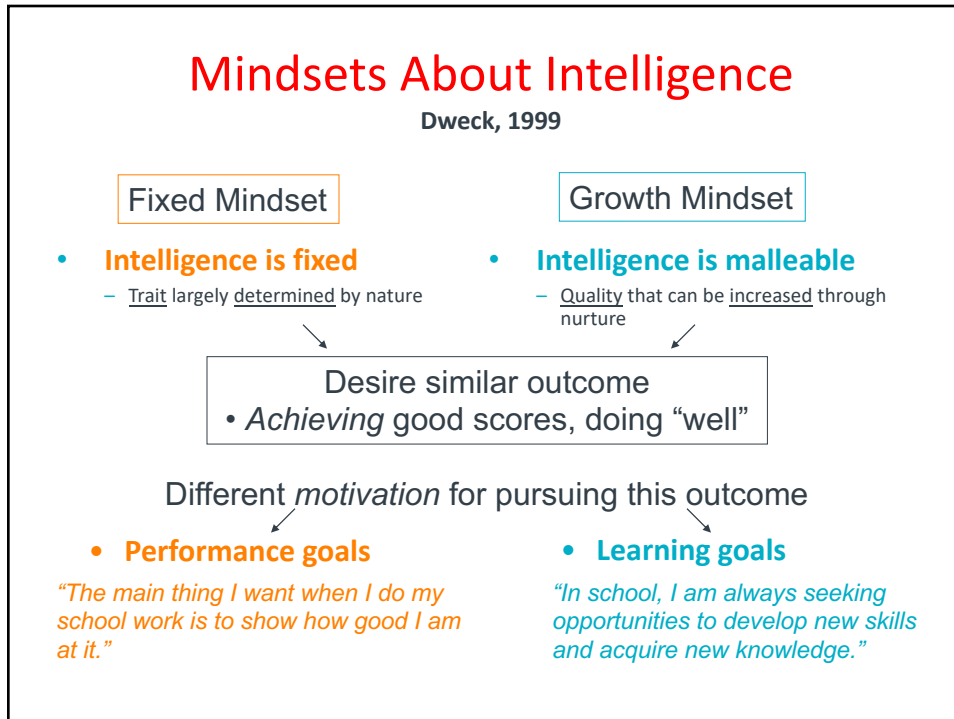
- What are 3 big takeaways so far?
- What questions do you have so far?

Mindsets That Matter in Math



- Theories of Math Intelligence
- Sense of Belonging

Growth Mindset





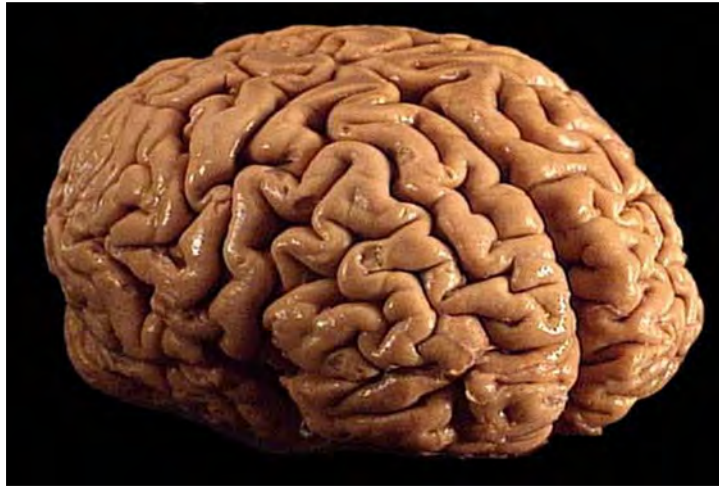
Do Mindsets Matter?

Goal	Look smart, even if sacrificing learning	Learn new things, even if hard or risky
Failure	Means low intelligence	Means low effort; poor strategy
Effort	Means low intelligence	Is the path to increased intelligence
Strategy after difficulty	Less effort	Increase effort
Performance after difficulty	Impaired	Equal or improved

Fostering Growth Mindsets Increases Performance on Standardized Tests

Texas Assessment of Academic Skills Test



Mindsets That Matter in Math

- Theories of Math Intelligence
- Sense of Belonging

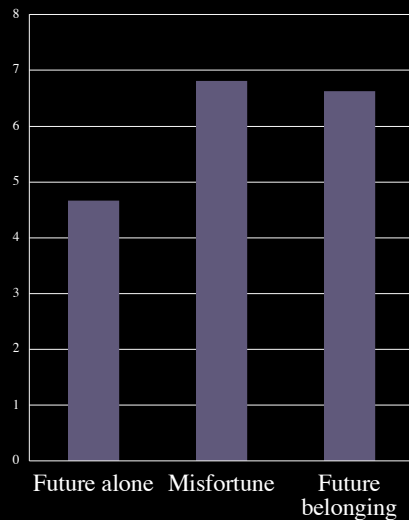
Sense of Belonging

Trusting that you are an accepted member of the math community whose presence and participation is valued



Belonging Concerns Disrupt Intellectual Performance

Performance on IQ Test

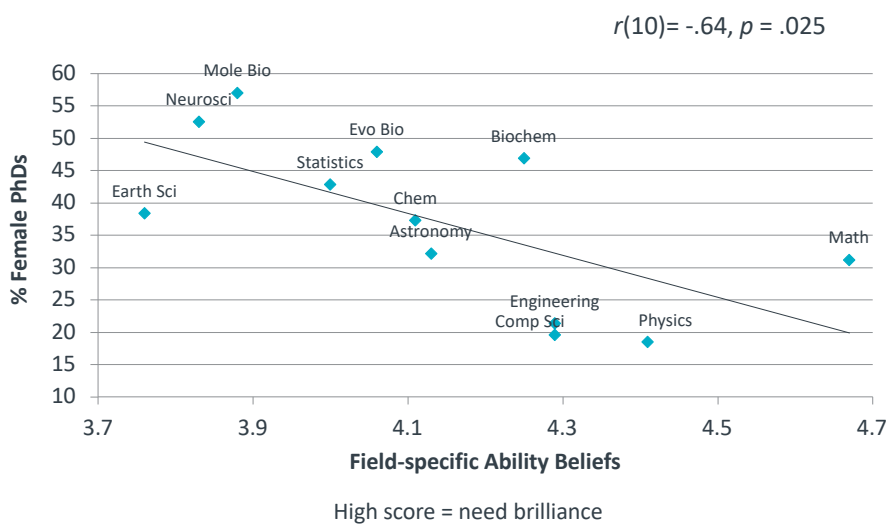


Baumeister, Twenge & Nuss, 2002

What is Necessary for Success in Various Fields of Study?



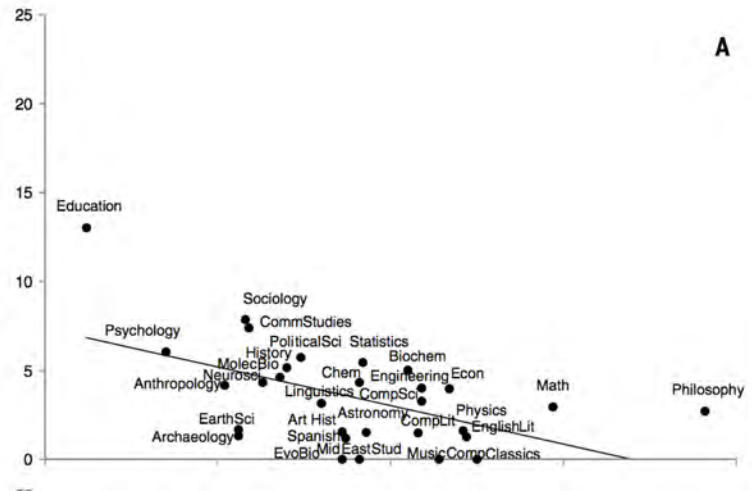
Culture of Talent and Female Underrepresentation in STEM



Leslie, Cimpian, Meyer, & Freeman, 2015

Culture of Talent and African American Underrepresentation in Ph.D. Academics

$r(28) = -.54, p = .002$



“Race matters because of the slights, the snickers, the silent judgments that reinforce that most crippling of thoughts: ‘I do not belong here.’”

SONIA SOTOMAYOR



Sense of Belonging

Trusting that you are an accepted member of the community whose presence and participation are valued by peers

Who Belongs?

- What characteristics do teachers value most in their students?
 - Perseverance?
 - Engagement?
 - Grit?
- What are the foundations upon which students feel valued?
 - High achievement?
 - Already knowing the material?
 - Quick, elegant solutions?
- Can effort-based belonging increase learning outcomes?

Fostering Belonging Mindsets in Classrooms

How to fit in and belong to math: Hard work
BY ALEX WARREN

WHAT HELPS STUDENTS to feel like they belong to math why is it so afternoon in a New teacher Michael Bol of 6th graders at a to come speak to you today to tell y

students like you feel more like they belong to math. He explained, "Teachers talk a lot about students who easily do well in math, but in my math classes that easy achievement doesn't matter that much. What really makes a 'math person' is *success through hard work*." The students who put in effort are the ones who truly belong in math classes."

Some research shows that Mr. Bolano's opinion might be correct. Several years ago, the school district asked a group of 6th students like you how they felt about math. They also asked th

they valued and re

some students, who e throughout middle

The school found the same things that Mr. Bolano had observed. The 6th graders who said that they "worked hard" to get an "A" in math also said that they fit in and belonged to math. Then, two years later, these students said that they did better in 7th and 8th grade overall. They felt more valued by their teachers in middle school and that they could

What really makes a math person is success through hard work.

The students who put in effort are the ones who truly belong in math.

Hard Work Boosts Belonging

Group	Rating of Sense of Belonging in Math
Those who "worked hard to get an A"	~8
Those who "easily received an A"	~3.5

Source: The State of New Jersey Department of Education

succeeded in difficult classes. These students seemed to be doing much better than the students who said they "easily earned an A." The math teachers reported that they valued and respected the other hand, students who passed are less accepted by the math teachers into the class. at the benefits of feeling like you belong in school. The 6th grade students aged to math more were more likely

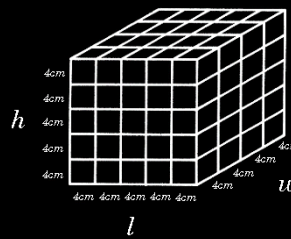
ings to help students like you do high school. When you work hard, belong more to math than the stu also go on to perform much better throughout middle school and high school. So remember, what can make you feel like you fit in and belong to math? Hard work!

Students who passed the class with very little effort were less accepted by the math teachers than those who put a lot of work into the class.

Math Tutor

Answer: (E) 6,400

Step 1: Label figure with edge length of each cube and length, width, and height. (more)



Step 2: Find the values of the length, height, and width of the solid. (more)

Step 3: Find the volume of the solid. (more)

Volume of a Rectangular Solid:

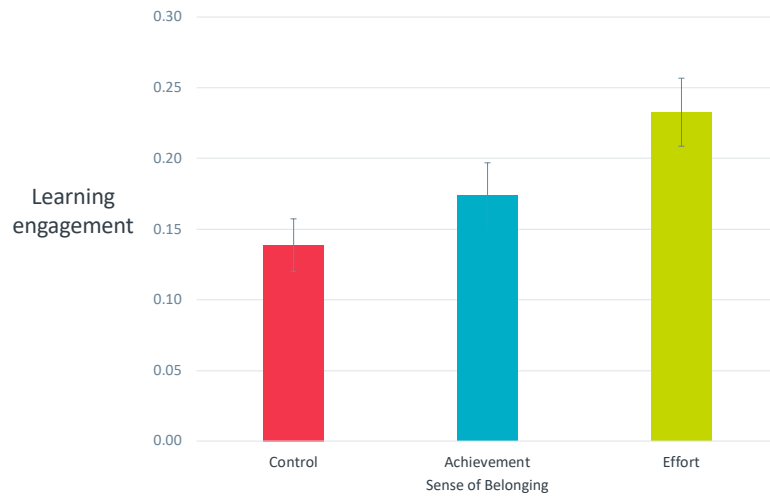
$$l \times w \times h$$

$$\text{Volume} = 20 \times 16 \times 20$$

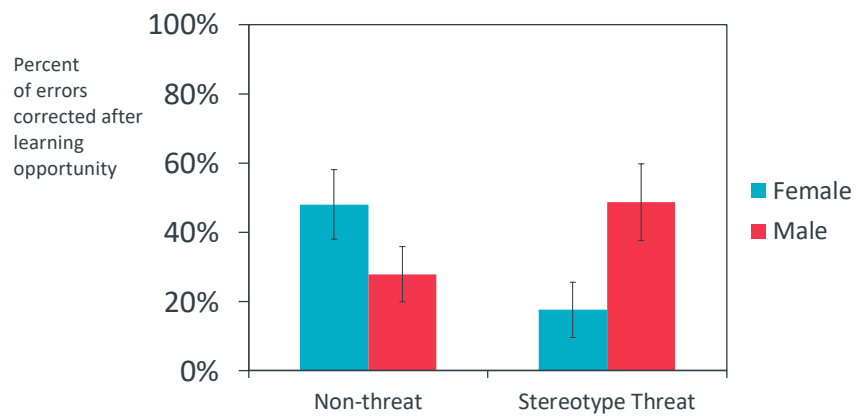
$$= 6,400$$



Effort-Based Belonging Improves Engagement with a Learning Task



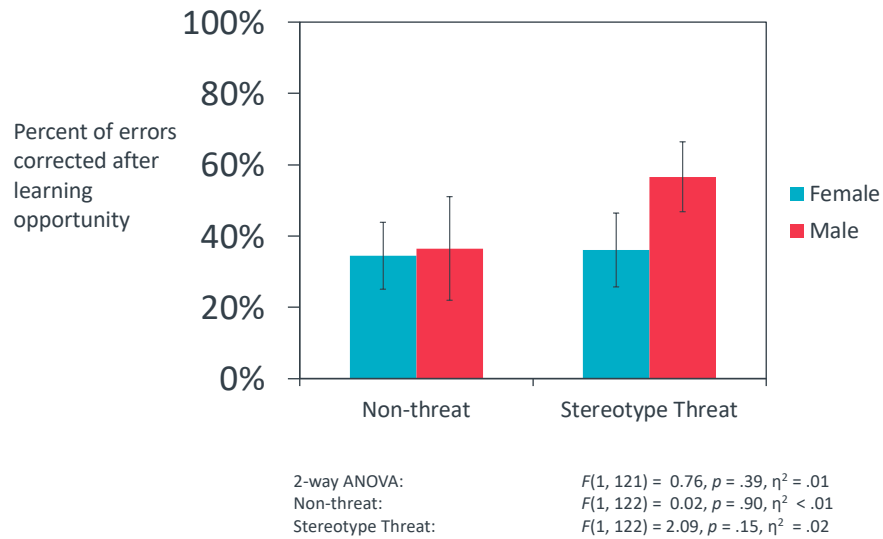
Stereotype Threat Undermines Math Learning



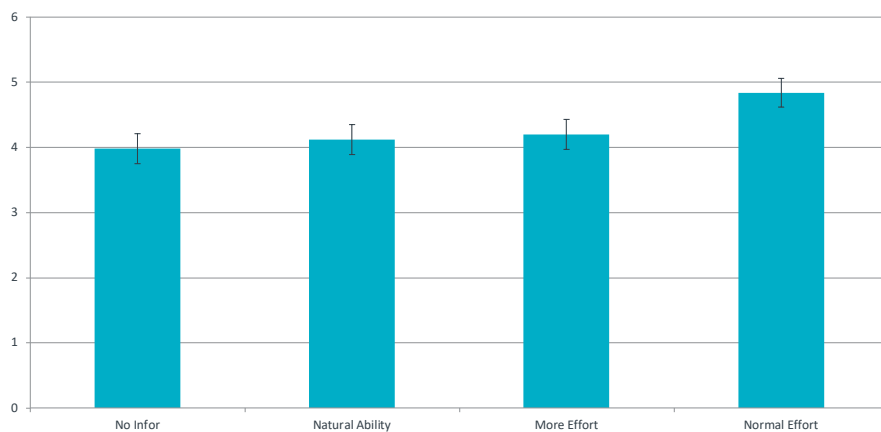
*2-way ANOVA:
 Non-threat: $F(1, 121) = 6.45, p = .01, \eta^2 = .05$
 $F(1, 122) = 2.06, p = .15, \eta^2 = .02$
 *Stereotype Threat: $F(1, 122) = 4.62, p = .03, \eta^2 = .04$

Good, Mangels, & Evelo, 2015

Effort-Based Sense of Belonging Protects Learning Deficits from Stereotype Threat

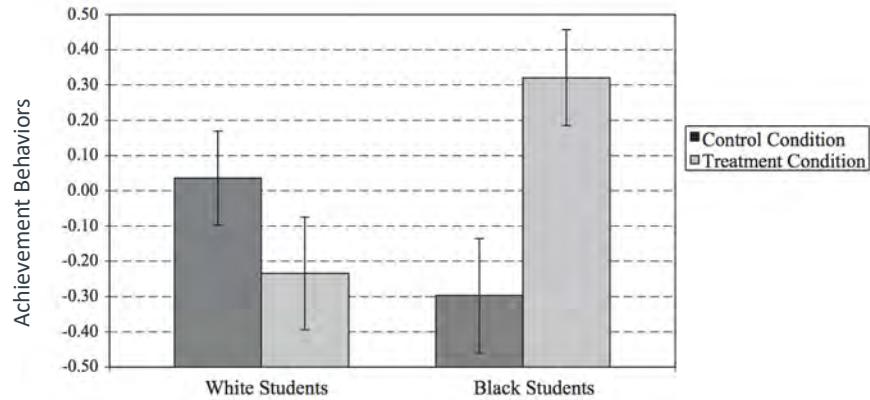


Normalizing Effort Expectations for Success Improves Academic Belonging



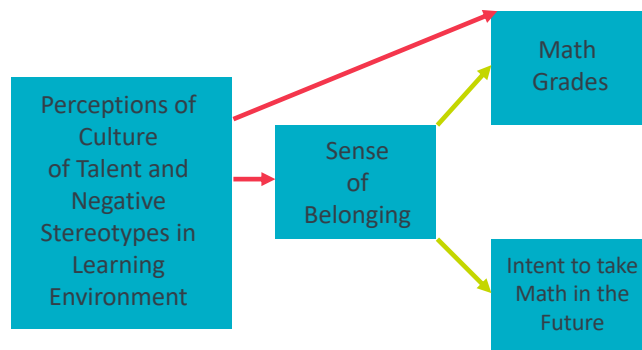
Smith et al., 2013

Do I Fit in Here?



Walton & Cohen, 2007

Classroom Culture: Belonging, Motivation, Grades



$\chi^2(20) = 46.82, p < .001, CFI = .84, NFI = .77, RMSEA < .004, Pclose = .95$

Good, Rattan, & Dweck, 2012

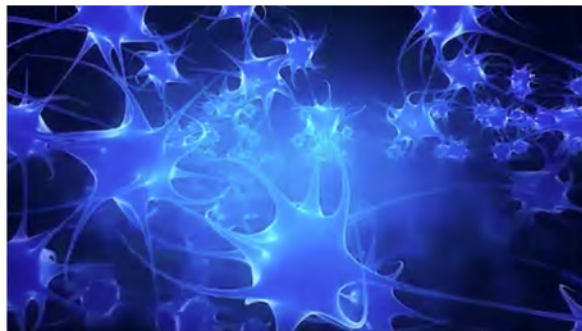
7 Things Growth Mindset is Not

1. Power of positive thinking
2. Only about effort
3. False effort praise
4. Celebrating mistakes
5. A way to blame students
6. Only for low-achieving students
7. Only about students

<http://www.turnaroundusa.org/category/the-180/>

In Practice

- Explicit Instruction and Embedded Supports for Students
- Explicit Instruction and Embedded Supports for Teachers
- Worthy Tasks to Meet High Expectations



Contact information

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