Carnegie Foundation
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From Gatekeeper to Gateway: Promoting Productive Persistence for Learning in Developmental Mathematics

Rachel Beattie & Ann Edwards
Community College Pathways Program
Carnegie Foundation for the Advancement of Teaching

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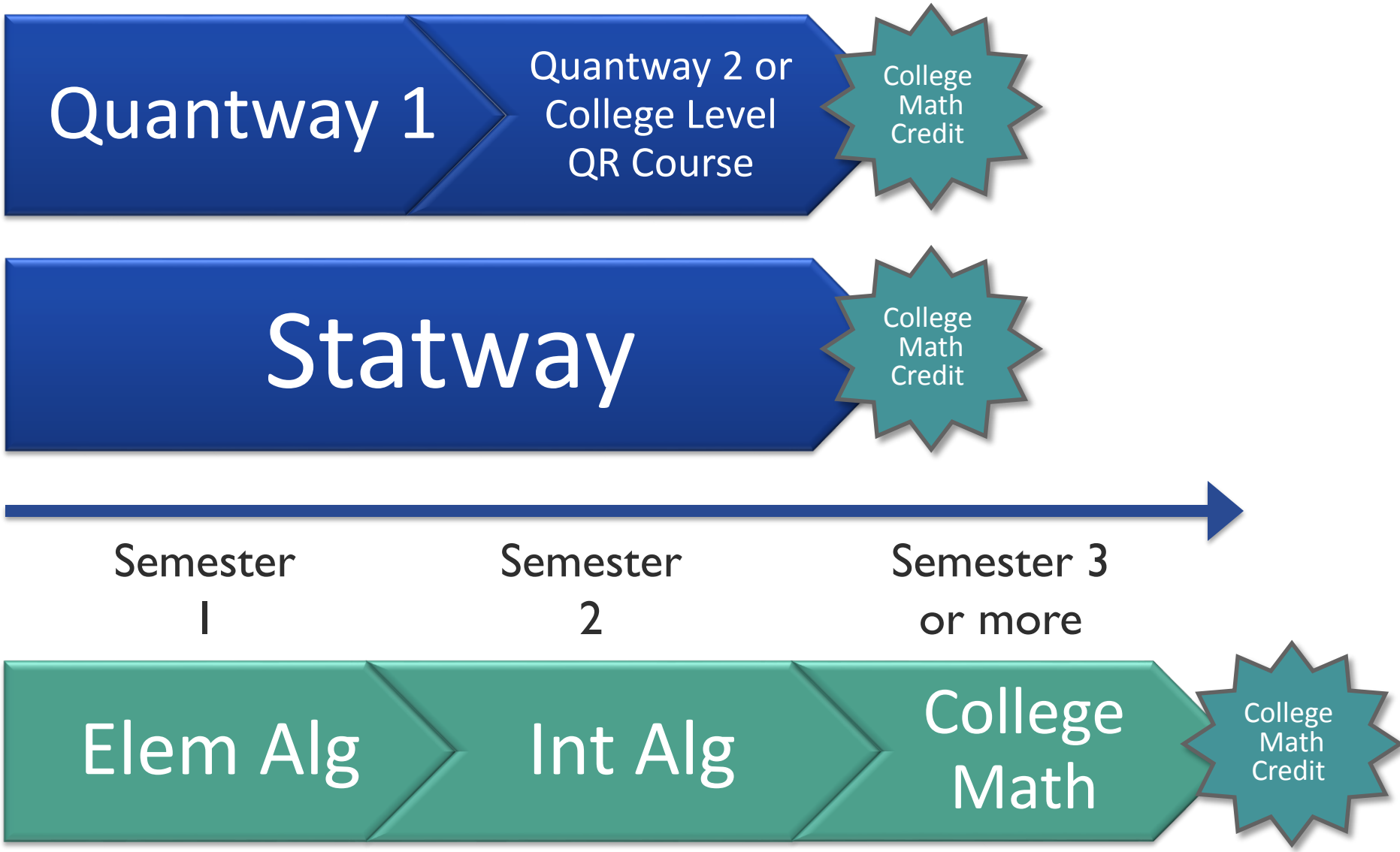
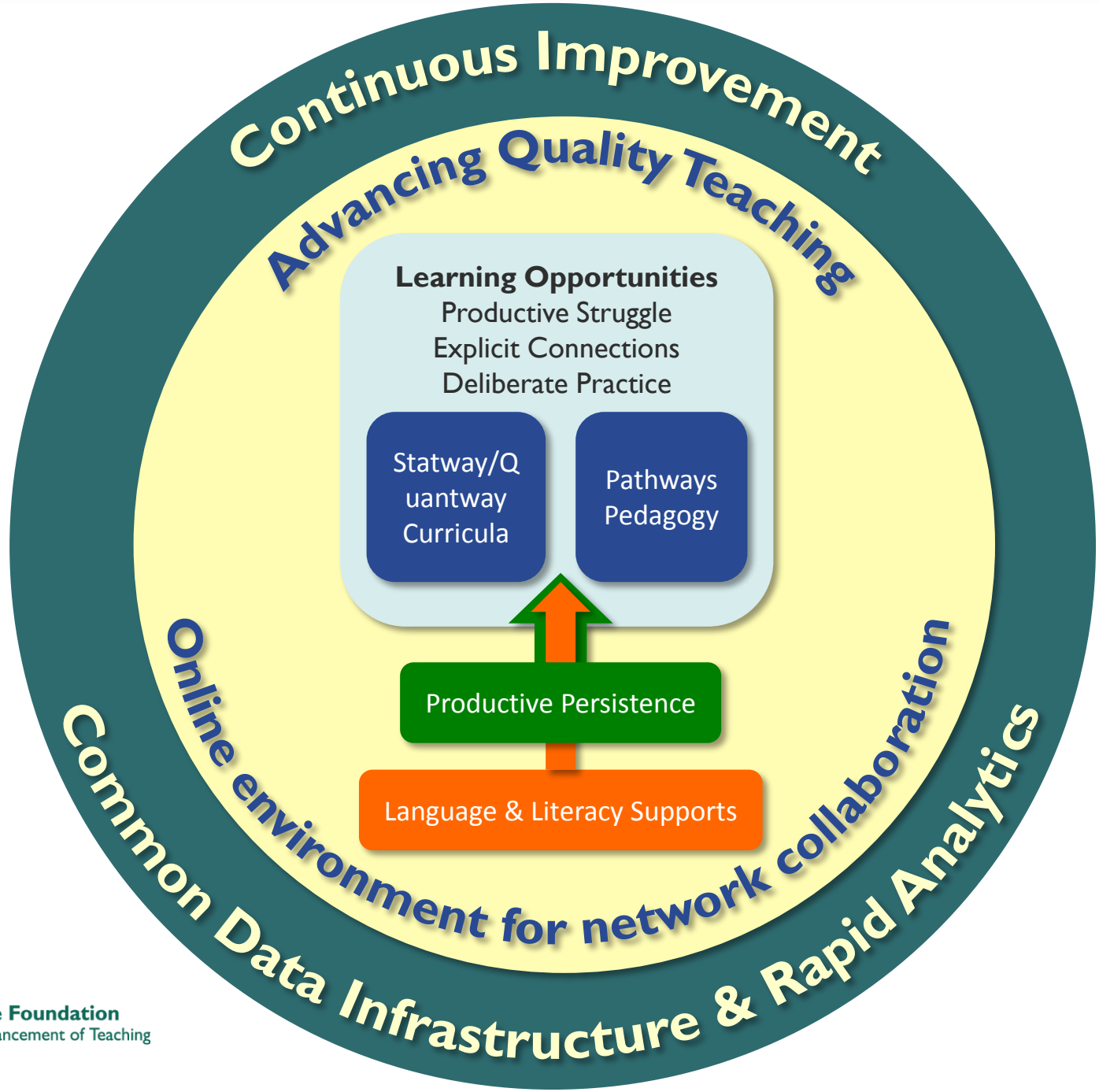
A New Way: Coherent, Intensive, Accelerated Learning



Traditional Math Sequence



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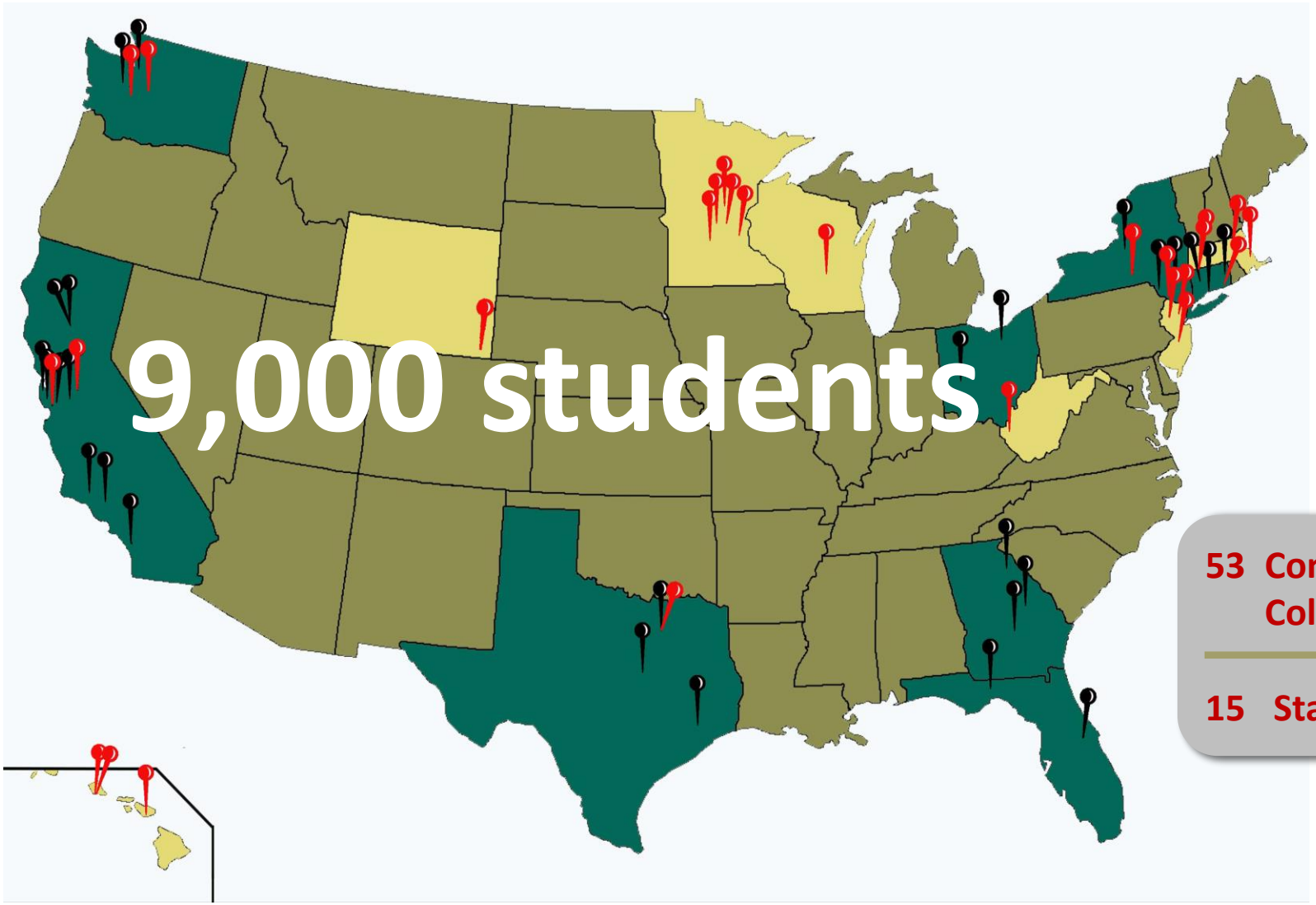
Where We Are Now - 2014

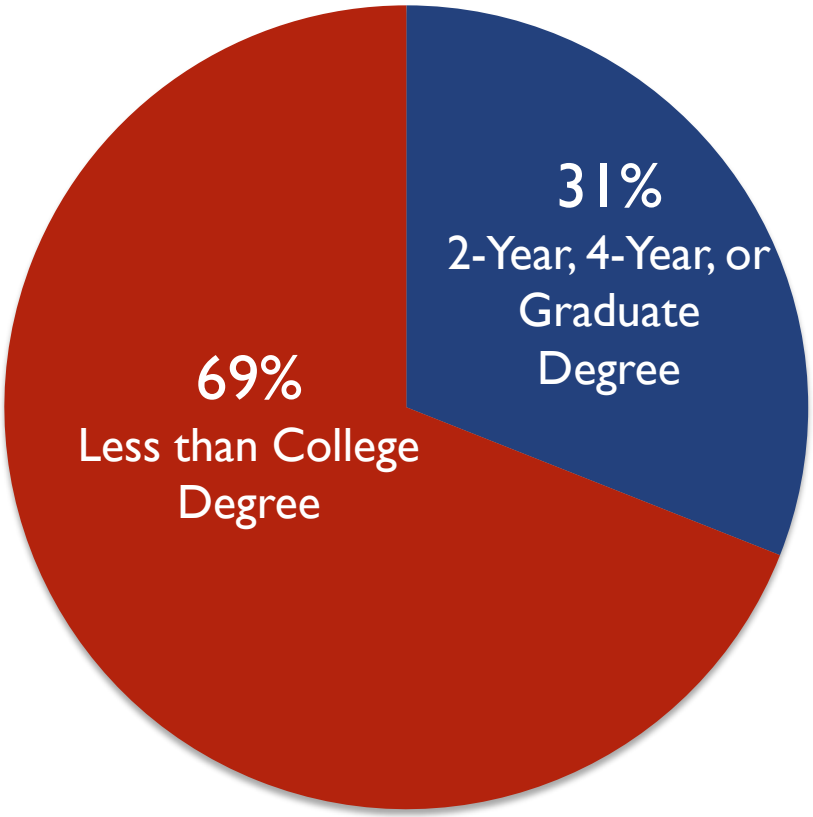


53 Community Colleges

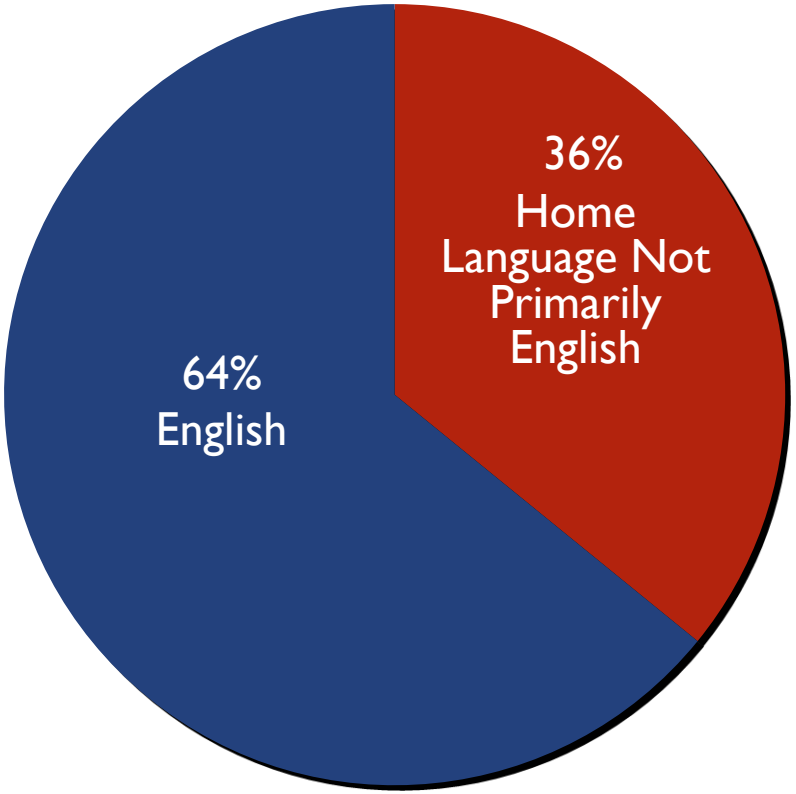
15 States

Who Are Our Pathways Students?

Maternal Education

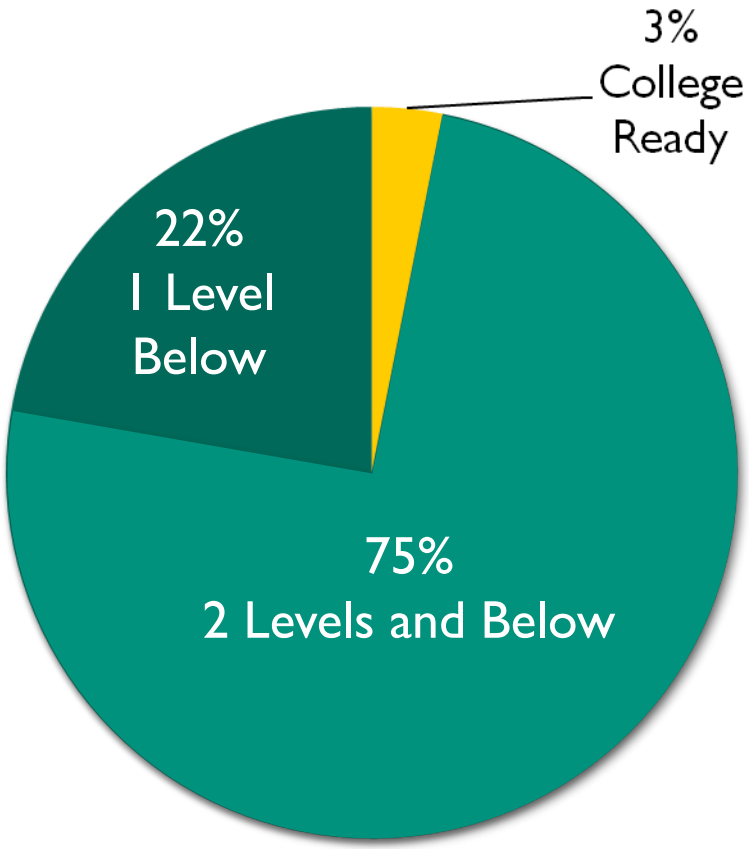


Home Language

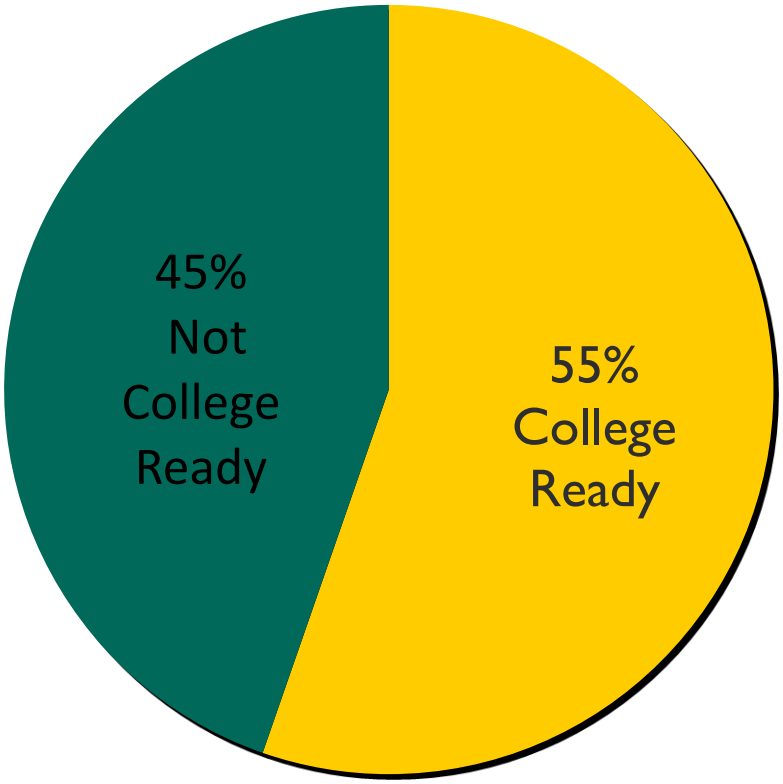


Who Are Our Pathways Students?

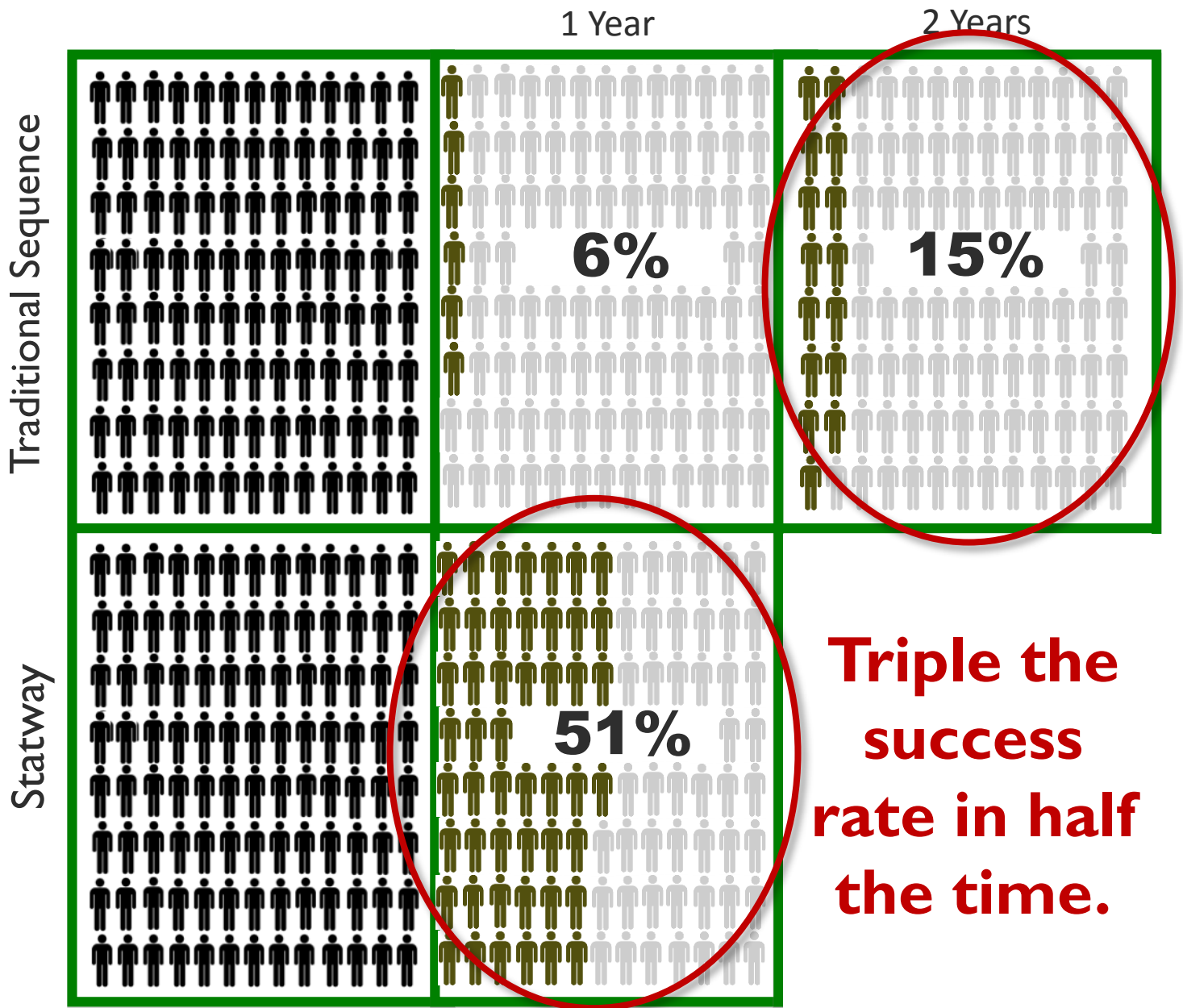
College Readiness: Math



College Readiness: Reading

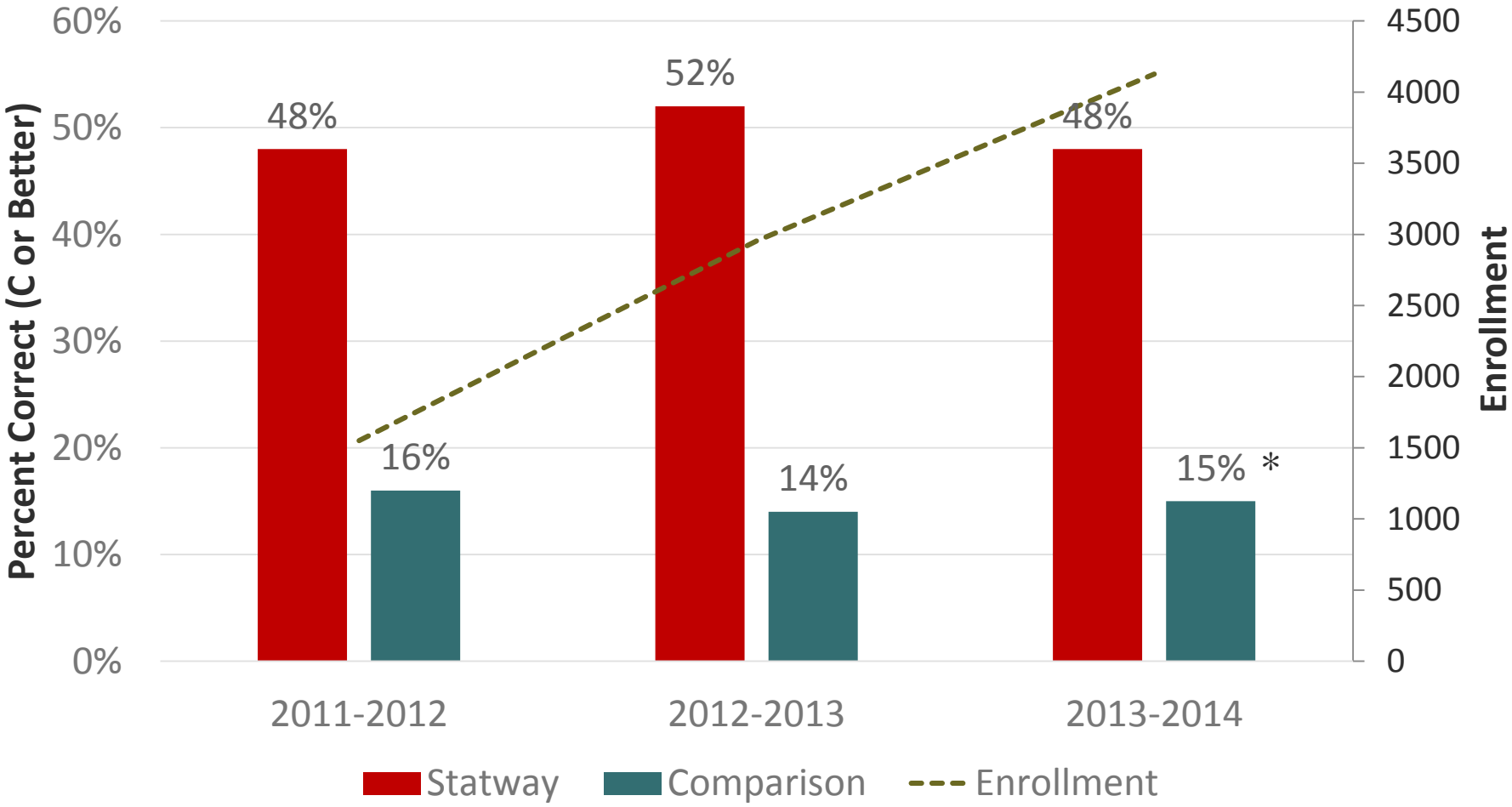


Time to Complete College Level Math Course: Statway vs. Traditional Sequence



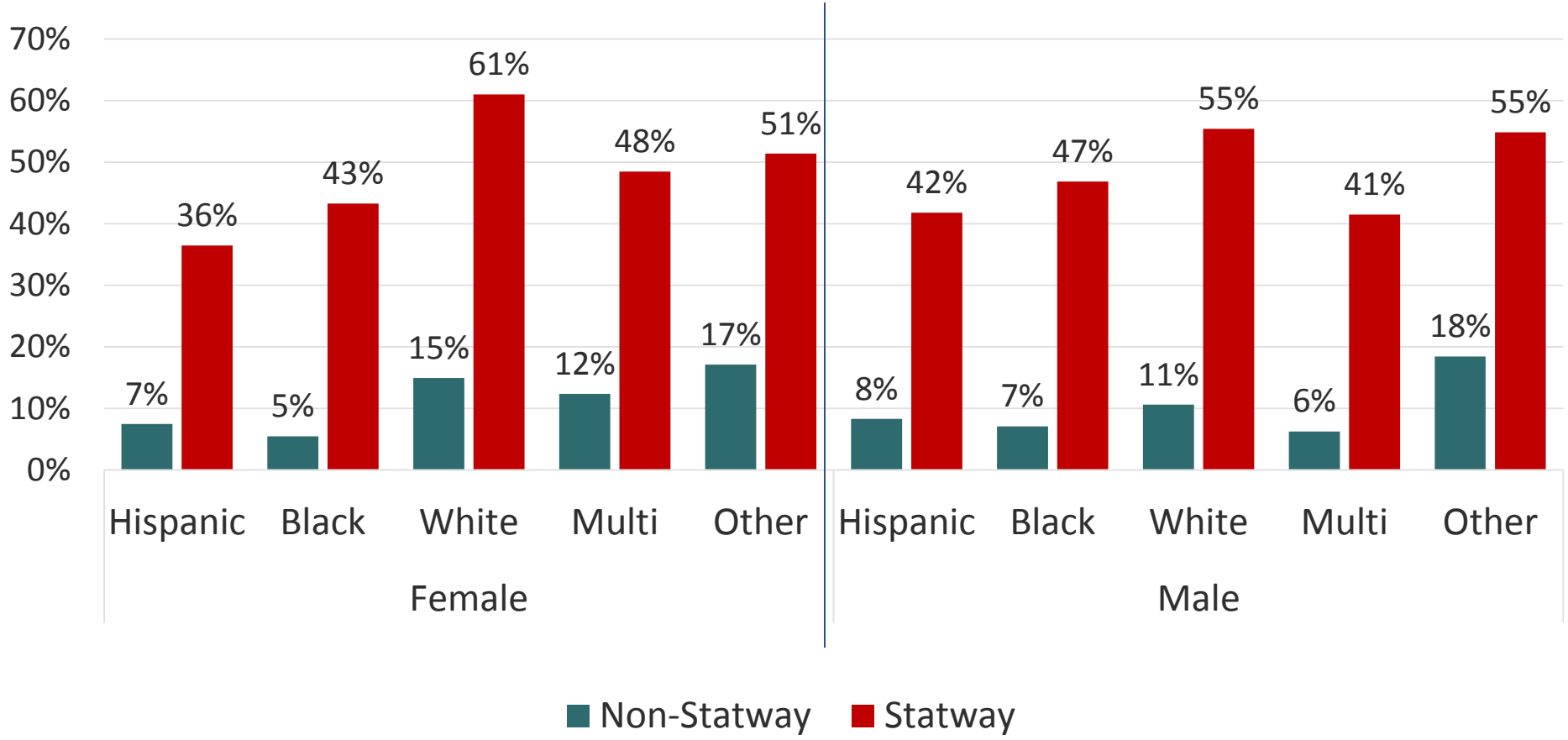
Triple the success rate in half the time.

Statway colleges have maintained success rate during period of expansion

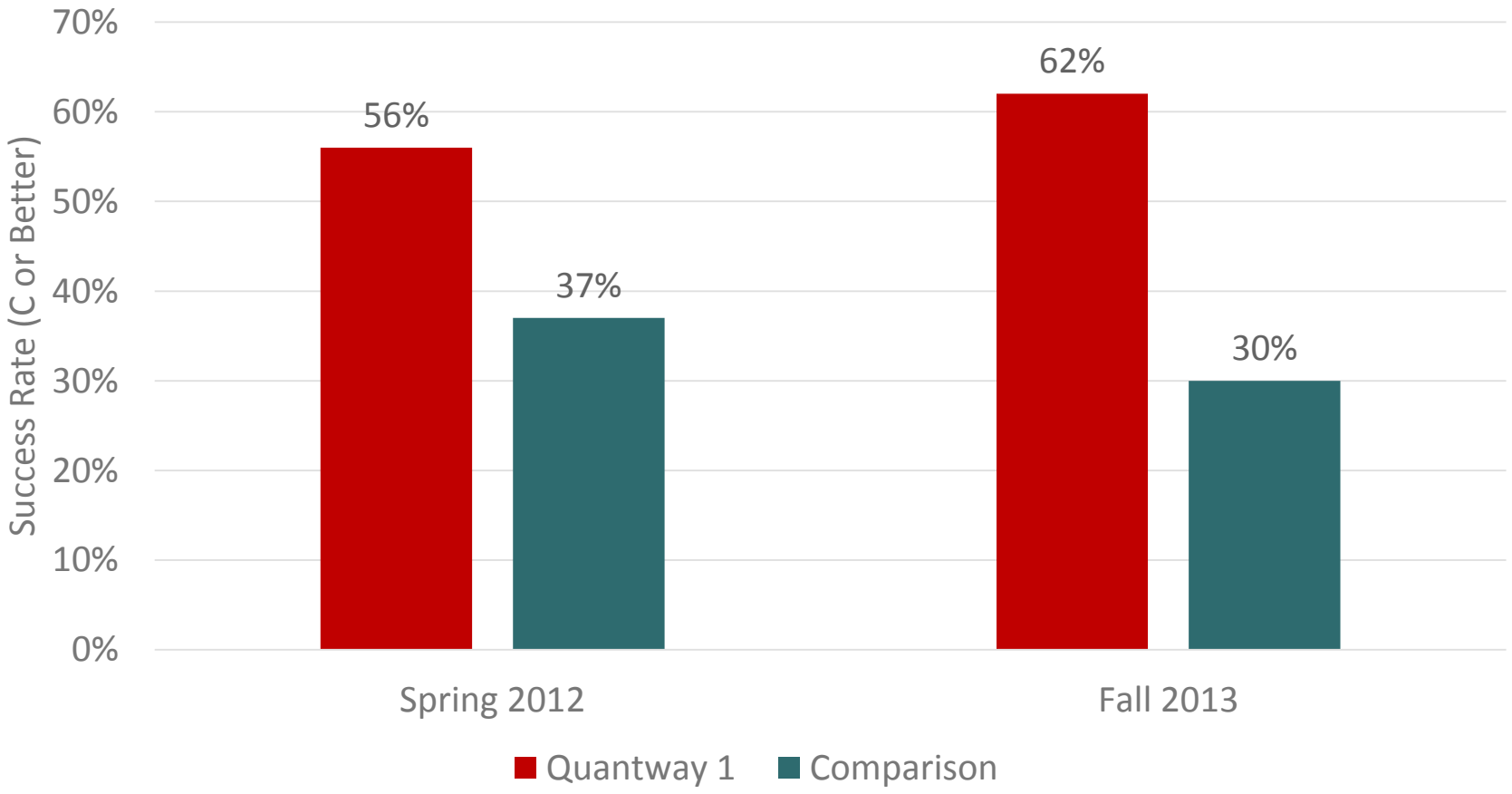


*Estimate – 11% success after one year, predicted 15% at two years

College Math Success by Subgroup



Quantway's success rate exceeds the comparison group's in one half the time



A student, upon completing a diagnostic assessment in a developmental math course:

"I am embarrassed by how stupid I am and suddenly feeling very discouraged … I can't even tell which fraction is bigger than another, or where they should fall on the number line. I feel like crying."

Productive Persistence

Aim:
Students continue to put forth effort during challenges and when they do so they use effective strategies.

Primary Driver
(Drivers of the solution)

Students believe they are capable of learning math.

Students feel socially tied to peers, faculty, and the course.

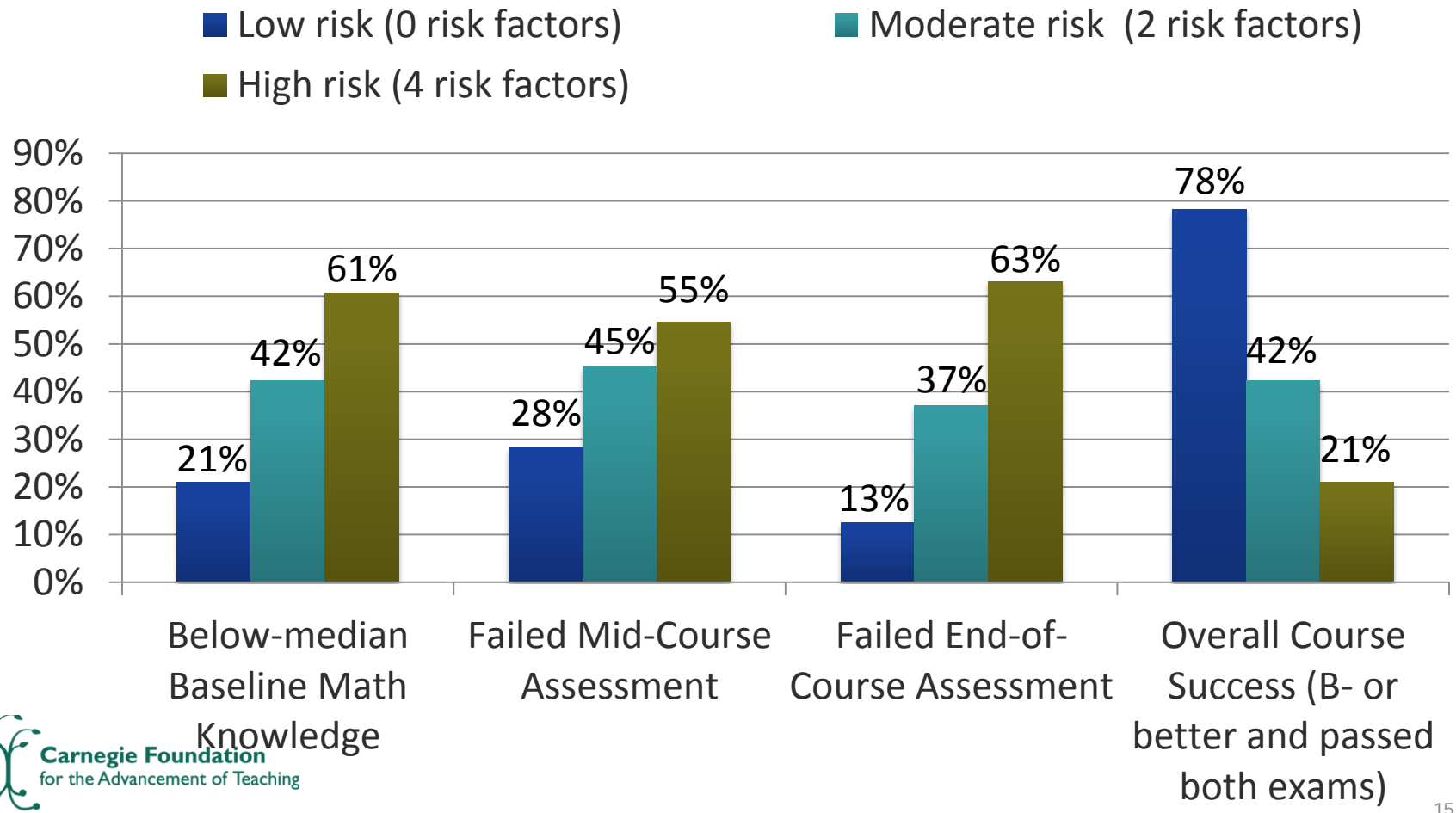
Students believe the course has value.

Students have skills, habits and know-how to succeed in college setting.

Faculty and college support students' skills and mindsets.

Do These Drivers Matter for CC Students?

- Based on survey with developmental math students.
- Categorized students as "at risk" or not in terms of the four drivers during week 1



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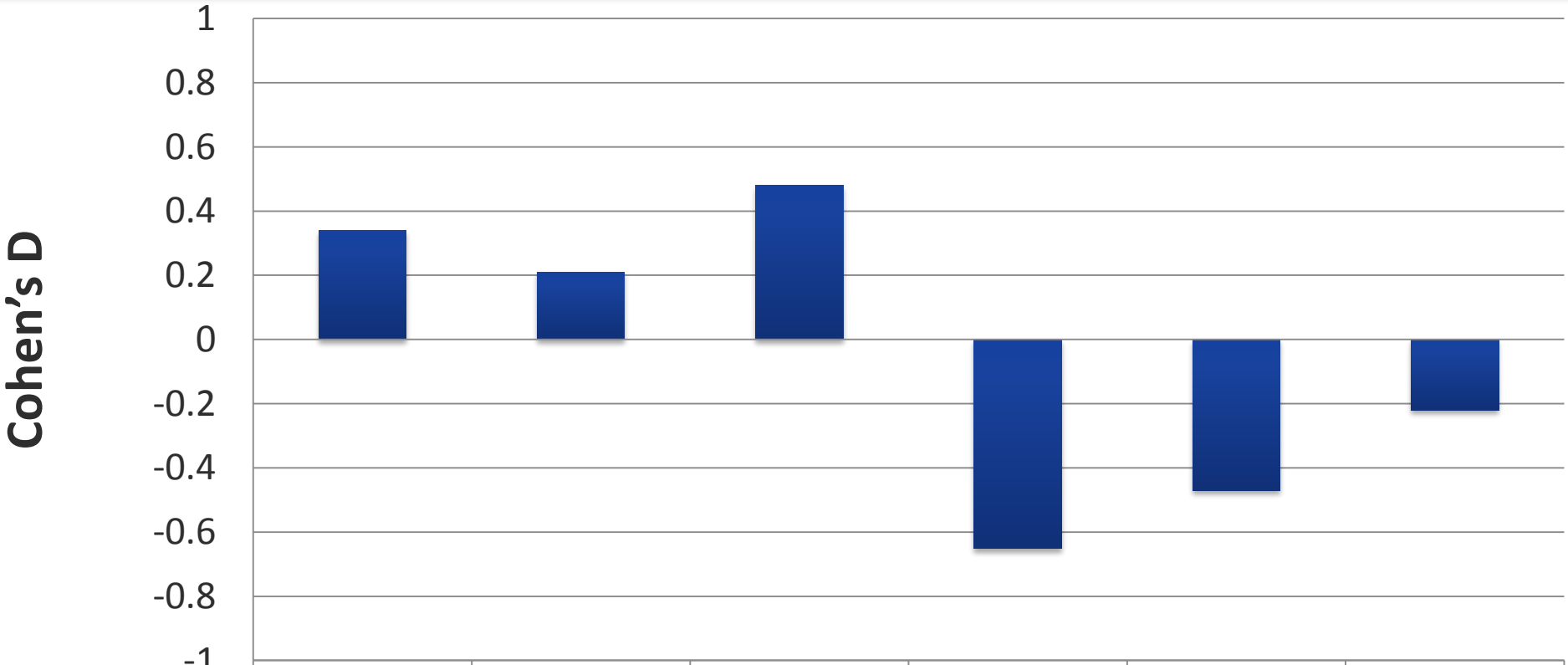
Can we change students' beliefs and attitudes in three weeks?



	Interest in Math	Confidence	Relevance of math in course	Belief that math intelligence is fixed	Math Anxiety	Stereotype Threat
Effect Size	0.34	0.21	0.48	-0.65	-0.47	-0.22

Predicting Course Grades with Productive Persistence Data, Demographic Data, and Math Conceptual Knowledge (MCK)

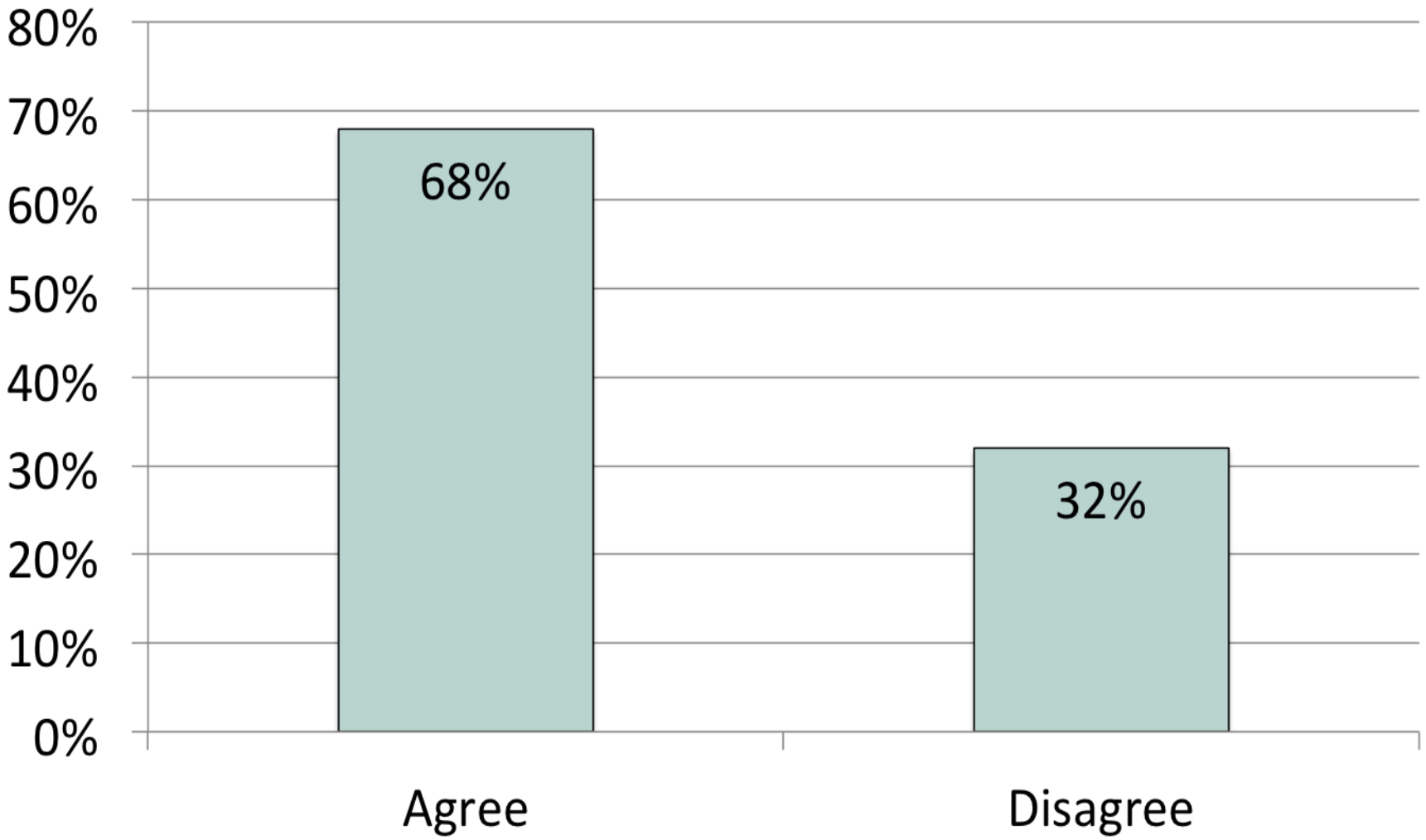
With Week 1 Survey Data

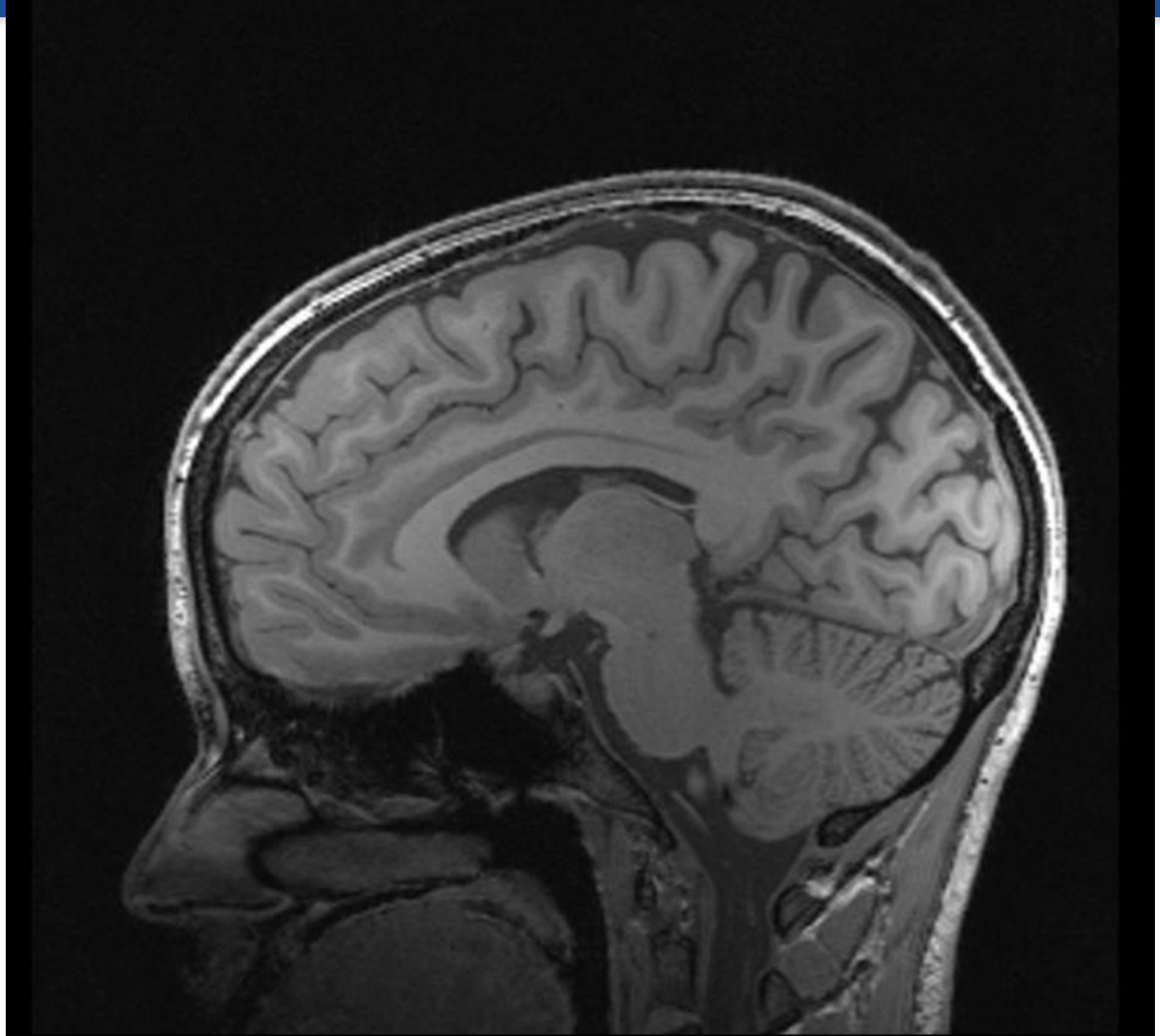
	2013	
	Coefficient	p-value
Intercept	2.292958	0.001
MCK	0.444641	0.001
Home Language	-0.02412	0.739
Maternal Education	0.09578	0.094
# of Dependents	-0.026586	0.107
Black	-0.282908	0.003
Hispanic	-0.134064	0.332
Asian	-0.265382	0.116
Other	-0.189846	0.247
Anxiety Score P1	-0.104605	0.011
Non-Belonging P1	0.039781	0.329
Stereotype Threat P1	0.043187	0.198
Mindset Score P1	0.097848	0.023
Grit	-0.468879	0.112

With Week 4 Survey Data

	2013	
	Coefficient	p-value
Intercept	2.44367	0.001
MCK	0.45643	0.001
Home Language	-0.1915	0.054
Maternal Education	0.22901	0.007
# of Dependents	-0.0407	0.069
Black	-0.2577	0.005
Hispanic	0.03556	0.717
Asian	-0.2701	0.178
Other	0.0095	0.956
Anxiety Score P2	-0.0635	0.24
Non-Belonging P2	0.09764	0.015
Stereotype Threat P2	-0.0204	0.536
Mindset Score P2	0.22969	0.001

“Being a 'math person' or not is something about you that you really can't change. Some people are good at math and other people aren't."





Students believe they are capable of learning.

You Can Grow Your Brain

New Research Shows the Brain Can Be Developed Like a Muscle

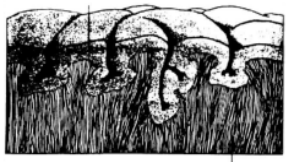
By: Lisa S. Blackwell and David S. Yeager

Many people think of the brain as a mystery. We don't often think about what intelligence is or how it works. And when you do think about what intelligence is, you might think that a person is born either smart, average, or dumb—either a "math person" or not—and stays that way for life.

But new research shows that the brain is more like a muscle—it changes and gets stronger when you use it. Scientists have been able to show just how the brain grows and gets stronger when you learn.

Everyone knows that when you lift weights, your muscles get bigger and you get stronger. A person who can't lift 20 pounds when they start exercising can get strong enough to lift 100 pounds after working out for a long time. That's because muscles become larger and stronger with exercise. And when you stop exercising, the muscles shrink and you get weaker. That's why people say "Use it or lose it!"

But most people don't know that when they practice and learn new things, parts of their brain change and get larger, a lot like the muscles do. This is true even for adults. So it's not true that some people are stuck being "not smart" or "not math people." You can improve your abilities a lot, as long as you practice and use good strategies.



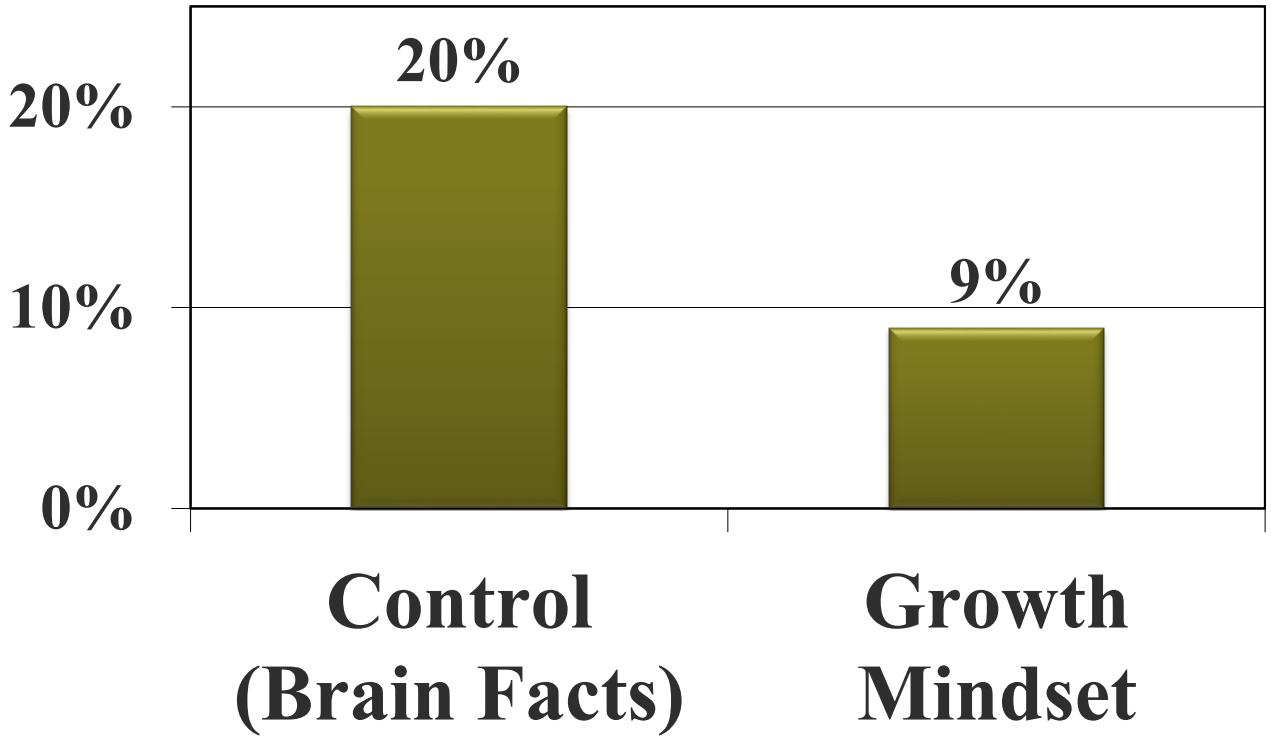
Inside the outside layer of the brain—called the cortex—are billions of tiny nerve cells, called neurons. The nerve cells have branches connecting them to other cells in a complicated network. Communication between these brain cells is what allows us to think and solve problems.

HEALTH & SCIENCE News You Can Use

"Most people don't know that when they practice and learn new things, parts of ***their brain change*** and get larger, a lot like the ***muscles*** do. This is true **even for adults**. So it's not true that some people are stuck being "not smart" or "not math people." ***You can improve*** your abilities a lot, as long as you ***practice*** and ***use good strategies***."

Course Dropout in Dev Math Students Who Withdrew

Students believe they are capable of learning.



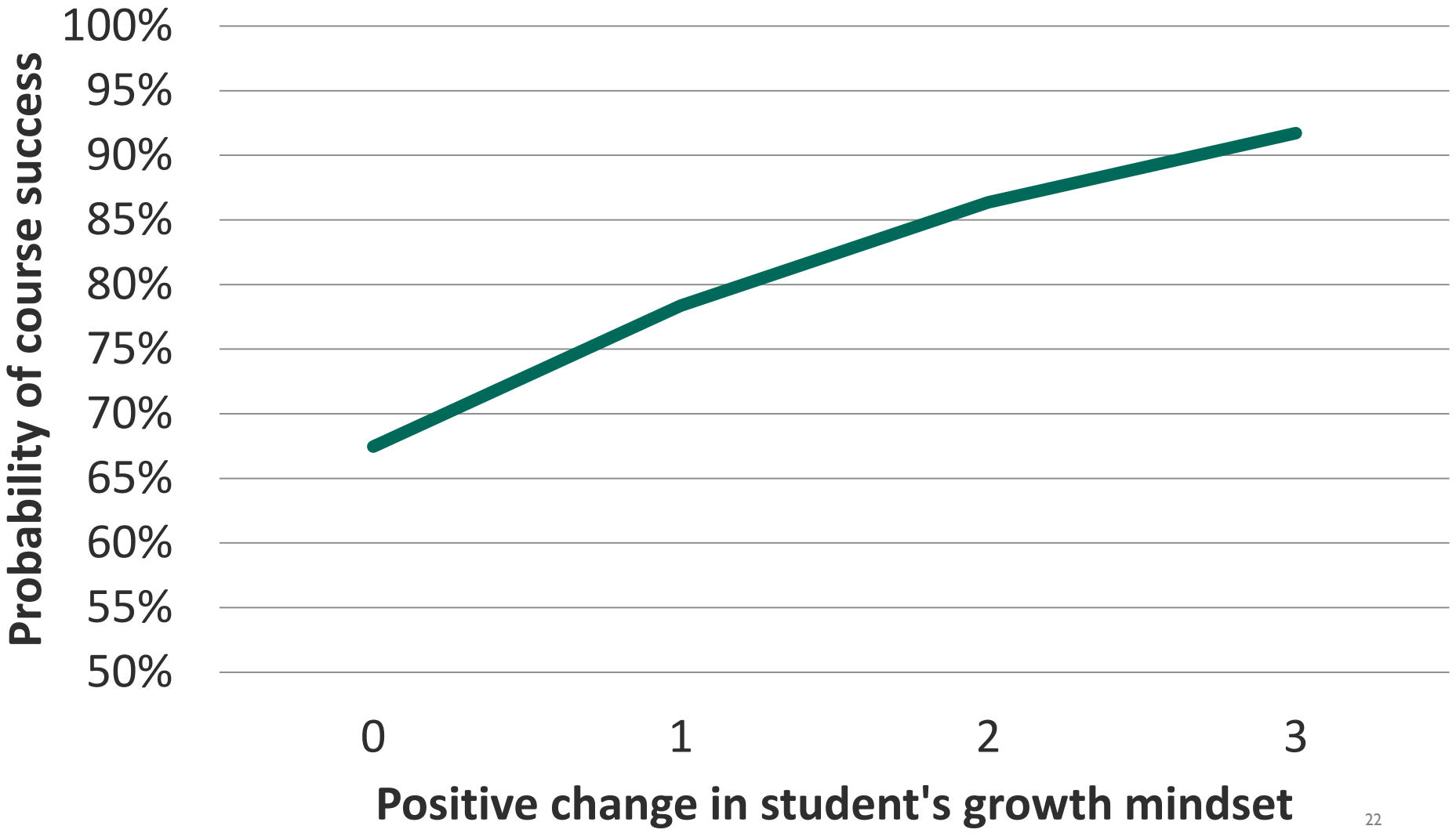
51% decrease
~40 minutes
$0

In collaboration with:
Greg Walton,
Dave Paunesku,
Carol Dweck,
Carissa Romero,
Roberta Carew,
& www.perts.net

N = 288, Z = 2.87, p = .004

Grade of C- or better at the end of the semester by increase of growth mindset in one month

Students believe they are capable of learning math.



Belonging Uncertainty
(Walton & Cohen, 2007)

Students feel socially tied to peers, faculty, and the course.

- People may commonly question their belonging in new social and academic settings
  - Especially when they are targeted by stigma and negative stereotypes
- This uncertainty makes the meaning of negative social events more ambiguous
  - After each negative event, they have to ask: "Do I belong here or don't I?"

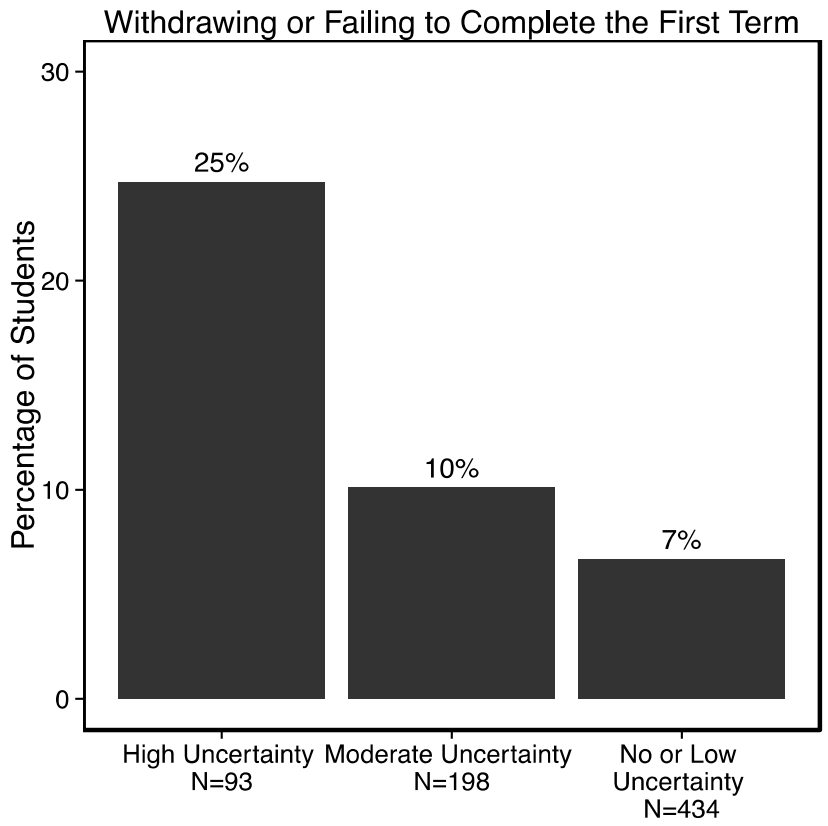
Interviews with Students

Students feel socially tied to peers, faculty, and the course.

Examples of Student Quotes:

- "I'm embarrassed to be at community college because high school teachers said I would end up at community college because I'm lazy"
- "I don't have any friends here. In between classes, I sit in my car and see everyone talking to others and I wonder: how did everyone else make friends?"
- " I felt that if I stopped coming no one would even notice."

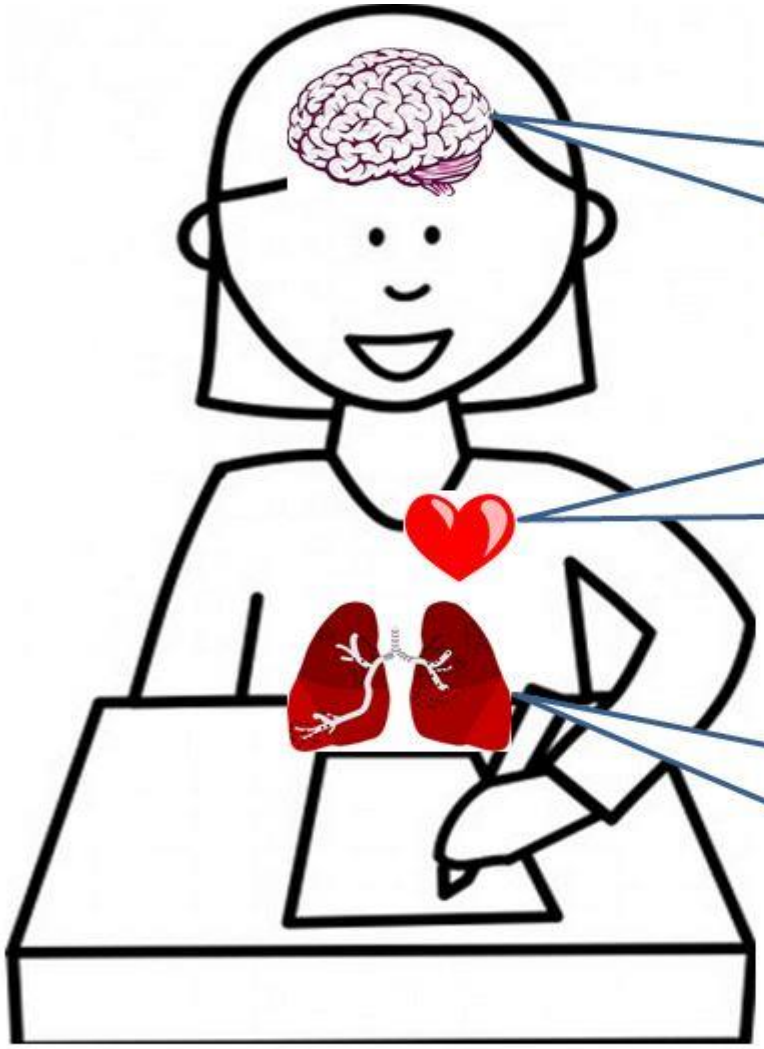
“How often, if ever, do you wonder: ‘Maybe I don't belong here?’”



(a) Course Withdrawal ($\chi^2(1)\, p < 0.001$)

Figure 26: Belonging uncertainty after four weeks. High uncertainty: response = 1 or 2; moderate uncertainty: response = 3; no or low uncertainty: response = 4 or 5.

Emotional Regulation Strategies: Including Stress Reappraisal



Stress releases chemicals that help you think more quickly & solve problems better.

Maybe you've even heard of one of these chemicals before: Adrenaline.

Stress increases your heart rate so it can deliver fuel to your brain to help you think.

Your heart sends oxygen to fuel your brain.

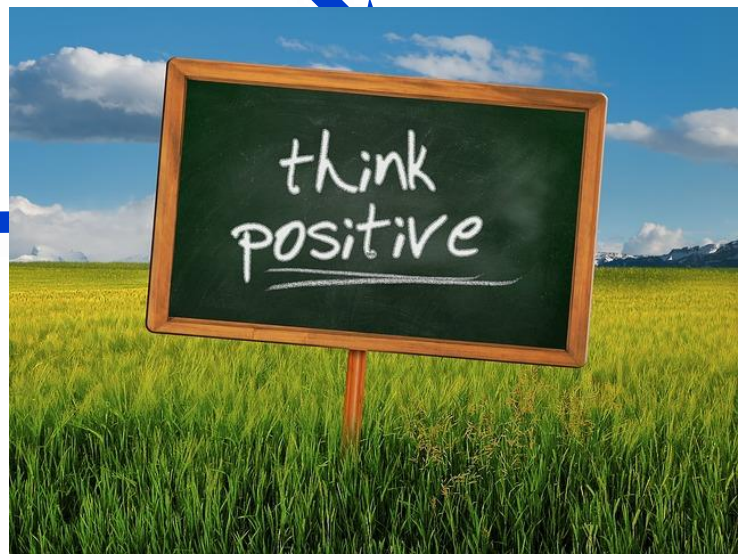
Stress speeds up your breathing. You might even feel short of breath.

This is okay because it means your body has lots of oxygen to help you do well.

The Mindset Process

Mindsets about mathematics

Higher achievement in mathematics



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Student Voices

"It's very refreshing to be not only grasping it, but actually interested in math…. It's nice to wake up and be excited for my first class of the day."

Student Voices

"It gave me hope at the beginning of this quarter. And so now it's kind of like 'I can [do this]' but I'm also doing something that I think is very useful. …The stereotypes [that minorities and females can't do math] aren't true!"

Student Voices

"This class has helped me in my other classes. This has…exercised my mind enough for me to become a better writer, believe it or not."

Statway Student versus Comparison Student Success Rates (C or better) AY 2013-1014