

The Links Between Student Attitudes, Engagement, and Learning in Introductory Data Science Courses

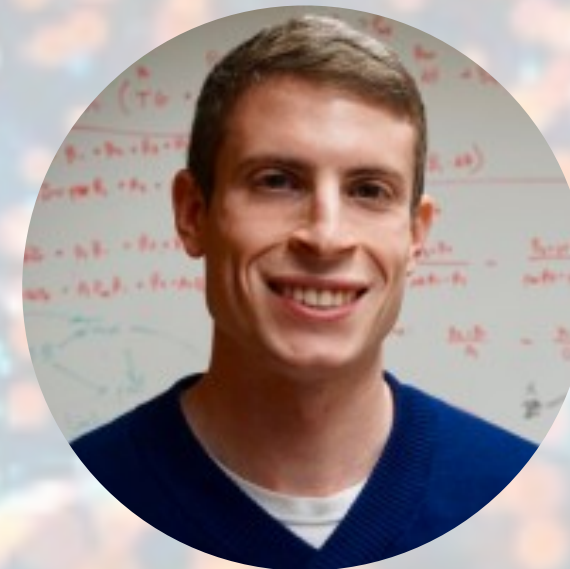
November 2nd, 2023



Hannah Lloyd



Erik Brockbank

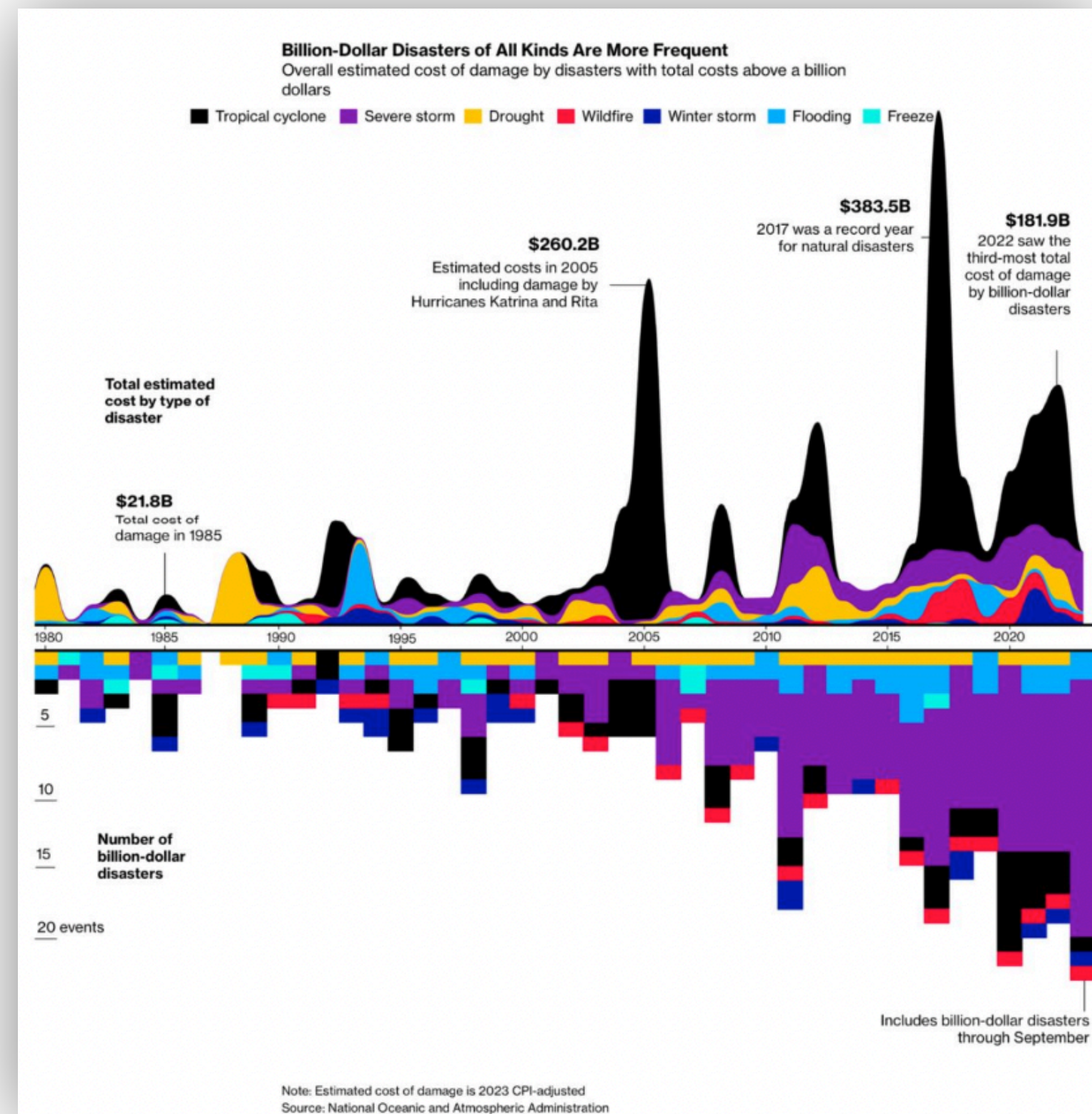


Adam Bear

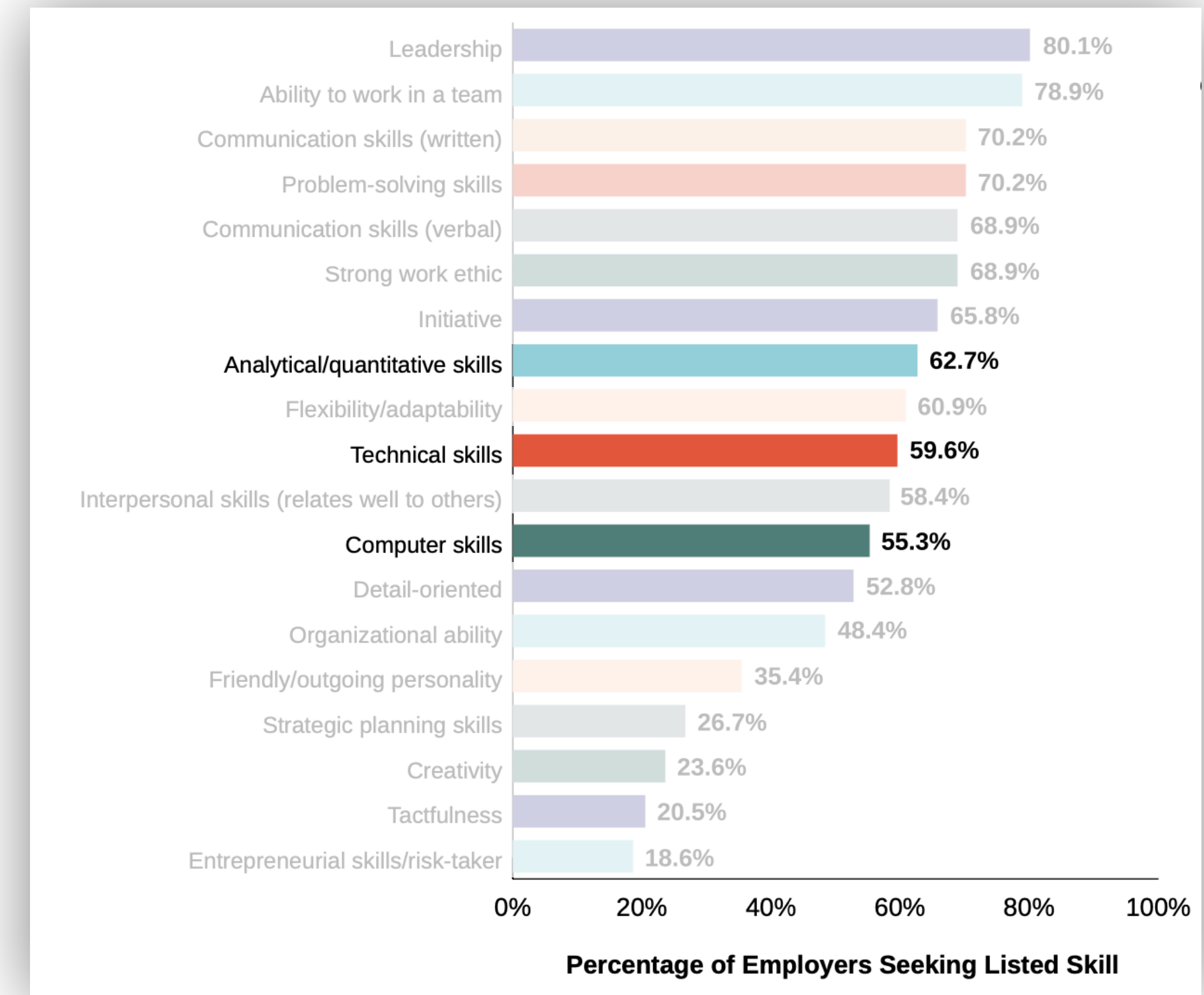


Judy Fan

We live in a **complex** world filled with **large-scale data**



New York Times

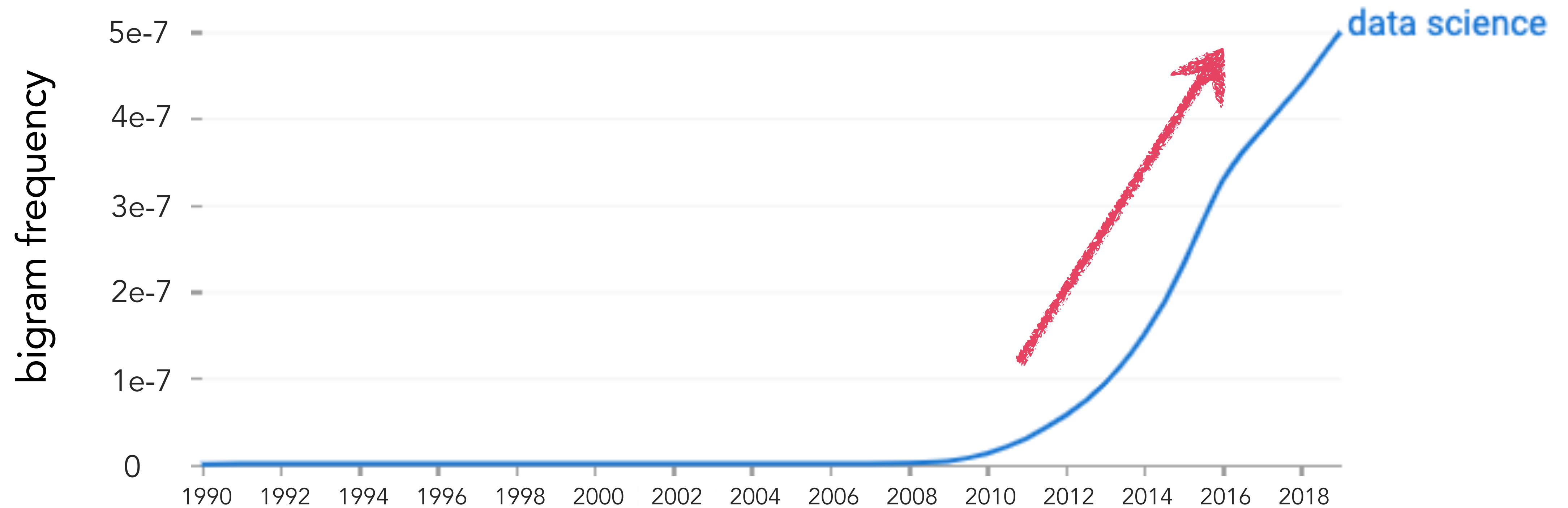


National Association of Colleges and Employers (NACE) Job Outlook 2016 Survey

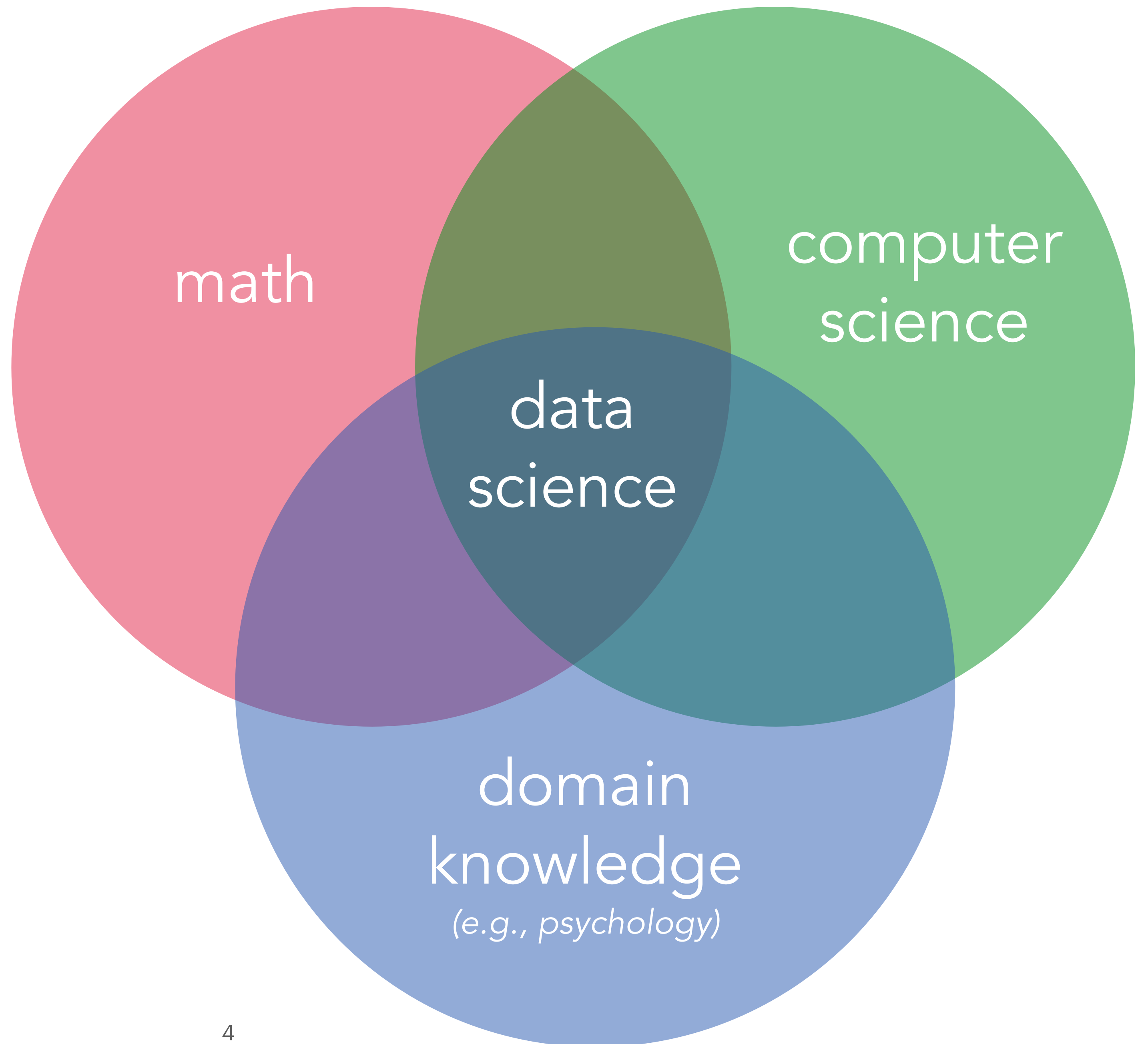
We **reason** with big data everyday

Workforce preparedness

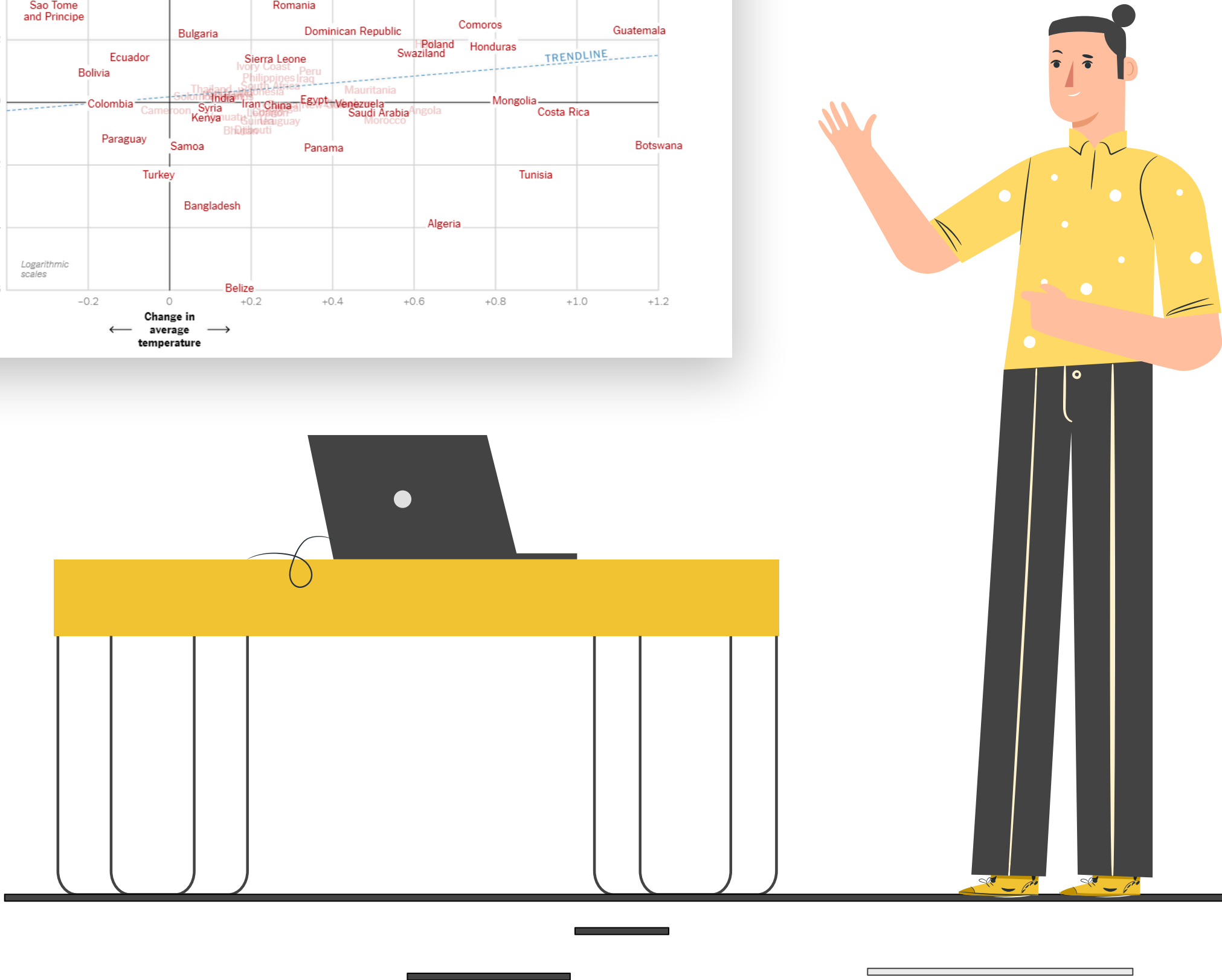
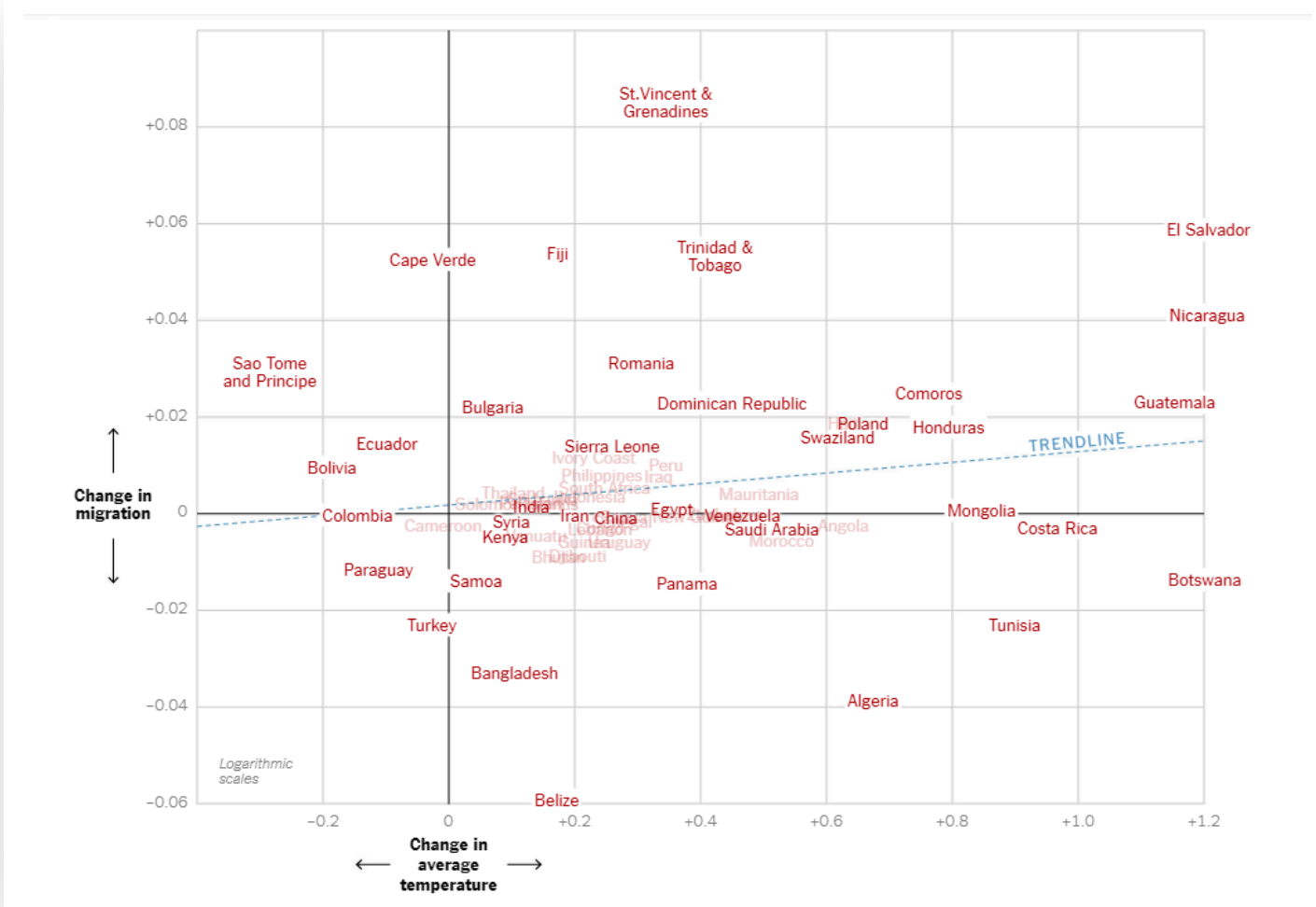
Rapid and recent rise in prominence of **data science**



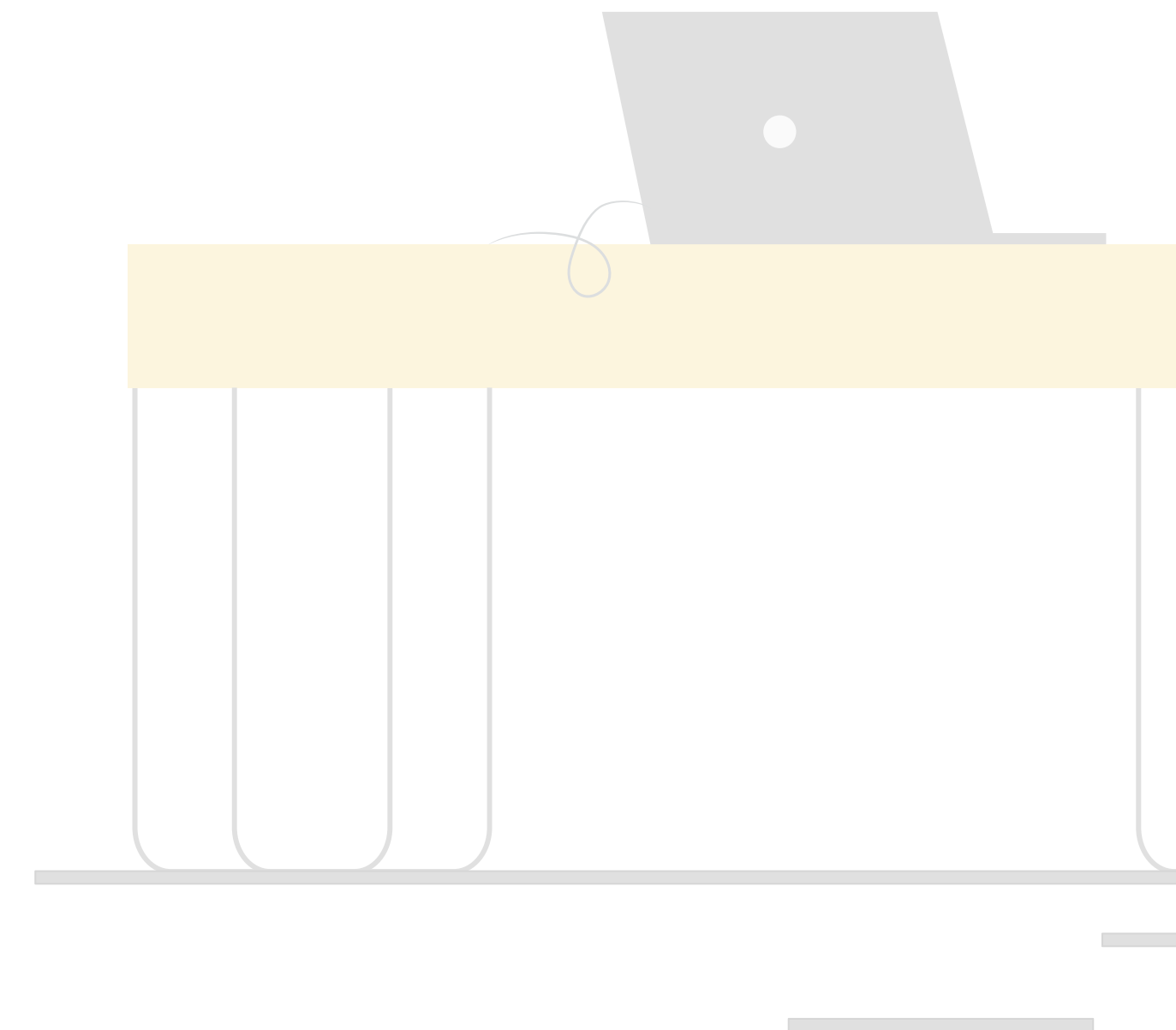
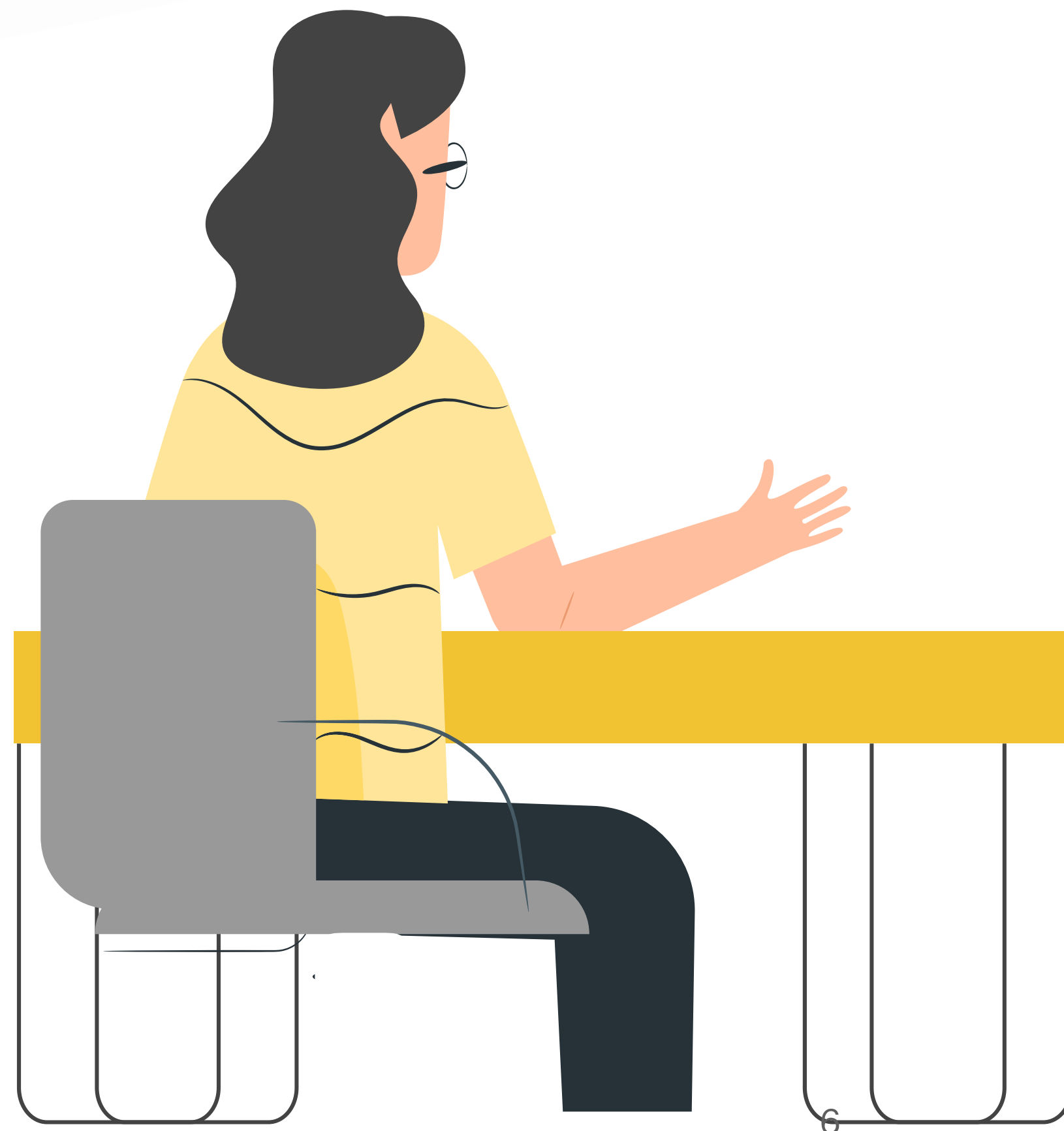
Multidisciplinary
of data science
poses challenges
for pedagogy



What predicts learning in data science courses?

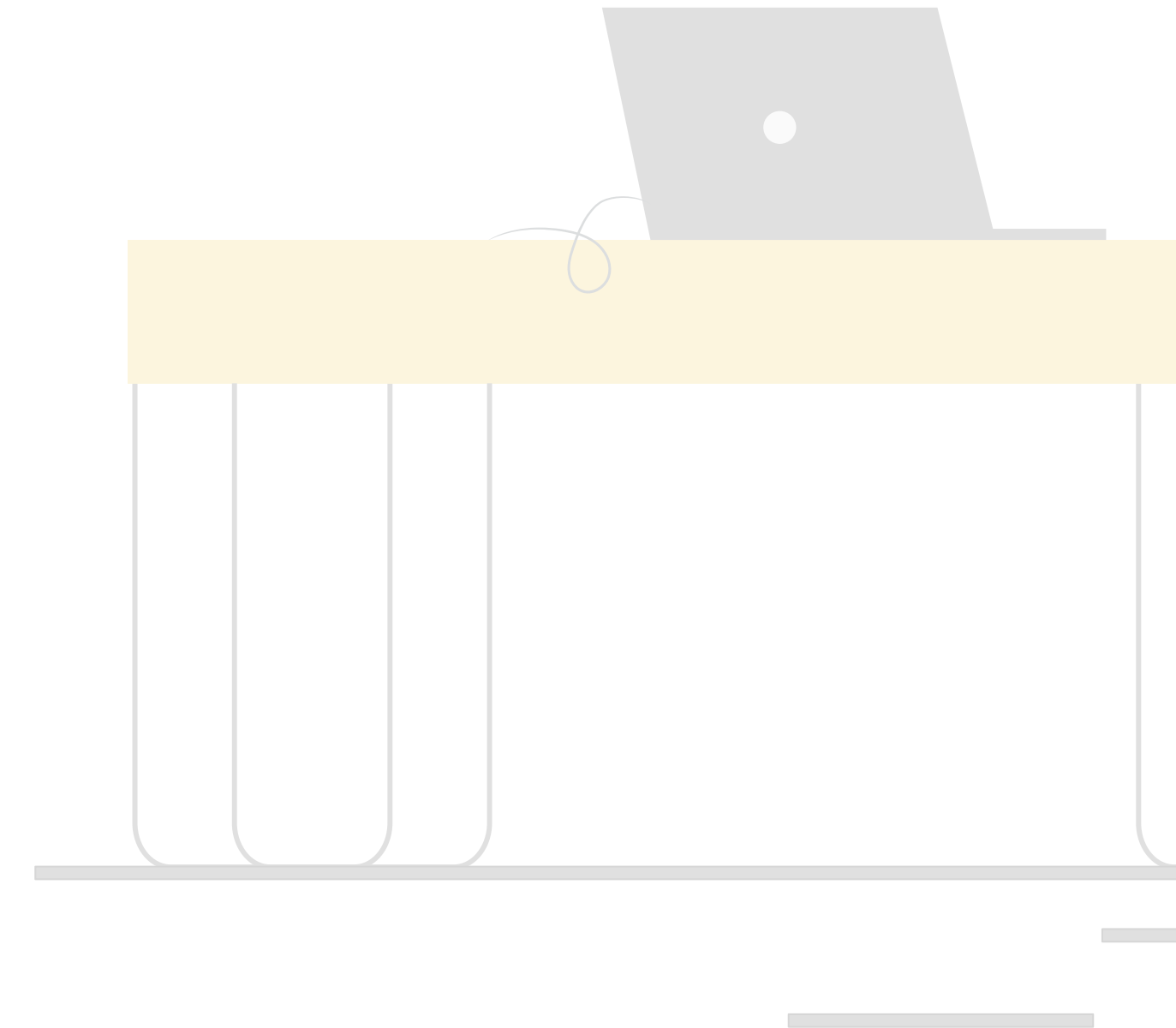
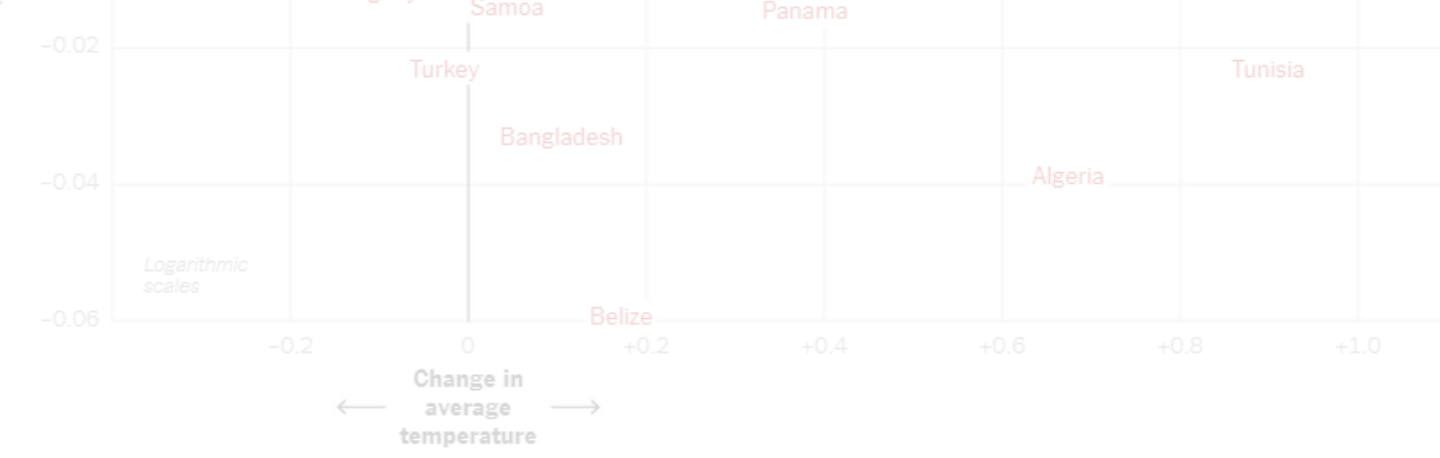
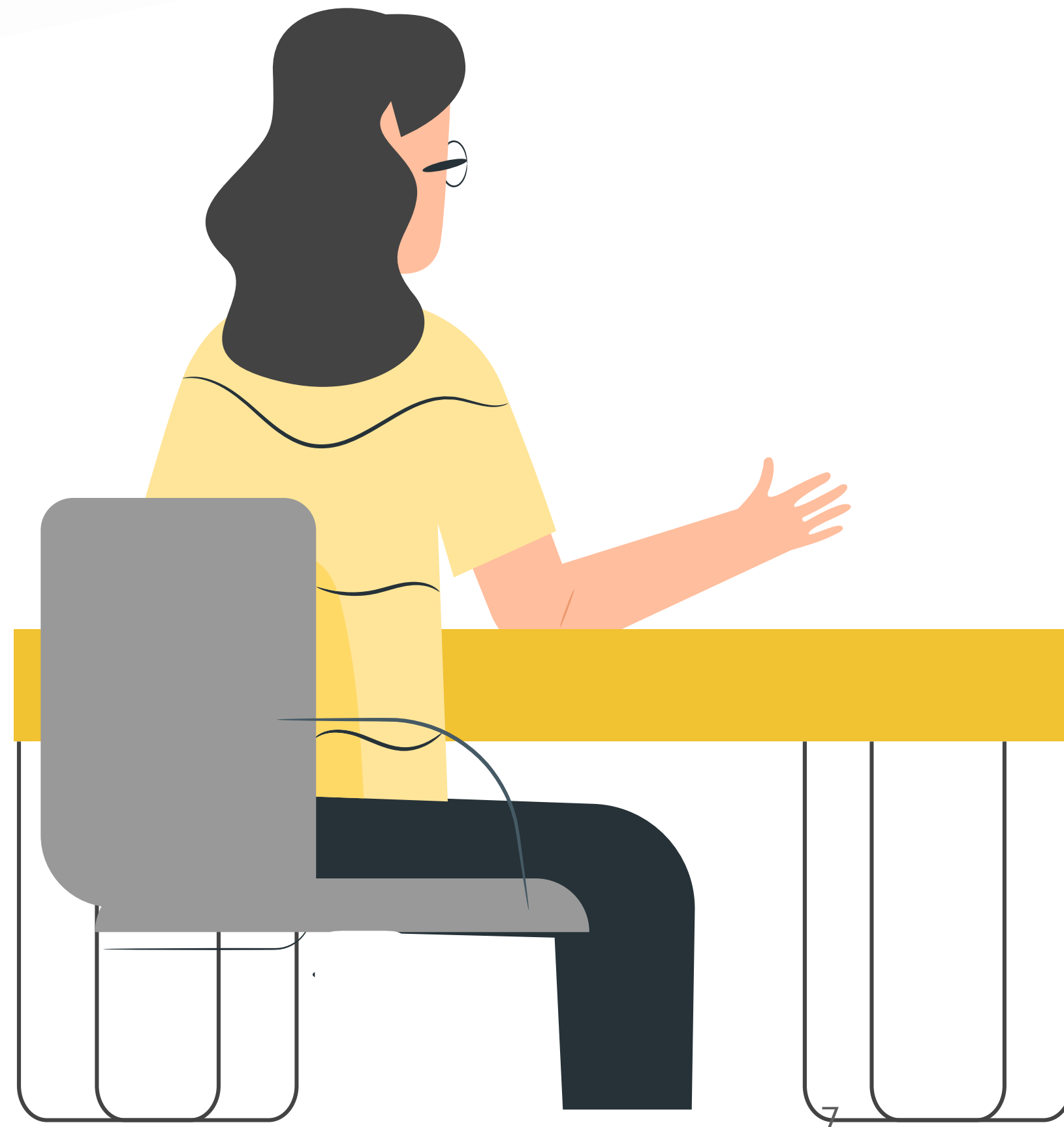


*Math stresses
me out*



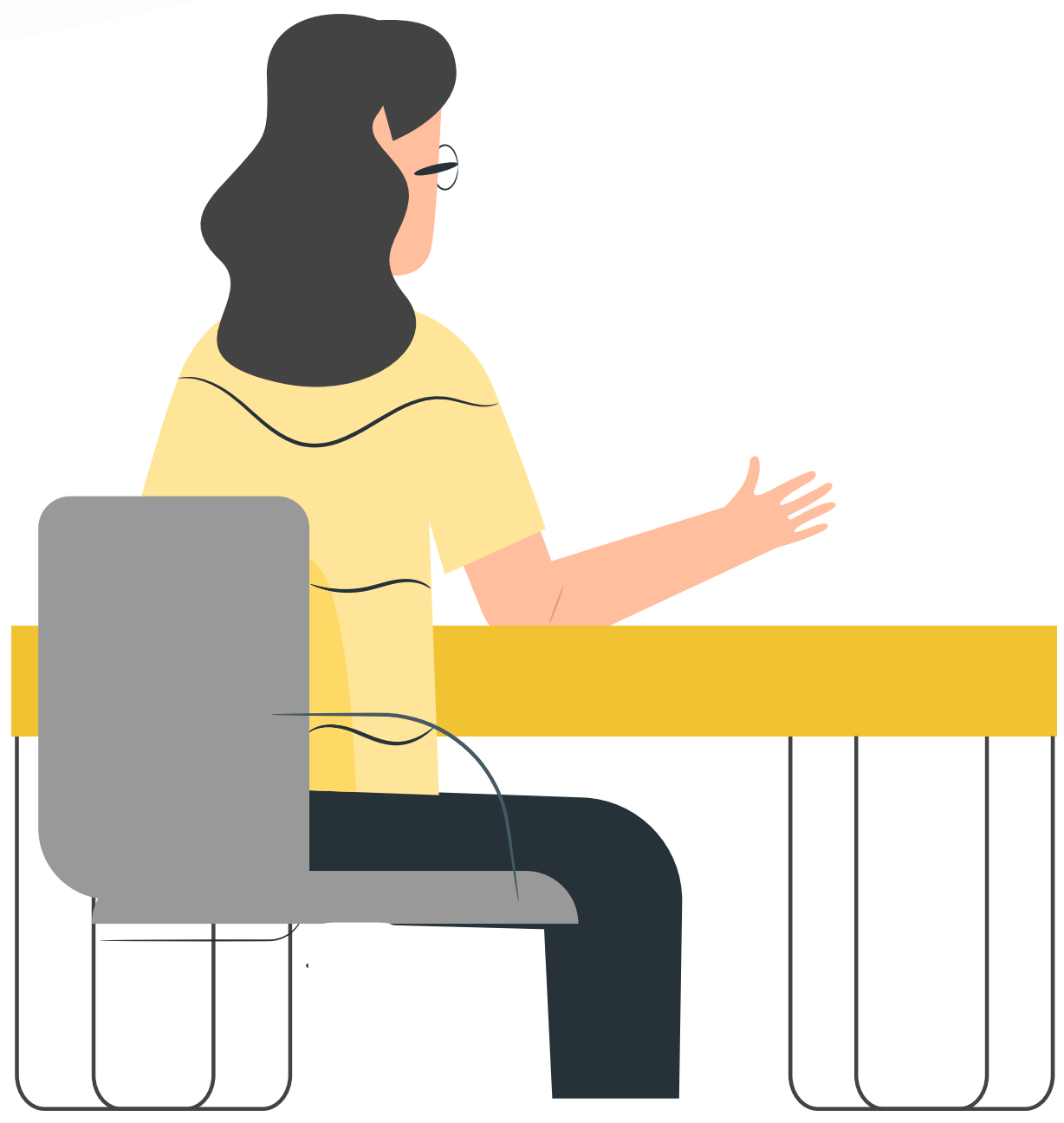
*Math stresses
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*Statistics is
cool*

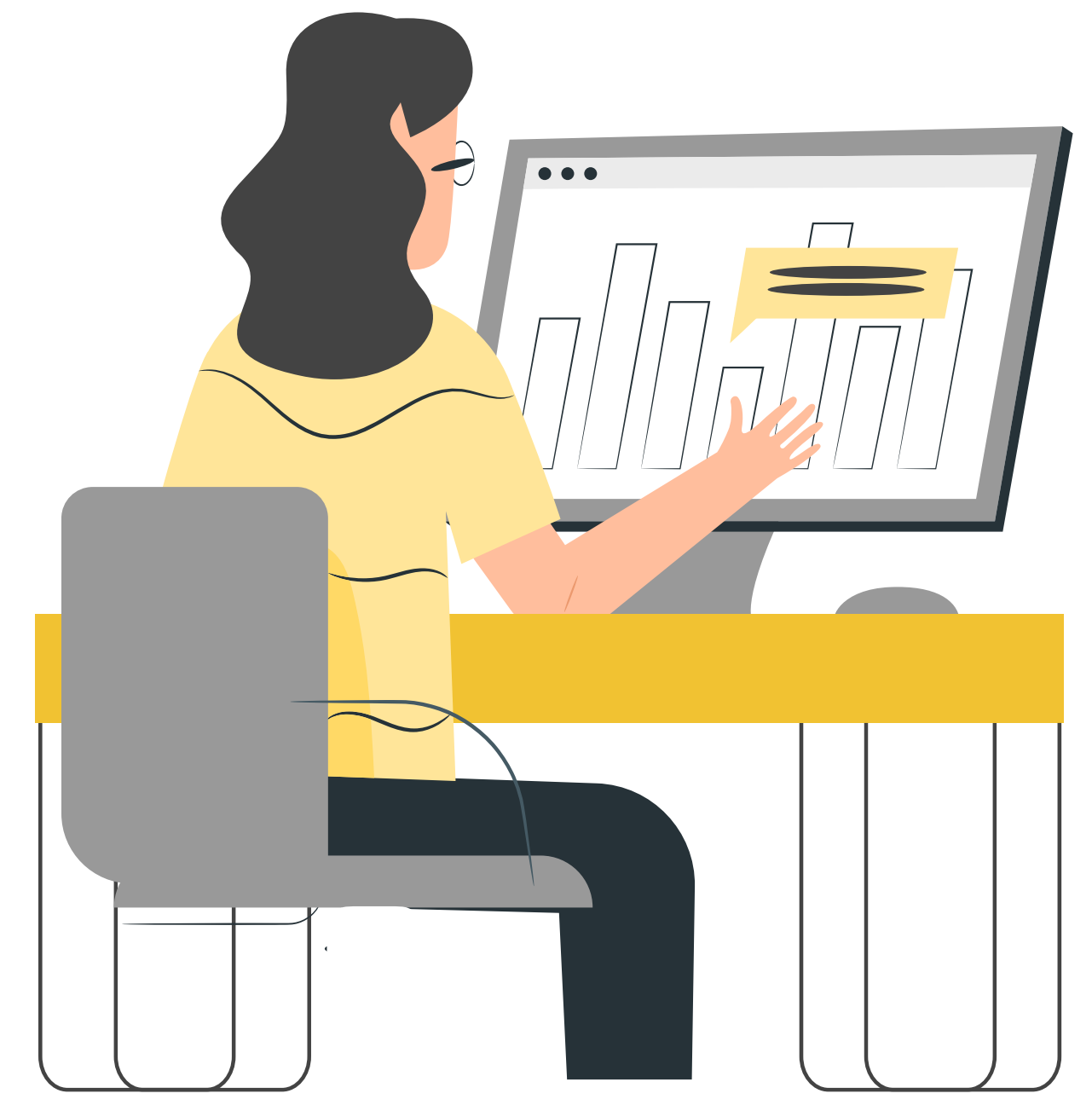


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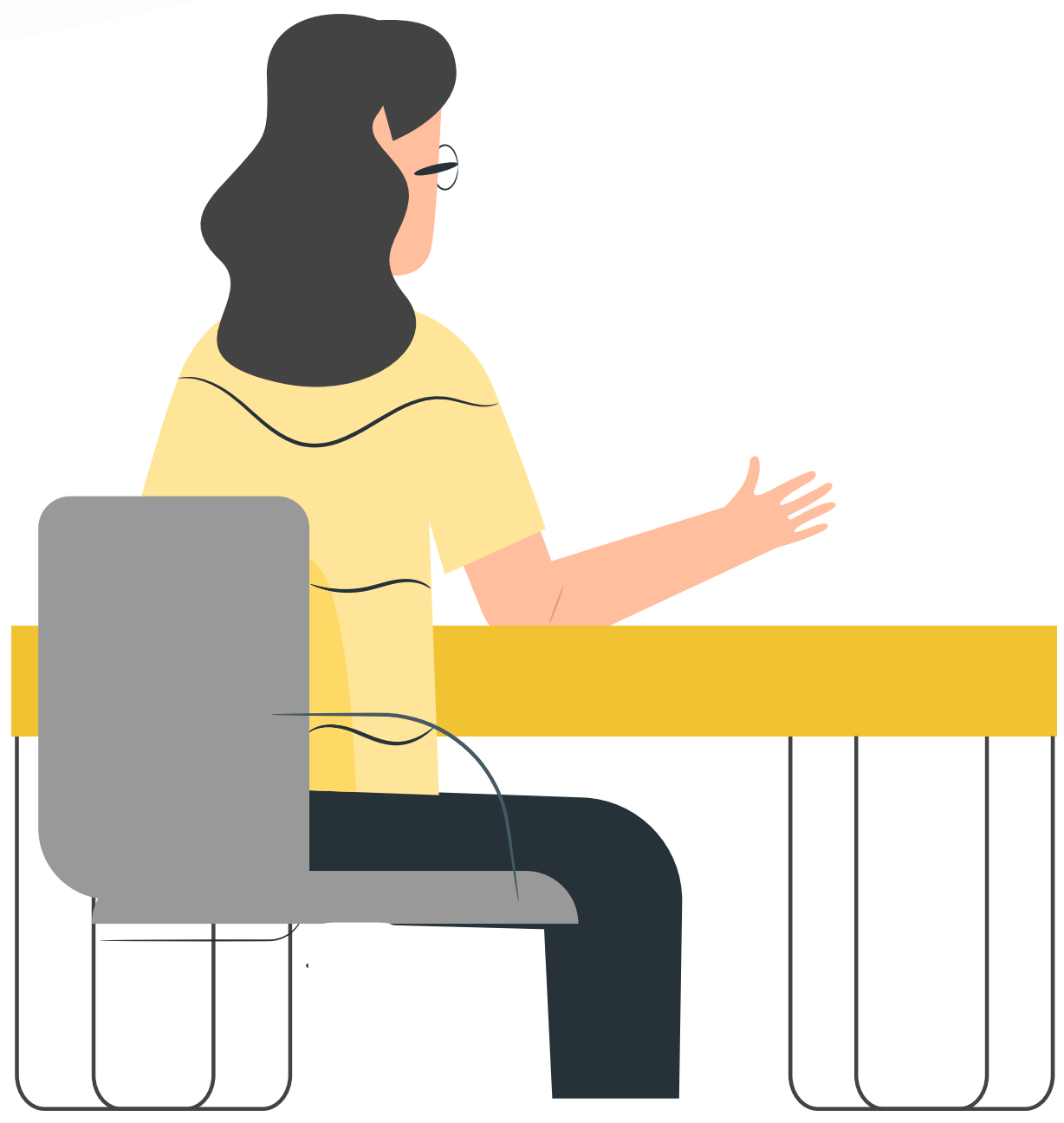


*I should do more
stats exercises*

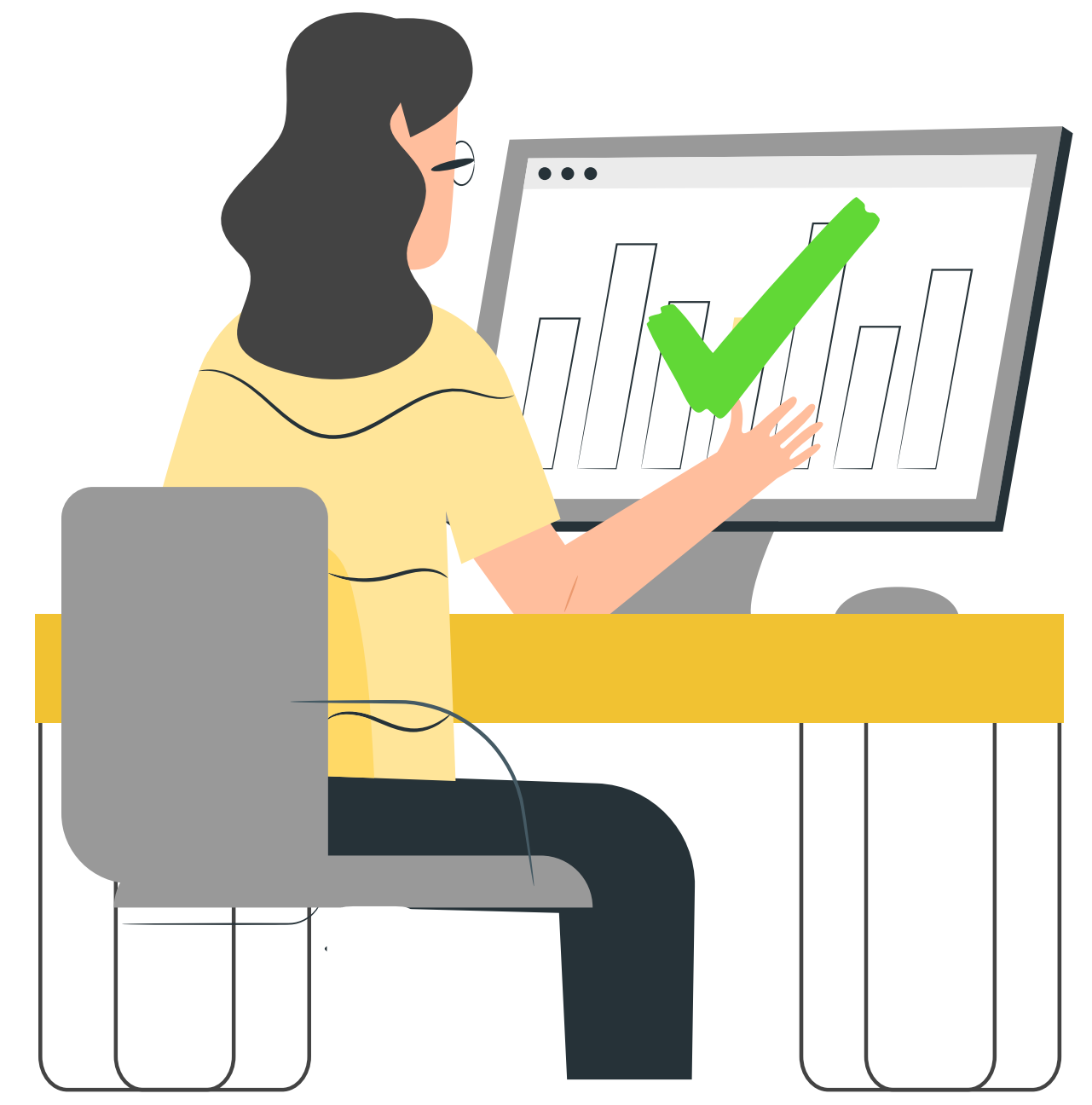


*Math stresses
me out*

*Statistics is
cool*



*Yes! I did well on
the quiz*



Measuring student attitudes & behavior using CourseKata



CourseKata Statistics & Data Science

Welcome to *CourseKata Statistics and Data Science*, an innovative interactive online textbook for teaching introductory statistics and data science in colleges, universities, and high schools.





CourseKata



high
school



community
college

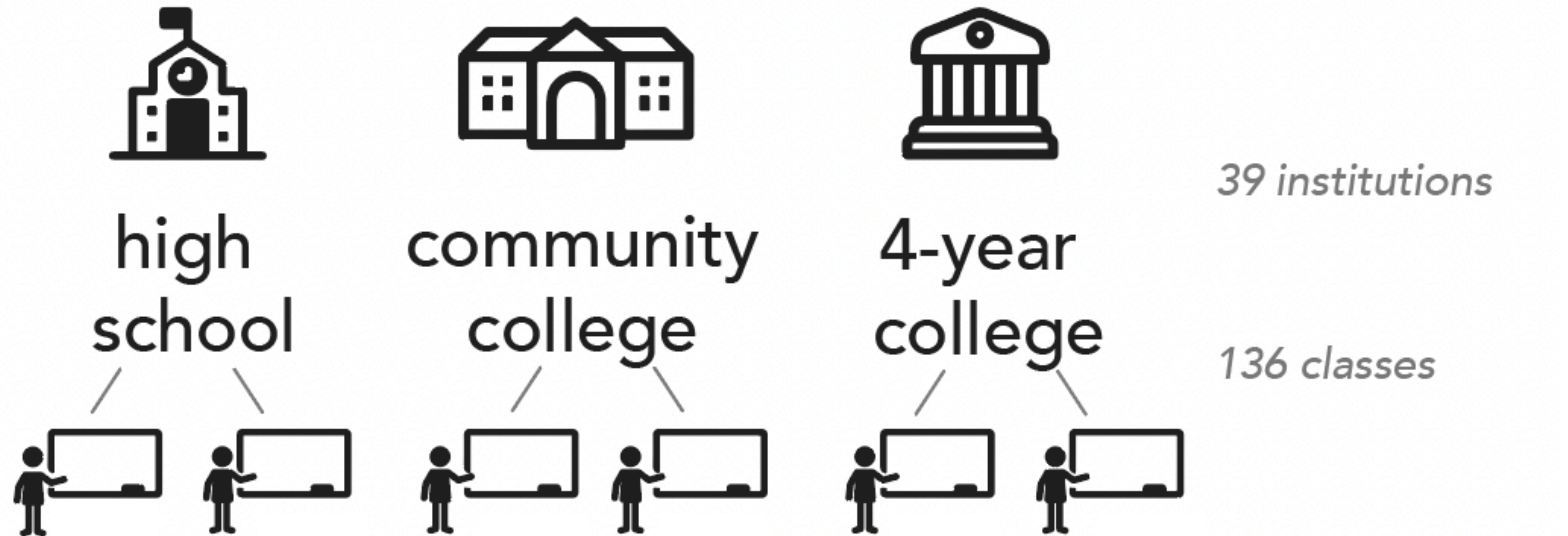


4-year
college

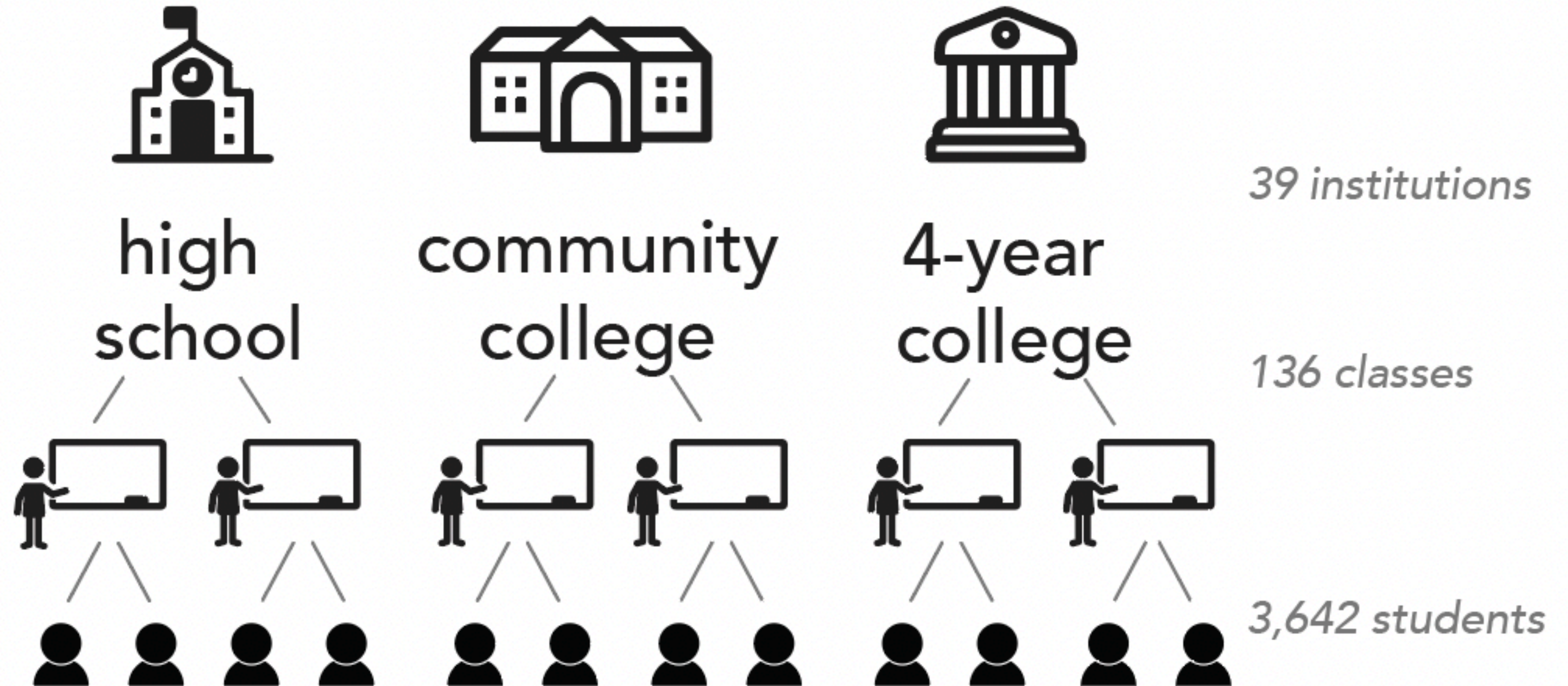
39 institutions



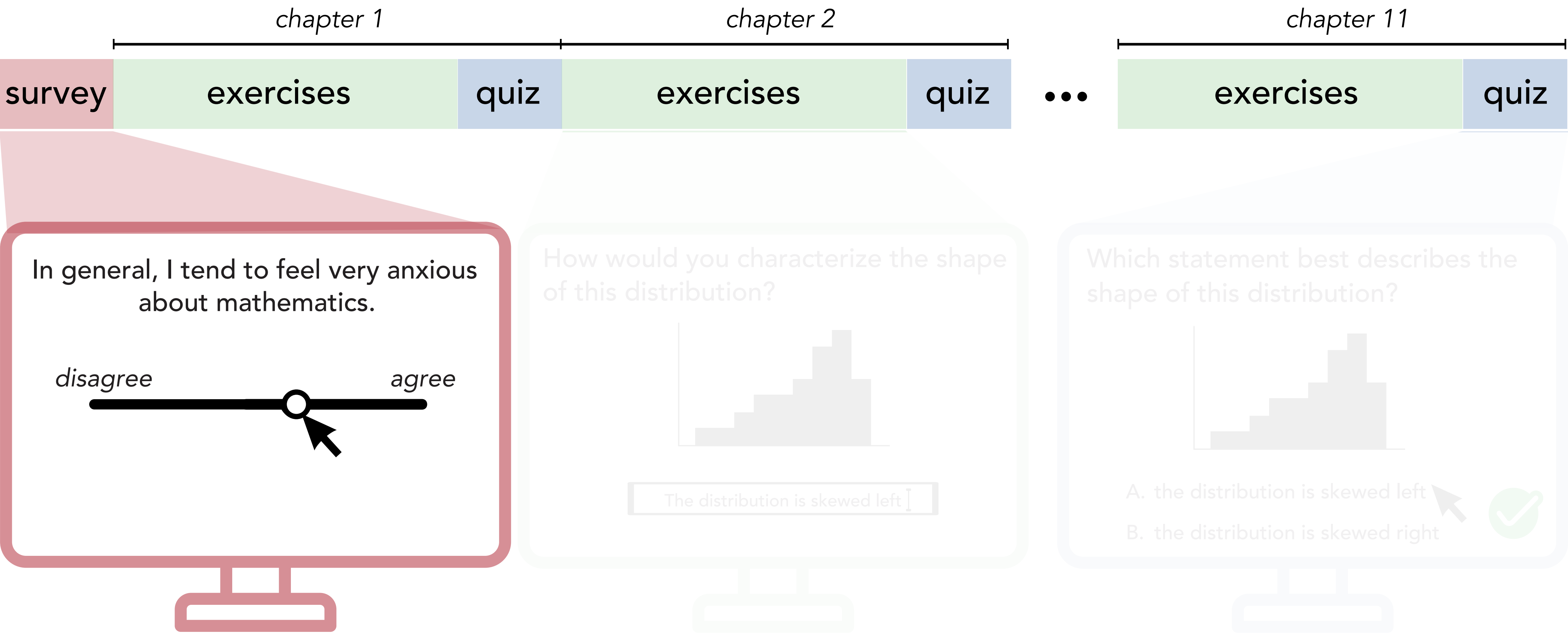
CourseKata



CourseKata



Measuring student attitudes & behavior using CourseKata



Embedded surveys to measure student background & interests

The screenshot shows a web interface for a pre-survey. At the top, there's a header with a hamburger menu icon and the text 'College / Statistics and Data Science (ABC)'. Below this is a dropdown menu with the same text. The main heading is 'Pre-Survey' followed by 'Welcome to Statistics and Data Science!'. A paragraph explains that completing the survey is a course requirement but answers won't count towards the grade, and that all answers are confidential. It also mentions an estimated time of 10 minutes. A yellow box contains a note: 'NOTE: Be sure to scroll down and answer all questions for each item before clicking NEXT.' Below this is a light blue box containing a progress indicator '1 of 14' and a question: 'Please rate your level of agreement (or disagreement) with each of the following statements.' The first statement is 'I am confident I can learn the material in this course.'

Broad set of constructs:

math anxiety

level of interest

mindset (*fixed vs. growth*)

confidence (*e.g., w/ programming*)

demographic variables
(*e.g., SES, gender, race, edu background*)

& many more!

Survey administered 4x throughout the book

Principal Components Analysis for Survey Dimensionality Reduction

example survey item

*I will have to **give up a lot to do well** in this class.*

*My **math ability** is something about me that I **can't change**.*

*In general, I tend to feel very **anxious about math**.*

*I expect this course will require a lot of **memorization**.*

*My grades in this **class will improve my career**.*

*I think this **class will be interesting**.*

*I think **statistics and data science are interesting**.*

*Have you had **experience with computer programming** before?*

***Performing well in this class is important** to me.*

*I **expect to do well** in this class.*

*How **well have you done in mathematics courses** ... in the past?*

target construct

expected level of sacrifice

fixed mindset

math anxiety

memorization

impact on career

interest in course

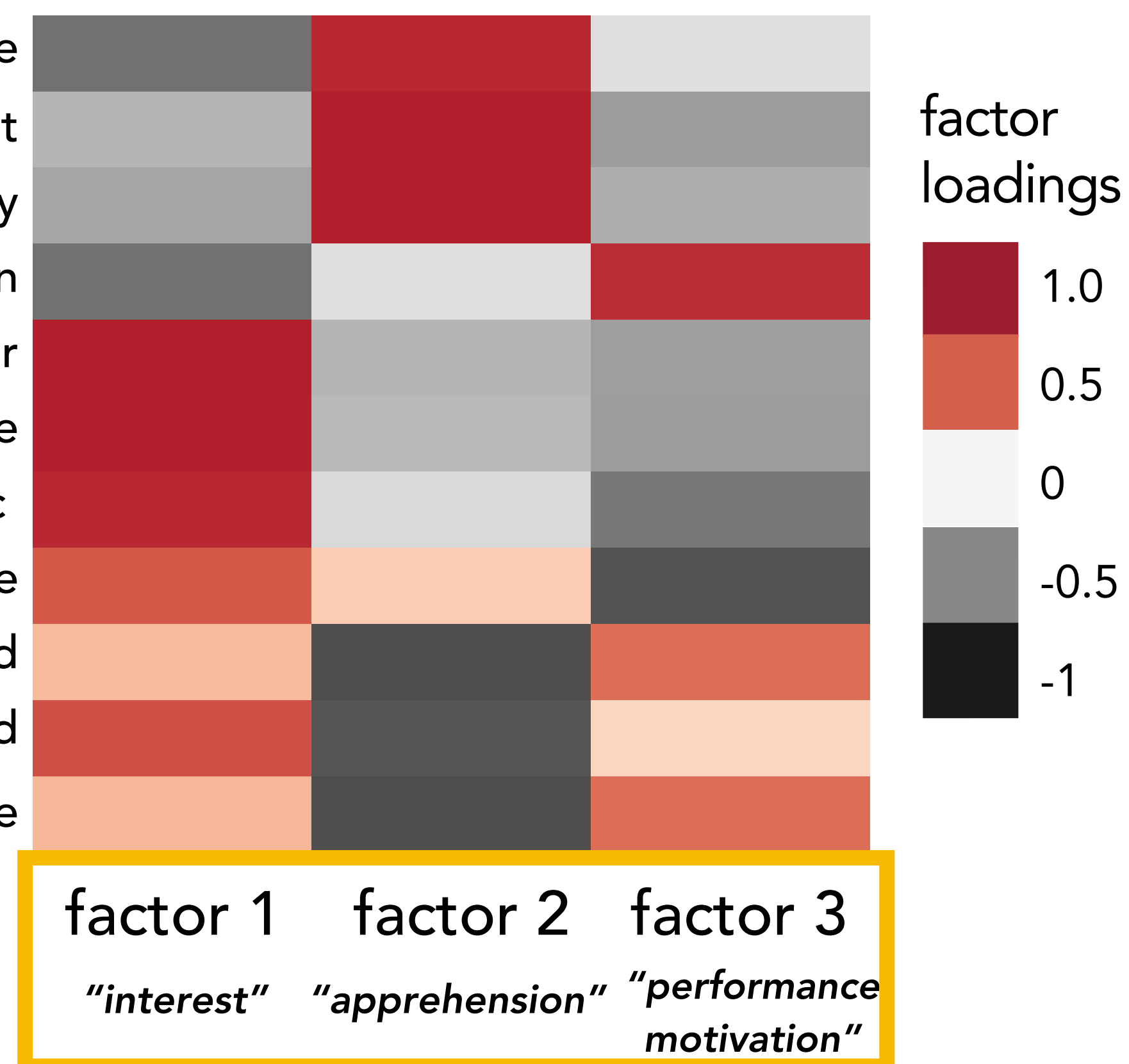
interest in topic

programming experience

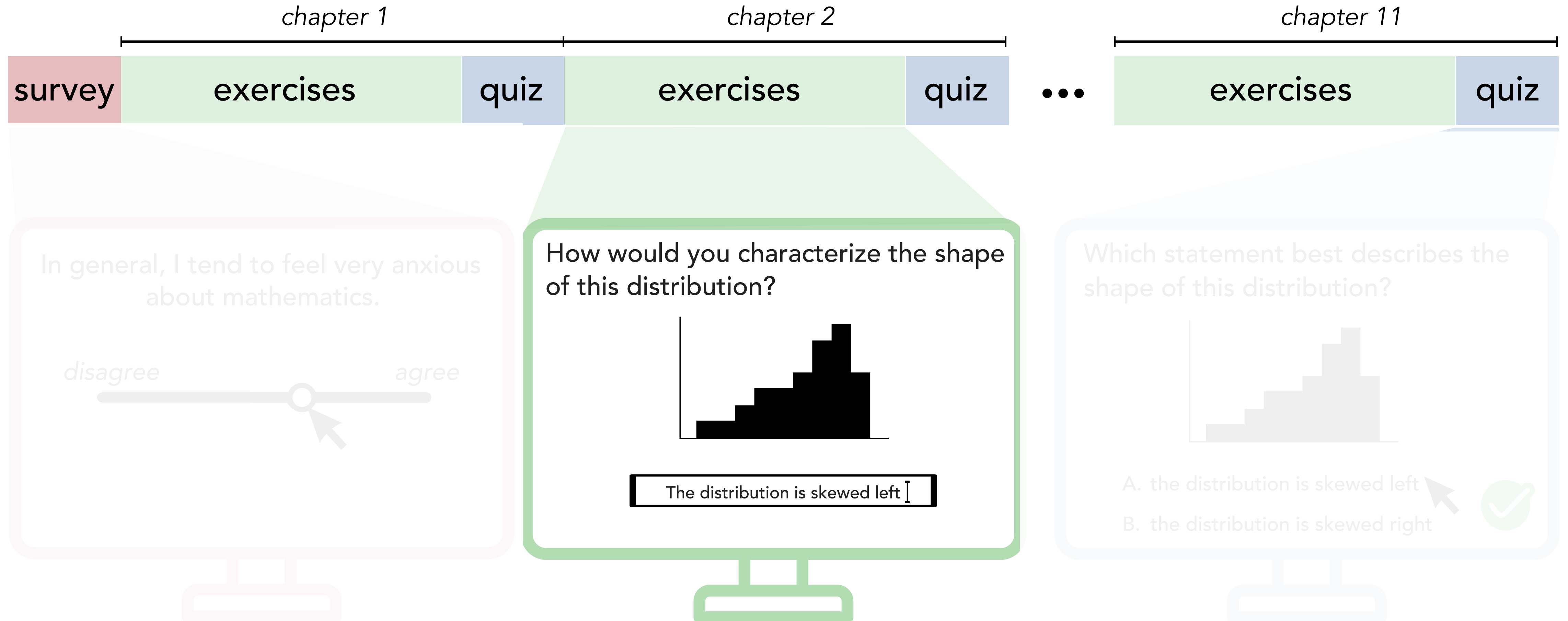
motivation to succeed

expectation to succeed

prior math performance



Measuring student attitudes & behavior using CourseKata



Learning activities interleaved with new material

should be more continuously distributed, with most people having thumbs of average length, and then some a little longer and some a little shorter.

This is exactly what we mean when we say “look for weird things.” One possibility is that some of the students didn’t follow instructions, and measured their thumbs in centimeters (or maybe even inches) instead of millimeters. Given what we know about students, this seems like a reasonable theory; they don’t always listen to instructions.

The point here, though, is this: if we hadn’t looked at the distribution, we would not have noticed this oddity and might have drawn some erroneous conclusions.

If our theory is correct, that some students reported their thumb lengths in centimeters instead of millimeters, what kind of error would this be?

A	Mistake
B	Measurement error
C	Missing data
D	Natural variation (or fluctuation) in thumb length

Learnosity: Ch3_Shape_2



Conceptual questions

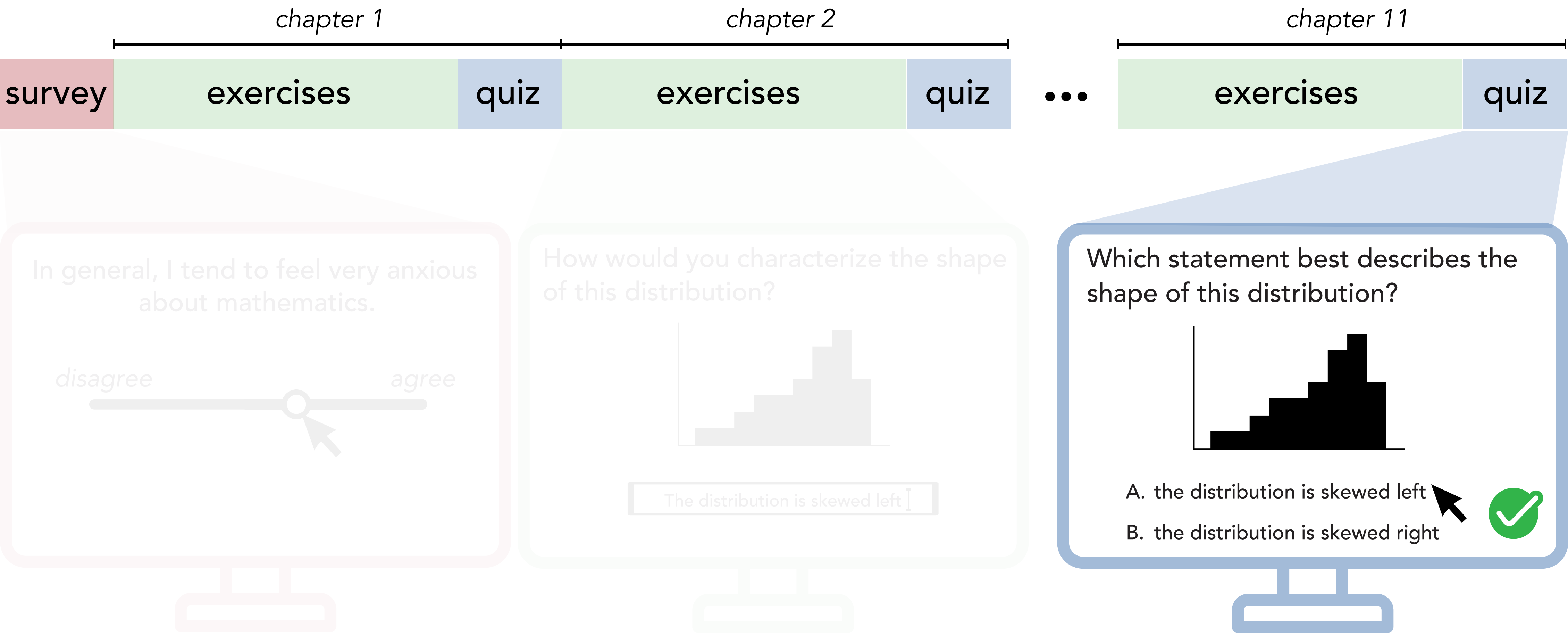


Coding exercises



Open-ended responses

Measuring student attitudes & behavior using CourseKata



Interspersed assessments to test comprehension & generalization

College / Statistics and Data Science (ABC)

Book

College / Statistics and Data Science (ABC)

2.10 Chapter 2 Review Questions

1. What's true about data?

A

They require that you've selected a sample.

B

They are the result of measurement.

C

They represent something about the world.

D

All of the above

Learnosity: A2_Review1_01

20



Conceptual questions
appearing at the end
of every chapter

1

How well do student **attitudes** & **engagement** predict **learning**?

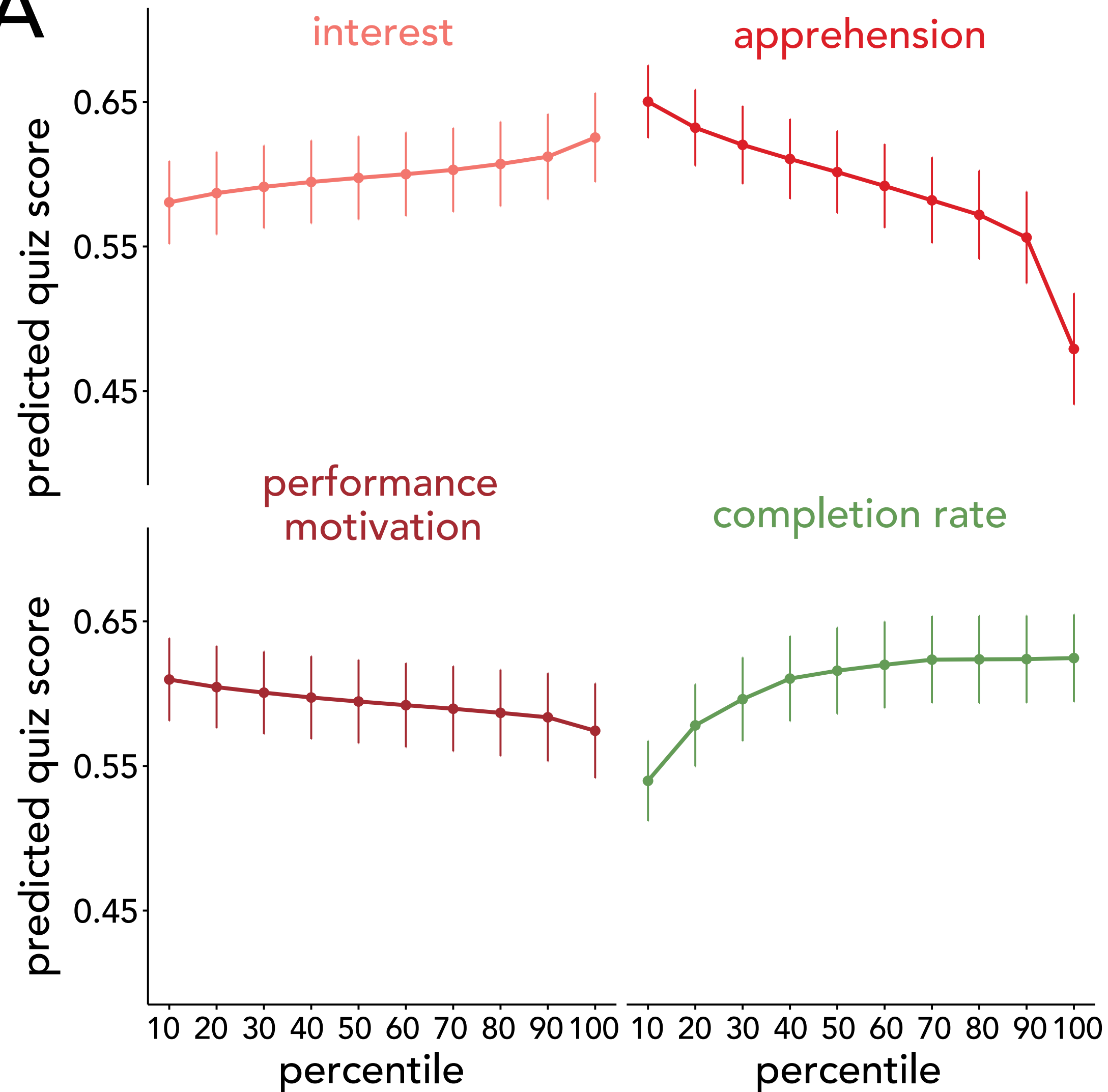
2

How well do student **attitudes** & **learning outcomes** predict **engagement**?

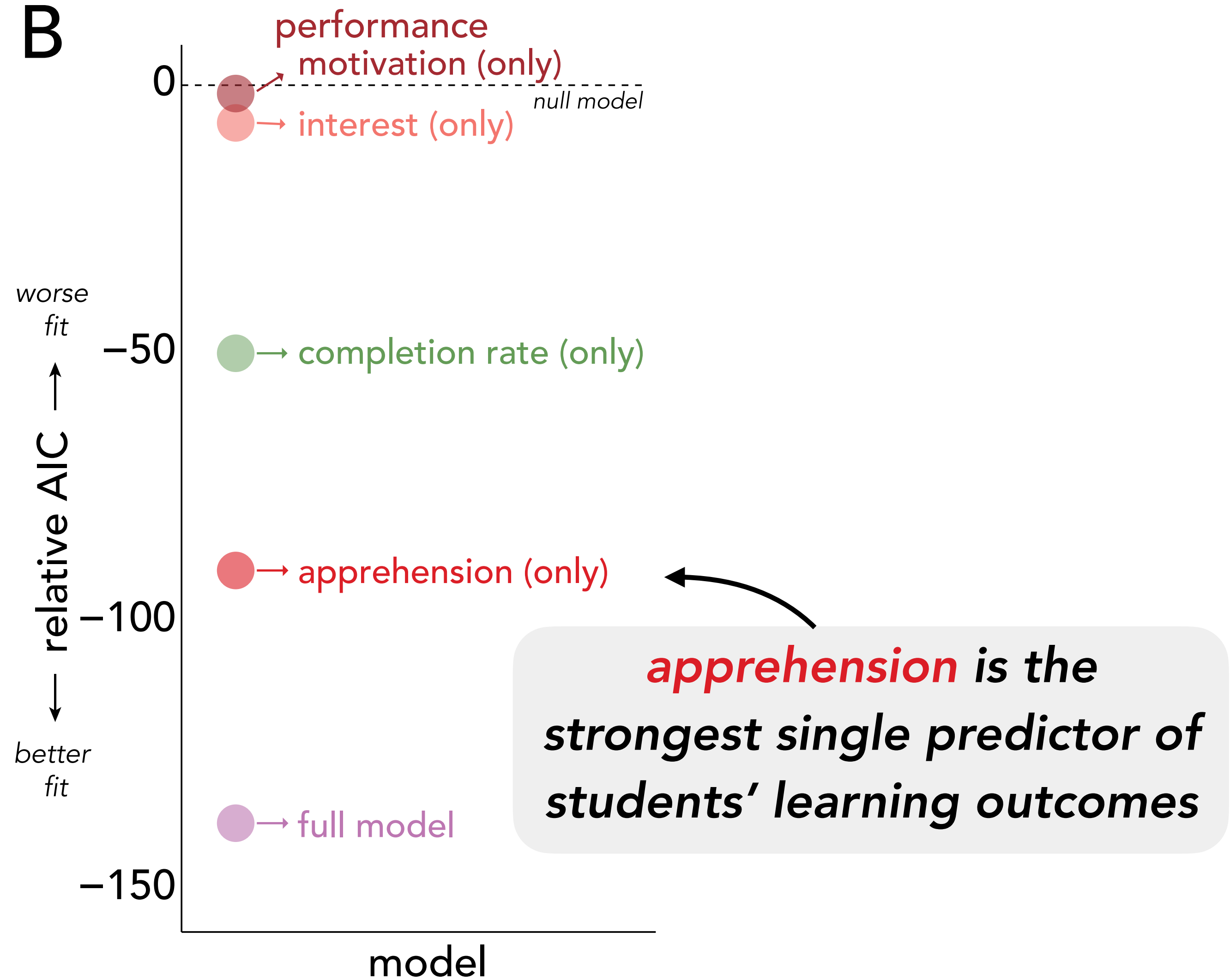
1

How well do student **attitudes** & **engagement** predict **learning**?

A



B



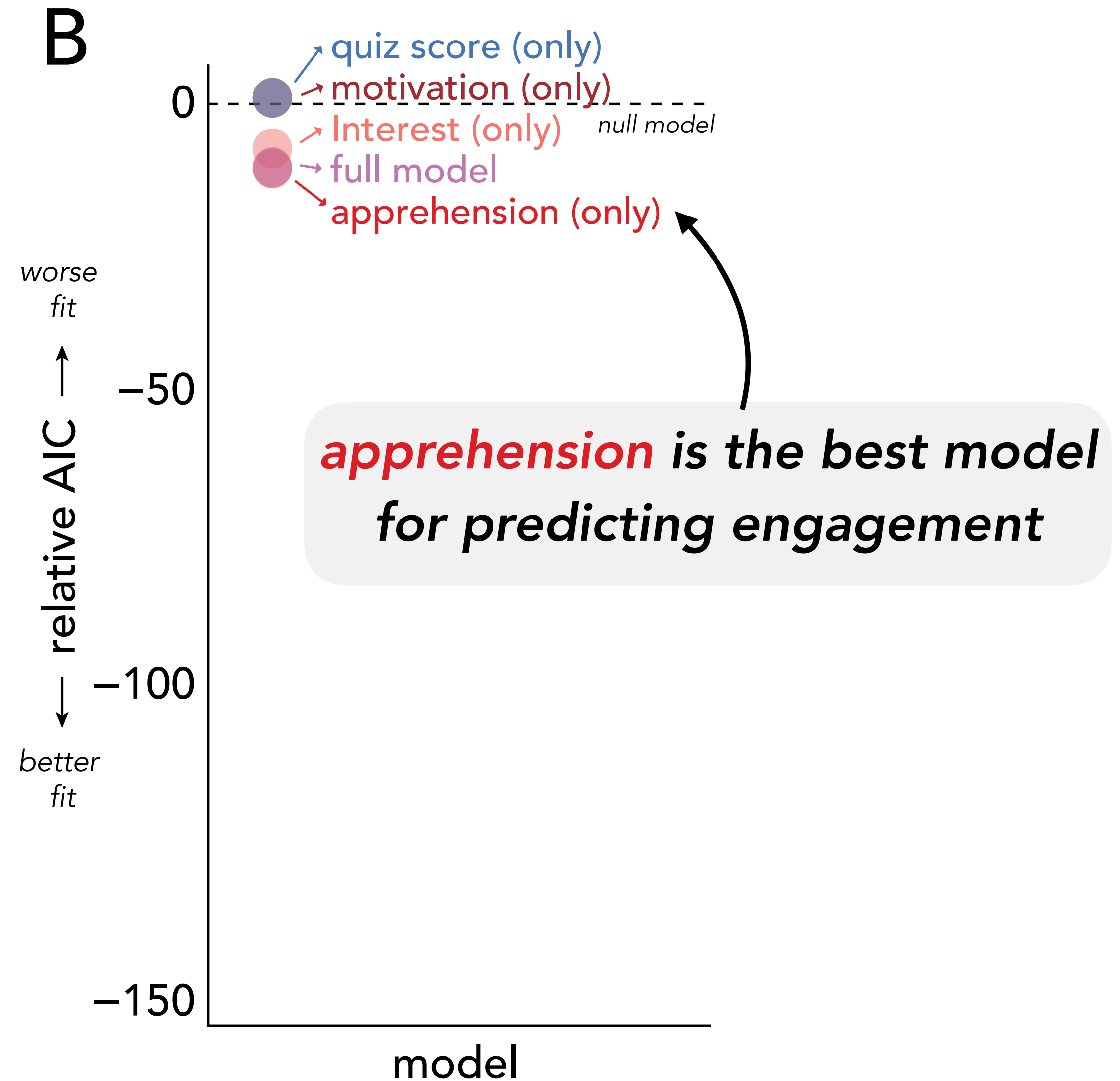
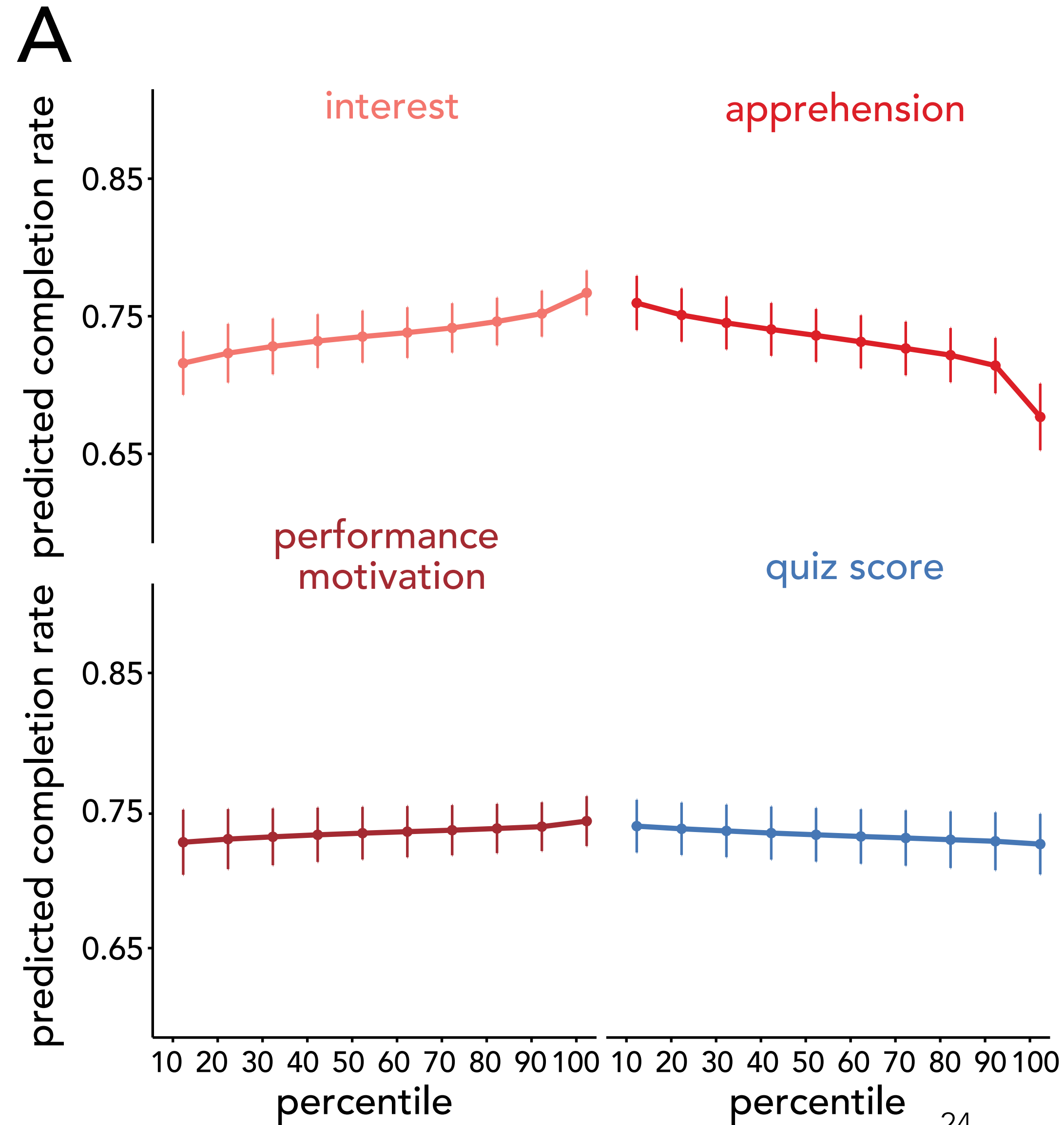
apprehension is the strongest single predictor of students' learning outcomes

1 How well do student **attitudes** & **engagement** predict **learning**?

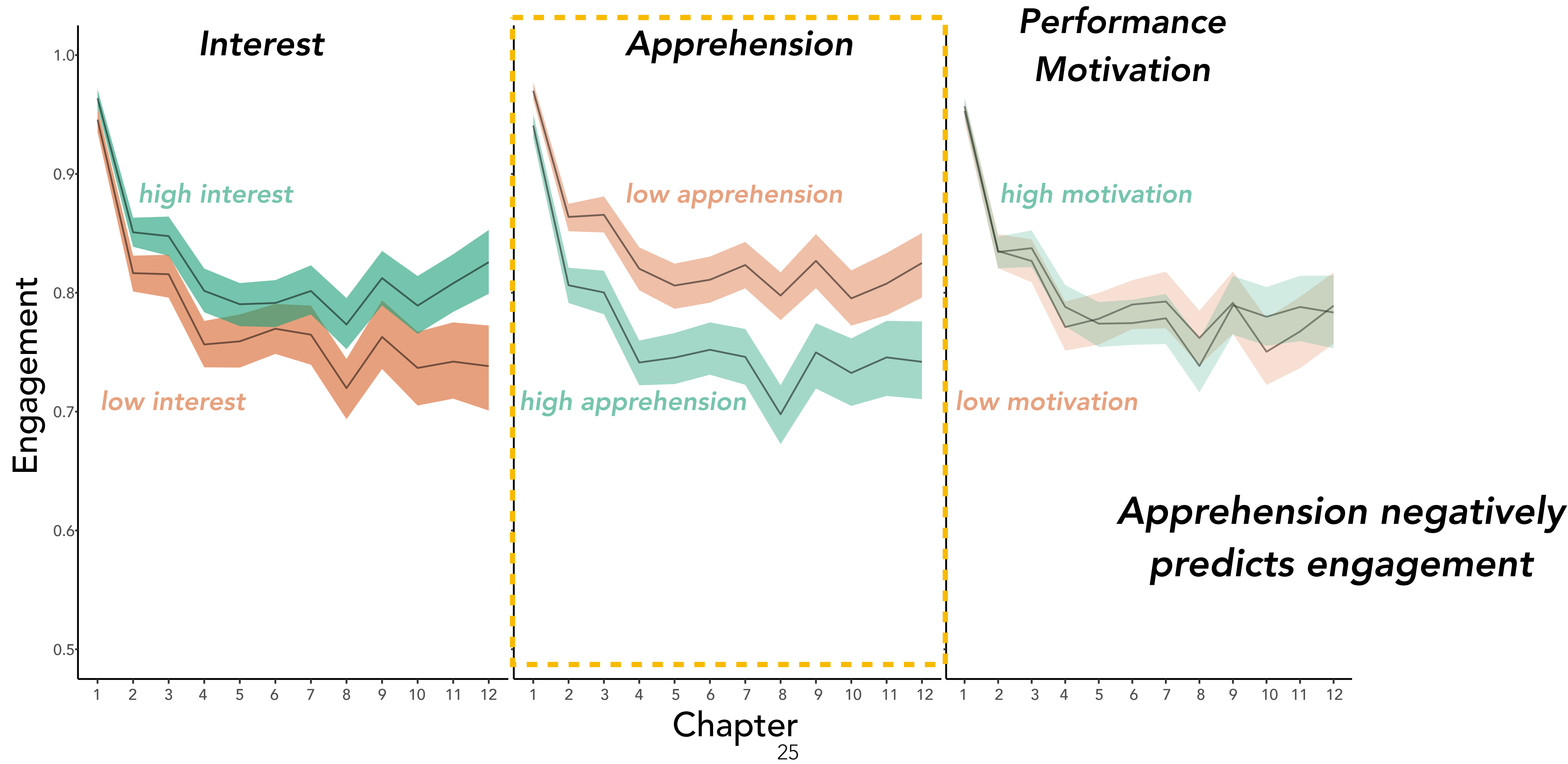
2 How well do student **attitudes** & **learning outcomes** predict **engagement**?

2

How well do student **attitudes** & **learning outcomes** predict **engagement**?



A closer look on how **attitudes** predict student **engagement**:



1

How well do student **attitudes** & **engagement** predict **learning**?

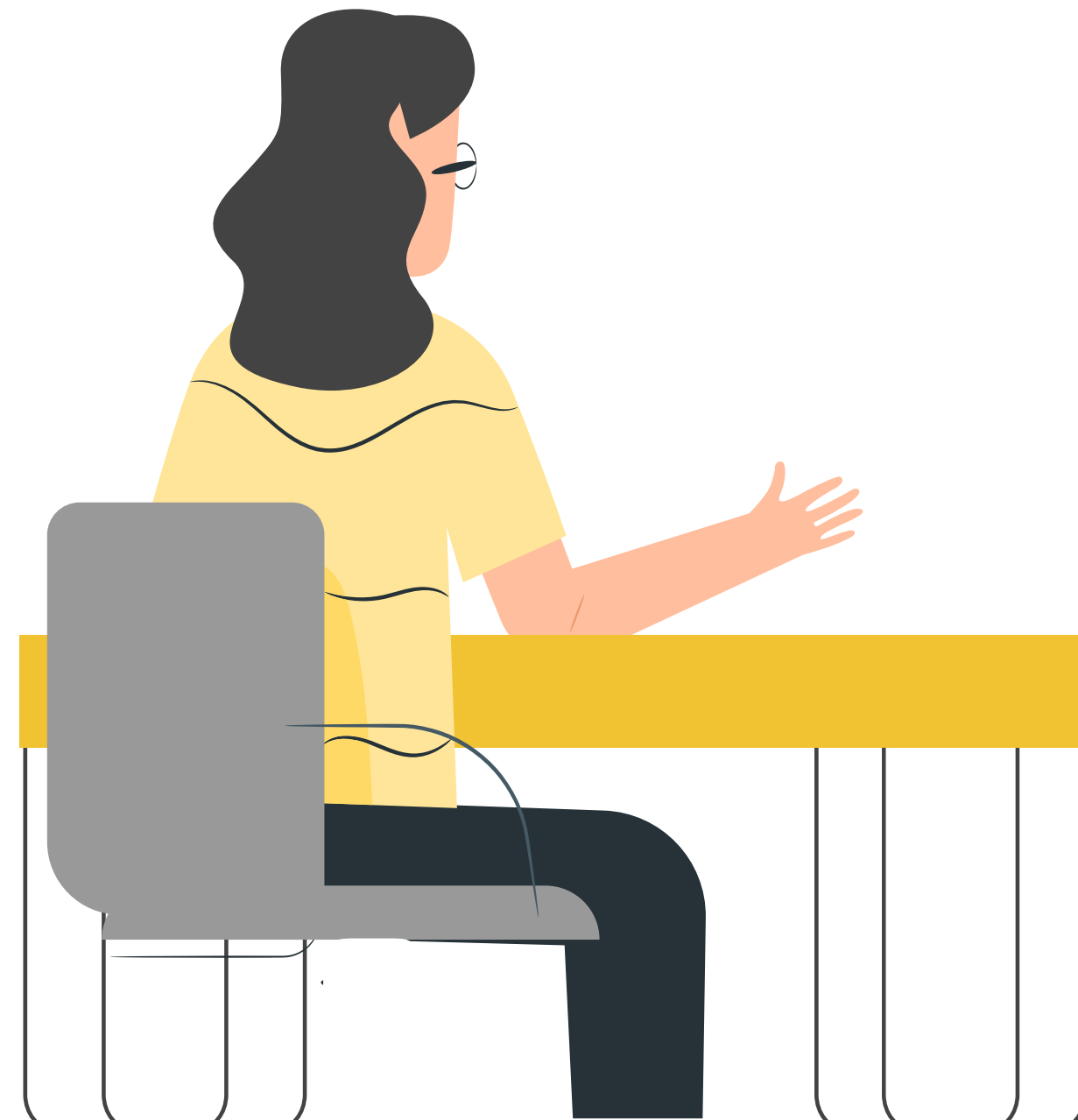
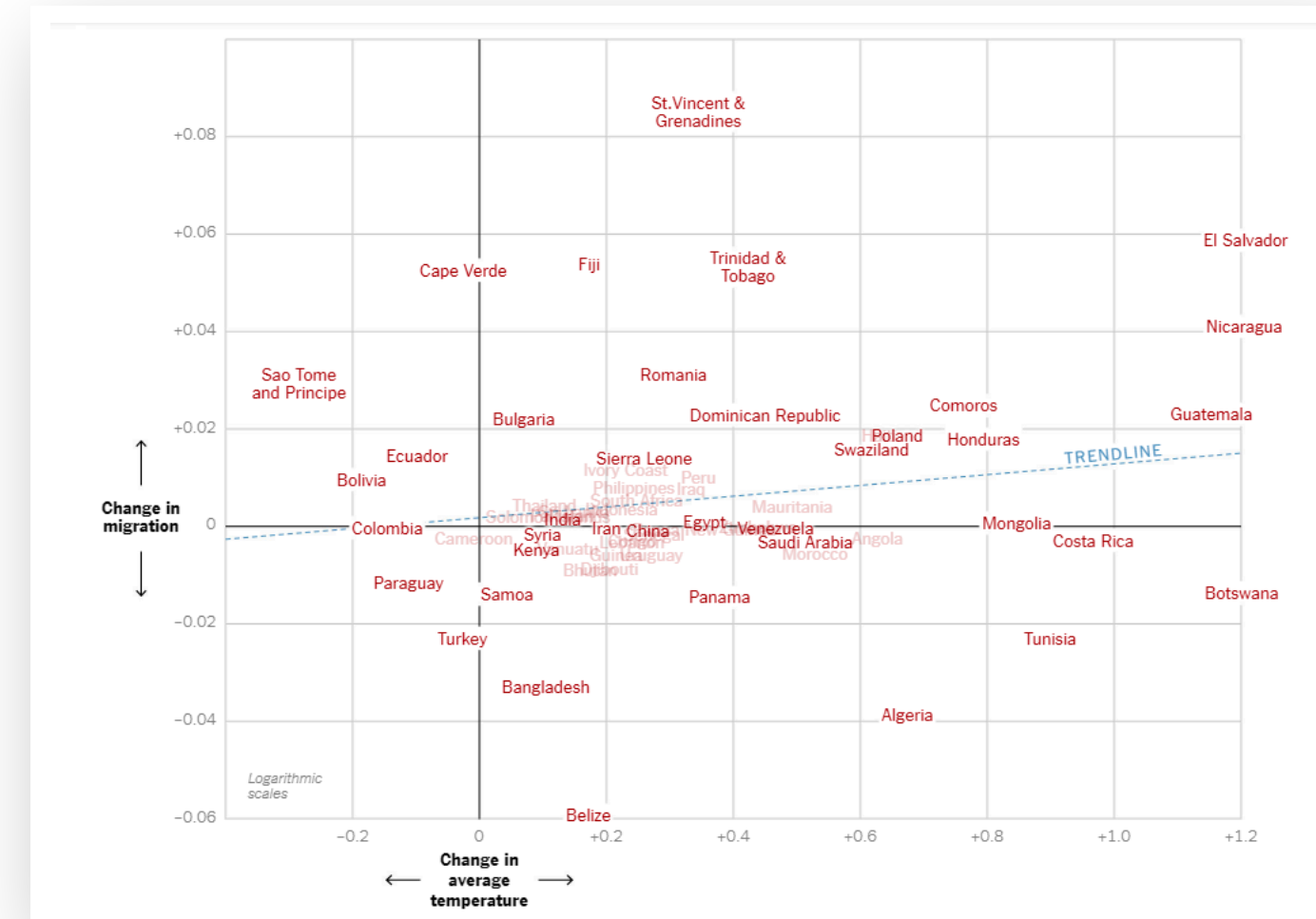
The attitudes, expectations, and motivation that students bring to the course have an impact on how they engage, and their learning outcomes

2

How well do student **attitudes** & **learning outcomes** predict **engagement**?

Students with greater levels of apprehension towards the material regulate their learning behavior differently.

Towards interventions for equitable learning in data science courses



Fine-grained measures of students attitude and behaviors can be useful indicators for teachers

Thank you! Questions?



Hannah Lloyd



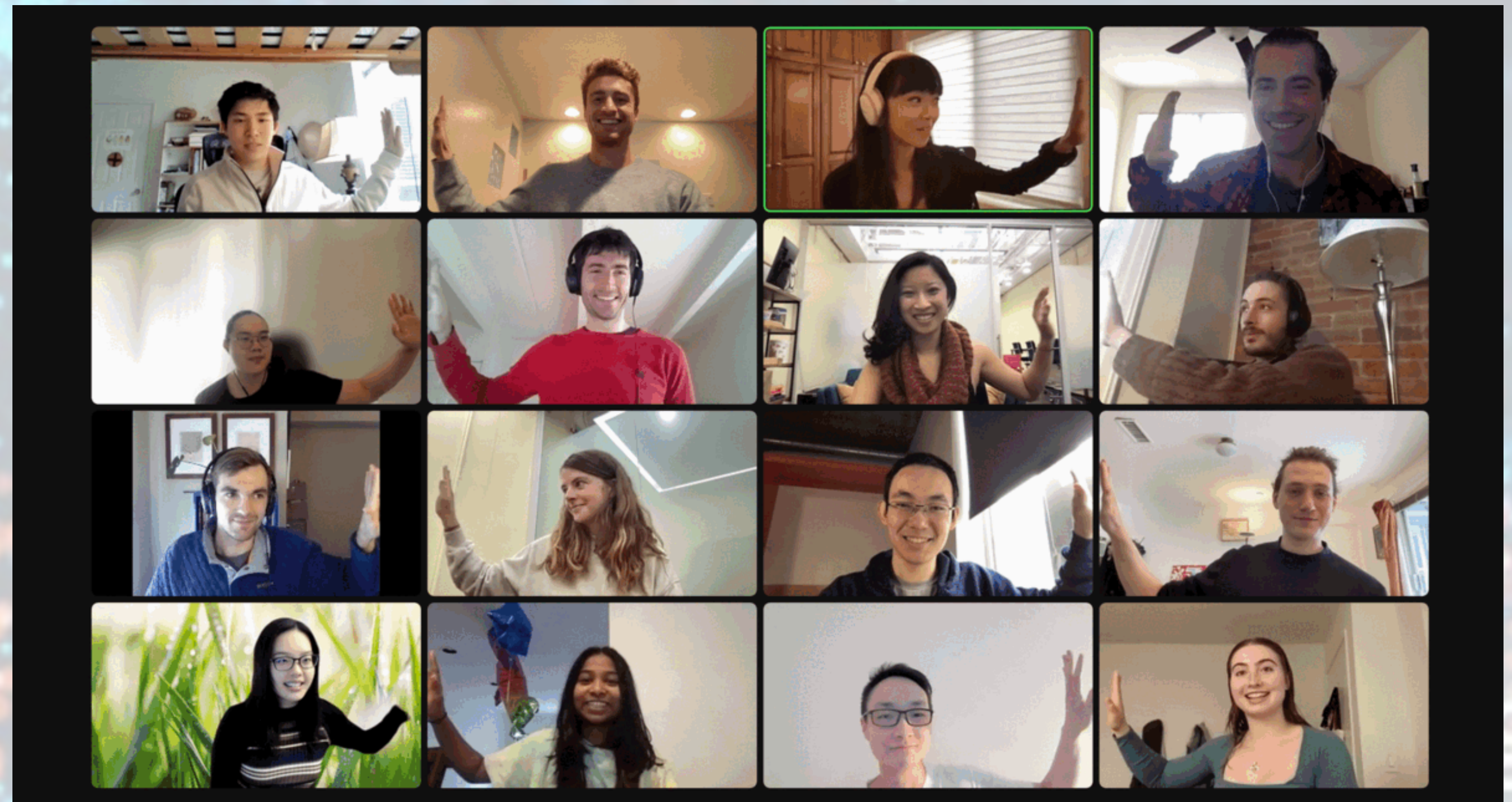
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cognitive tools lab