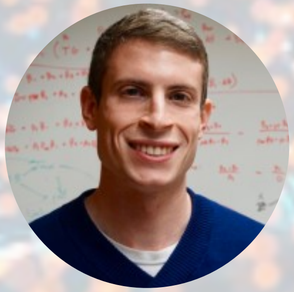
The Links Between Student Attitudes, Engagement, and Learning in Introductory Data Science Courses

November 2nd, 2023

Hannah Lloyd

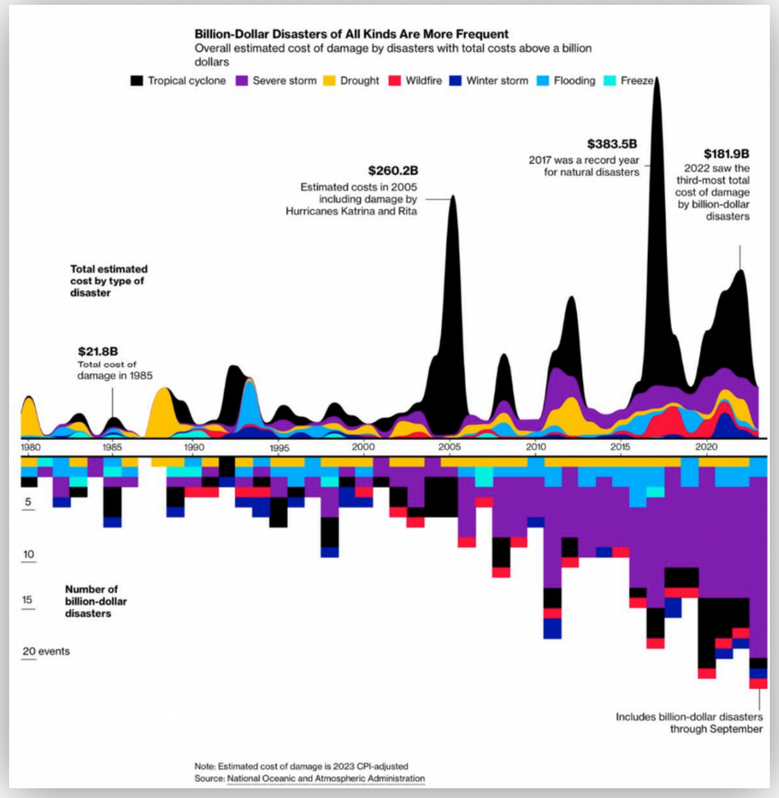
Erik Brockbank



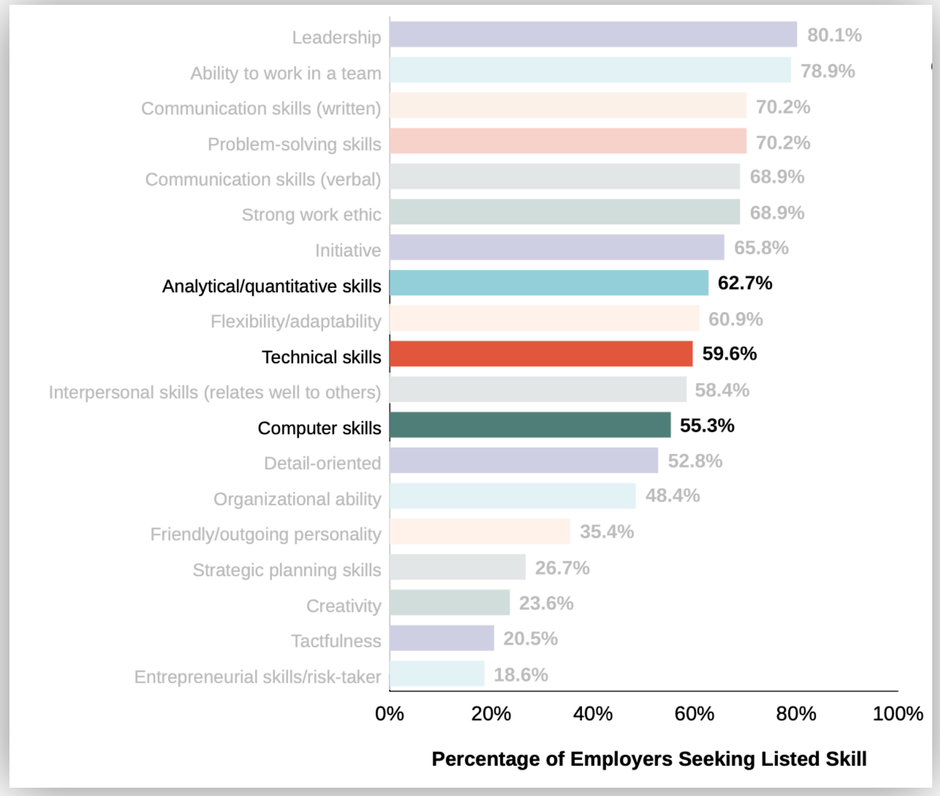
Adam Bear

Judy Fan

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



New York Times

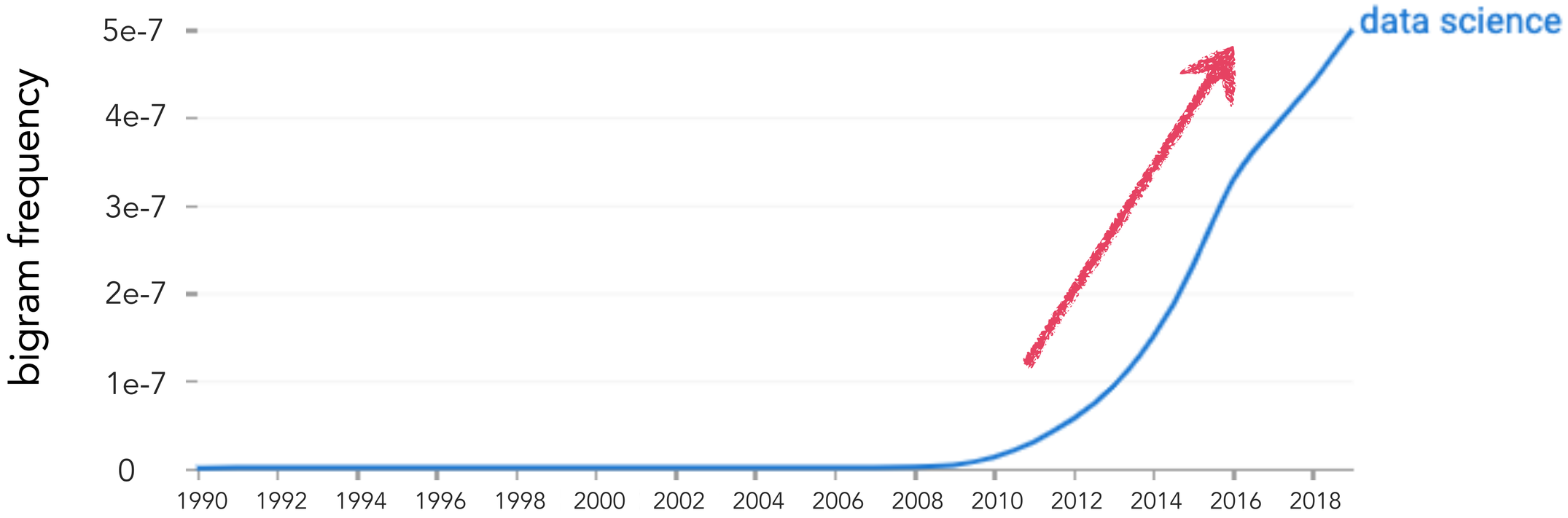


National Association of Colleges and Employers (NACE) Job Outlook 2016 Survey

We **reason** with big data everyday

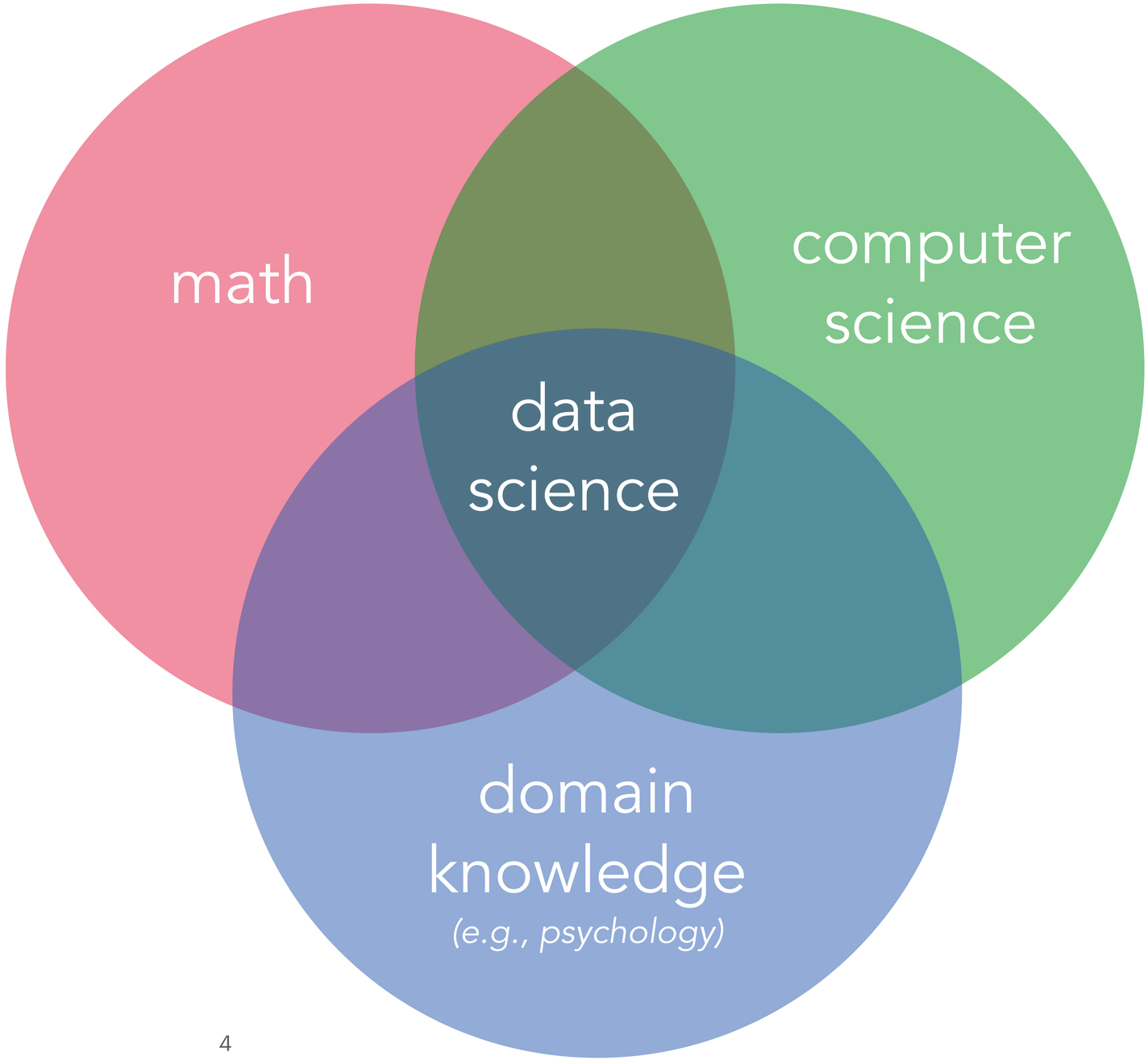
Workforce preparedness

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

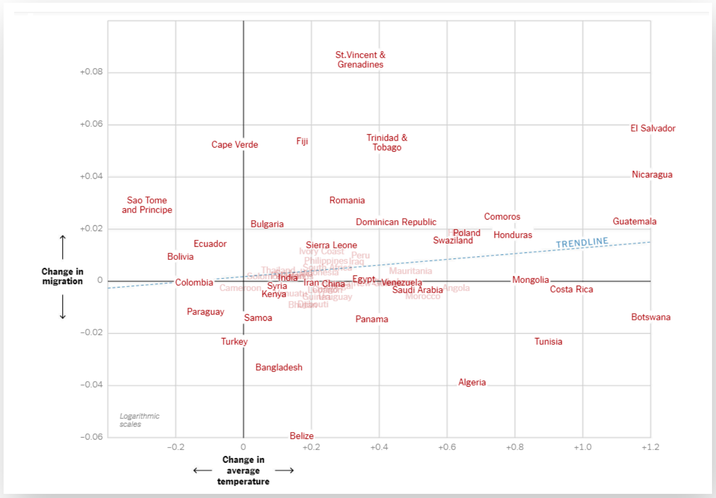


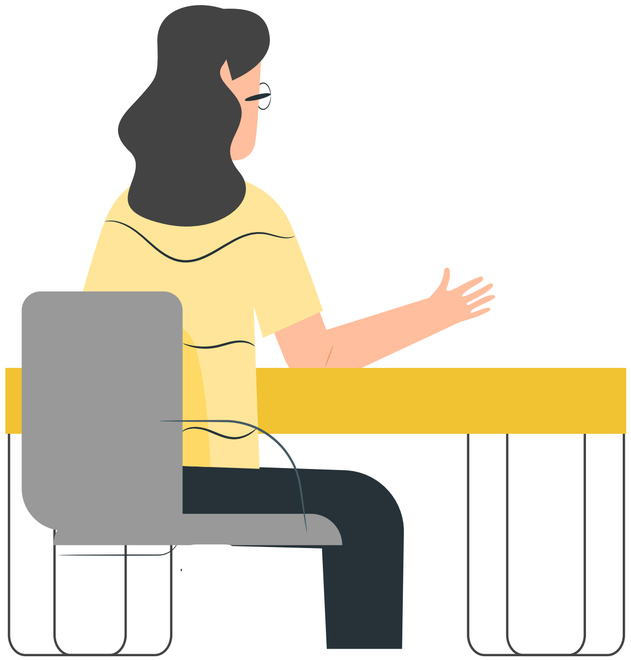
source: Google Books N-gram viewer

Multidisciplinarity of data science poses challenges for pedagogy

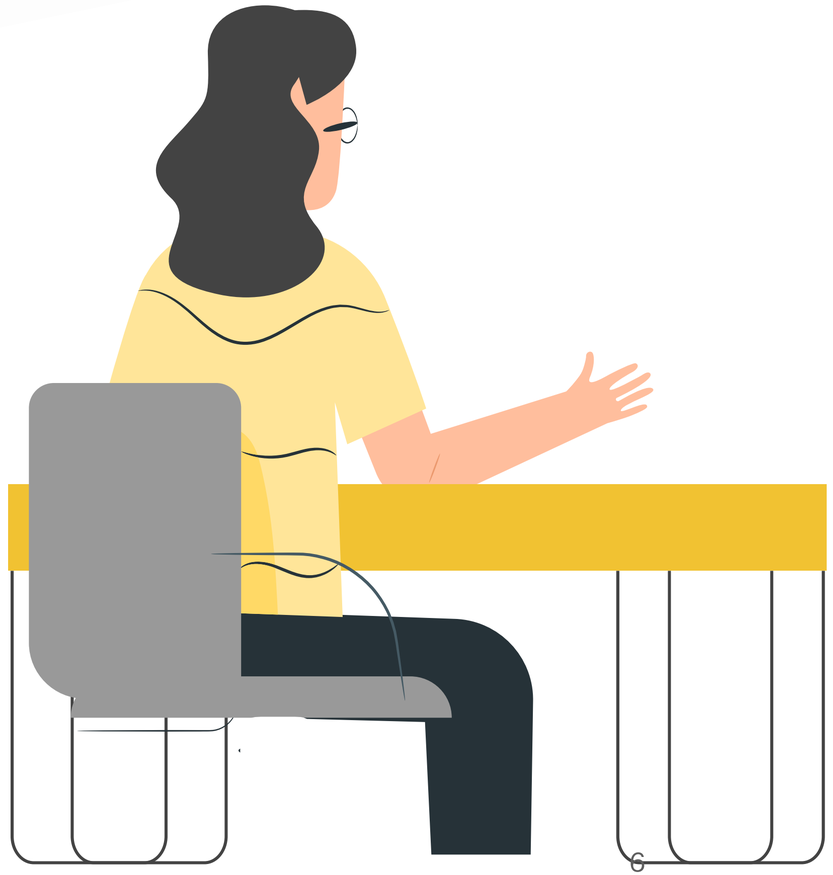


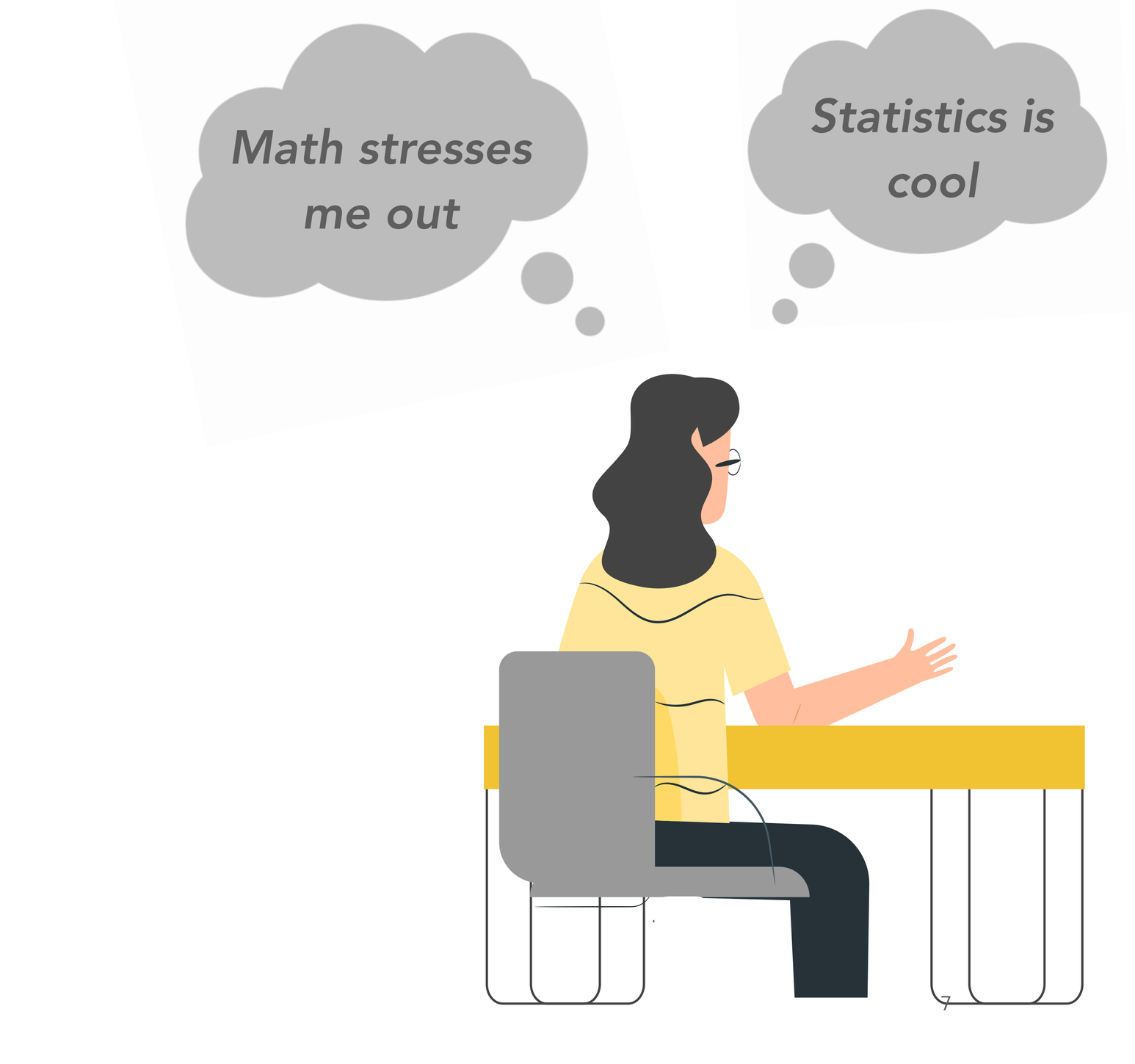
What predicts learning in data science courses?



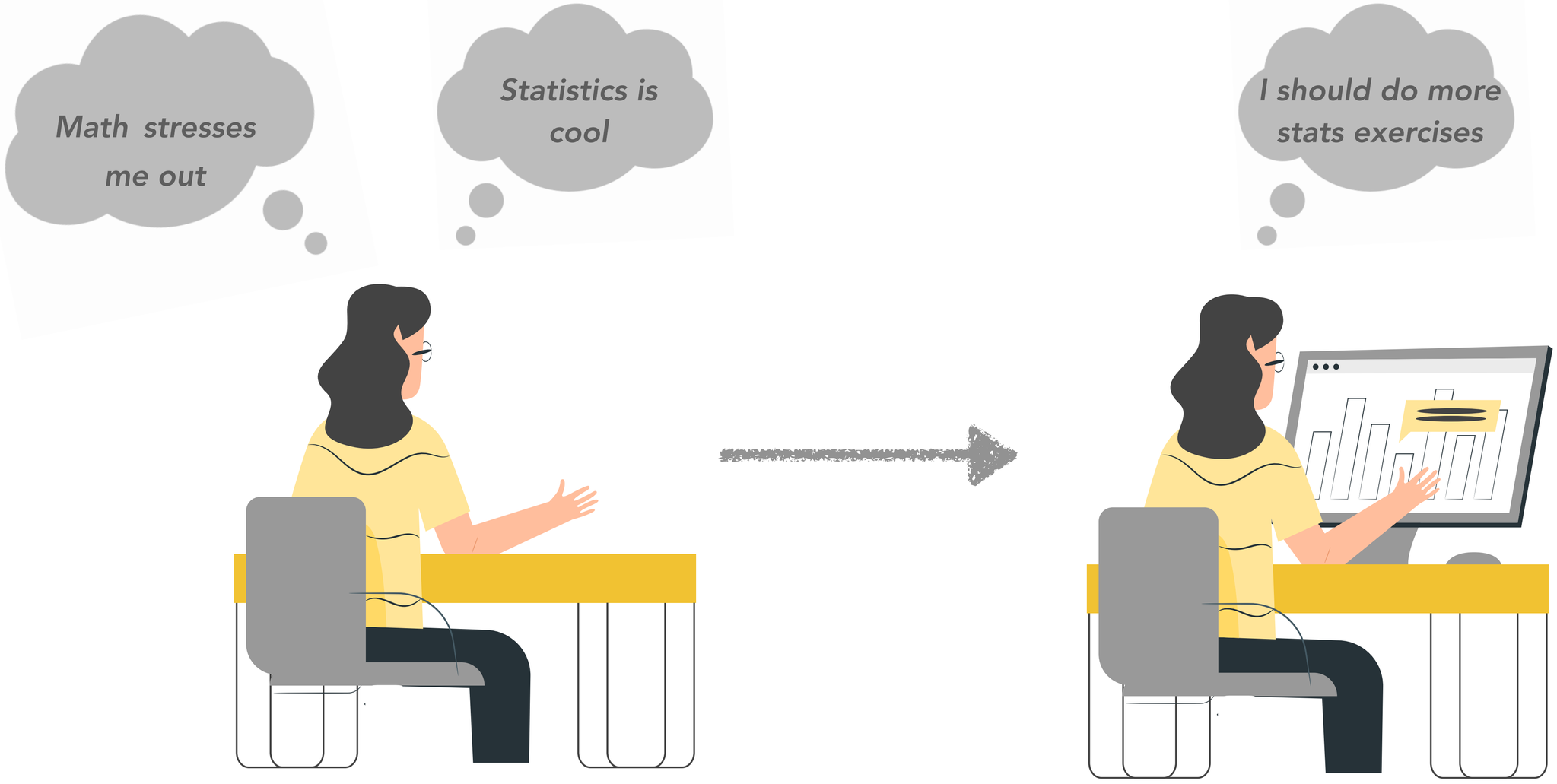


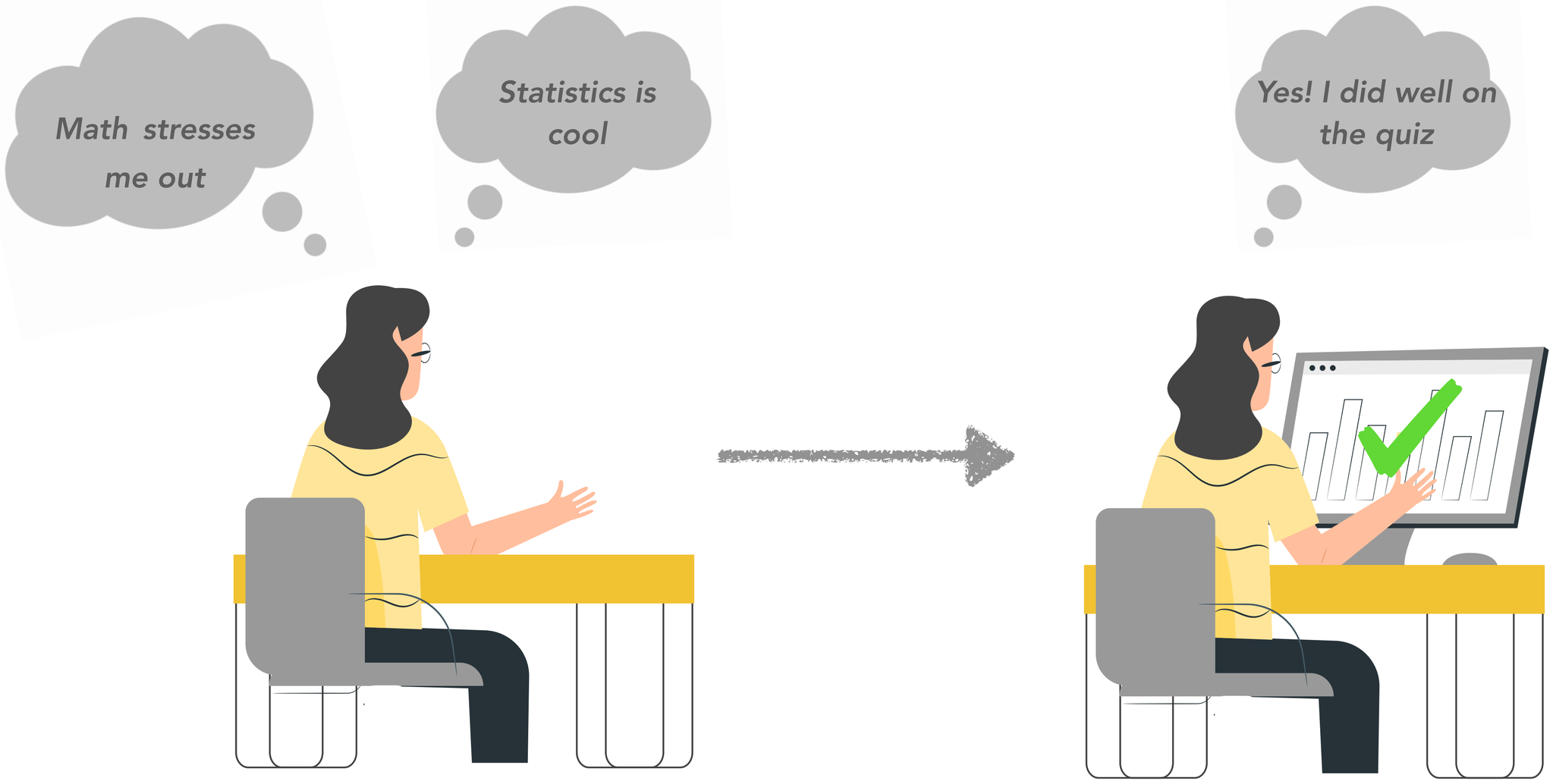
Math stresses me out




Math stresses me out
Statistics is cool

Samoa
Panama
Turkey
Tunisia
Bangladesh
Algeria
Logarithmic scales
Belize
-0.02
-0.04
-0.06
-0.2
0
+0.2
+0.4
+0.6
+0.8
+1.0
Change in average temperature


Math stresses me out
Statistics is cool
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.

Stigler, Son, Givvin, et al. (2020)

CourseKata

high school

community college

4-year college

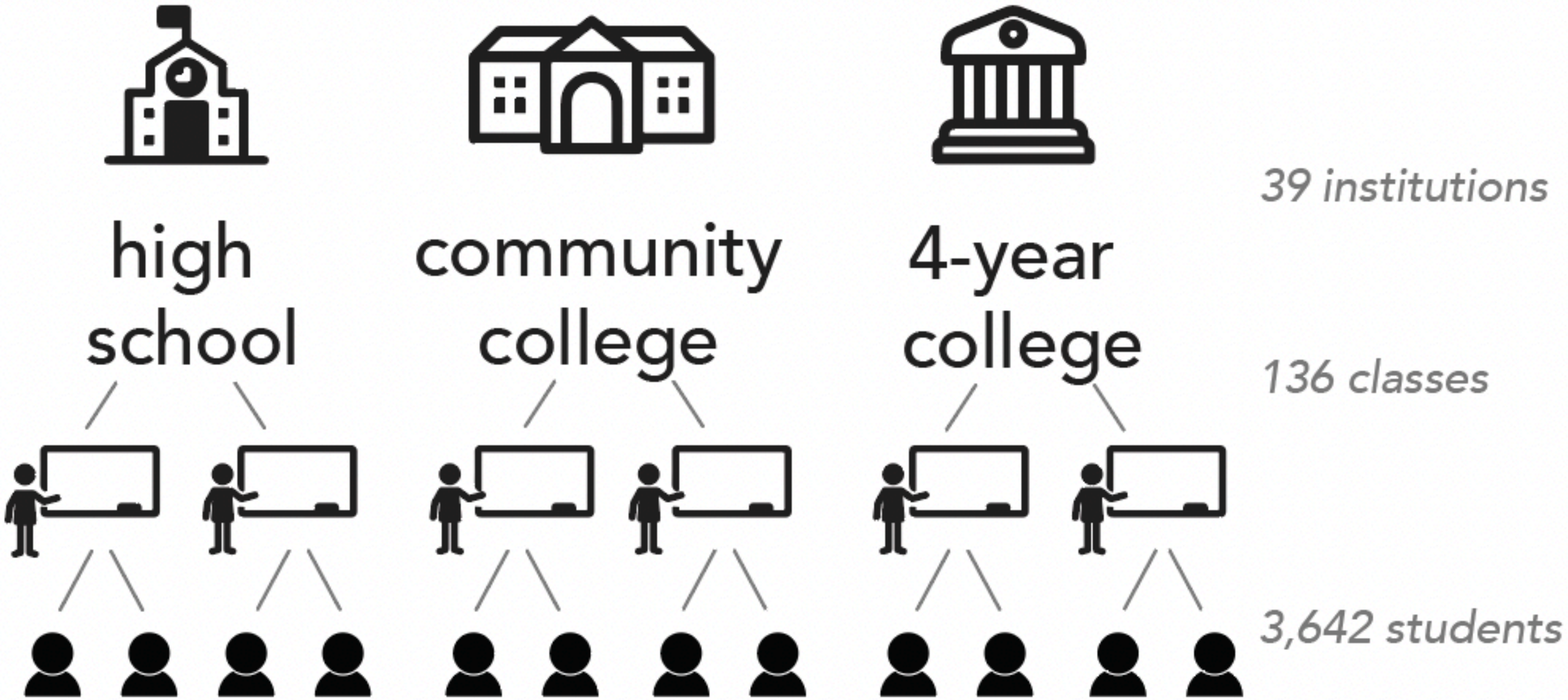
39 institutions

CourseKata

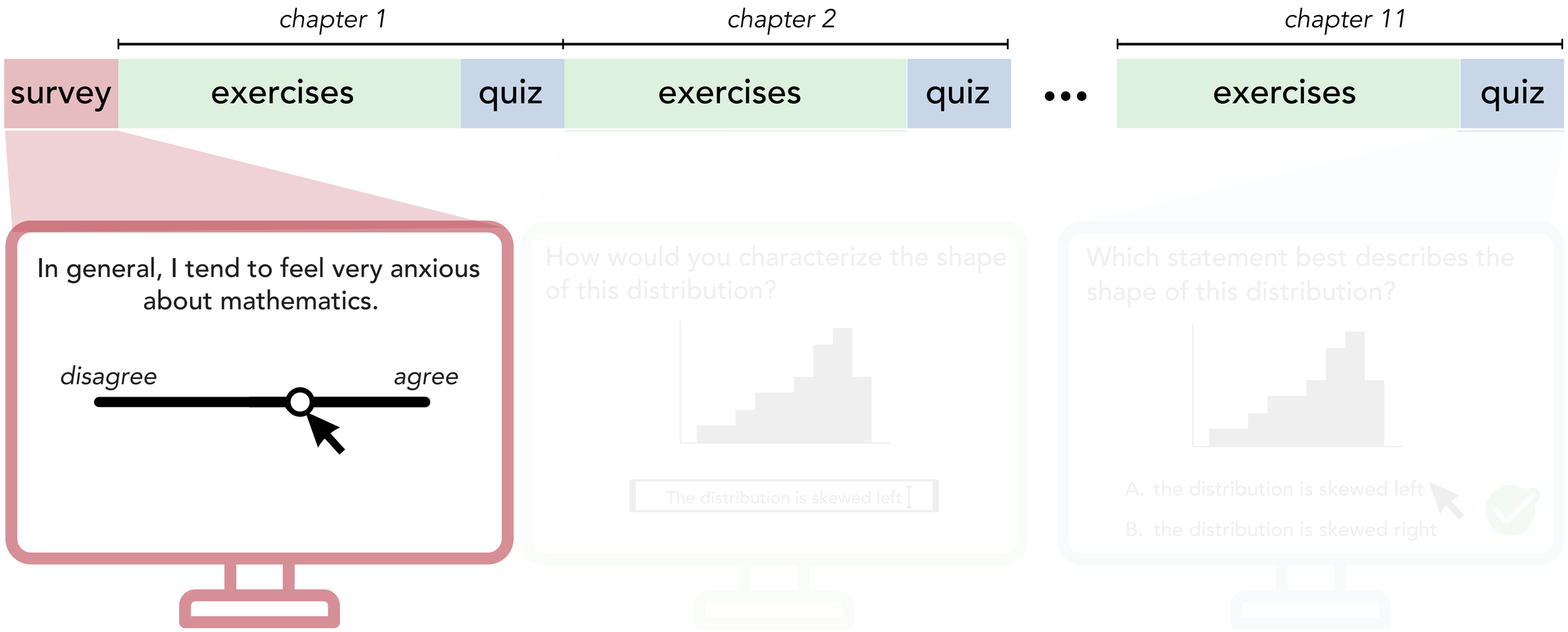
39 institutions

136 classes

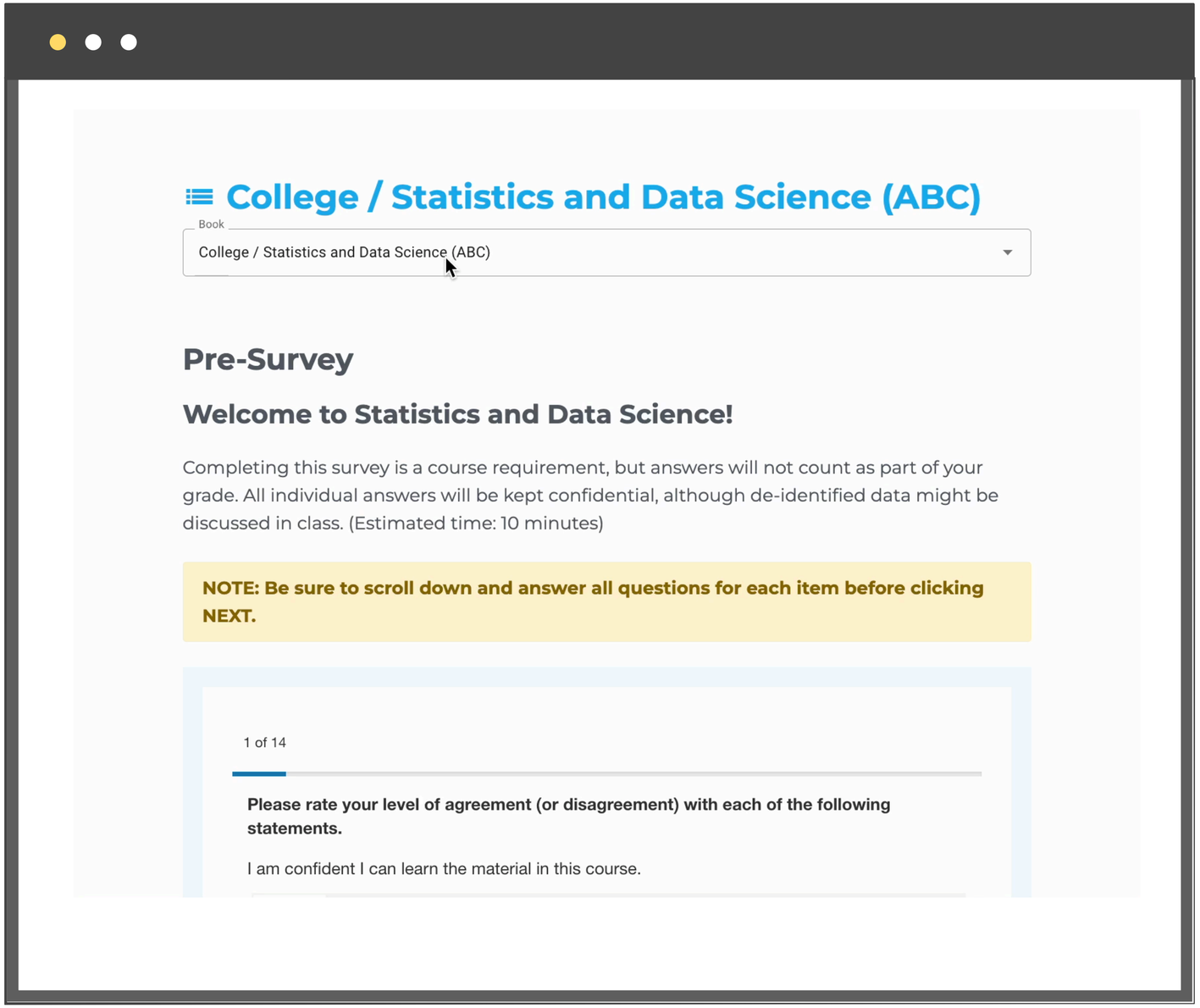
CourseKata


high school
community college
4-year college
39 institutions
136 classes
3,642 students

Measuring student attitudes & behavior using CourseKata



Embedded surveys to measure student background & interests



Survey administered 4x throughout the book

Broad set of constructs:

math anxiety

level of interest

mindset *(fixed vs. growth)*

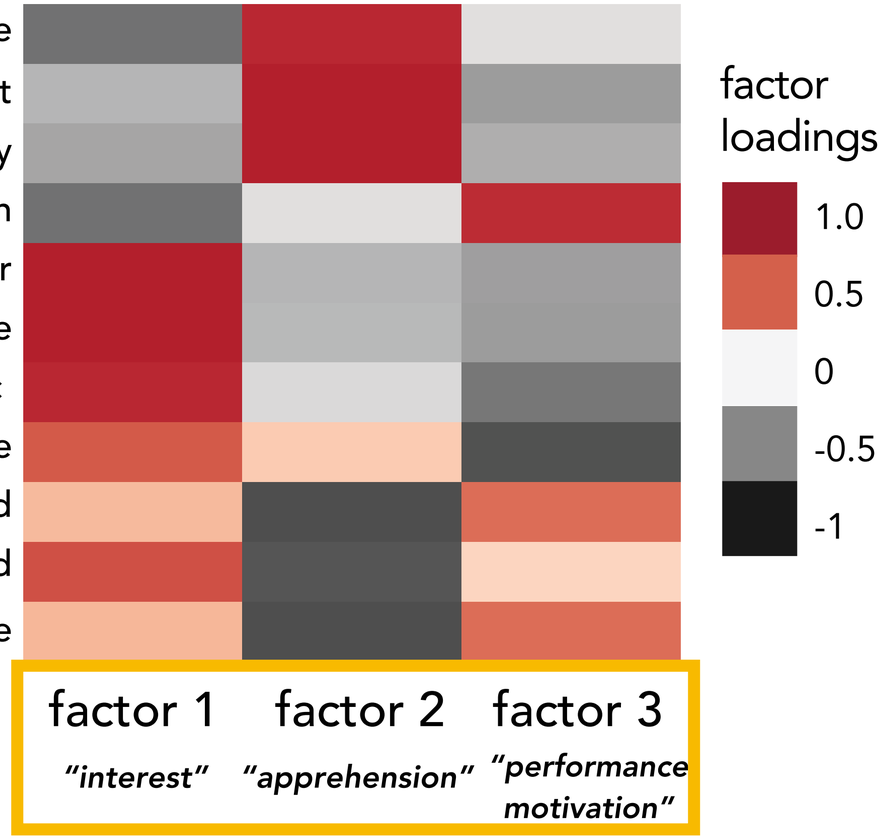
confidence *(e.g., w/ programming)*

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

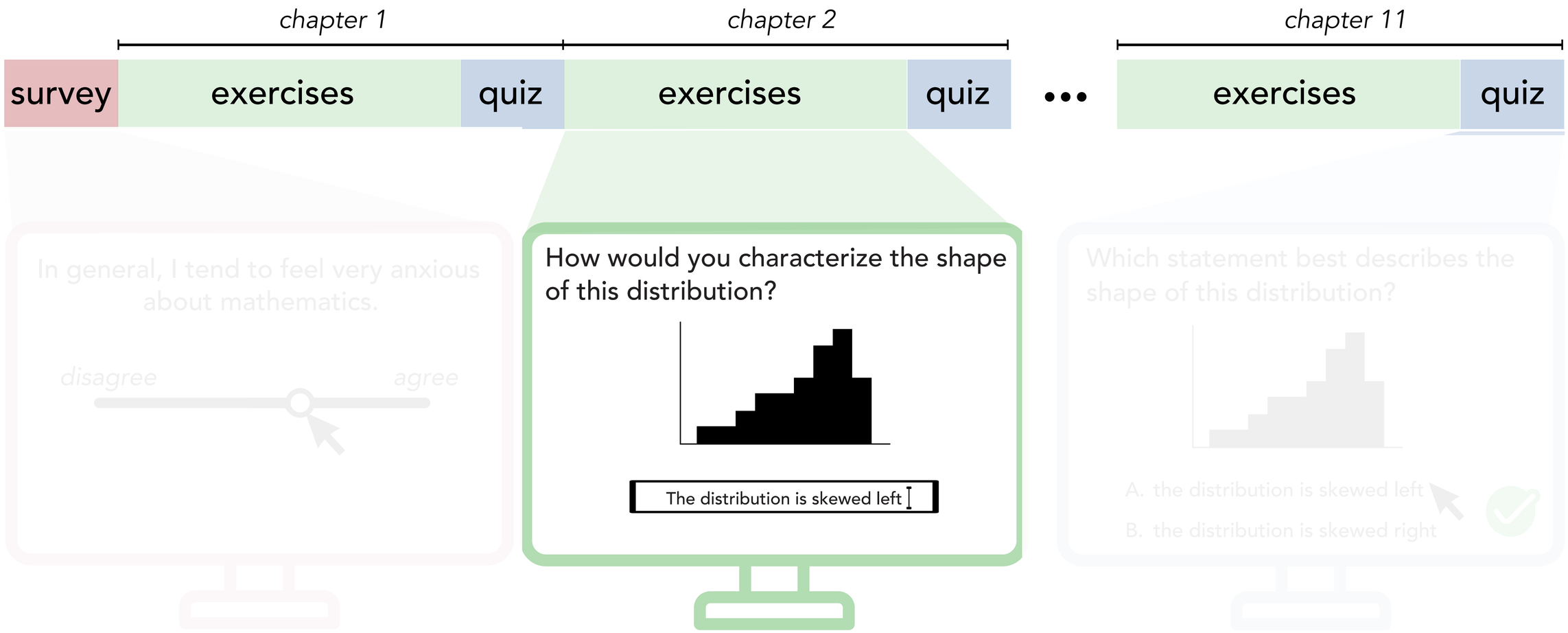
& many more!

Principal Components Analysis for Survey Dimensionality Reduction

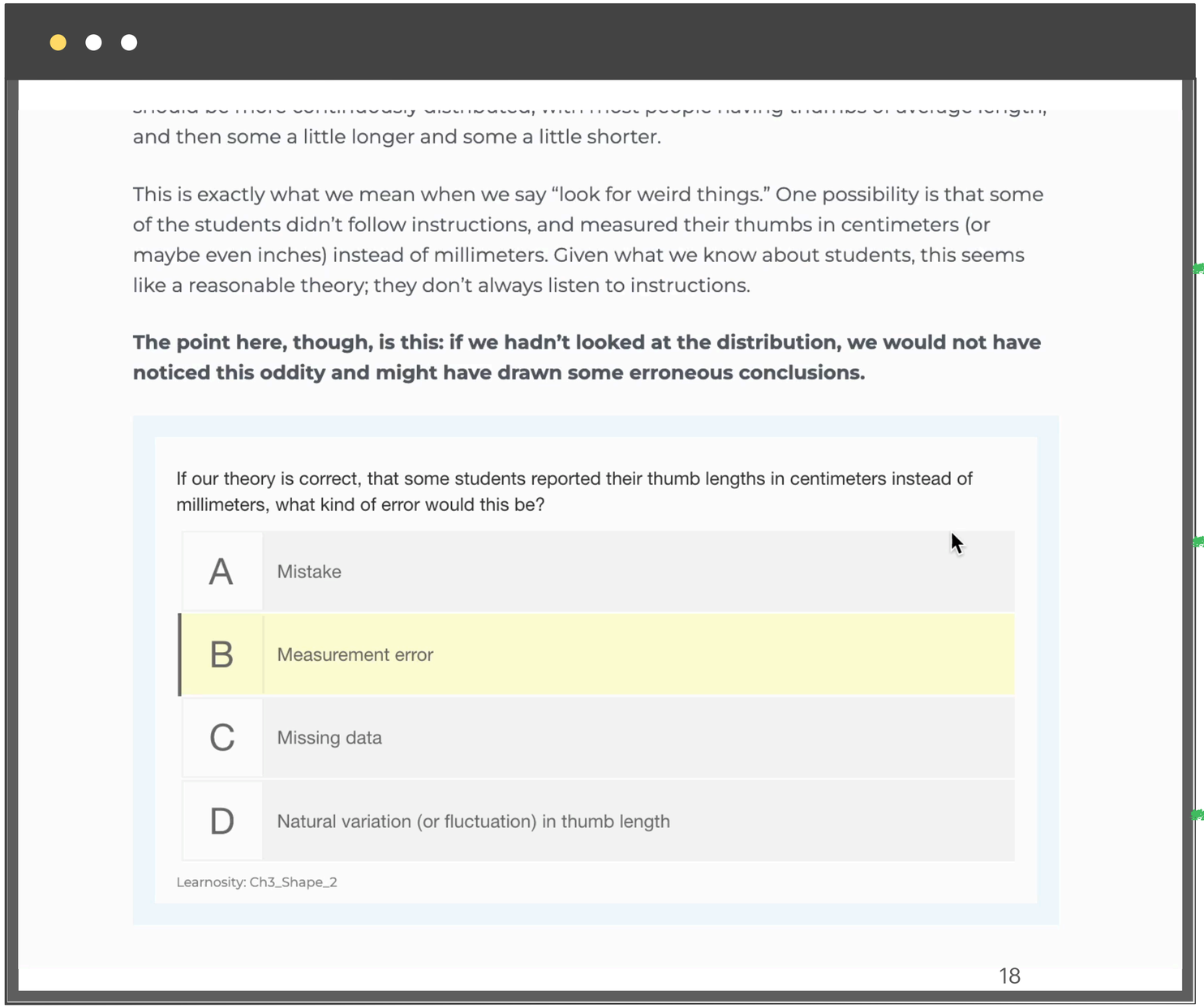
example survey item	target construct
*I will have to **give up a lot to do well** in this class.*	expected level of sacrifice
*My **math ability** is something about me that I **can't change**.*	fixed mindset
*In general, I tend to feel very **anxious about math**.*	math anxiety
*I expect this course will require a lot of **memorization**.*	memorization
*My grades in this **class will improve my career**.*	impact on career
*I think this **class will be interesting**.*	interest in course
*I think **statistics and data science are interesting**.*	interest in topic
*Have you had **experience with computer programming** before?*	programming experience
***Performing well in this class is important** to me.*	motivation to succeed
*I **expect to do well** in this class.*	expectation to succeed
*How **well have you done in mathematics courses** ... in the past?*	prior math performance



Measuring student attitudes & behavior using CourseKata



Learning activities interleaved with new material

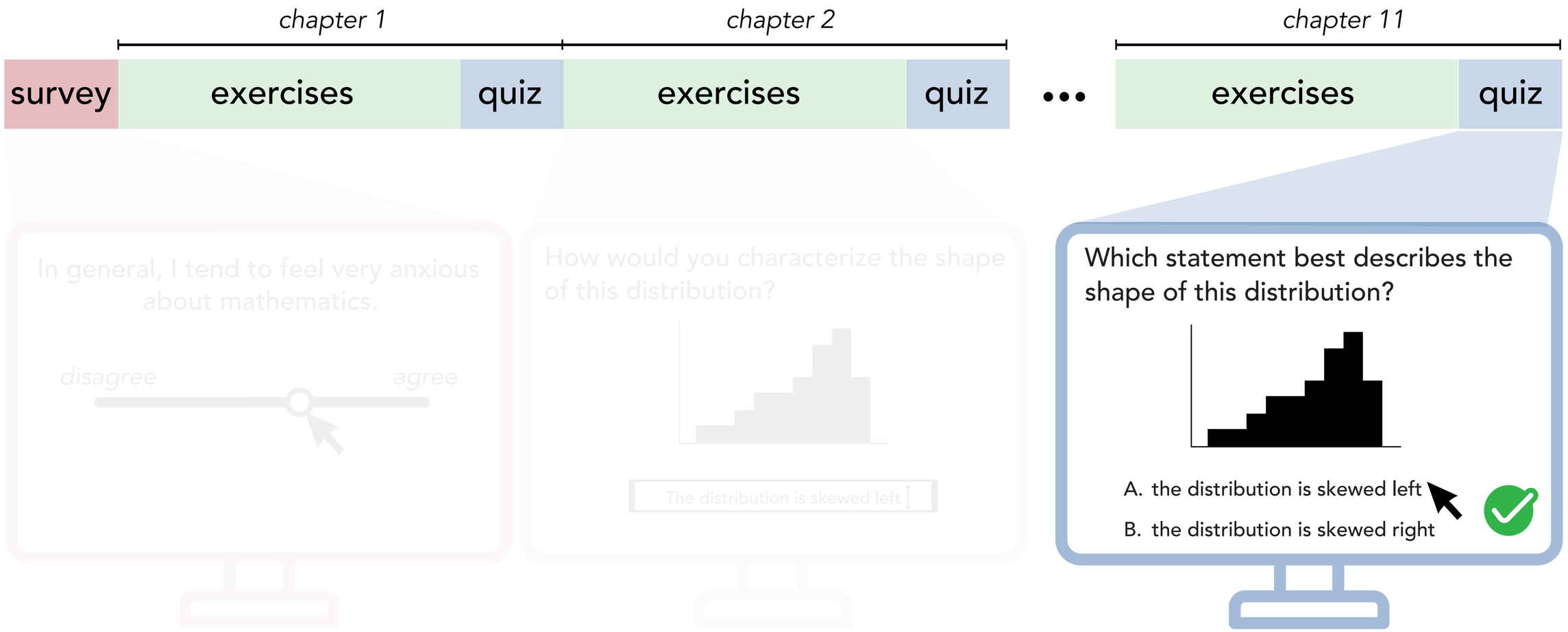


Conceptual questions

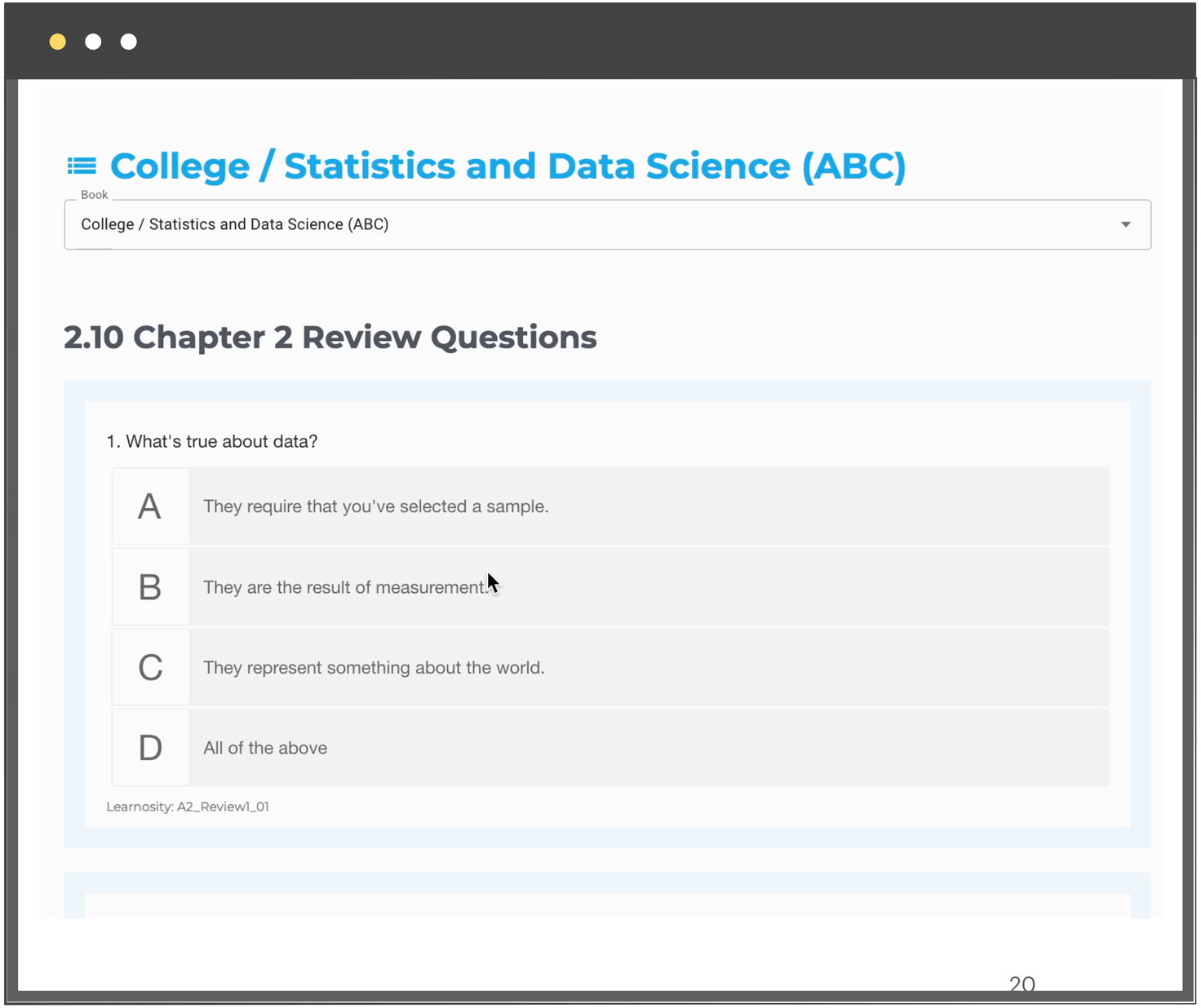
Coding exercises

Open-ended responses

Measuring student attitudes & behavior using CourseKata



Interspersed assessments to test comprehension & generalization

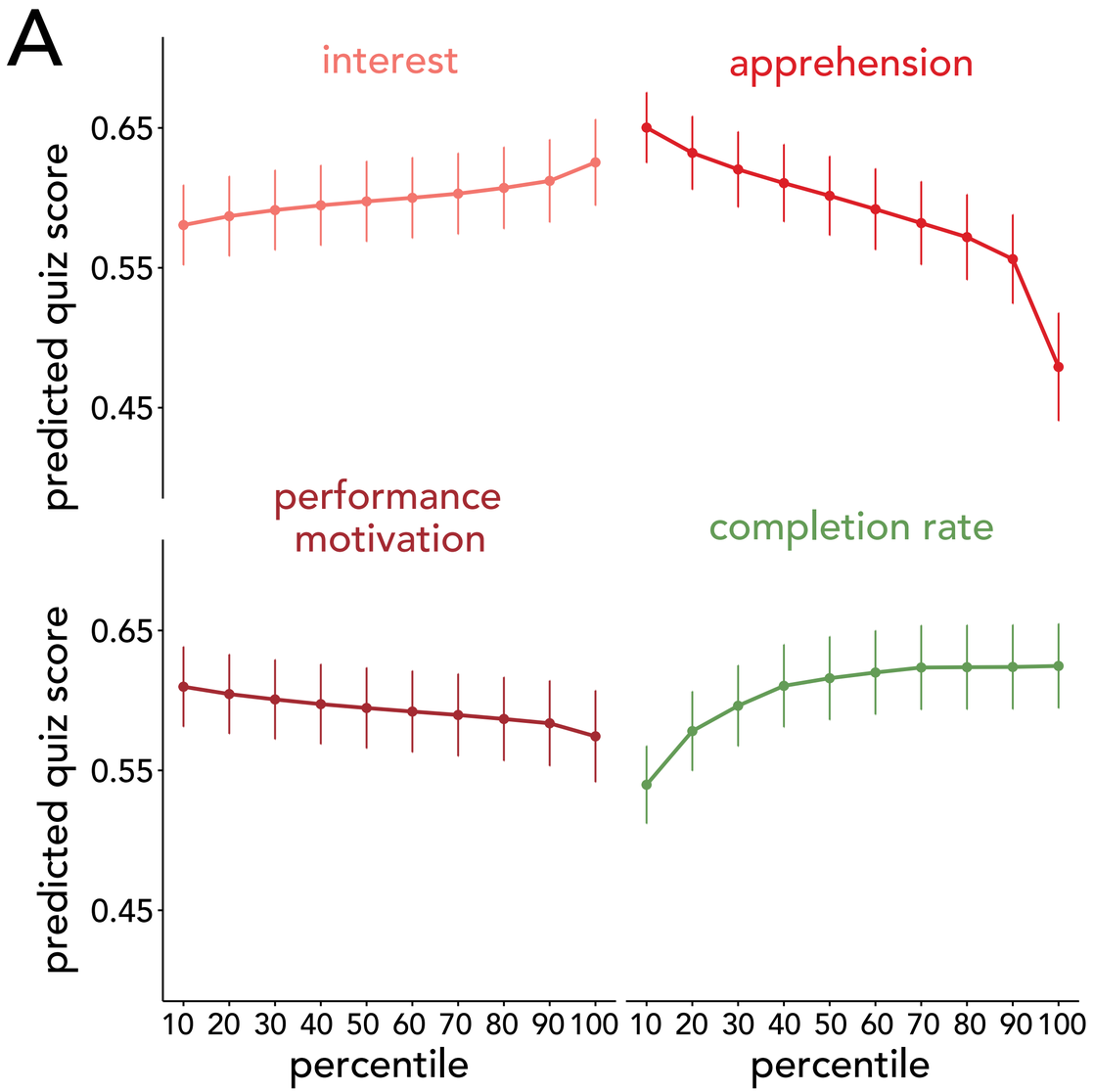


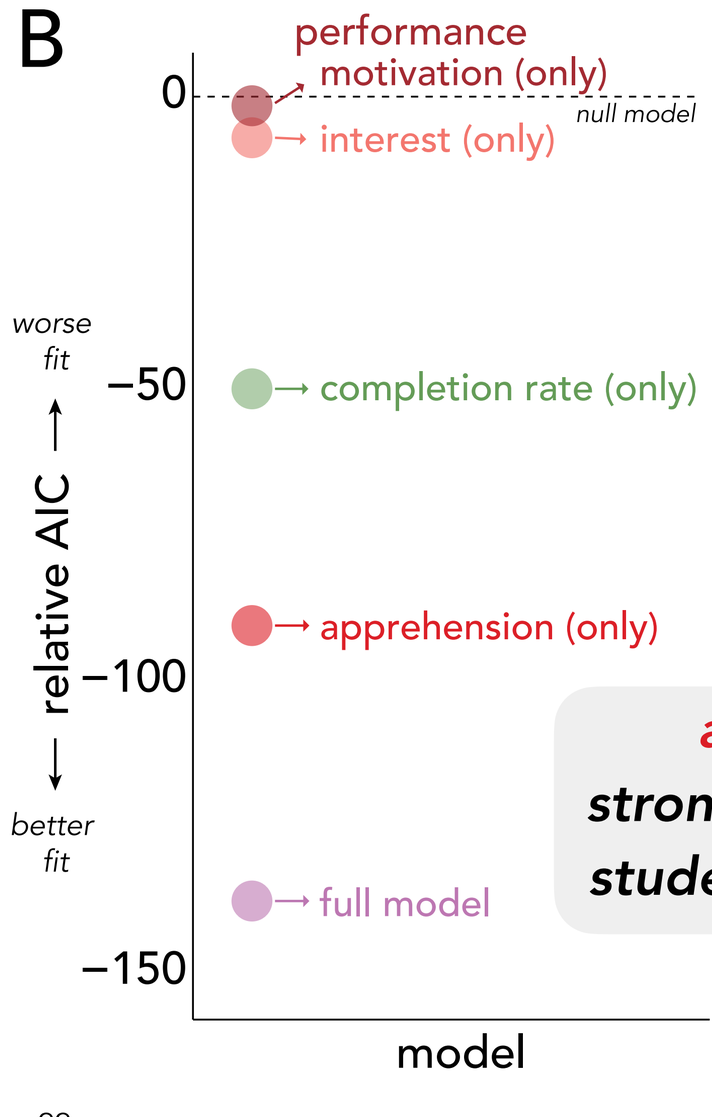
Conceptual questions appearing at the end of every chapter

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?





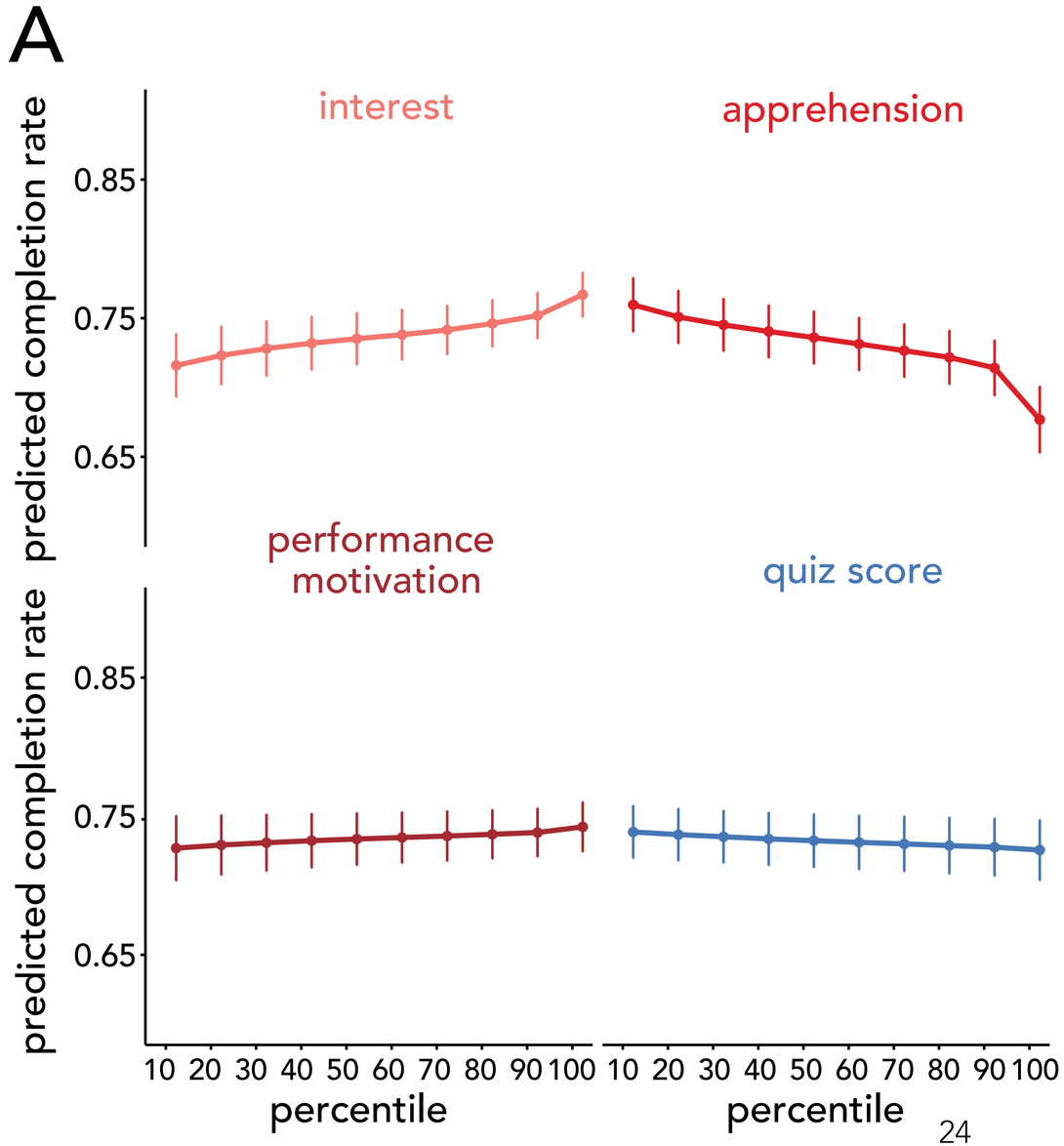
***apprehension** is the strongest single predictor of students' learning outcomes*

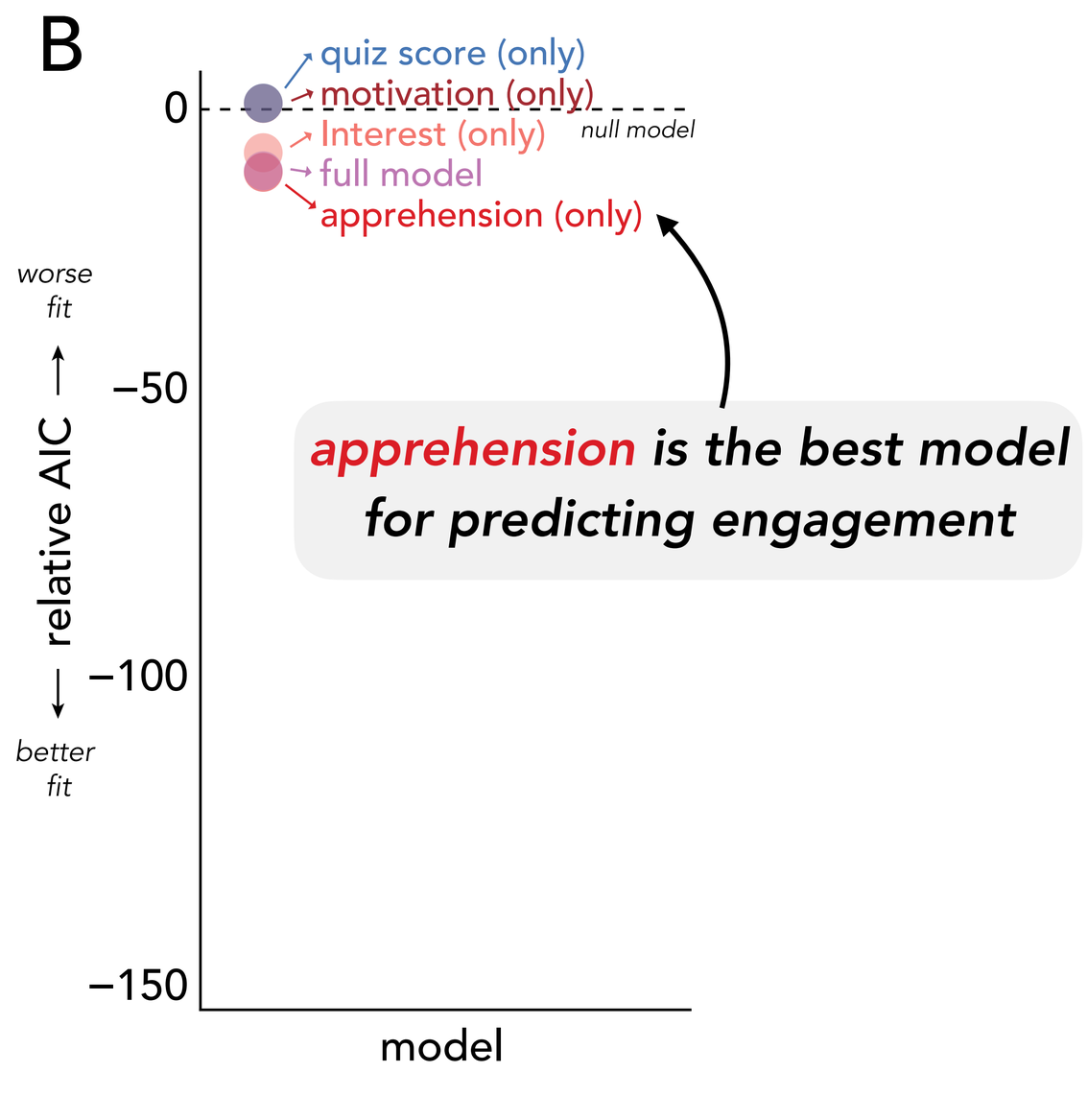
1 How well do student attitudes & engagement predict learning?

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

2

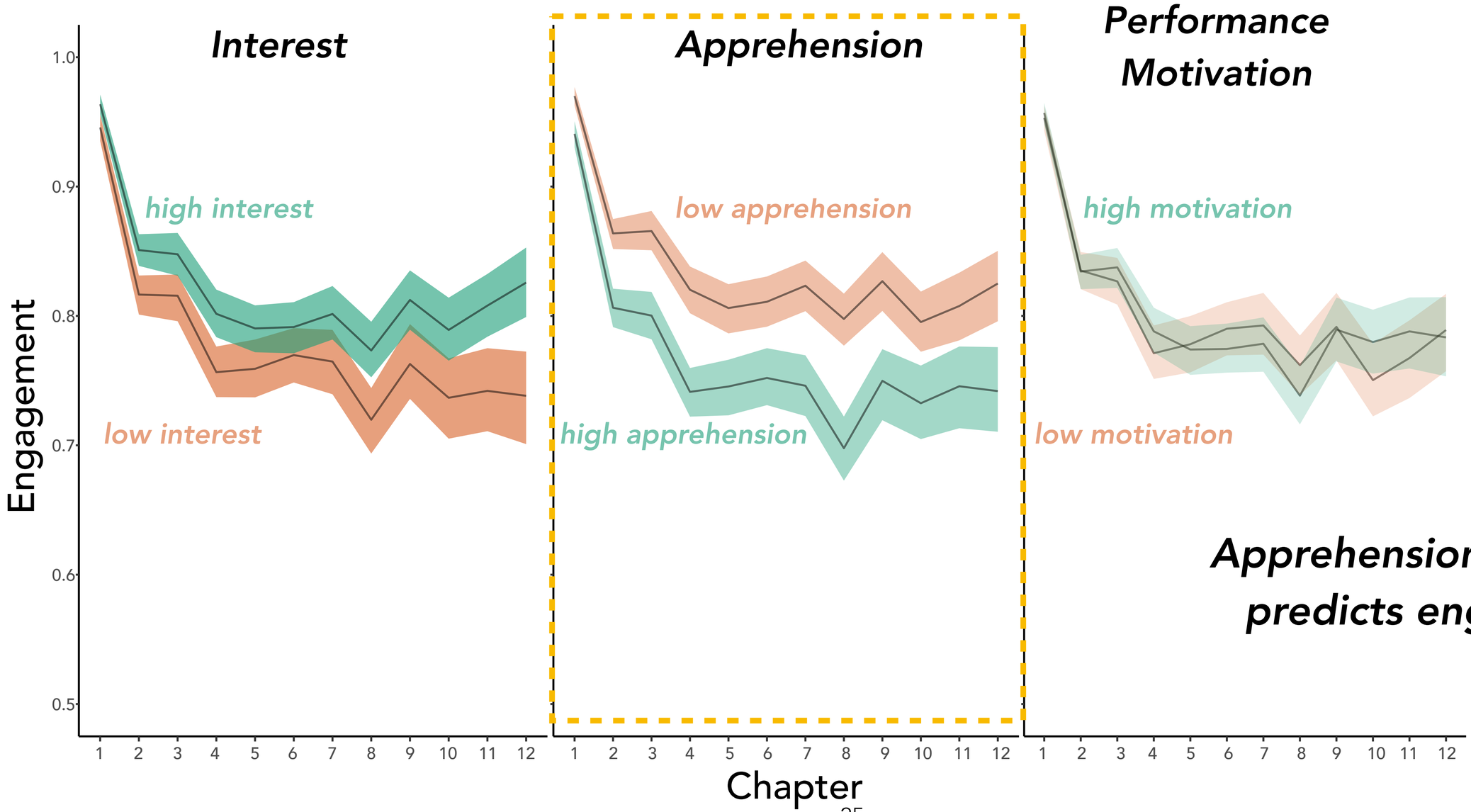
How well do student attitudes & learning outcomes predict engagement?





***apprehension* is the best model for predicting engagement**

A closer look on how attitudes predict student engagement:



Apprehension negatively predicts engagement

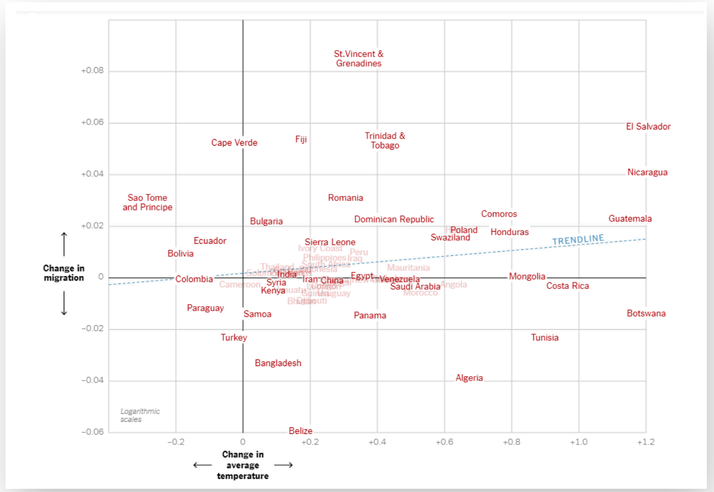
1 **How well do student attitudes & engagement predict learning?**

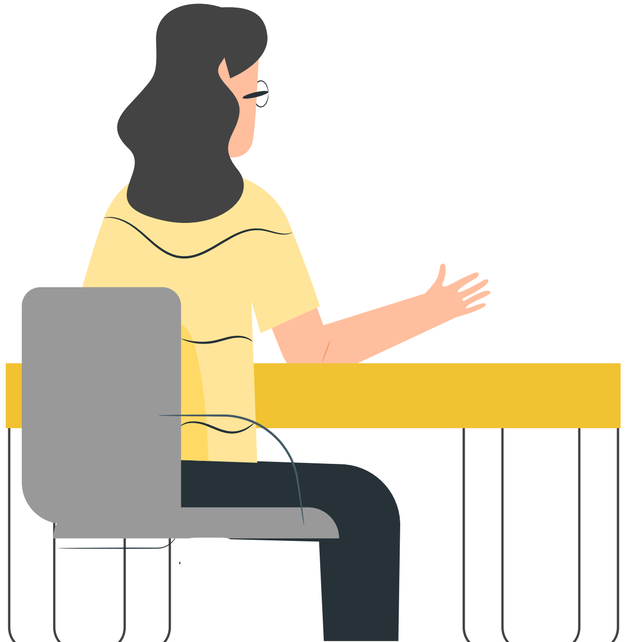
The attitudes, expectations, and motivation that students bring to the course have an impact on how they engage, and their learning outcomes

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