


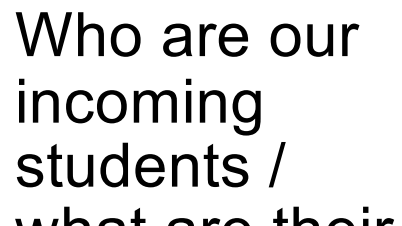
Caltech Student Data and Insights on Teaching

Inclusive Caltech Core Project


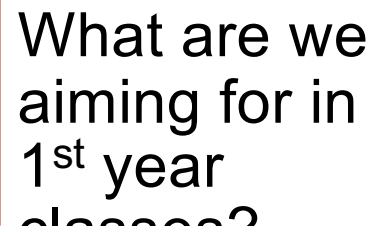
2018-19 Kickoff Lunch

September 12, 2018


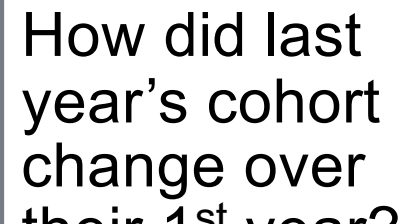
Plan for today



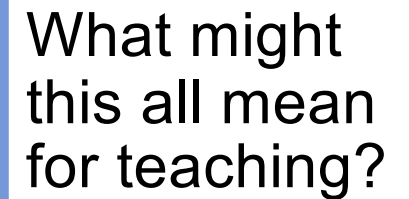
Who are our incoming students / what are their strengths?



What are we aiming for in 1st year classes?



How did last year's cohort change over their 1st year?



What might this all mean for teaching?

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The Class Entering in Fall 2018

- 234 Students
- 110 women (47.0%, new high %)
- URM = 24% (previous high 17.7%)
 - 42 Hispanic / Latinos
 - 12 African Americans (previous high 10)
 - 2 American Indians
 - 1 Native Hawaiian
- 19 International (Peak of 34 in 2009)

Diversity numbers reflect Caltech admission reporting, not IPEDS guidelines

NOTE: These are not the final numbers for the entering class -- there will be small changes of a few students

The Class Entering in Fall 2018

- 70.9% are from *public or charter high schools*
- 10.3% are *first generation*
- 10.7% are *Pell eligible*
- 22% are coded *athletes*
- 10.3% *LGBTQ (self-reported)*

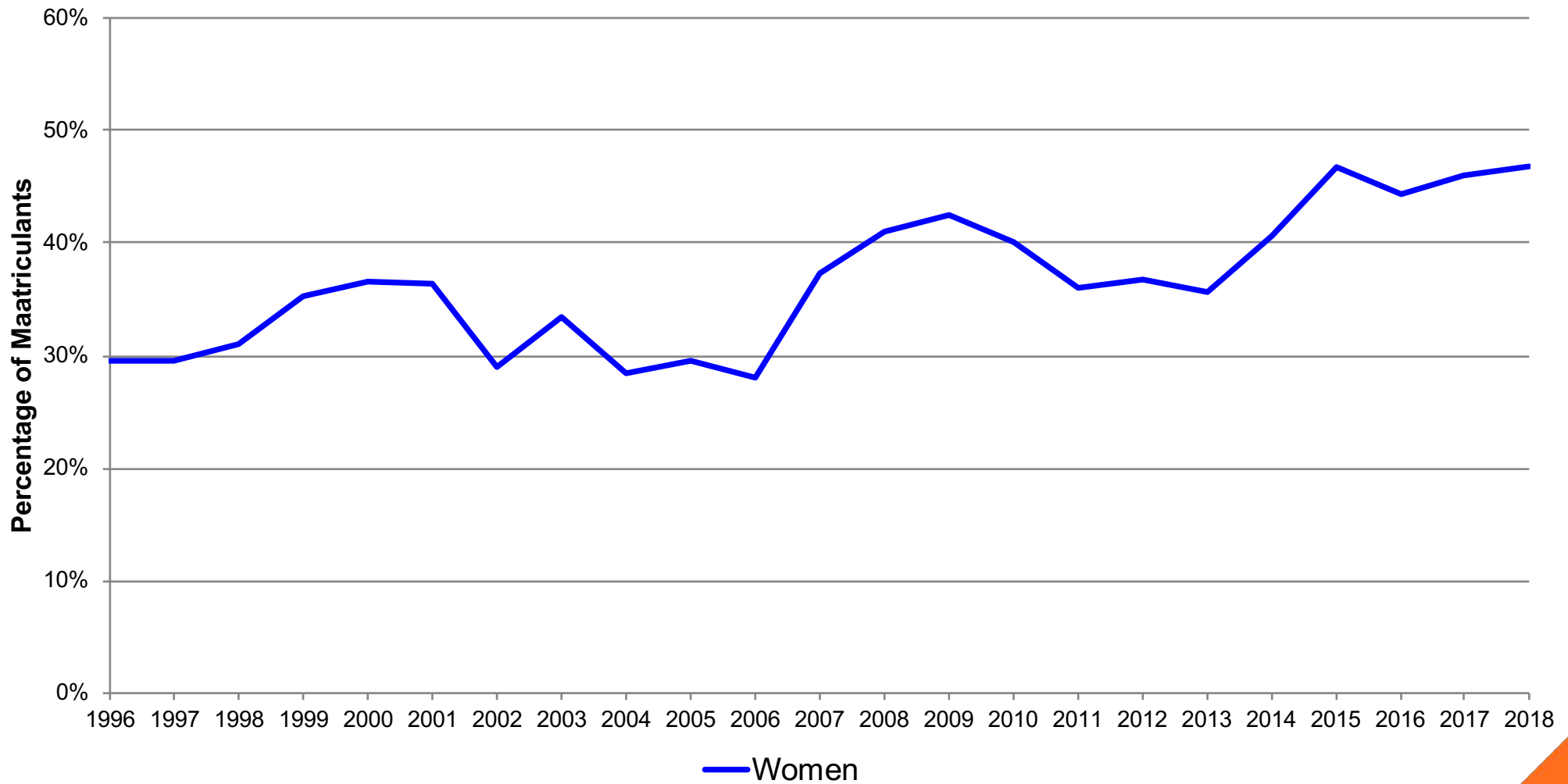
Enrolling Testing Profile

Test	Mid-50%
SAT EBRW	740-780
SAT Math	790-800
ACT Comp	35-36
ACT English	35-36
ACT Math	35-36
ACT Read	34-36
ACT Sci	34-36

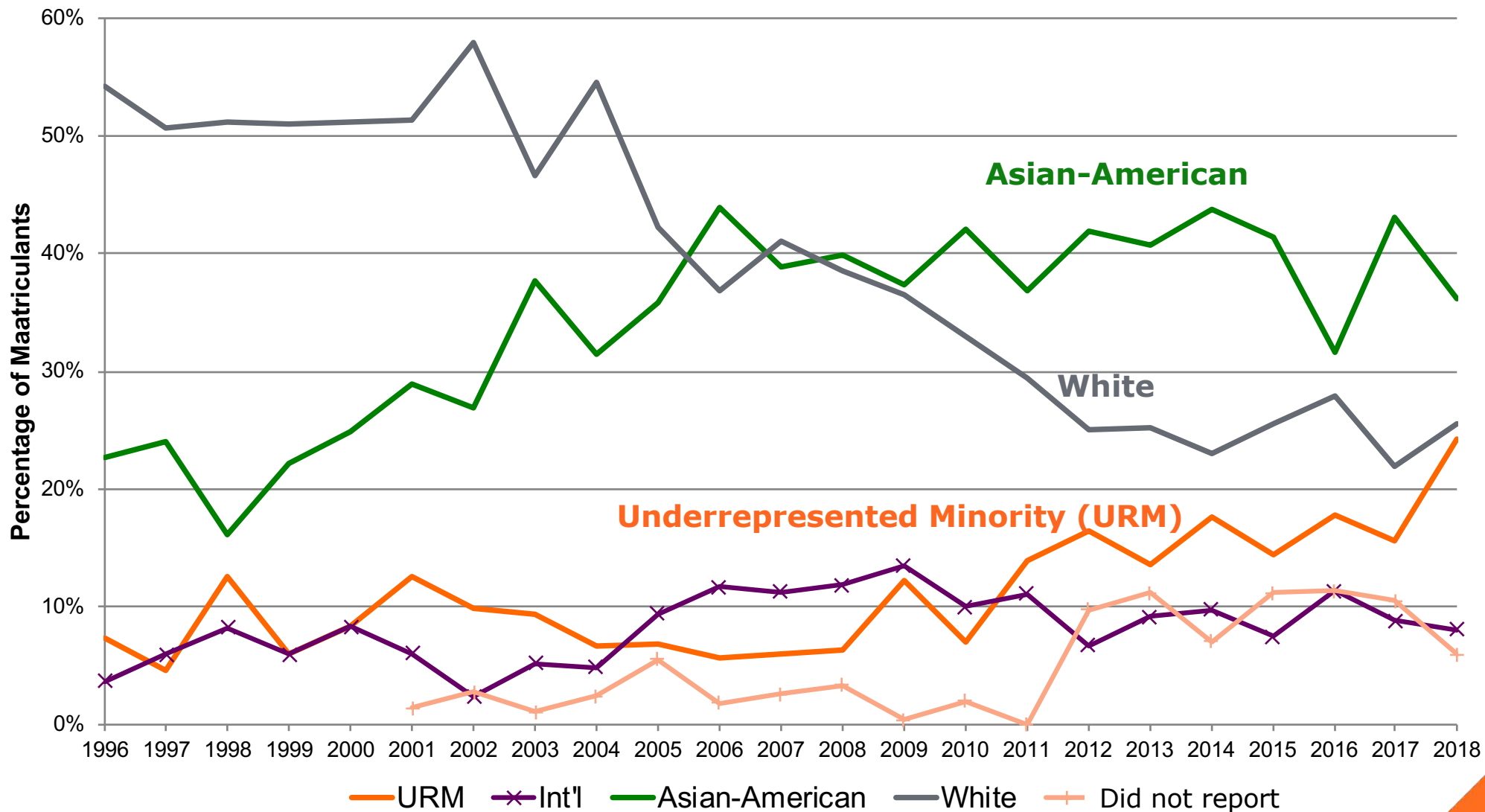
No statistically significant differences by gender (female averages are slightly higher)

Class Makeup over Time

Women



Class Makeup over Time



Generational Characteristics

“iGen” - born late 1990s, early 2000s

- Connected via **social media**, on their terms (often via mobile phones; less email)
- Despite “digital native” status – appreciate **face-to-face**, in person connections
- Most **ethnically diverse** generation ever
- Increased use of **mental health** supports
- Interested in **hands-on, future/job-relevant** experiences
- Frugal...Ambitious...Cautious (fear of failure)

Past Caltech Cohorts (National Surveys)

Incoming Caltech students tend to arrive with strong academic self-concept and strong science and research self-efficacy (belief in one's ability to succeed)

Implications for Learning:

Self-awareness, confidence, and self-efficacy in academic environments help students learn by encouraging intellectual inquiry and motivation.

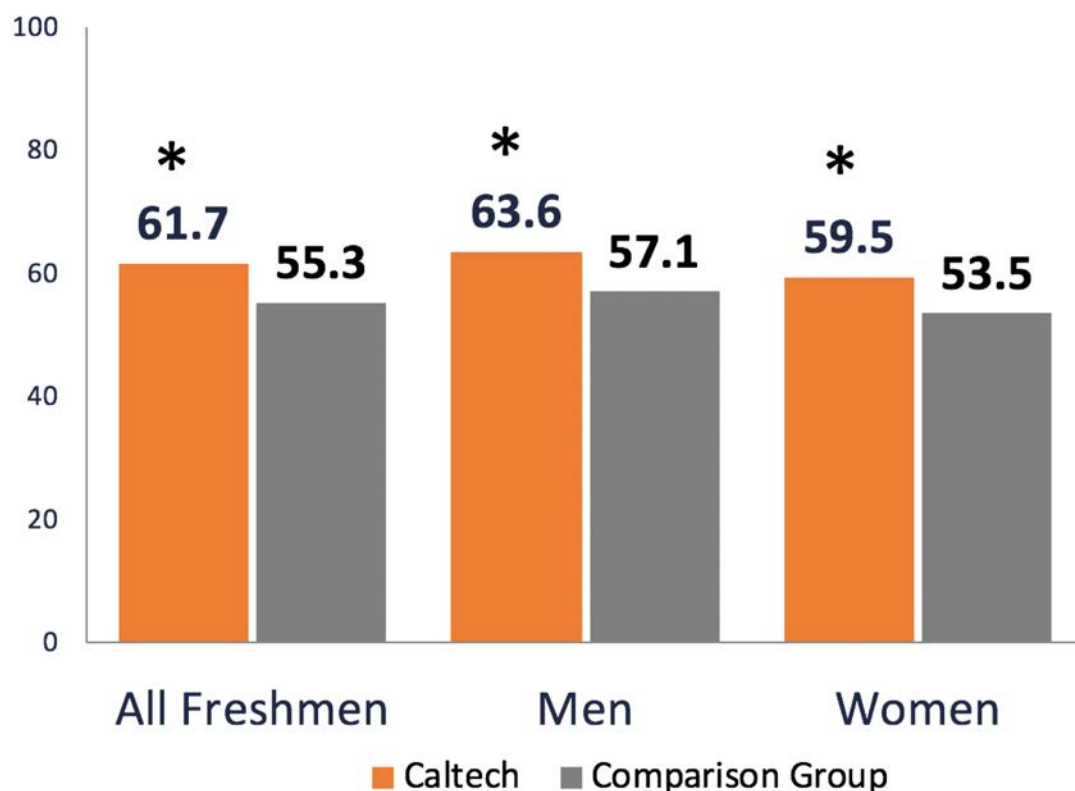
- **Incoming Caltech students are academically confident compared to students at other colleges, with strong “Academic Self-Concept”**
- ***Male-identifying incoming Caltech students report significantly stronger academic self-concept than female students.***

Academic Self-Concept includes:

- Self-rated academic ability
- Self-rated mathematical ability
- Self-rated intellectual self-confidence
- Self-rated drive to achieve

Data from previous class of Caltech entering freshmen; Caltech conducts the Freshman Survey in select years.

“Comparison Group” includes other small elite institutions participating in the Freshman Survey.



Who are our incoming students / what are their strengths?

What are we aiming for in 1st year classes?

How did last year's cohort change over their 1st year?

What might this all mean for teaching?

Common desired outcomes?

- Kinds of learning?
- Kinds of problem solving?
- Academic/personal traits?
- Confidence, belief in abilities?
- Belonging in / passion for science, mathematics, engineering?

9/12/2018 Discussion

- Core/pseudo-core faculty want students to:
 - Gain specific skills
 - ...while seeing their relevance and how they're associated with real applications
 - ...and recognizing their own understanding/mastery – building appropriate, accurate confidence
 - Recognize different kinds of problems and how to approach them
 - Learn how to collaborate effectively:
 - May be a new skill for undergraduates
 - This matters for their future careers and science
 - Collaboration is a complex ability and develops over time

9/12/2018 Discussion

- Core/pseudo-core faculty want students to:
 - Learn how to ask questions...
 - ...and how to know when they need to ask questions
 - *aka* “metacognition” – being aware of, monitoring, and acting to manage their own learning
- Other topics discussed:
 - What contributes to student choices about attendance?
 - Strategies at end of this discussion may be helpful
 - Students might benefit from some workshops or support on managing email – also a complex, professionally-important skill

9/12/2018 Discussion

- Other topics discussed:
 - What contributes to student choices about attendance?
 - Strategies at end of this discussion may be helpful
 - Managing email, time, and sleep
 - Students could benefit from workshops/support on managing email – also a professionally-important skill
 - Most of the main STEM core courses have coordinated due times/days to help with sleep; students still have a task to plan and manage (sometimes things are just due at the same time).
 - Having a complete syllabus really helps
 - Sharing these ideas to Occupational Therapy, residence life, and additional faculty.

Malleable traits related to student success



Growth Mindset

Belief that one's abilities are developed through effort and practice (vs. being fixed traits)

Academic Self-Efficacy

Belief in one's own ability to succeed academically



Sense of Belonging

Sense of being accepted, valued, included, and encouraged by others; feeling like an important member of the community

Who are our incoming students / what are their strengths?

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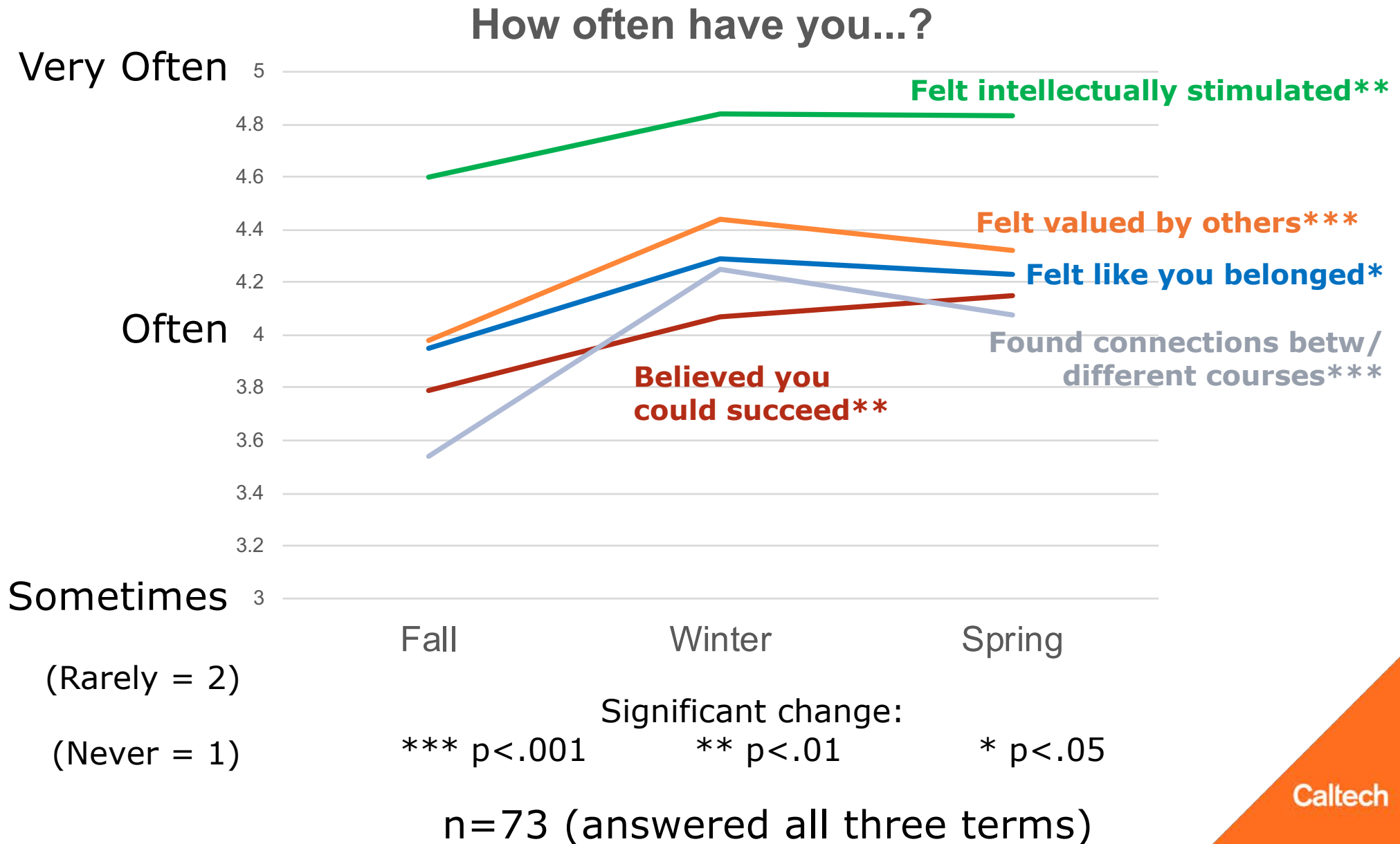
How did last year's cohort change over their 1st year?

What might this all mean for teaching?

2017-18 first year Caltech students

- Mid-quarter surveys, main science/math Core courses, fall/winter/spring
 - Course and TA-specific feedback
 - General questions about their experience (academic self-concept, belonging, etc.)
-
- N = 235 (2017 entering class)
 - Fall: n=178
 - Winter: n=139
 - Spring: n=78
- Analysis:
- Gender (nearly balanced)
 - Race, ethnicity, first generation: small numbers with one cohort; we hope to learn more with two years' cohorts)

Whole cohort: Winter increase; spring dip



+ belonging, growth mindset, self-efficacy +

- “Caltech makes me feel more at home than any other educational institution has in my life. I'm so grateful.”
- “I love it. Being with people that are all focused on doing well is awesome, and pushes me to work harder.”
- “Sometimes it is difficult because I feel like my peers are way smarter than me, which is nice because I get a lot of help from them, but difficult because I feel I can't help them back.”

- self-efficacy, belonging -

- “It's hard to see the connection between the lectures and the homework sets. It seems like what we practice is not well reflected on the quizzes.”
- “If you understand very little of a week's material, then there is little that you can do to get help. You don't want to be a drag on your fellow students.”
- This term is better, but last term I felt like my professors didn't really care about me.

Whole cohort: continuous increases in academic self-concept

How do you feel you've changed in the following areas?

Much stronger

4.5

Stronger 4

3.5

No change 3

2.5

Weaker 2

(Much weaker = 1)

Fall

Winter

Spring

Mathematical ability***

Academic ability***

Intellectual self-confidence*

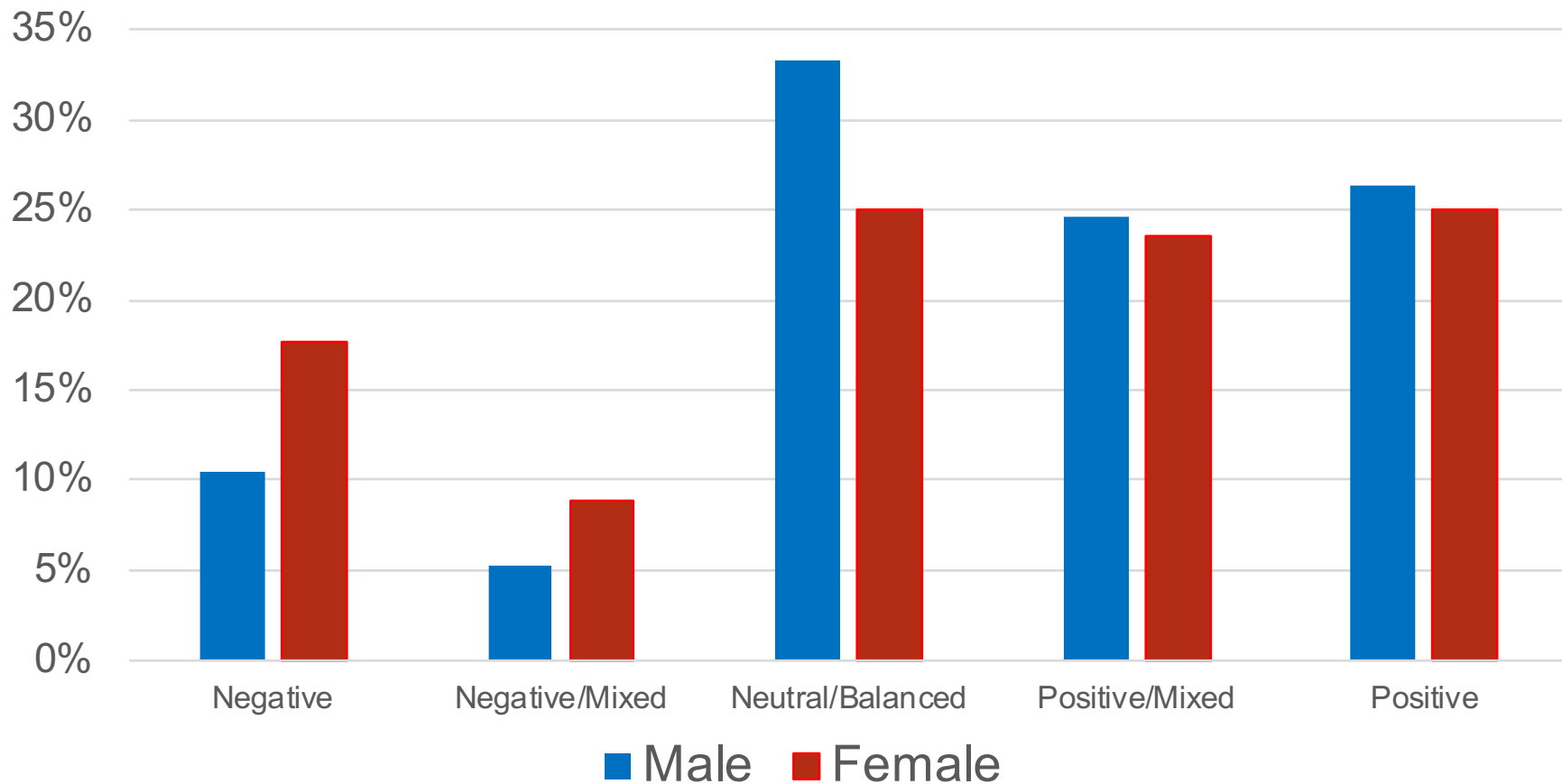
Significant change:
*** $p < .001$ * $p < .05$

n=73 (answered all three terms)

- “I'm not as academically confident as I was in high school, but I feel more supported by my peers.”

Gender effects

Content of **Qualitative Comments**, All Three Terms
2017-18, Separated by Gender
(n=55 Male, 66 Female; not all students wrote comments)



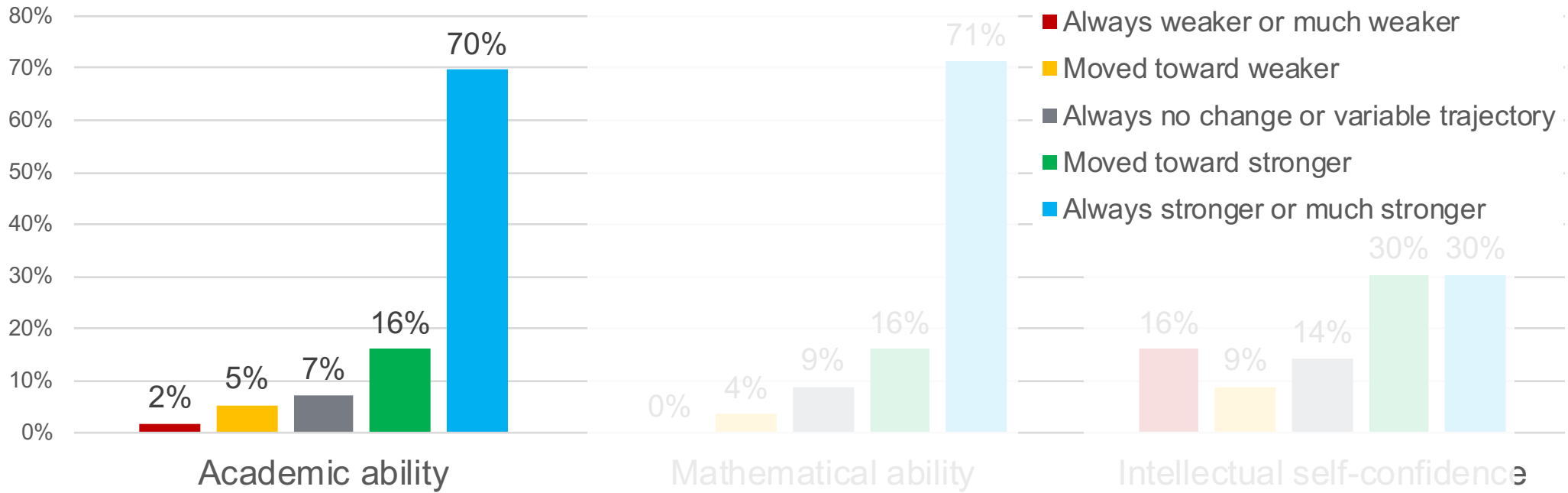
How do you feel you've changed in the following areas?

- **Mathematical Ability**
- **Academic Ability**
- **Intellectual Self-confidence**

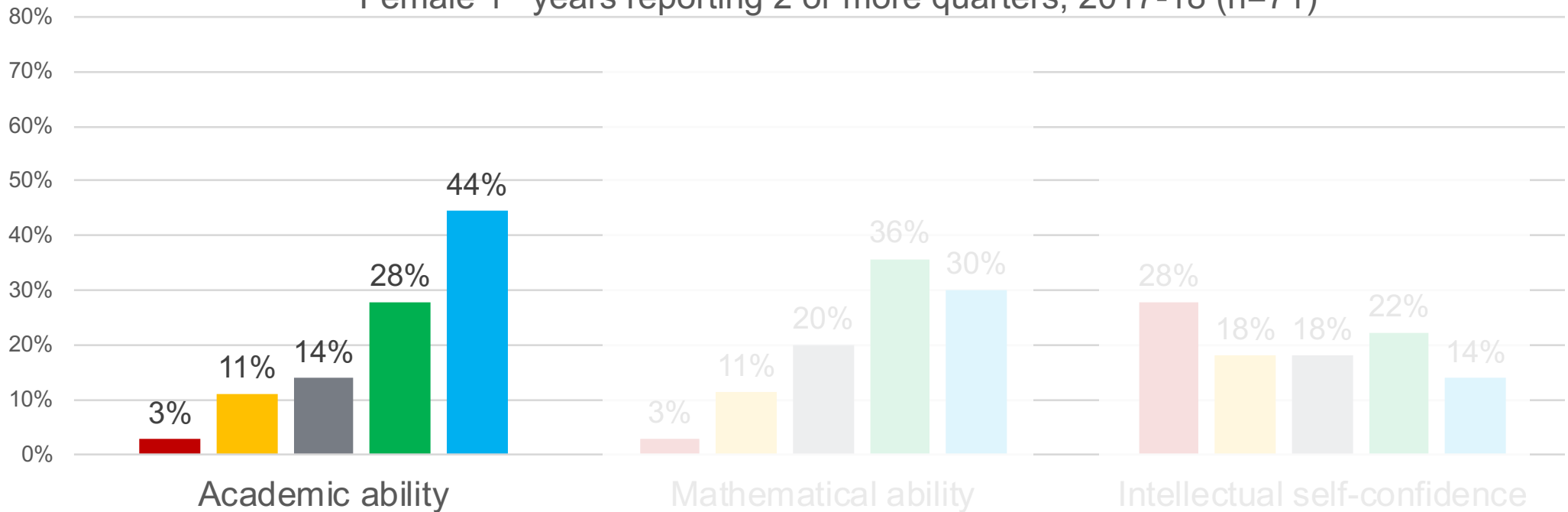
For students who answered 2 or more quarters:

- Which students **ALWAYS** felt they were getting stronger or much stronger?
- Which students started out feeling they weren't changing or were getting weaker, but **ended up** feeling they were getting stronger or much stronger?
- Which students started out feeling they weren't changing or were getting stronger, but **ended up** feeling they were getting weaker or much weaker?
- Which students **ALWAYS** felt they were getting weaker or much weaker?

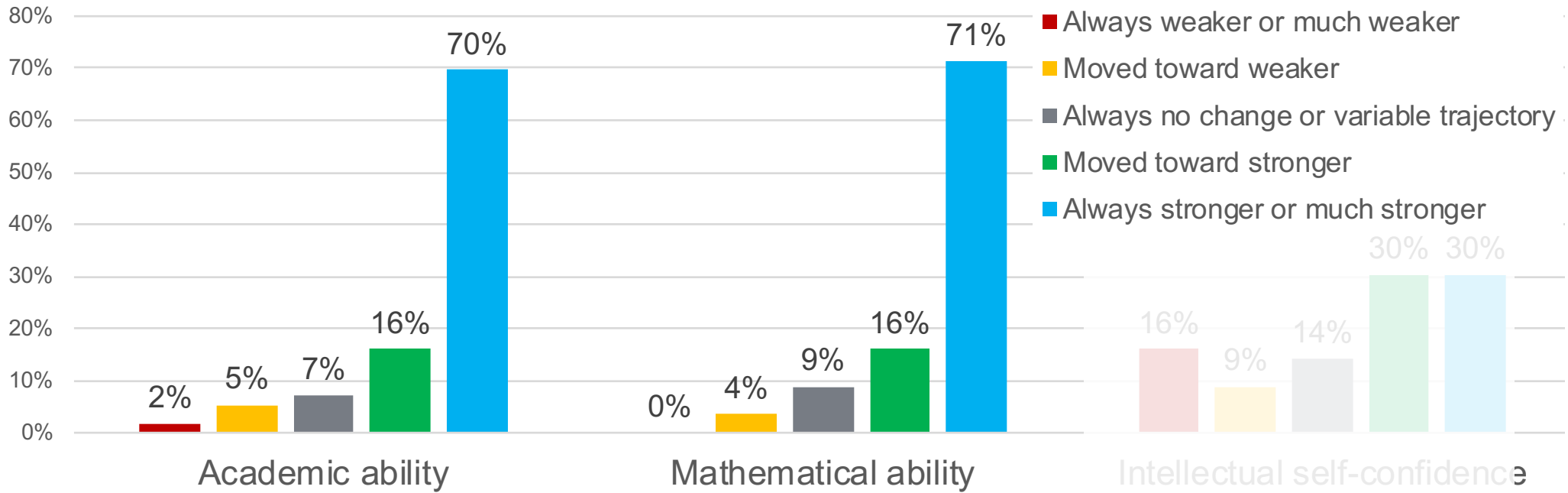
Male 1st years reporting 2 or more quarters, 2017-18 (n=55)



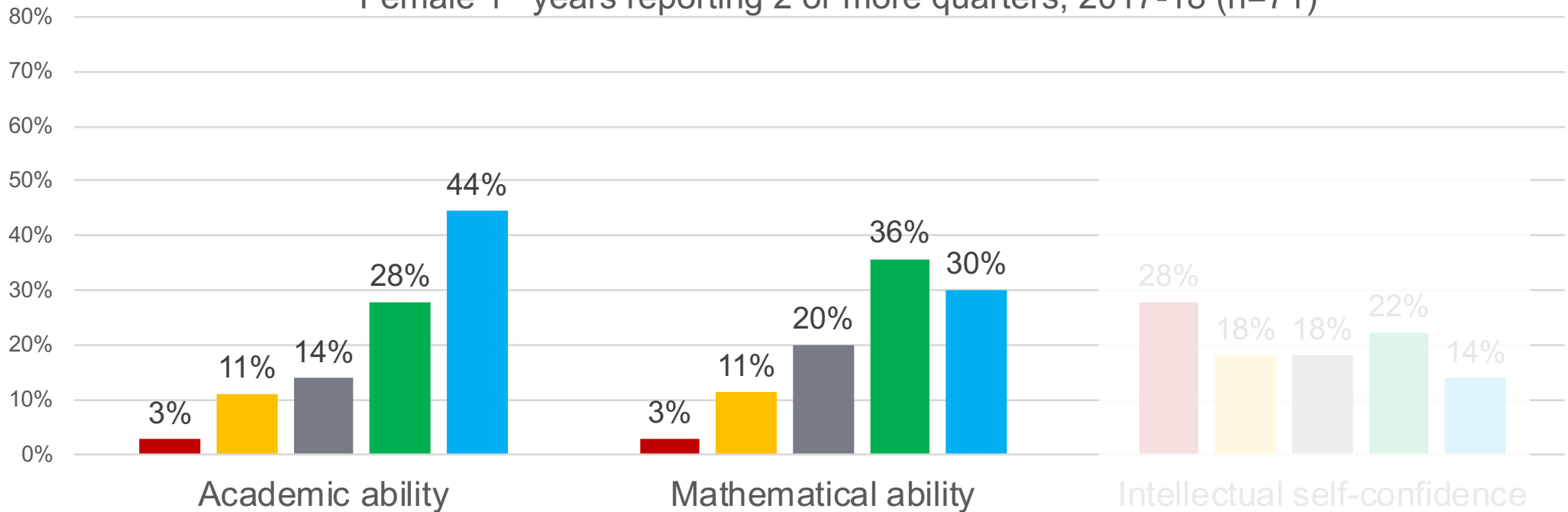
Female 1st years reporting 2 or more quarters, 2017-18 (n=71)



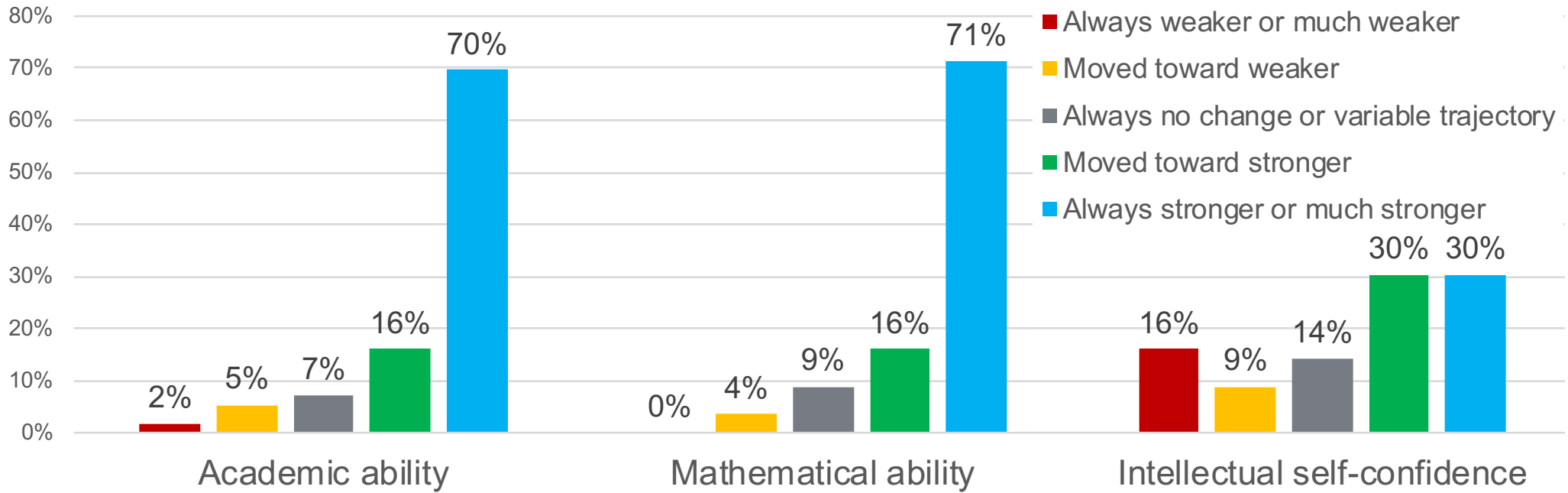
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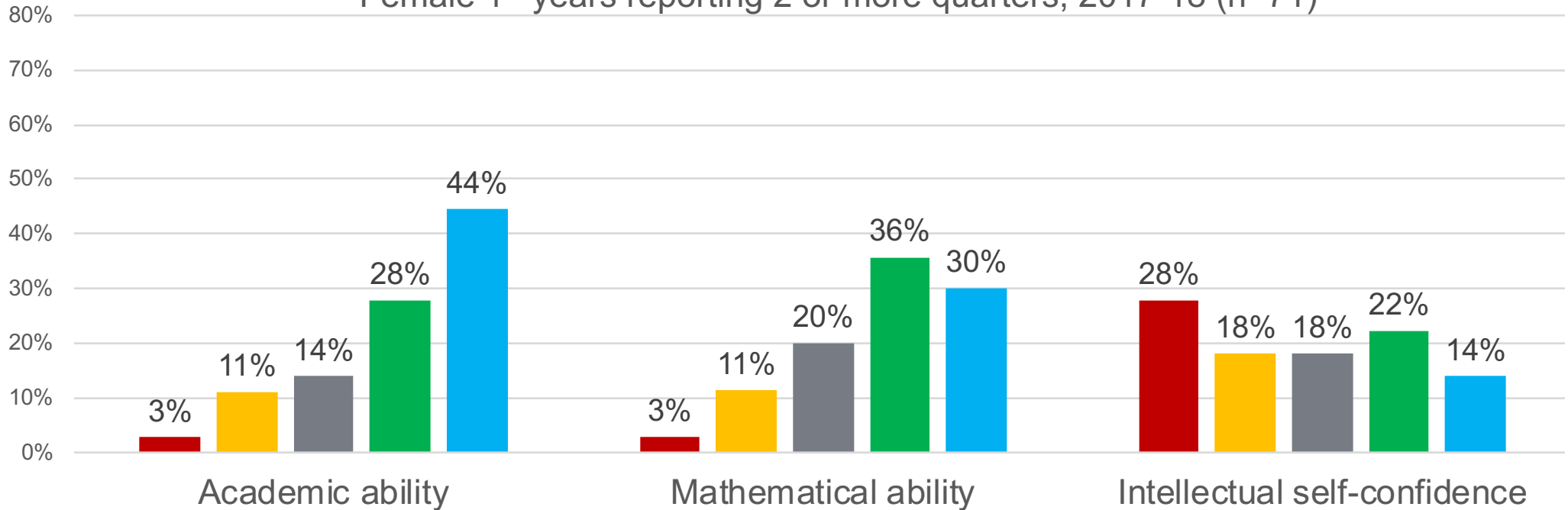
Female 1st years reporting 2 or more quarters, 2017-18 (n=71)



Male 1st years reporting 2 or more quarters, 2017-18 (n=55)



Female 1st years reporting 2 or more quarters, 2017-18 (n=71)



Who are our incoming students / what are their strengths?

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In classes...

- What might a confidence gap look like in class?
- What kinds of experiences might build academic self-concept, sense of belonging, self-efficacy, growth mindset in class?

9/12/2018 Discussion

- “Confidence gap” - examples shared:
 - Who speaks up in class
 - Who thinks they’re qualified to be a TA
 - Often not associated with achievement/understanding/accomplishment
- Faculty noticed it helps to:
 - Make opportunities in class where **EVERYONE** comes up with an idea or possible answer (not just the most confident/quick)
 - Include diverse examples in course material (contributions to the field, recent papers)

What helps? Evidence-based:

- Methods with equitable engagement (“active learning”)
- Articulate the purpose, task, and criteria for assignments (“transparency”)
- Add “structure”:
 - Syllabus, daily/weekly outline, big ideas, connections
 - More frequent, low-stakes practice/testing (several quizzes vs. one big exam)

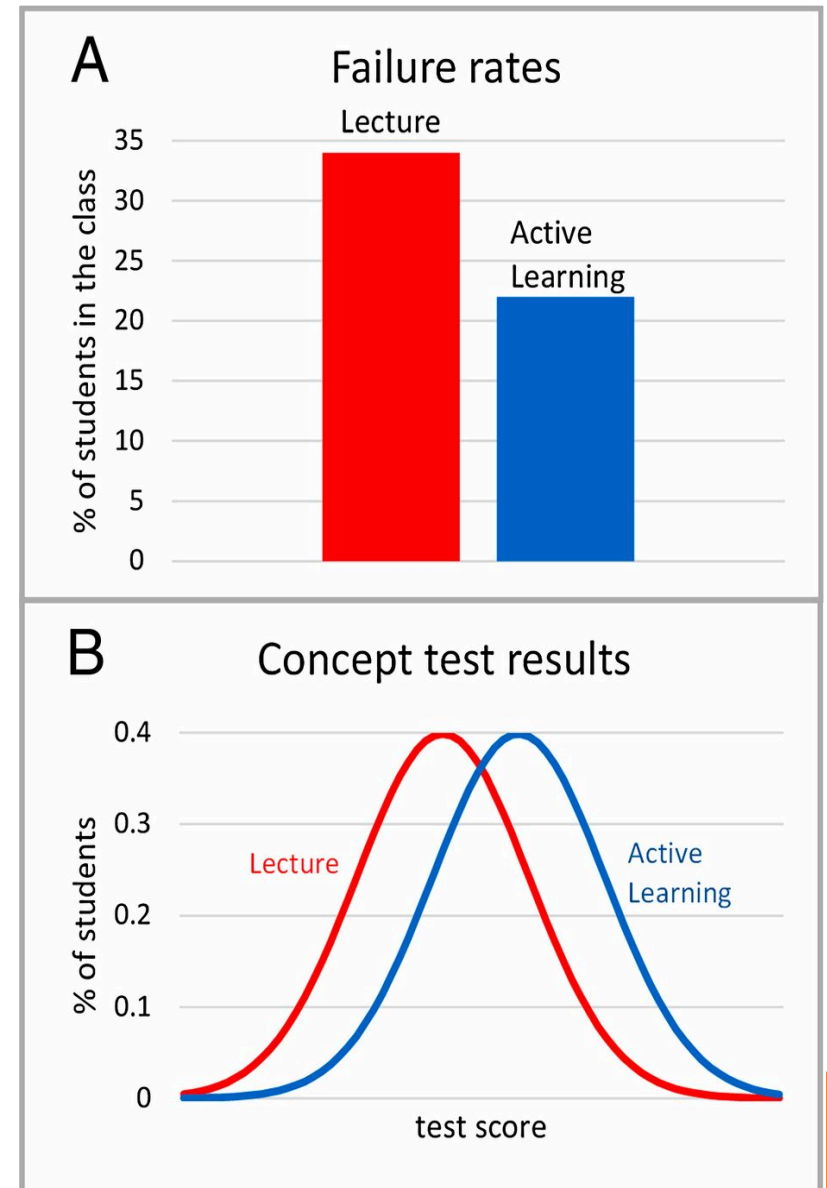
Equitable Engagement in Class

Active learning increases student performance in science, engineering, and mathematics

Freeman et al. PNAS 2014, 111: 8410-8415.
Large meta-analysis across STEM disciplines, levels, and types of institutions

Students **1.5 times more likely to fail** in lecture-only courses.

Students perform **0.47 standard deviations better** with **active learning**.



Equitable Engagement in Class

CBE—Life Sciences Education
Vol. 12, 322–331, Fall 2013

Feature

Approaches to Biology Teaching and Learning

Structure Matters: Twenty-One Teaching Strategies to Promote Student Engagement and Cultivate Classroom Equity

Kimberly D. Tanner

Department of Biology, San Francisco State University, San Francisco, CA 94132

THESE WORK NOT JUST FOR BIOLOGY
(it's just a great summary/list)

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E.g.:

- Wait time
- Write time
- Think-pair-share
- Multiple hands, multiple voices
- Open-ended questions
- Minute papers

Purpose, Task, Criteria

FIGURE 1. TRANSPARENT ASSIGNMENT TEMPLATE

Purpose

- Skills practiced
 - Knowledge gained
- } relevance to students 5 years out
connection to Learning Outcomes

Task

- What to do
- How to do it

Criteria

- What excellence looks like (multiple annotated examples)
- Criteria in advance to help students to self-evaluate

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Transparent assignments:

- + academic confidence
- + sense of belonging
- + mastery of skills

Improvements for everyone.

More so for first-generation, low-income, and underrepresented students.

Course Structure

Knowledge organization:

Syllabus, daily/weekly outline, big ideas, connections across parts of the course

“When students are provided with an organizational structure in which to fit new knowledge, they learn more effectively and efficiently than when they are left to deduce this conceptual structure for themselves.” - *HLW*

More frequent, low-stakes practice/testing:

e.g., several quizzes vs. one big exam

Tends to help all students, with disproportionate positive effects for underrepresented students.

References: https://teachlearn.caltech.edu/documents/232-s_malcom_references.pdf

Book: *How Learning Works*, Caltech library online, <http://caltech.tind.io/record/744766>

Conculsion / Discussion

Who are our incoming students / what are their strengths?

What are we aiming for in 1st year classes?

How did last year's cohort change over their 1st year?

What might this all mean for teaching?

2018-19

- Cont. mid-quarter surveys in main first year courses + others.
- Other questions/ things you would like to know about students?
- Reconvene – guest speakers, dive into student data/experience this year
- New: “Teaching Fellows” – Ph, Ma, CS
- Syllabus workshop – rescheduled to Monday 9/17 10:00 am, CTLO

Additional discussion/extra

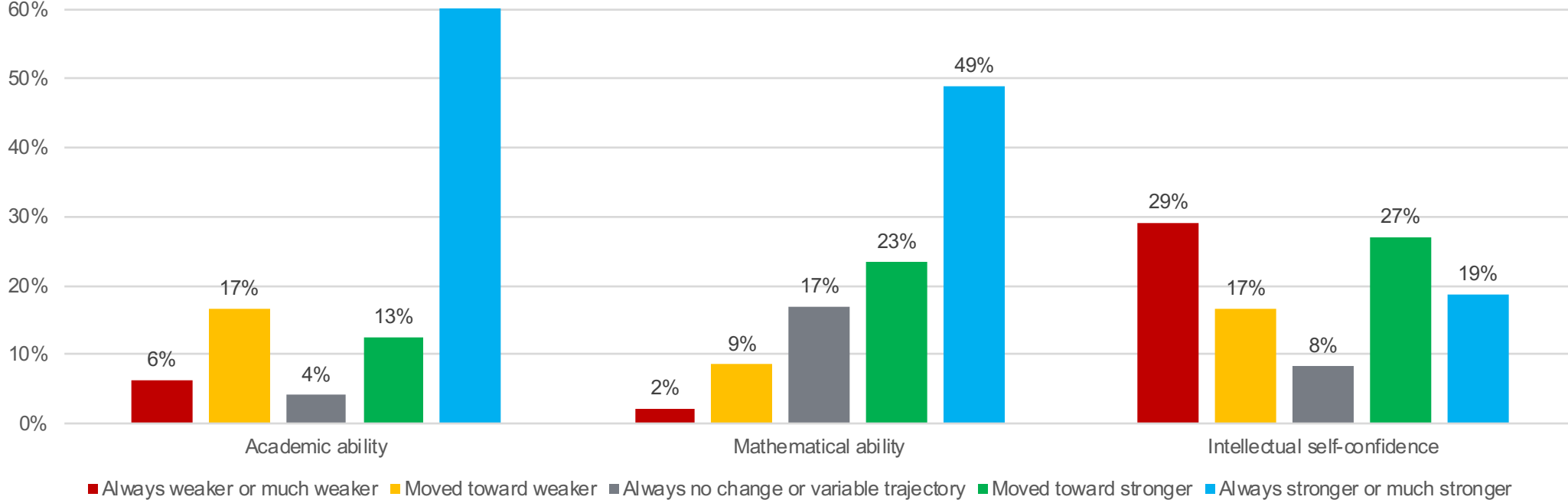
Question:

Is confidence gap associated with grades?

How much of it is warranted?

→ We didn't look at GPA, but did look at data on students who got one or more C or below at midterm. That association was not as strong as with gender. (see next slide)

One or more midterm C or below – first years reporting 2 or more quarters, 2017-18 (n=48)



No midterm C or below – first years reporting 2 or more quarters, 2017-18 (n=80)

