

# From Cognitive Science to Physic Education and Back: Academic Performance under Stress

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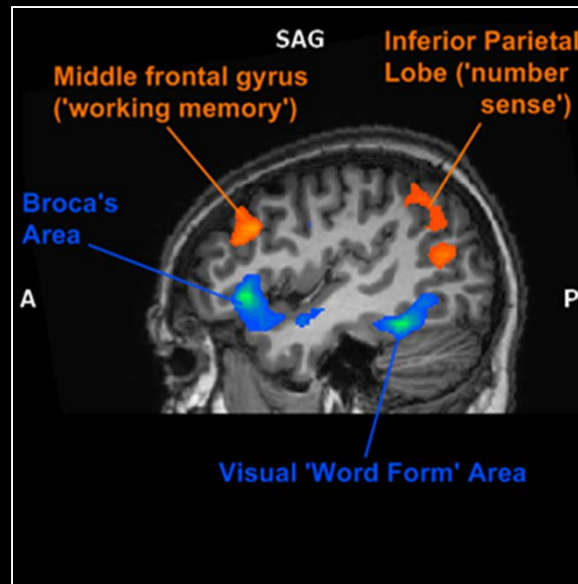
# Stressors we study...

- High-stakes testing situations
- Math anxiety
- Academic situations in which students are aware of negative stereotypes about the ability of the social group to which they belong (i.e., *stereotype threat*)

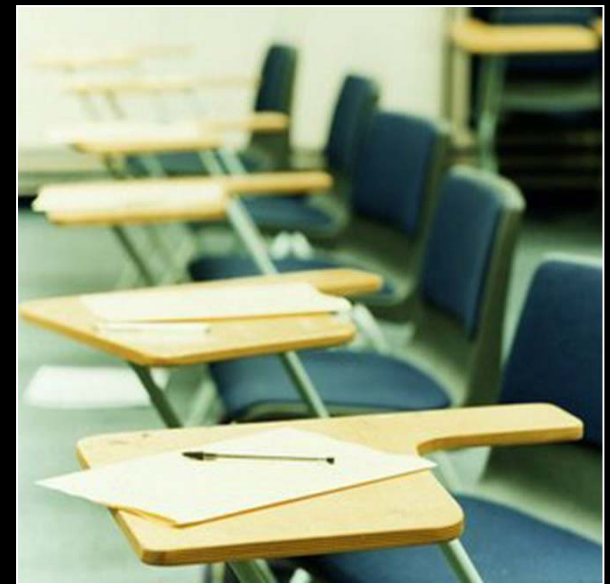
# The Tools of the Trade...



Performance  
in the laboratory



fMRI



Performance  
in the classroom

It's NOT Just What You Know...

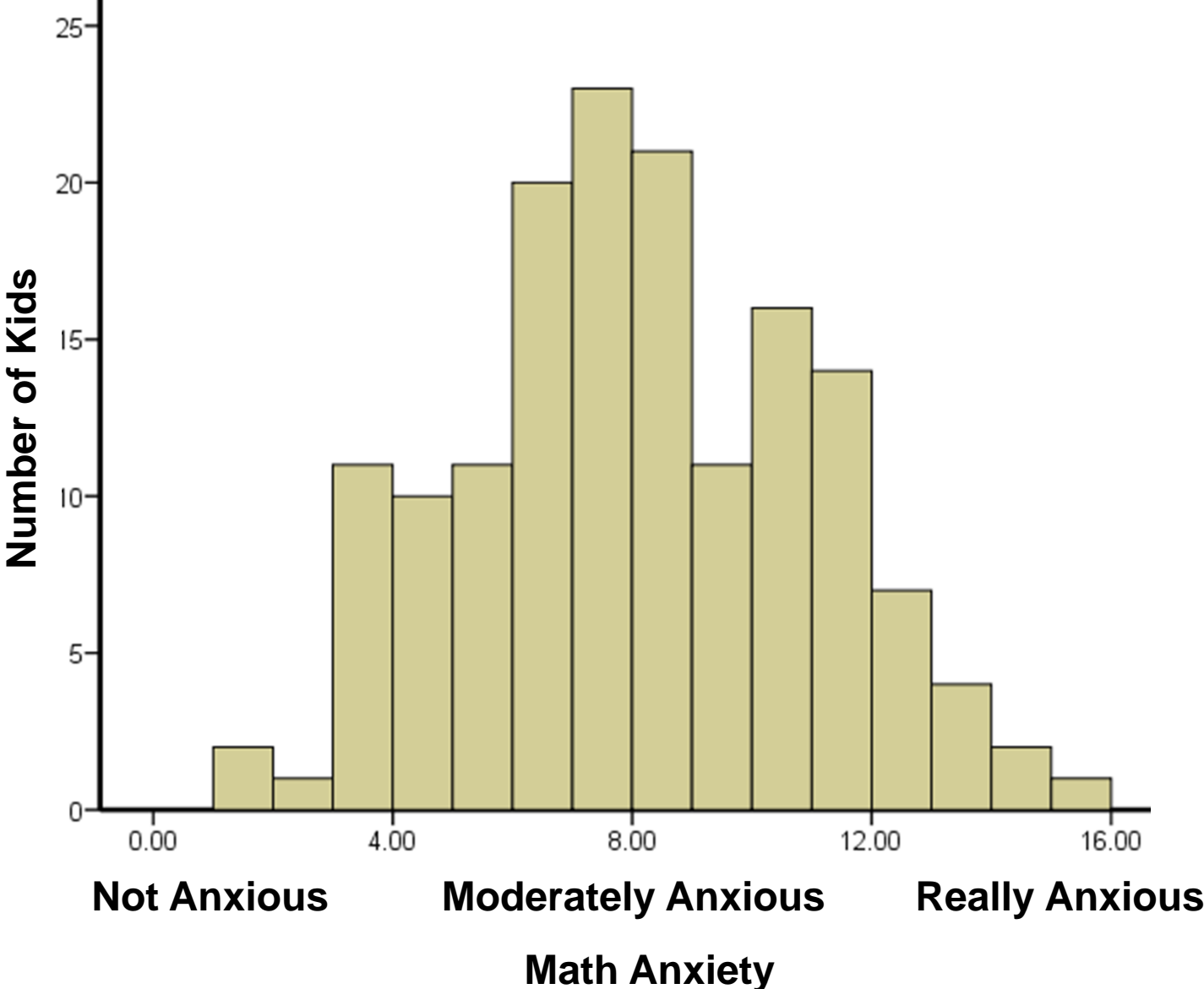
# Child Math Anxiety Questionnaire

How do you feel when taking a big test  
in your math class?

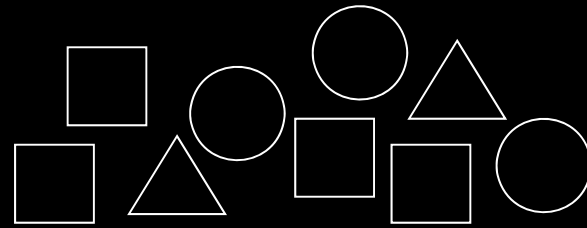
How do you feel when getting your math  
book and seeing all the numbers in it?



# 1<sup>st</sup> and 2<sup>nd</sup> graders



# Math Achievement



**“How many squares are there?”**

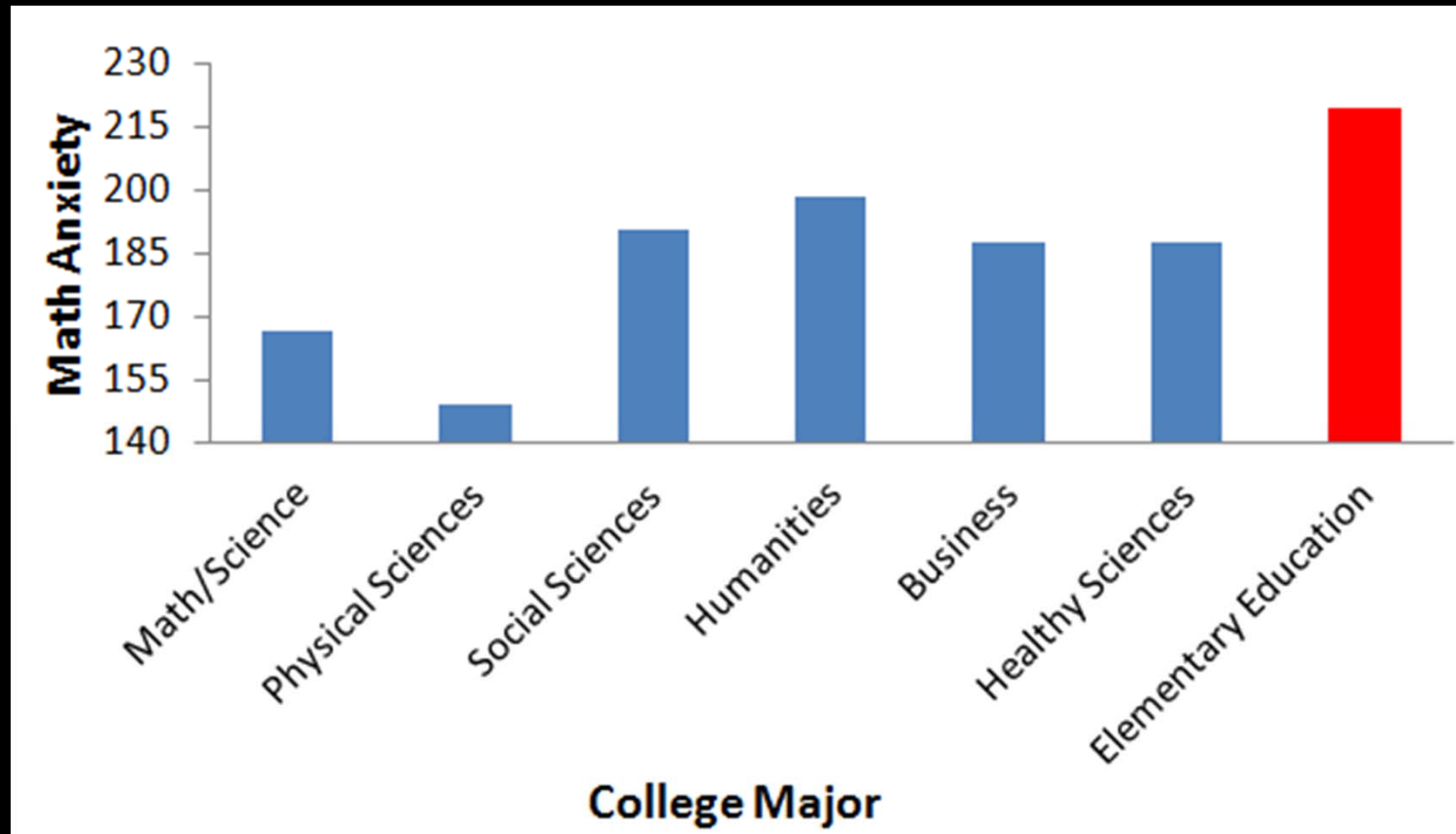


**“If you have seven pennies and you spend three, how many pennies would you have left?”**

What Are The Origins?



# Math Anxiety by College Major



Hembree (1990)

# Math Anxiety

How anxious would the following make you feel?

(SMARS, Alexander & Martray, 1989)

- “Reading a cash register receipt after you buy something”
- “Studying for a math test”
- “Receiving a math text book”



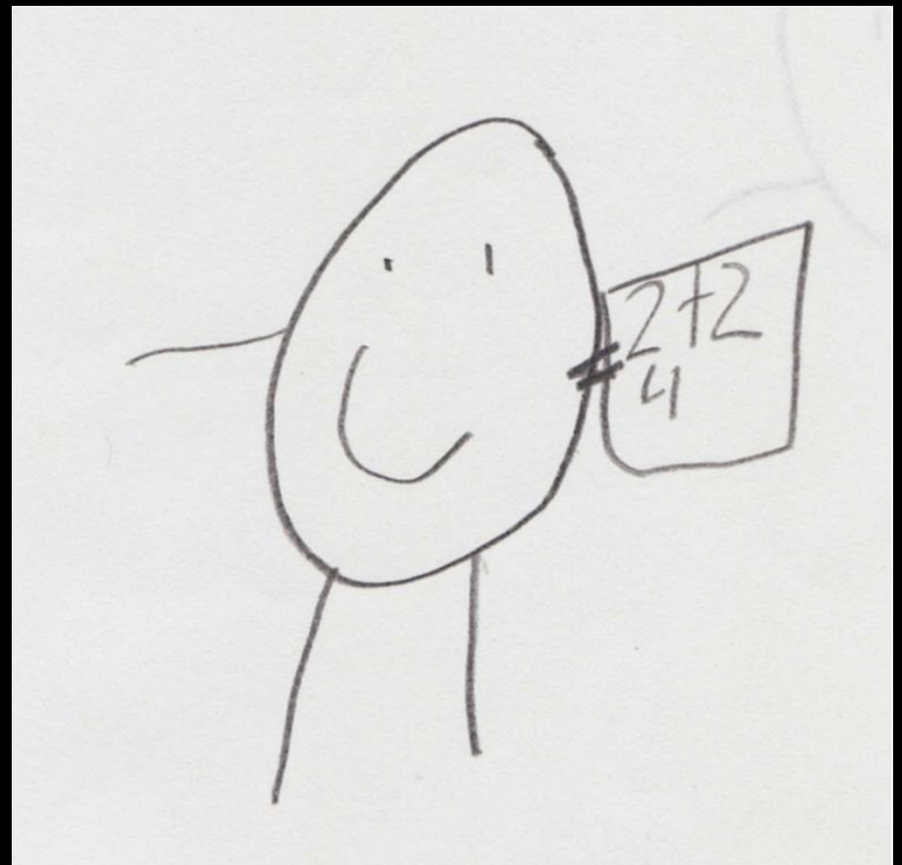
Beilock et al. (2010). *Proc Natl Acad Sci*

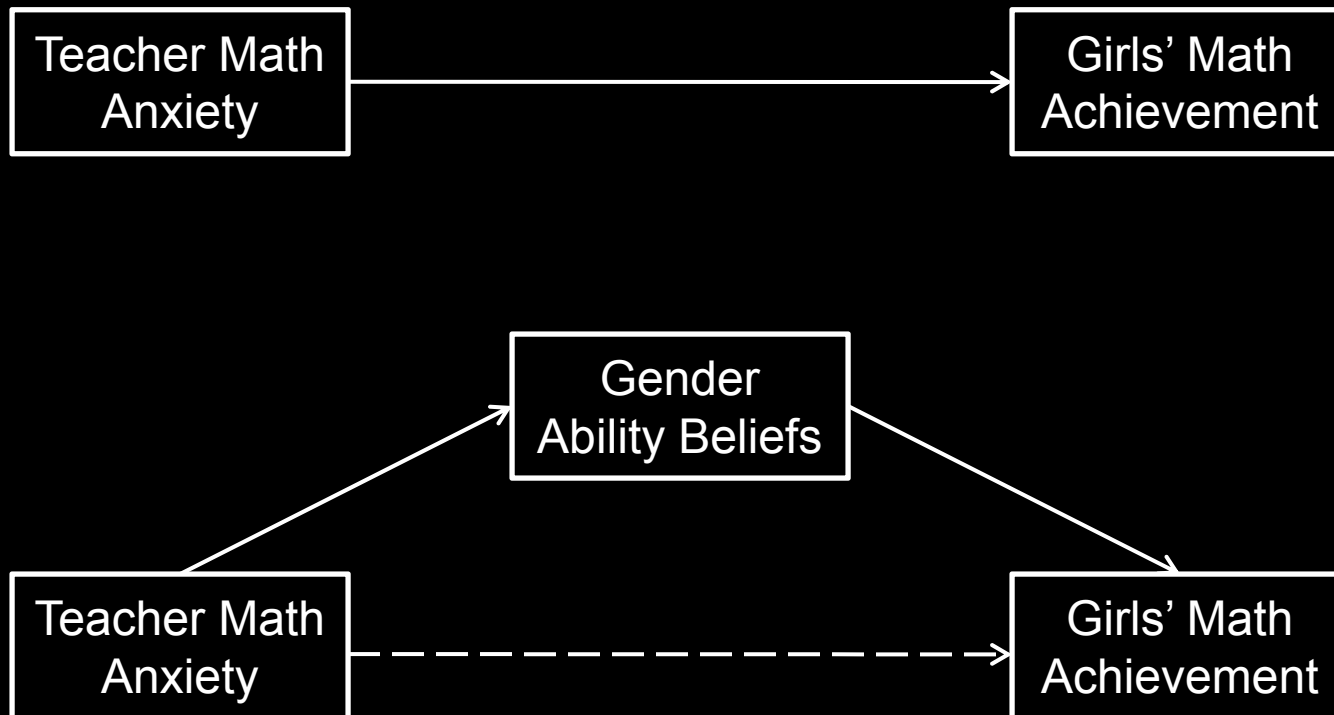
# Confirming Academic Stereotypes

**Reading = Girl**



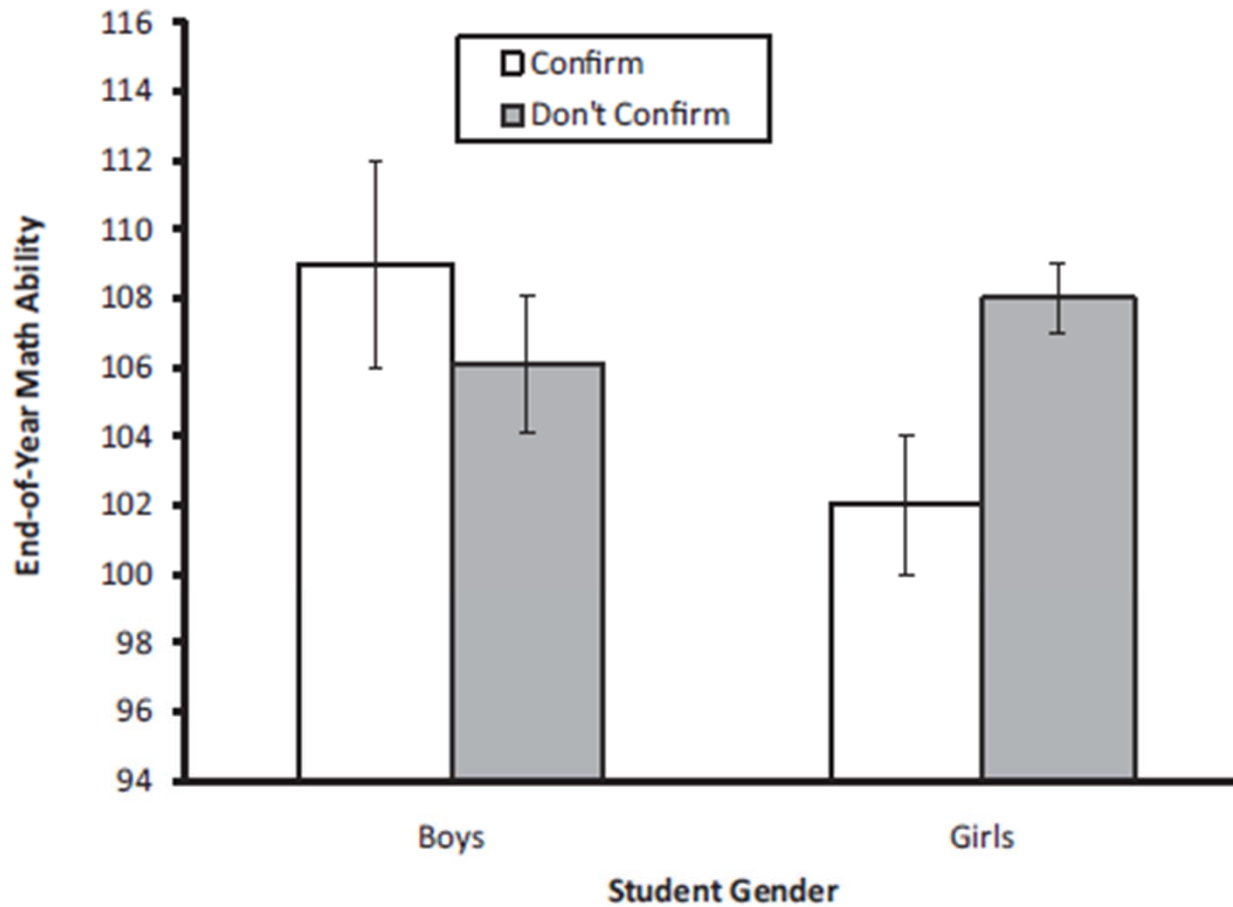
**Math = Boy**





Beilock et al. (2010). *Proc Natl Acad Sci*

# End-of-year Math Ability



Beilock et al. (2010). *Proc Natl Acad Sci*

It's Not Just Teachers...



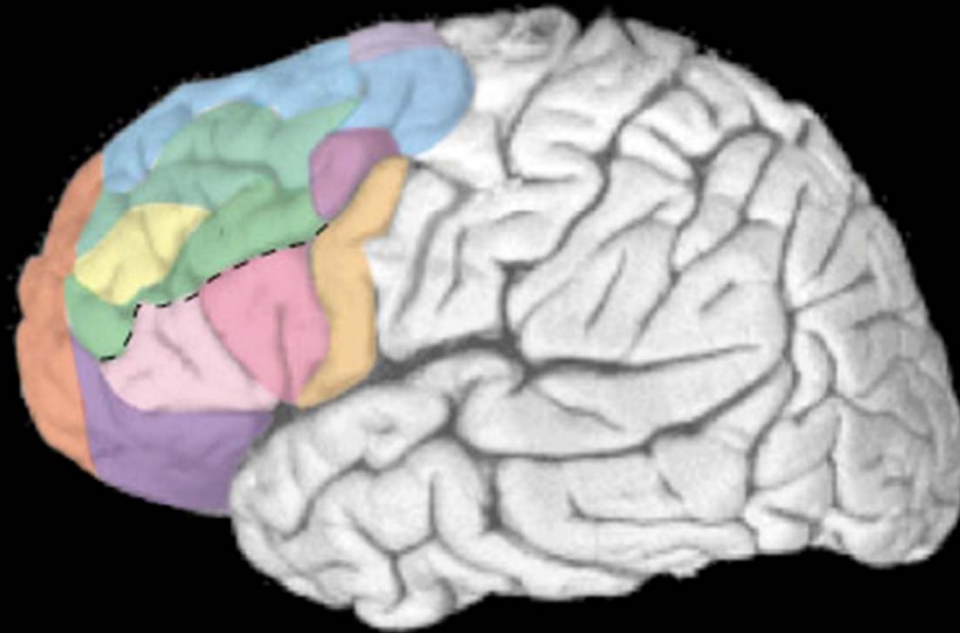
**I'm too pretty  
to do math.**

dani & quinn

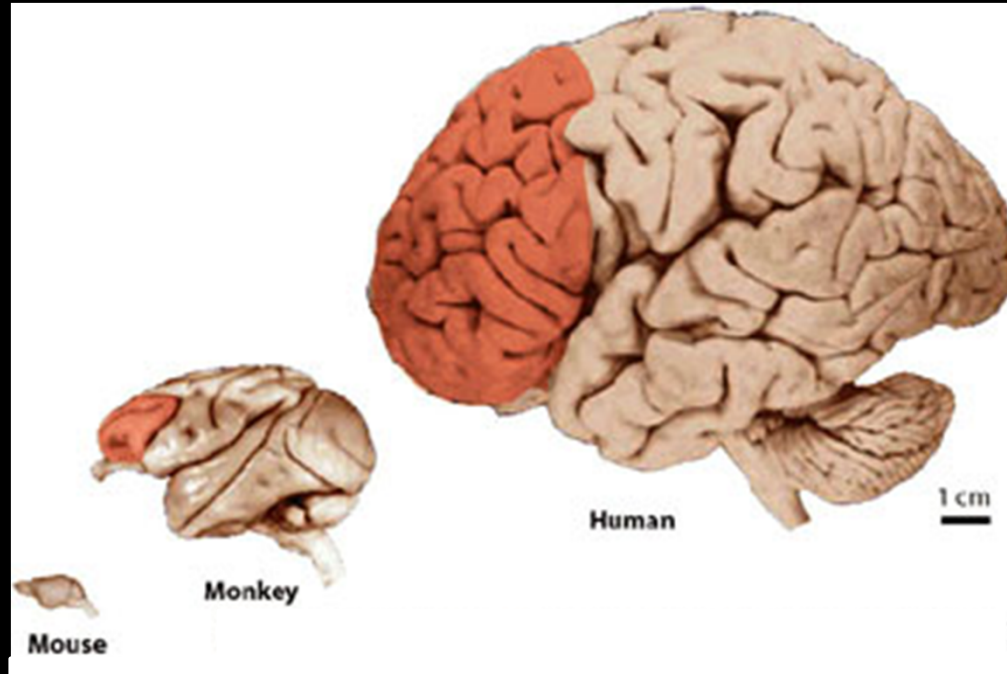


# Anxiety vs. Ability

- “I hope I don’t look stupid.”
- “I thought about how boys are usually better than girls at math so I was trying harder not to make mistakes...even though I did.”
- “Oh fuck. There is no way I am going to [perform well].”



**Working Memory (WM):** Limited mental scratchpad; allows us to “work” with whatever information is held in consciousness.



## Evolution of the prefrontal cortex

- Modular arithmetic (Gauss, 1801)
- $51 \equiv 19 \pmod{4}$

$$\text{Step 1: } 51 - 19 = 32$$

$$\text{Step 2: } 32 \div 4 = 8$$

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- $51 \equiv 19 \pmod{4}$

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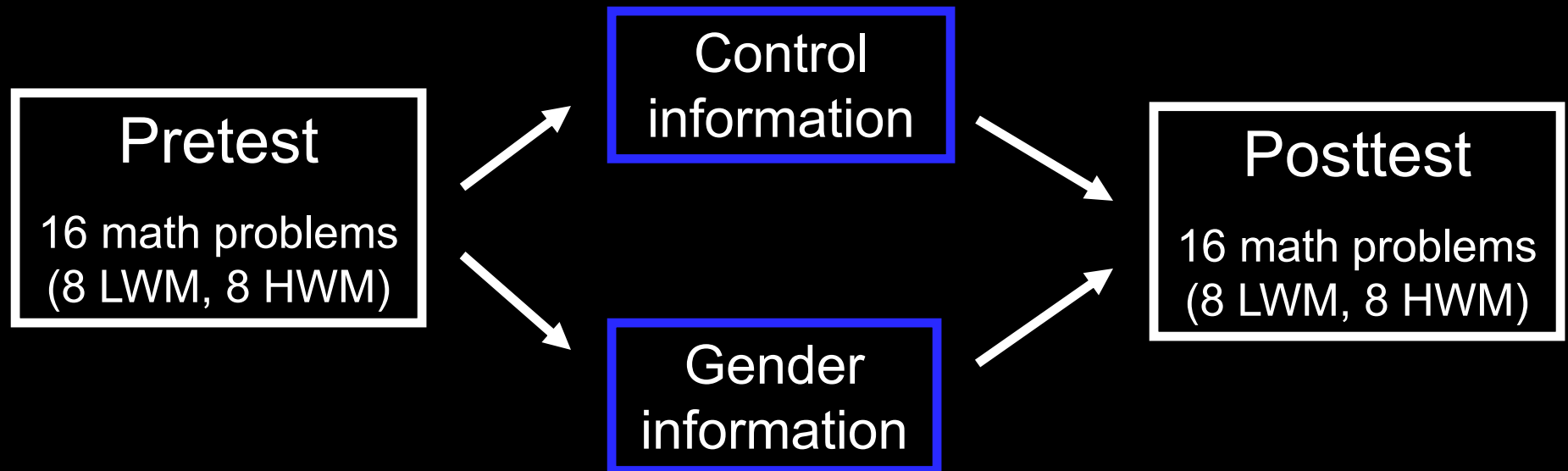
$$\text{Step 2: } 32 \div 4 = 8$$

Low WM Problems:  
 $9 \equiv 4 \pmod{5}$

High WM Problems:  
 $51 \equiv 19 \pmod{4}$

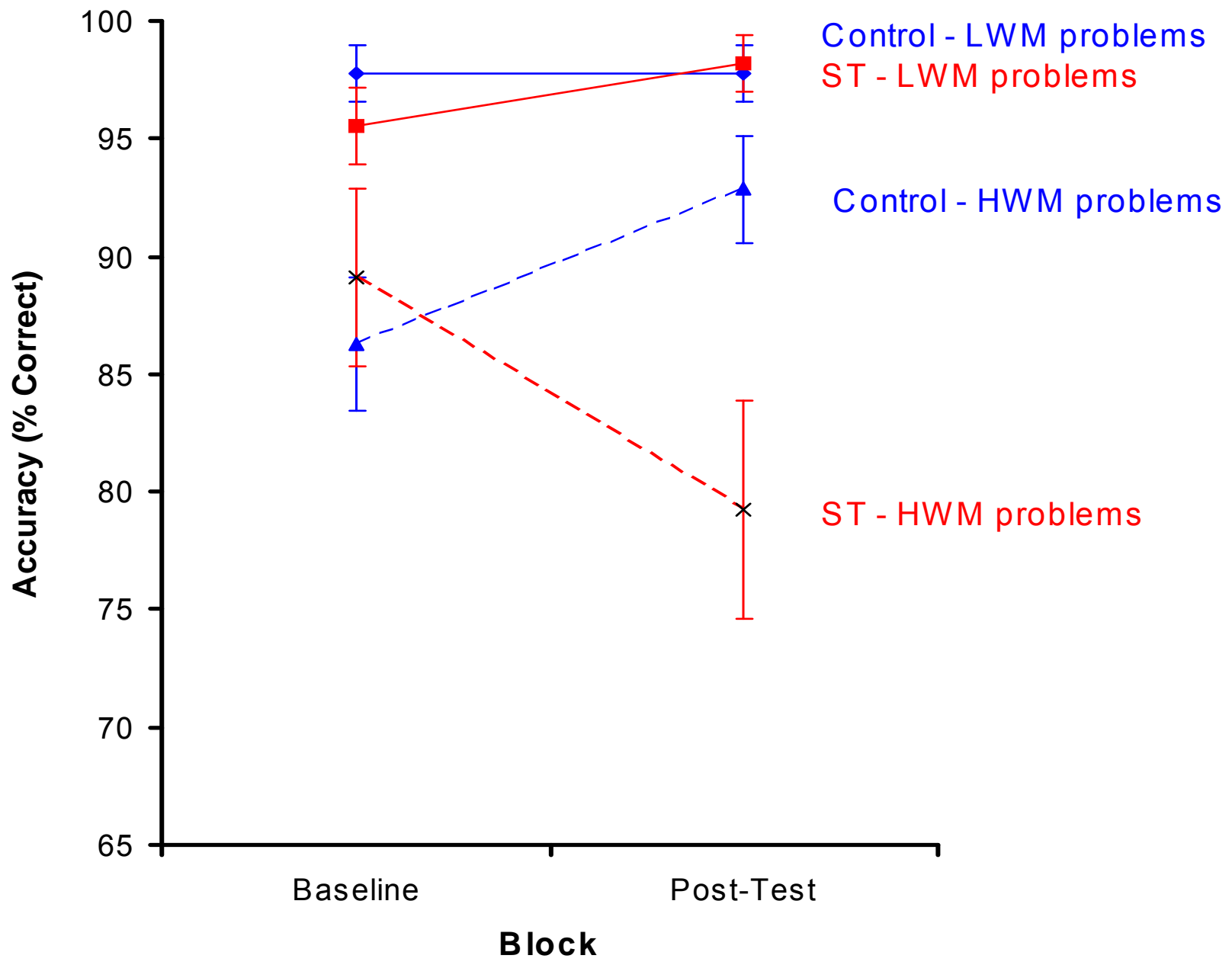
# Stereotype Threat

Only used female participants...



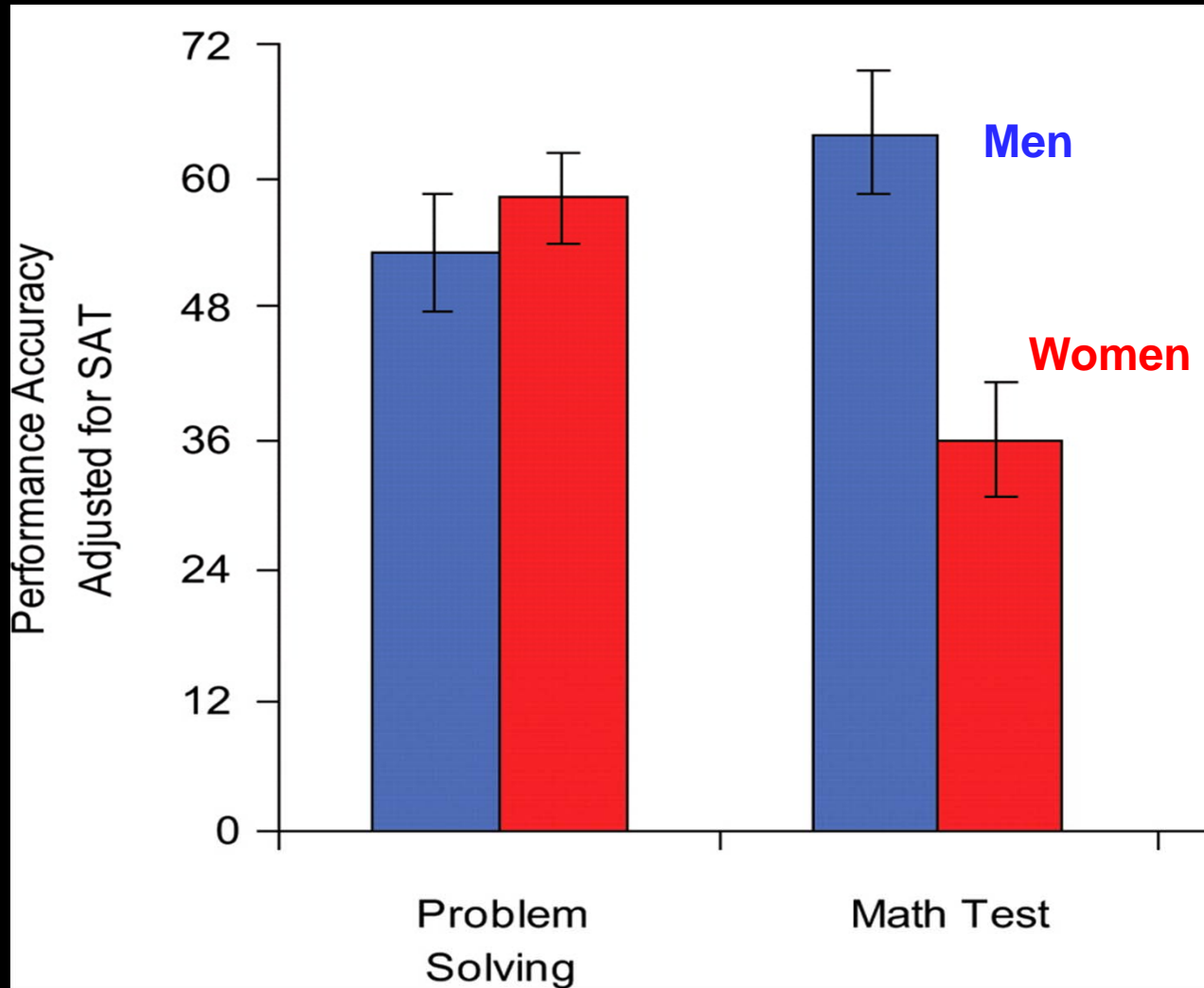
Beilock et al. (2007). *JEP: General*

Rydell, McConnell, & Beilock (2009). *JPSP*



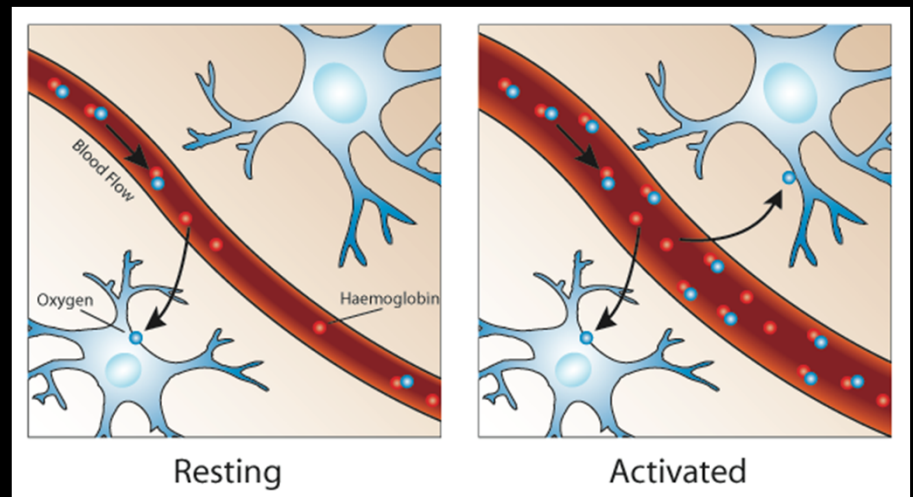


# Framing of the Test



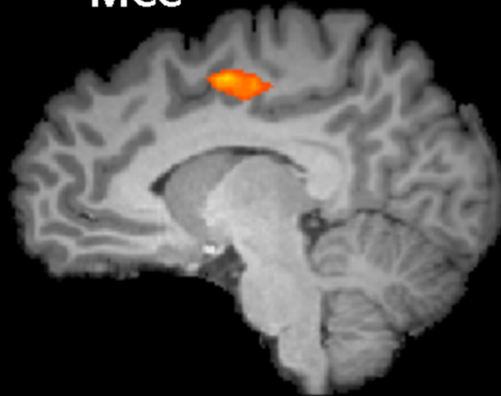
Johns et al. (2005). *Psychological Science*

# fMRI



# Negative Anticipation

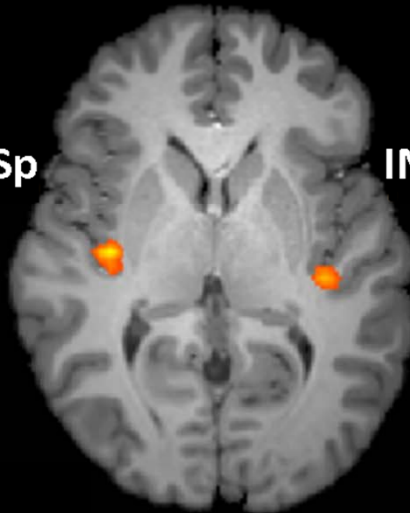
MCC



Is this equation true?  
 $(4 * 8) - 15 = 19$

INSp

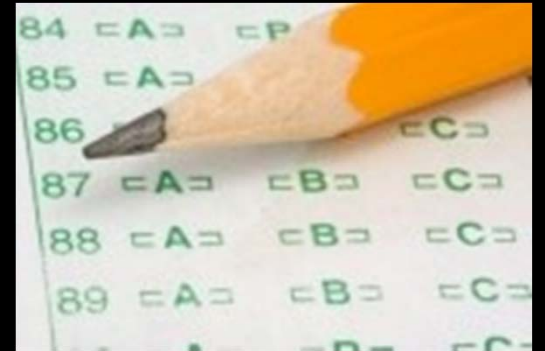
INSp



LH

# Mindset Matters!

- Stereotypes and expectations...



# Changing Mindsets

- Watch failed race
- Intervention
  - Reappraisal of failure
  - Planning for future race
- Watch failed race again



Team Canada

# Get Used To It!

- Southern Utah University
- Coach Reid Arrived – ranked 217<sup>th</sup> in NCAA, now ranked at the top in free-throw % success...

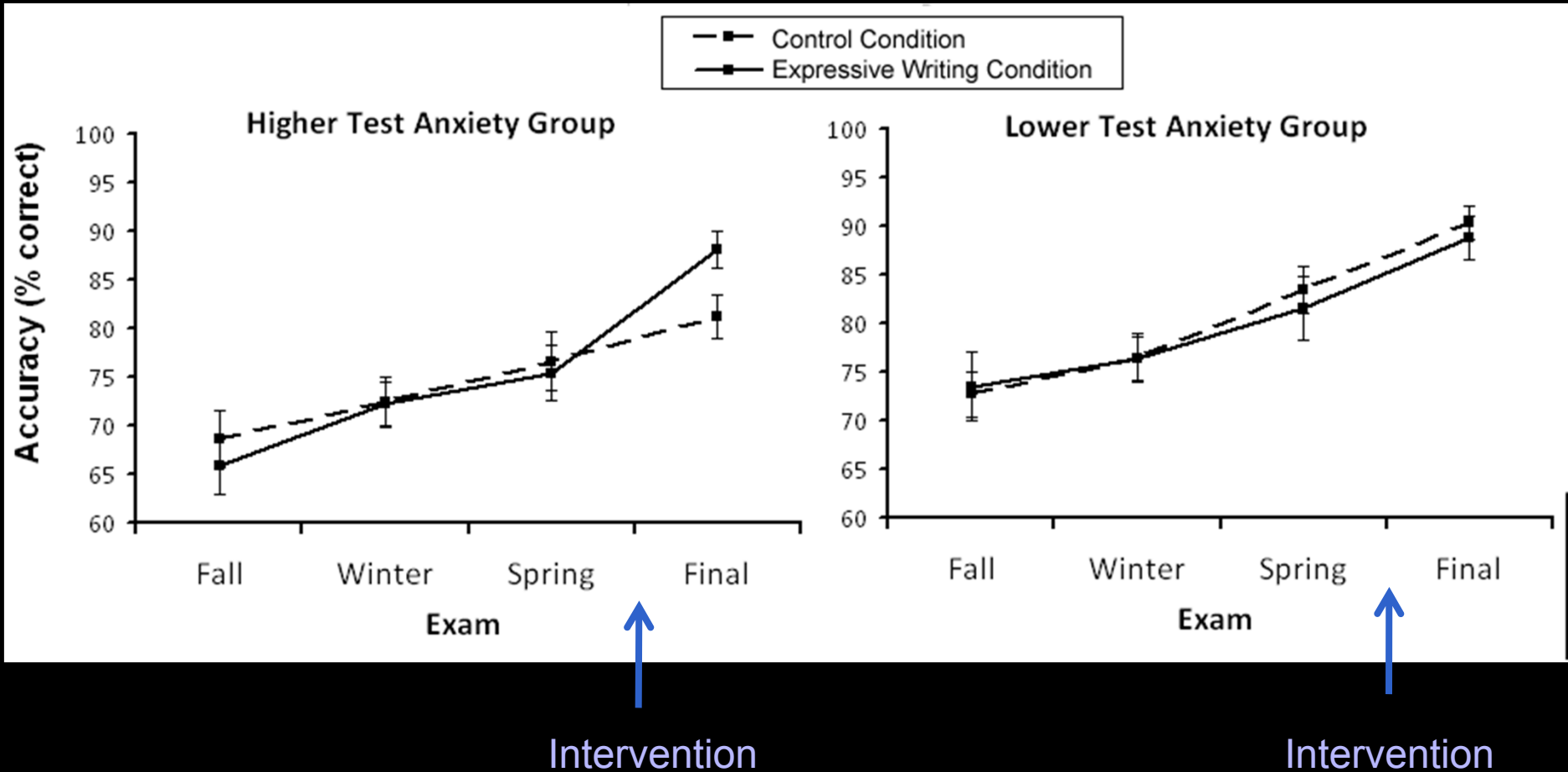


# Expressive Writing

- “This short assignment will not be graded.....

We would like YOU to take the next 10 minutes to write as openly as possible about your thoughts and feelings regarding the exam you are about to take. In your writing, I want you to really let yourself go and explore your emotions and thoughts as you are getting ready to start the exam. You might relate your current thoughts to the way you have felt during other similar situations at school or in other situations in your life. Please try to be as open as possible as you write about your thoughts at this time.”

# In the Classroom



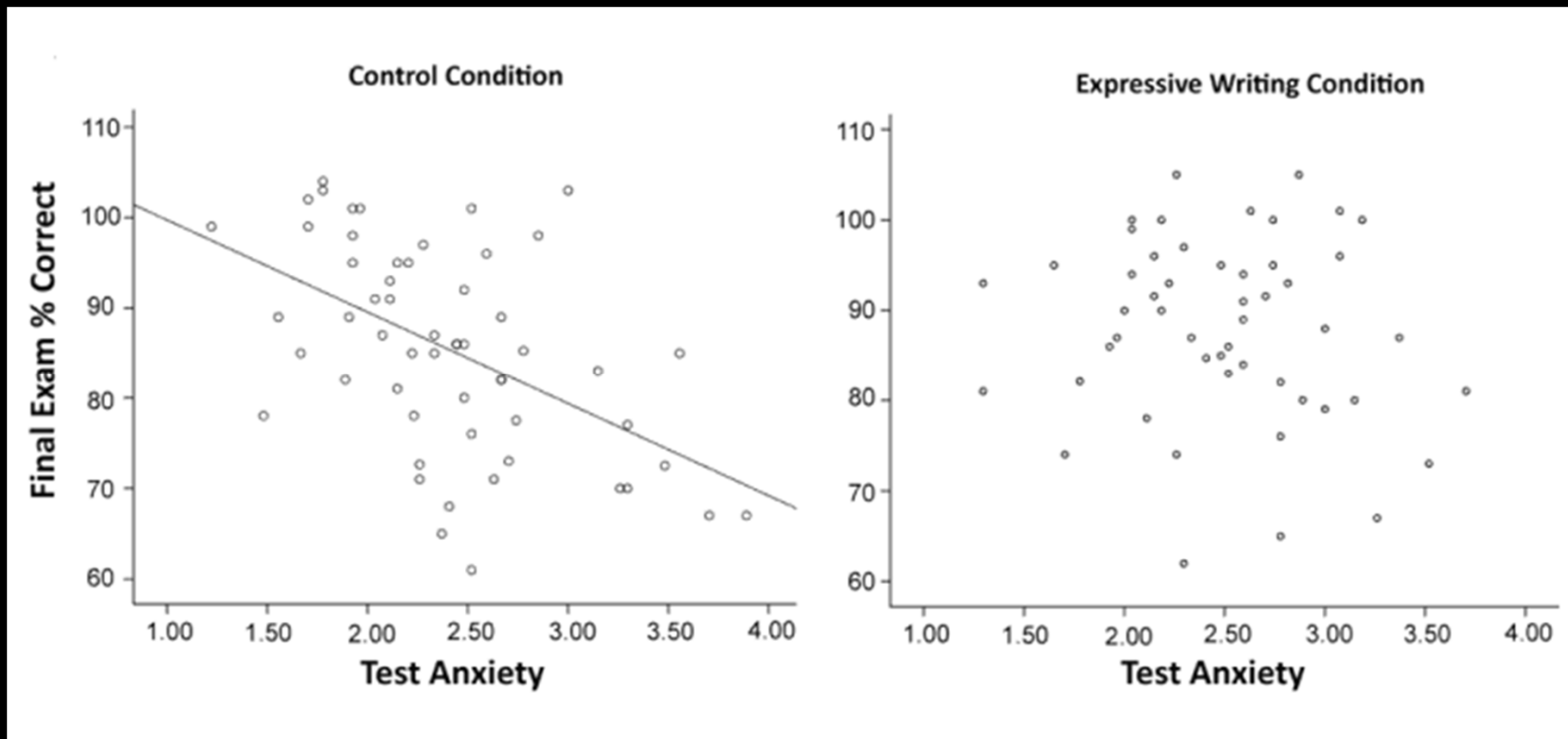
Ramirez & Beilock (2011). *Science*



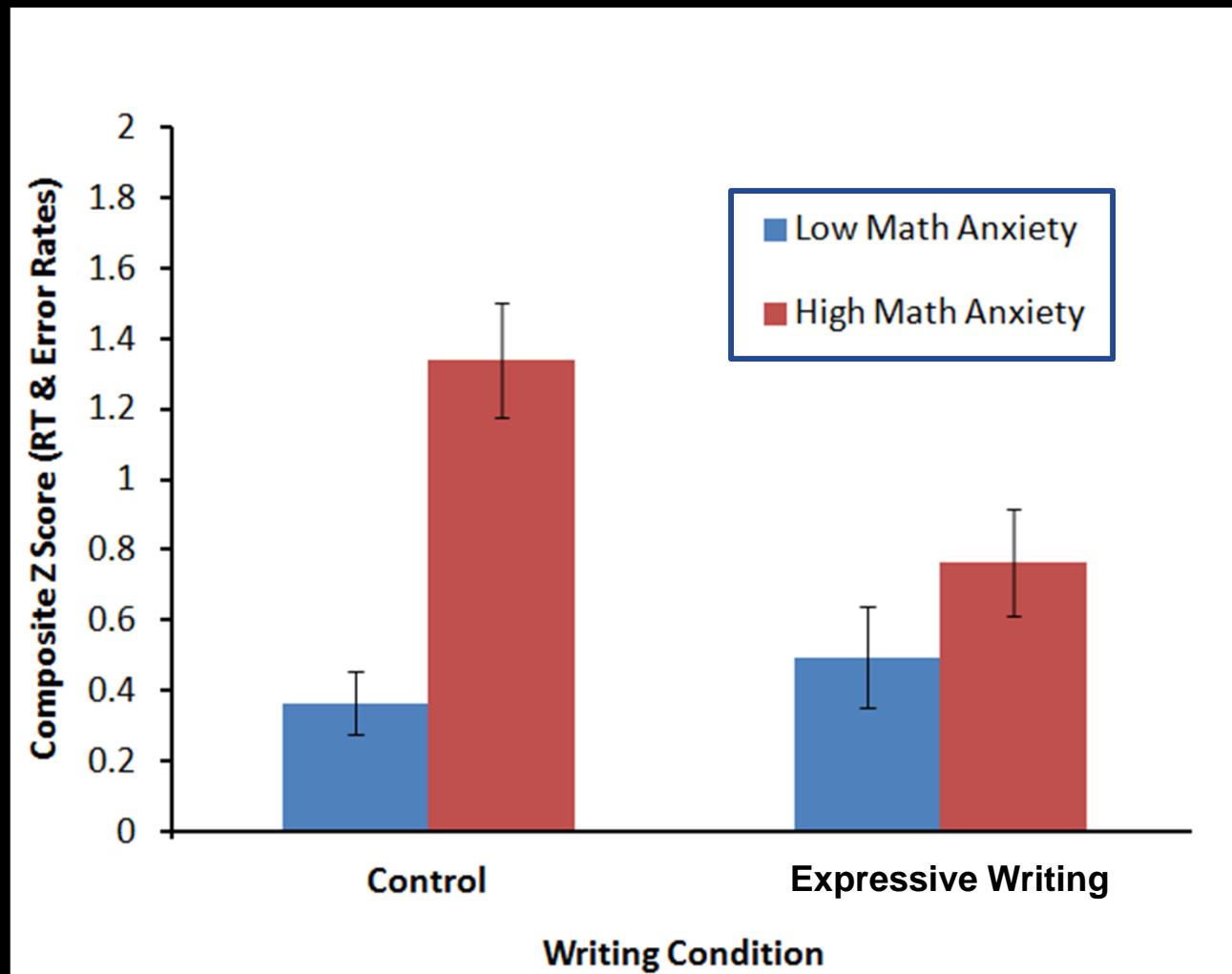
# Sample Writing

- When I first think about this upcoming final I feel really stressed. I am worried that it will be on everything that I don't know very well and that I haven't prepared enough. This really stresses me because I am always worried about grades, I really like doing well, and when I don't do so well it upsets me. I also have really high standards. As I continue to think about the final, I relax significantly. I realize that it is only a test. I realize that I've studied enough. What I don't know I don't. And I think that I know everything that I need to. I realize that I was blowing this final out of proportions. I don't have to worry as much. It is only one test. It won't affect my life drastically so now I'm reconciled in terms of stress. I don't have to worry as much. It is not as stressful now. I know I will do well, great even. I know this stuff. I've learned what my teacher taught me. I don't have to worry. But there is still an undertone of stress. I am still a little bit worried. But everything will be ok. I know that I will do as well as I can.

# In the Classroom



# Math Anxiety



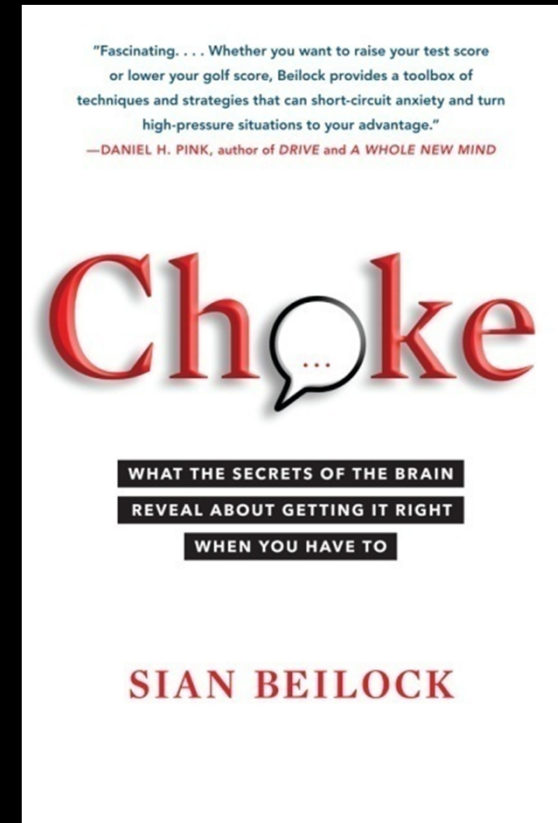
(Park et al. (in prep).

# The Take Home...

- Success is more than simply what you know
  - Attitudes, motivation and anxieties are critical
- Having insight into the science behind human performance lets students apply the right techniques to perform at their best under stress.

# Thank You

Support...



<http://sianbeilock.com/>