

# Engineering Graduate & Scholarly Talks

## Growth Mindset Workshop

GROWTH MINDSET



FIXED MINDSET



**Prof. Adam Burgasser**



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UC San Diego  
PHYSICAL SCIENCES  
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On the Google jamboard linked below, describe one of your core values

Example: I believe everyone should have equal opportunity, and potato chips



Add yours here: <https://bit.ly/2JOOJmD>

**Brainstorm: Core Values**

*Why did we do this?*

## **Gender Differences in Physics 1: The Impact of a Self-Affirmation Intervention**

Lauren E. Kost-Smith\*, Steven J. Pollock\*, Noah D. Finkelstein\*,  
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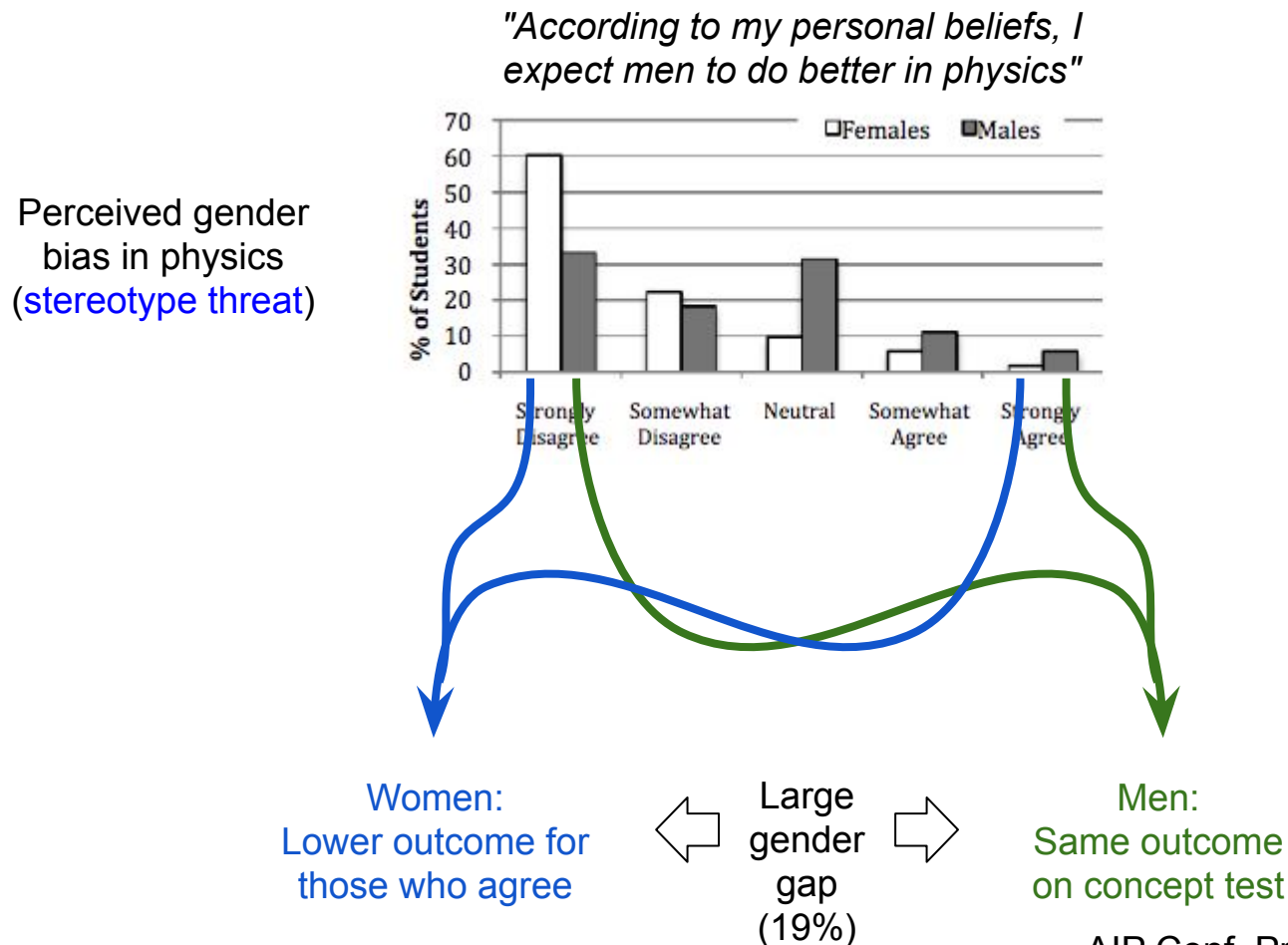
**Abstract.** Prior work at CU-Boulder has shown that a gender gap (difference in male and female performance) exists in both the pre- and post-course conceptual surveys, despite the use of interactive engagement techniques [Kost, et al., PRST-PER 5, 010101]. A potential explanation for this persistent gap is that stereotype threat, the fear of confirming a stereotype about one self, is inhibiting females' performance. Prior research has demonstrated that stereotype threat can be alleviated through the use of self-affirmation, a process of affirming one's overall self-worth and integrity [Cohen, et al., Science 313, 1307]. We report results of a randomized experiment testing the impact of a self-affirmation exercise on the gender gap in Physics 1. The gender gap on a conceptual post-survey is reduced from 19% for students who did not affirm their own values, to 9% for students who completed two 15-minute self-affirmation exercises at the beginning of the semester.

**Keywords:** gender, stereotype threat, self-affirmation, conceptual learning, introductory physics

**PACS:** 01.40.Fk, 01.40.G-, 01.40.gb, 01.75.+m

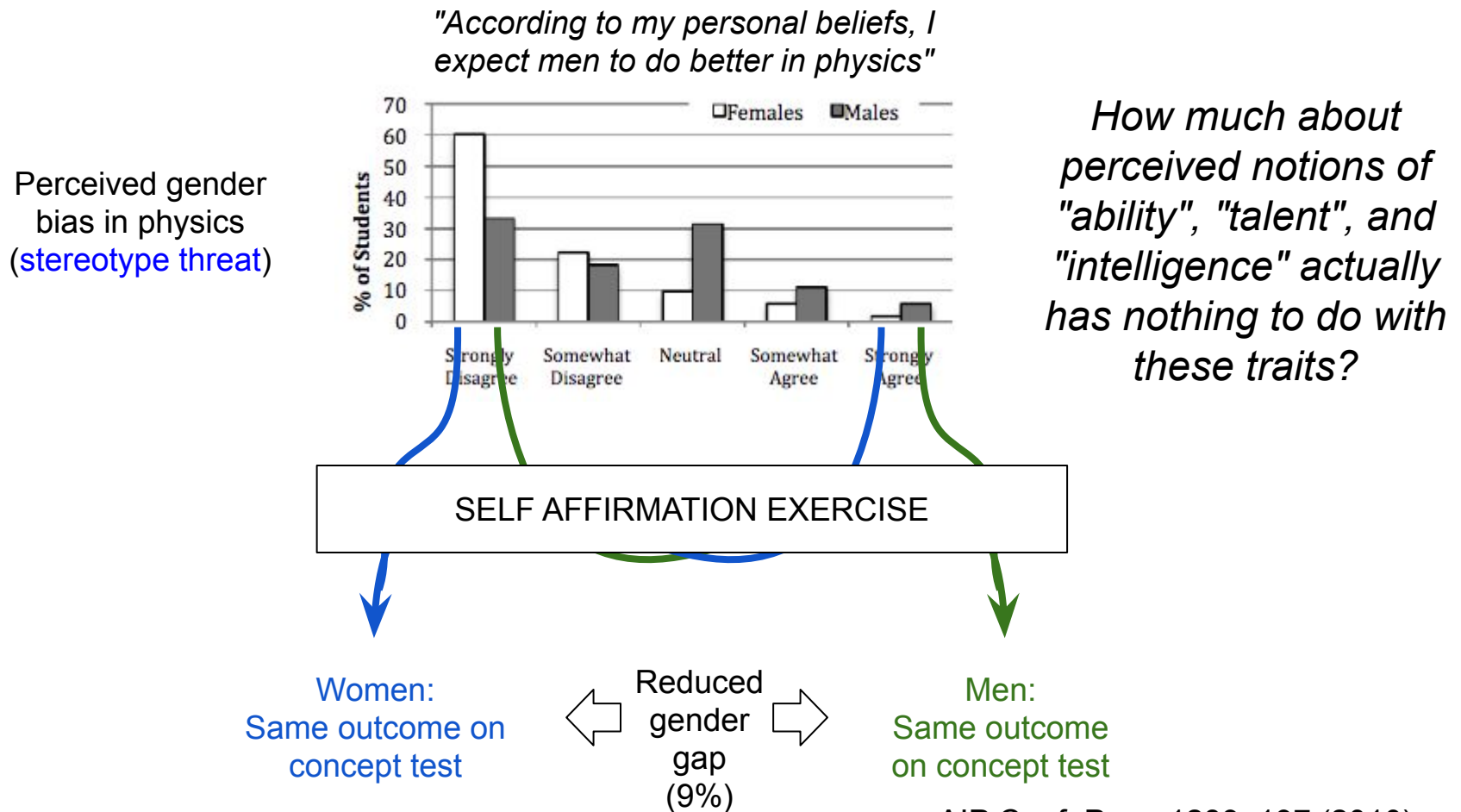
*Why did we do this?*

## Gender Differences in Physics 1: The Impact of a Self-Affirmation Intervention



*Why did we do this?*

## Gender Differences in Physics 1: The Impact of a Self-Affirmation Intervention



# Workshop Learning Goals

Learn about the concept of mindset and its influence on various aspects of your life

Identify the differences between fixed and growth mindsets, and their implications

Recognize how society/culture encourages fixed mindset, and how we can overcome this

Develop strategies to encourage growth mindset in yourself and others





FIXED



GROWTH

# MINDSETS

Video by John Spencer

<https://www.youtube.com/watch?v=M1CHPnZfFmU>

# What is Mindset?

- The view you adopt for yourself
- The view you adopt for others
- Your approach and reaction to setbacks and successes
- **The filter through which you interact with the world**
- Mindset influences work, business, academics, relationships, social & family interactions



# The two kinds of Mindset



Carol Dweck & co. argue that these views lie on a *spectrum* between two poles:

- **Fixed:** you have a certain amount of intelligence & talent, a fixed personality, a certain moral character, etc.
- **Growth:** basic qualities and abilities are mutable; they can grow through applied effort

# Why is this important?

Research shows that student success correlates strongly with mindset

- taking on challenges
- persistence in complex tasks
- performance on standardized tests
- response to failure
- stereotype threat
- imposter syndrome
- cheating/lying

# Mindset & student performance

Child Development, January/February 2007, Volume 78, Number 1, Pages 246–263

## Implicit Theories of Intelligence Predict Achievement Across an Adolescent Transition: A Longitudinal Study and an Intervention

Lisa S. Blackwell  
*Columbia University*

Kali H. Trzesniewski and  
Carol Sorich Dweck  
*Stanford University*

Two studies explored the role of implicit theories of intelligence in adolescents' mathematics achievement. In Study 1 with 373 7th graders, the belief that intelligence is malleable (incremental theory) predicted an upward trajectory in grades over the two years of junior high school, while a belief that intelligence is fixed (entity theory) predicted a flat trajectory. A mediational model including learning goals, positive beliefs about effort, and causal attributions and strategies was tested. In Study 2, an intervention teaching an incremental theory to 7th graders ( $N = 48$ ) promoted positive change in classroom motivation, compared with a control group ( $N = 43$ ). Simultaneously, students in the control group displayed a continuing downward trajectory in grades, while this decline was reversed for students in the experimental group.

# Mindset, standardized tests & stereotype threat

Improving adolescents' standardized test performance:  
An intervention to reduce the effects of stereotype threat

Catherine Good<sup>a,\*</sup>, Joshua Aronson<sup>b,1</sup>, Michael Inzlicht<sup>b</sup>

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## Abstract

Standardized tests continue to generate gender and race gaps in achievement despite decades of national attention. Research on “stereotype threat” (Steele & Aronson, 1995) suggests that these gaps may be partly due to stereotypes that impugn the math abilities of females and the intellectual abilities of Black, Hispanic, and low-income students. A field experiment was performed to test methods of helping female, minority, and low-income adolescents overcome the anxiety-inducing effects of stereotype threat and, consequently, improve their standardized test scores. Specifically, seventh-grade students in the experimental conditions were mentored by college students who encouraged them either to view intelligence as malleable or to attribute academic difficulties in the seventh grade to the novelty of the educational setting. Results showed that females in both experimental conditions earned significantly higher math standardized test scores than females in the control condition. Similarly, the students—who were largely minority and low-income adolescents—in the experimental conditions earned significantly higher reading standardized test scores than students in the control condition.

# STEM faculty who believe ability is fixed have larger racial achievement gaps and inspire less student motivation in their classes

Elizabeth A. Canning<sup>\*</sup>, Katherine Muenks<sup>†</sup>, Dorainne J. Green and Mary C. Murphy<sup>\*</sup>

+ See all authors and affiliations

Science Advances 15 Feb 2019:  
Vol. 5, no. 2, eaau4734  
DOI: 10.1126/sciadv.aau4734

*"[R]acial achievement gaps in courses taught by more fixed mindset faculty were twice as large as the achievement gaps in courses taught by more growth mindset faculty. Course evaluations revealed that students were demotivated and had more negative experiences in classes taught by fixed (versus growth) mindset faculty. Faculty mindset beliefs predicted student achievement and motivation above and beyond any other faculty characteristic, including their gender, race/ethnicity, age, teaching experience, or tenure status."*

**Our mindset affects others**

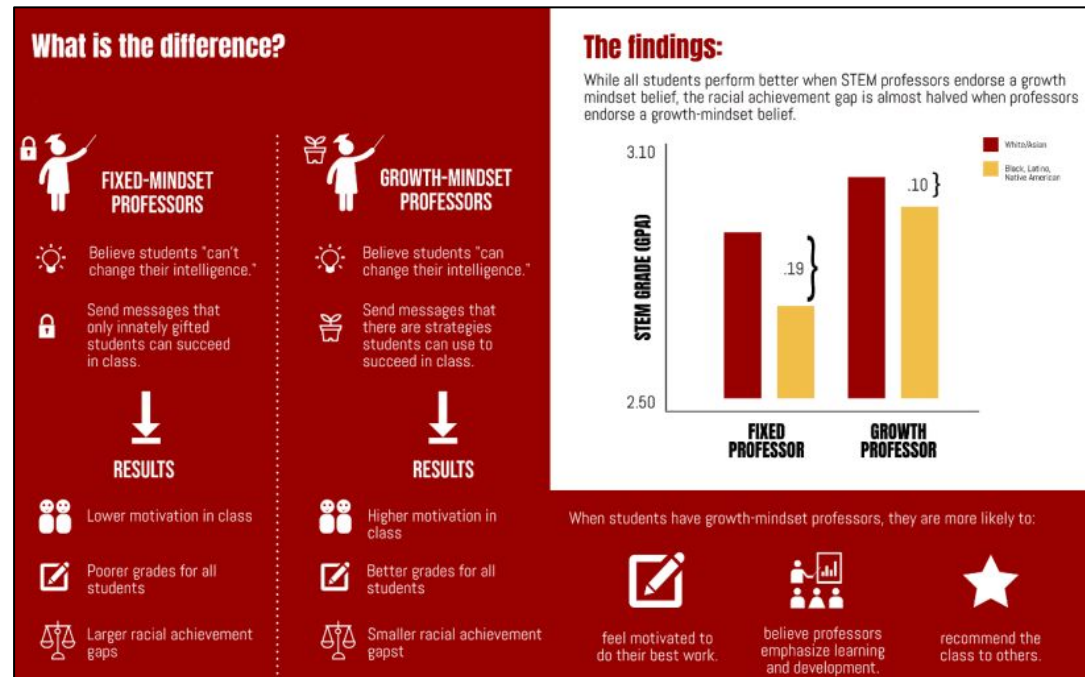


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*Science Advances* 15 Feb 2019:  
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## Our mindset affects others



John McEnroe had a fixed mindset. He believed that talent was all. He did not love to learn. He did not thrive on challenges; when the going got rough, he often folded. As a result, by his own admission, he did not fulfill his potential.

But his talent was so great that he was the number one tennis player in the world for four years. Here he tells us what it was like to be number one.

**Readings from "Growth Mindset" by Dweck**



McEnroe used sawdust to absorb the sweat on his hands during a match. This time the sawdust was not to his liking, so he went over to the can of sawdust and knocked it over with his racket. His agent, Gary, came dashing over to find out what was wrong.



**Readings from "Growth Mindset" by Dweck**



"You call that sawdust?" I said. I was actually screaming at him: The sawdust was ground too fine! "This looks like rat poison. Can't you get anything right?" So Gary ran out, and twenty minutes later, cam back with a fresh can of coarser sawdust...and twenty dollars less in his pocket. He'd had to pay a union employee to grind up a two-by-four. This is what it was like to be number one.

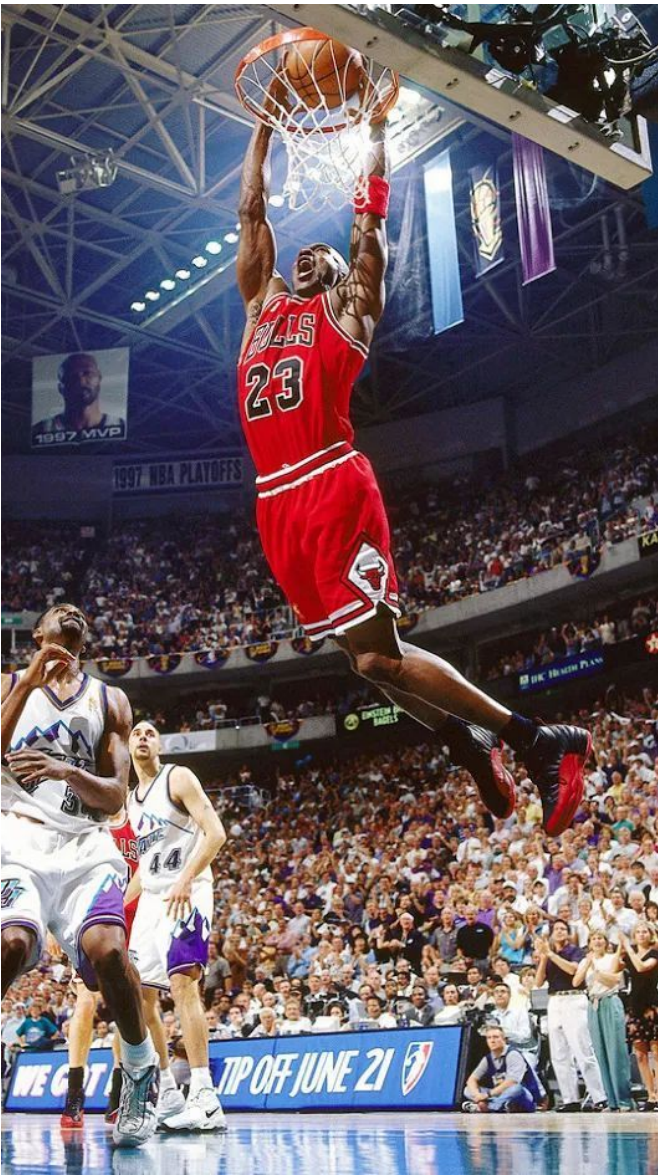
**Readings from "Growth Mindset" by Dweck**

"Everything was about you... 'Did you get everything you need? Is everything okay?' You only have to do what you want; your reaction to anything else is, 'Get the hell out of here.' For a long time I didn't mind a bit. Would you?"

So let's see. If you're successful, you're better than other people. You get to abuse them and have them grovel. In the fixed mindset, this is what can pass for self-esteem.



**Readings from "Growth Mindset" by Dweck**



As a contrast, let's look at Michael Jordan - growth-mindset athlete par excellence - whose greatness is regularly proclaimed by the world: "Superman", "God in person", "Jesus in tennis shoes." If anyone has reason to think of himself as special, it's he.

**Readings from "Growth Mindset" by Dweck**



But here's what he said when his return to basketball caused a huge commotion: "I was shocked with the level of intensity my coming back to the game created... People were praising me like I was a religious cult or something. That was very embarrassing. I'm a human being like everyone else."

Jordan knew how hard he had worked to develop his abilities. He was a person who had struggled and grown, not a person who was inherently better than others.



**Readings from "Growth Mindset" by Dweck**

People who believe in fixed traits feel an urgency to succeed, and when they do, they may feel more than pride. They may feel a sense of superiority, since success means that their fixed traits are better than other people's. However, lurking behind that self-esteem of the fixed mindset is a simple question. If you're somebody when you're successful, what are you when you're unsuccessful?



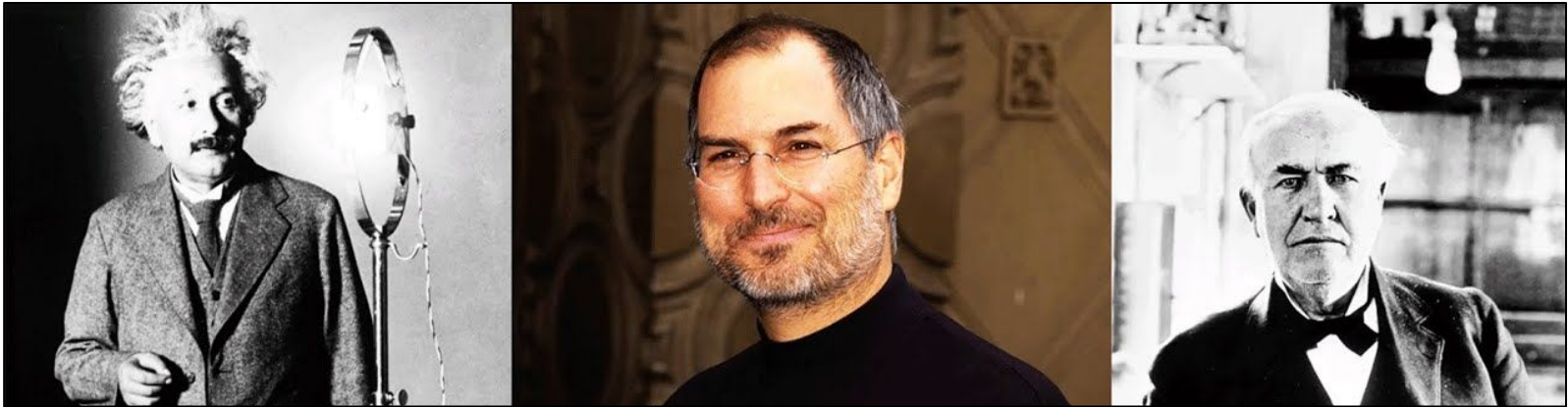
**Readings from "Growth Mindset" by Dweck**

# Discussion: personality traits of fixed & growth mindset

Fixed & Growth Mindset Traits: <https://bit.ly/2VCF854>



# Fixed Mindset is a socially-constructed and endorsed construct





## The Myth of the Lone Genius

(NB: usually white and male)

See <https://www.youtube.com/watch?v=LHYt2QeS8FM>

# Fixed Mindset is a socially-constructed and endorsed construct

**Nobel Prize in Physics**



Andrea Ghez (USA, left), Reinhard Genzel (GER, centre), and Roger Penrose (UK, right), share the Nobel Prize for their discoveries about one of the most exotic phenomena in the universe, the black hole

**114** Nobel Prizes in Physics awarded from 1901 to 2020

<b>1</b> double winner, <b>John Bardeen</b> , awarded prize in 1956 and 1972	<b>25</b> Age of youngest laureate, <b>Lawrence Bragg</b> , awarded prize in 1915	<b>4</b> Women awarded prize, including <b>Marie Curie</b> in 1903
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Source: Nobelprize.org

Pictures: Nobel Foundation, Newscom, Getty Images, Cirone-Musi, AP © GRAPHIC NEWS

**Nobel Prize in Physics**  
Only goes to individuals  
(NB: overwhelmingly white and male)

**2020 MacArthur Fellows**

**21 Extraordinarily  
Creative and  
Inspiring  
Individuals**



[www.macfound.org/fellows](http://www.macfound.org/fellows)  
#MacFellow

MacArthur  
Foundation

**MacArthur "Genius"  
Fellowship**  
Only goes to individuals



# Fixed Mindset is a socially-constructed and endorsed construct



# Negative reinforcement of Fixed Mindset



"You should know this by now"

"This problem may be beyond you"

"The solution is trivial"

"Have you considered a different major?"

"There aren't many women engineers, are you sure you can do this?"

**Implicit Bias ⇒ Stereotype Threat**

What are the factors that discourage women from becoming engineers?

# Positive reinforcement of Fixed Mindset



"You're a natural!"

"You were born to be a engineer"

"You've clearly got good genetics!"

"Engineering comes so easy to you"

"Asians are always good at math/science/engineering"

Implicit Bias  $\Rightarrow$  Stereotype Threat

What if you're not into Math/Science/Engineering?

Is something wrong with you?

*Who decided this??*



# You have a choice on how you respond to situations



Actively choosing to respond to positive and negative situations **from a growth mindset perspective** helps to reinforce that perspective - it's just like working out



Choose one of the following situations, and on the Google jamboard link below describe how you would react with a FIXED and with a GROWTH mindset

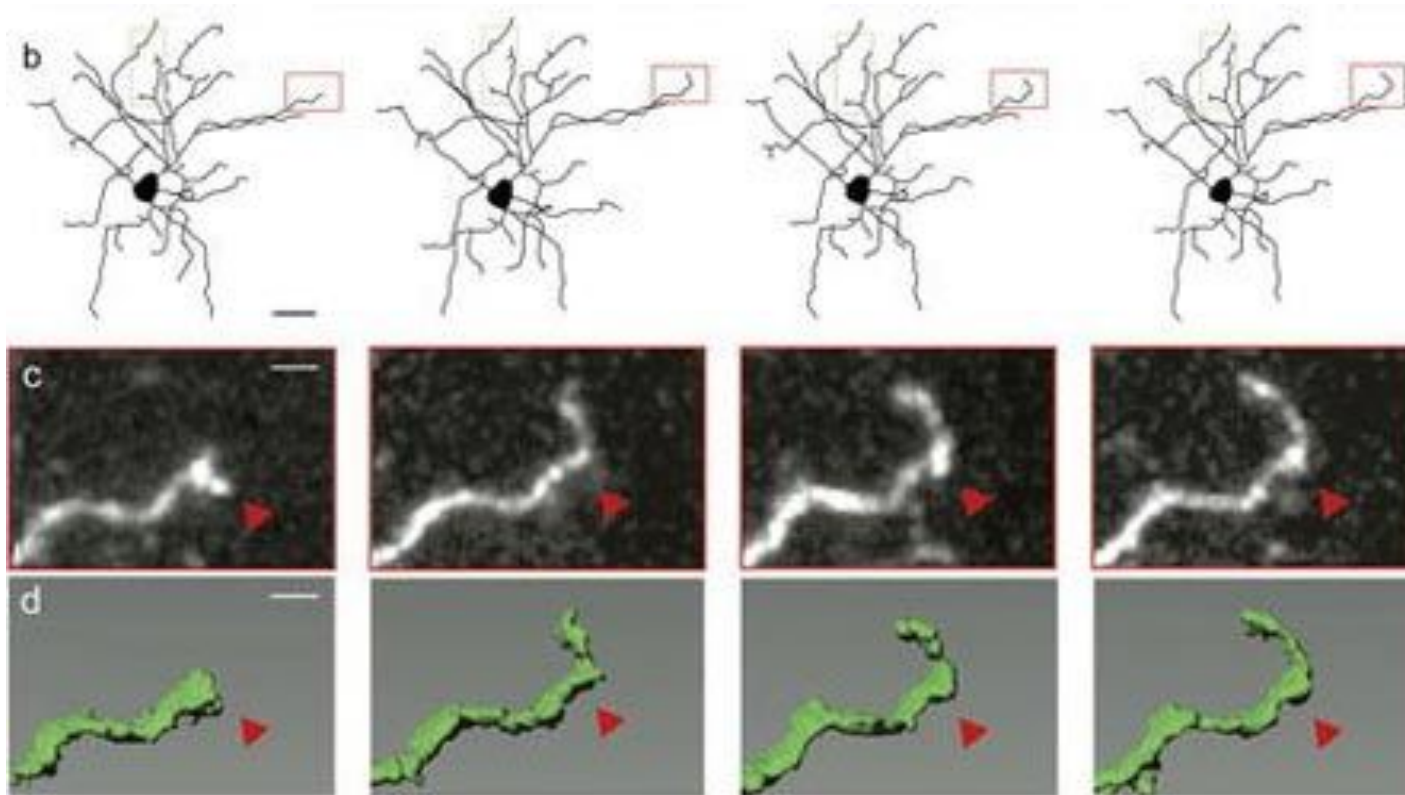
- Your graduate/postdoc advisor has decided to let you go from the group
- You've just won a prestigious fellowship
- You're about halfway through the job season and you haven't gotten an offer yet
- Your experiment isn't going as well as you hoped

Post responses here: <https://bit.ly/2JlOt91>

**Brainstorm: Responding with Fixed/Growth Mindset**



# Your brains can change



So et al. (2005) PLOS-1 Biology

# Your brains can change

## Temporal and Spatial Dynamics of Brain Structure Changes during Extensive Learning

Bogdan Draganski<sup>1</sup>, Christian Gaser<sup>2</sup>, Gerd Kempermann<sup>3</sup>, H. Georg Kuhn<sup>4</sup>, Jürgen Winkler<sup>1</sup>, Christian Büchel<sup>5</sup>,  
and Arne May<sup>1,5</sup>

The current view regarding human long-term memory as an active process of encoding and retrieval includes a highly specific learning-induced functional plasticity in a network of multiple memory systems. Voxel-based morphometry was used to detect possible structural brain changes associated with learning. Magnetic resonance images were obtained at three different time points while medical students learned for their medical examination. During the learning period, the gray matter increased significantly in the posterior and lateral parietal cortex bilaterally. These structural changes did not change significantly toward the third scan during the semester break 3 months after the exam. The posterior hippocampus showed a different pattern over time: the initial increase in gray matter during the learning period was even more pronounced toward the third time point. These results indicate that the acquisition of a great amount of highly abstract information may be related to a particular pattern of structural gray matter changes in particular brain areas.

# Your intelligence can change

NATURE | LETTER



日本語要約

## Verbal and non-verbal intelligence changes in the teenage brain

Sue Ramsden, Fiona M. Richardson, Goulven Josse, Michael S. C. Thomas, Caroline Ellis, Clare Shakeshaft, Mohamed L. Seghier & Cathy J. Price

*"Here we show that verbal and non-verbal IQ can rise or fall in the teenage years, with these changes in performance validated by their close correlation with changes in local brain structure.... More generally, our results emphasize the possibility that an individual's intellectual capacity relative to their peers can decrease or increase in the teenage years. This would be encouraging to those whose intellectual potential may improve, and would be a warning that early achievers may not maintain their potential."*

Nature 479, 113 (2011)

# How to do it

- Active thinking - recognize current and past responses of fixed mindset, imagine an alternate growth mindset response
- Recognize fixed mindset responses in others, and point it out when appropriate
- **CHANGE REQUIRES WORK**: make plans, commit to them, reflect on your process, adapt
- Accept failure as a natural phase of growth and an indicator that you are pushing your boundaries

**IT'S NOT THAT  
I'M SO SMART,  
IT'S JUST THAT  
I STAY WITH  
PROBLEMS  
LONGER**

Albert Einstein

**IT DOES NOT  
MATTER HOW  
SLOWLY YOU  
GO SO LONG  
AS YOU DO  
NOT STOP.**

Confucius

**YOU'RE IN  
CHARGE OF  
YOUR MIND.  
YOU CAN HELP  
IT GROW BY  
USING IT IN  
THE RIGHT  
WAY.**

Carol Dweck



On your own, describe an event or situation you have experienced as a graduate student/postdoc in which you definitely reacted in a fixed mindset. How did that turn out? How could you have changed your response to reflect a growth mindset, and how would the outcome have differed?

**Free Write: Personal Reflection**

# Resources

- Mindset Works website: <http://www.mindsetworks.com/>
- Mindset (Carol Dweck):  
[http://www.amazon.com/Mindset-Psychology-Success-Carol-Dweck/dp/1400062756/sr=8-1/qid=1158604938/ref=pd\\_bbs\\_1/102-1809568-4984946?ie=UTF8&s=books](http://www.amazon.com/Mindset-Psychology-Success-Carol-Dweck/dp/1400062756/sr=8-1/qid=1158604938/ref=pd_bbs_1/102-1809568-4984946?ie=UTF8&s=books)
- Self-Theories (Carol Dweck):  
<http://www.amazon.com/Self-theories-Motivation-Personality-Development-Psychology/dp/1841690244>
- The Talent Myth (Malcom Gladwell): <http://gladwell.com/the-talent-myth/>
- Eduardo Briceño TedX talk on Growth Mindset:  
<https://www.youtube.com/watch?v=pN34FNbOKXc>
- Why I Teach Growth Mindset (me!)  
<https://www.nature.com/articles/s41550-019-0940-7>