# MAPS – Math Attitudes and Perceptions Survey

Joseph Lo
Sandi Merchant
Warren Code

Carl Wieman Science Education Initiative
Department of Mathematics, UBC

# Abstract

Student perceptions of mathematics play a role in their motivation and approaches to learning in their math courses. We adapted an existing survey for Physics and surveyed students at the beginning and end of a range of first and second year Math courses. This has allowed us to assess student attitudes and perceptions relative to those of experts, and to track how they shift over time. We present our development of the survey and some of the results.

# What is it? Why bother?

- Our Math Attitude and Perception Survey (MAPS) modelled on the C-LASS* for Physics developed at Colorado U.
- Surveys alignment of student attitudes with professional academics in the field.
- More a measure of population, not really of individual students.
- Good at finding low scores and shifts over time.

*C-LASS: Colorado Learning Attitudes about Science Survey

# Development


- Develop Initial Survey Items
  - What items do experts care about and reflect novice or expert attitudes to learning math?
- Field Test: Collect Student Responses
- Categories
  - Factor analysis: What questions make sense as a group?
- Validate
  - Are students interpreting the questions consistently?
- Collect Expert Responses
  - Determine “expert response” and ensure experts agree.

# New work in 2012 – 2013

- Student and expert validations
- New version
  - Removed/reworded statements with ambiguous expert and novice responses
  - Added statements to expand certain categories
- Robustness calculations and category refinements
- New data collected and analyzed

# Validation examples

"Knowledge in math consists of many disconnected topics"

- removed because there was no expert consensus.

"People who can do quick mental calculations are good at math"

- removed because students who said it was "necessary but not sufficient to be able to do quick mental calculations" answered all of agree, disagree and neutral.

# Categorization

- Explore possible categories with factor analysis
  - Which groups of questions are usually answered in the same direction but independently from the other questions/blocks? (Move beyond pair-wise correlation)
- Optimize categories by adding/removing statements
  - Do the statements in a group describe a theme that is different from other statements?
- Confirm categories with further factor analysis

- Interest
  - I only learn math when it is required. (Q.41)
- Confidence/Anxiety
  - No matter how much I prepare, I am still not confident when taking math tests. (Q.22)
- Connections to the world
  - I study math to learn things that will be useful in my life outside of school. (Q.7)
- Persistence in problem solving
  - I can usually figure out a way to solve math problems. (Q.25)

- Sense making
  - I am satisfied if I can do the exercises for a math topic, even if I don't understand how everything works. (Q.4)
- Formulas
  - All I need to solve a math problem is to have the necessary formulas. (Q.36)
- Nature of mathematics
  - There is usually only one correct approach to solve a math problem. (Q.3)

# Scoring – how much students agree with experts

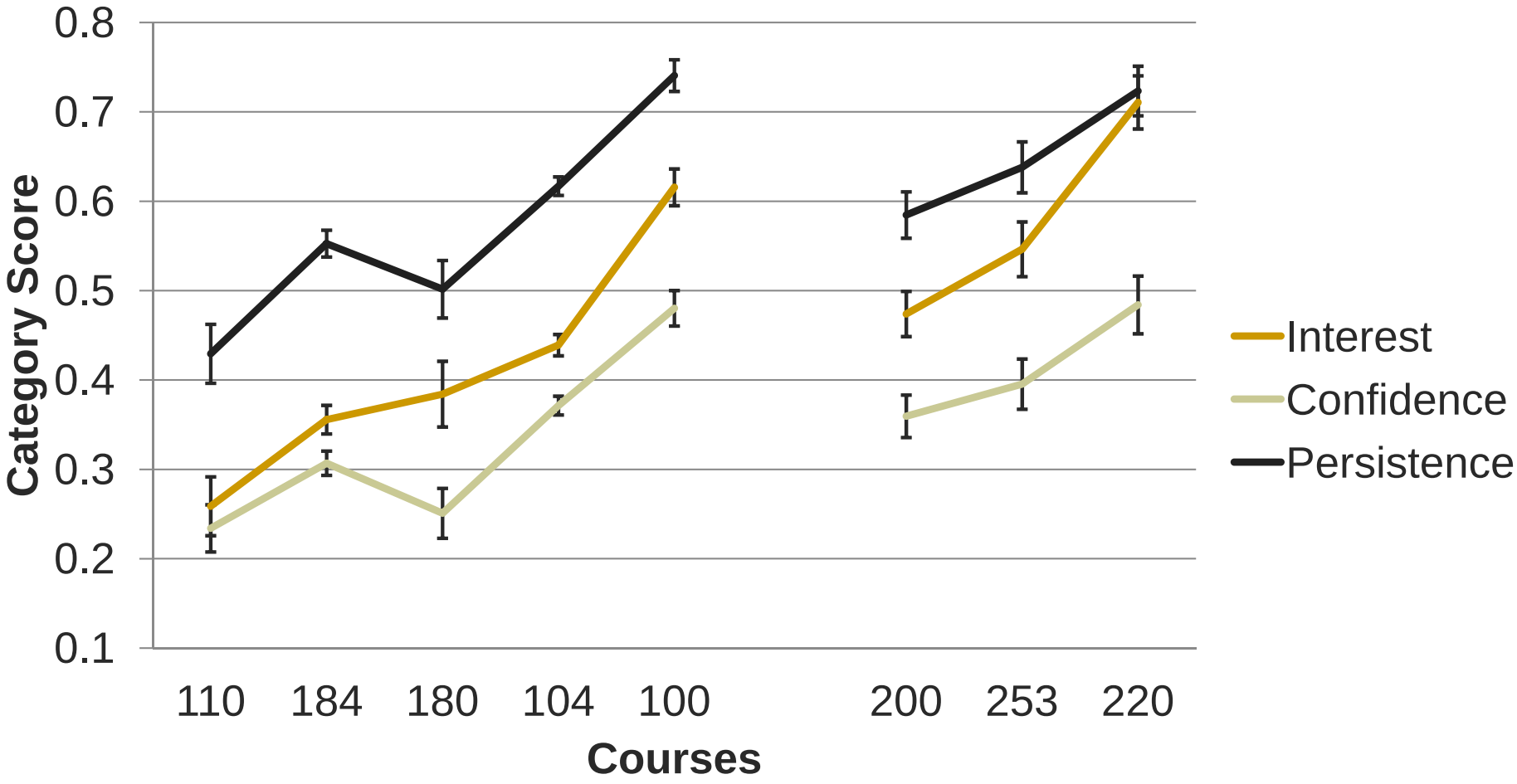
- Percent favourable
  - the percentage of responses from each student that agree with experts' view.
- Category scores
  - averages of individual percent favourable in each category.
- Uses
  - To measure different learning attitudes between different groups of students, longitudinal attitude shifts, correlation between attitudes and course performance, etc

# Who did the survey?

- Differential Caluclus
  - without calculus background:
    - Math 110 – 2-Term Course
    - Math 180 – Physical Science and Engineering
    - Math 184 – Commerce and Social Sciences
  - with calculus background:
    - Math 100 – Physical Science and Engineering
    - Math 104 – Commerce and Social Sciences
- Integral Calculus
  - Math 101 – Physical Science and Engineering
  - Math 105 – Commerce and Social Sciences
- Other courses
  - Math 200 – Multivariable Calculus
  - Math 220 – Introductory Proof
  - Math 221 – Linear Algebra
  - Math 253 – Multivariable Calculus for Engineers

Number of students surveyed:
2969 in 2011
3279 in 2012

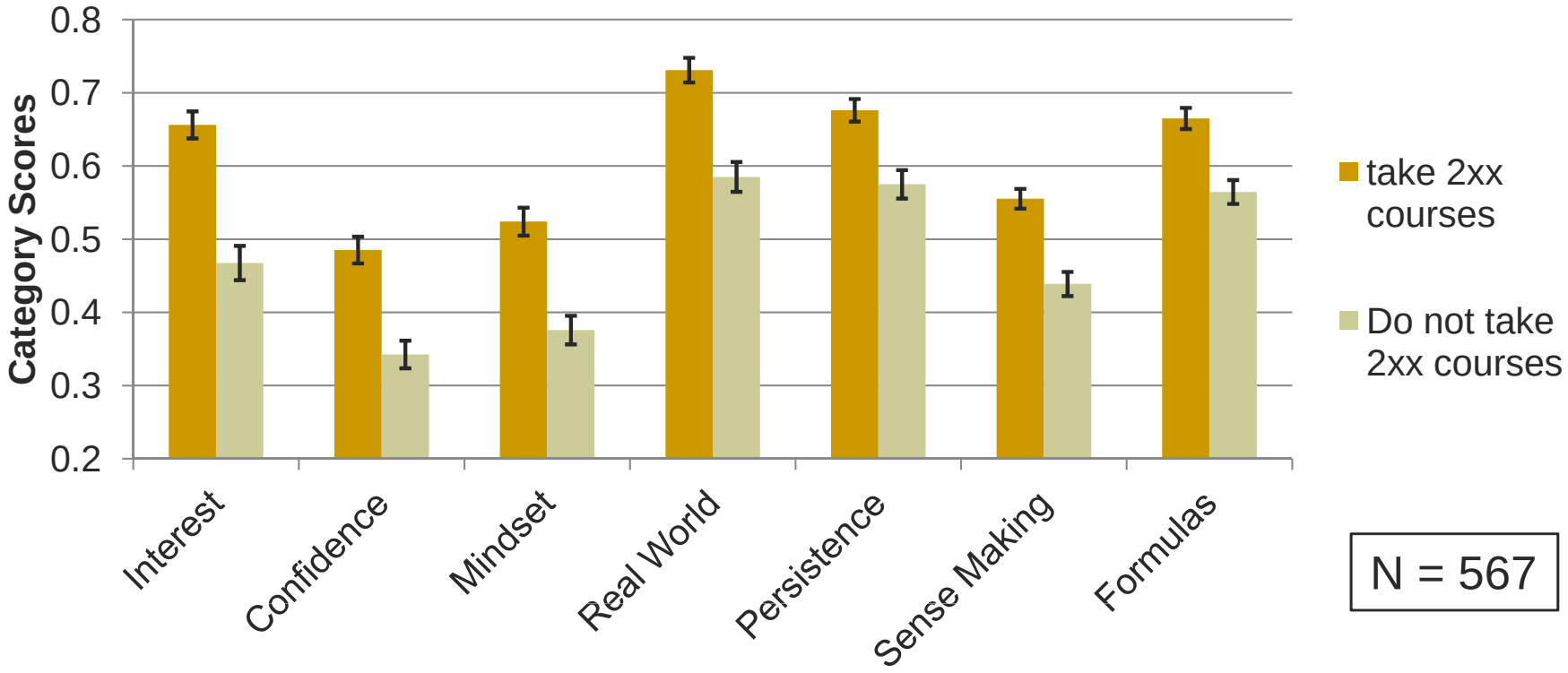
# Attitudes by courses requiring different math background (beginning of Term 1, 2012)



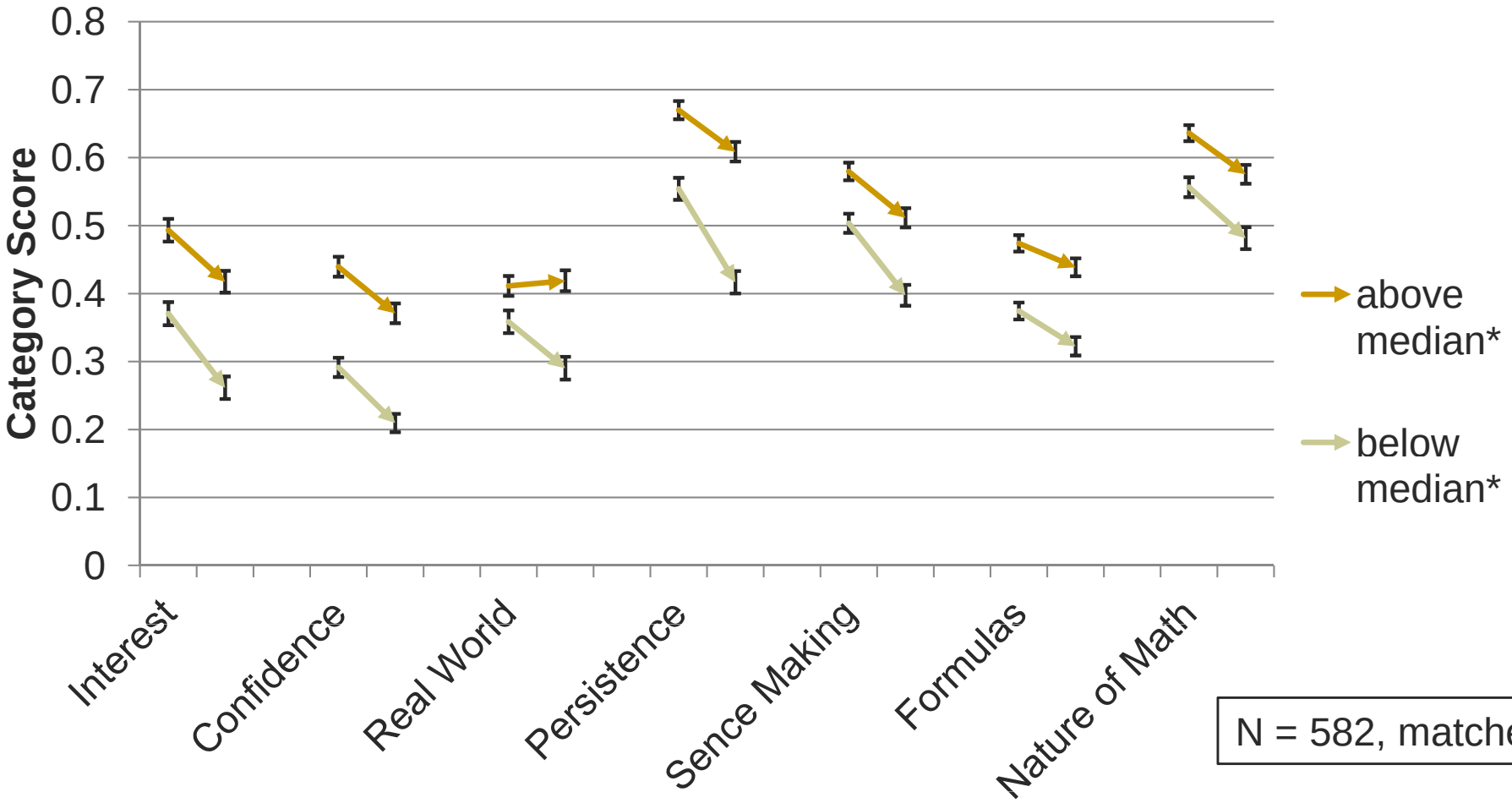

* Similar trends observed in other categories

# Students in 2nd year math – did they start off more expert-like? (Math 100/180, Sept 2011)

- Compared to those who do not, students who take 2nd year math courses were already more expert-like when they started in university a year ago.



# Attitude shifts – pre to post by course performance (Math 104, 2012 Term 1)




N = 582, matched

*Median course grade

# Correlations with course grades (Math 104, pre to post 2012)

- In general, attitudes correlate positively with course performance.
- Interest, confidence and persistence in problem solving are among the most highly correlated.

| Categories | Pre | Post |
|---|---|---|
| Interest | 0.22 | 0.33 |
| Confidence | 0.28 | 0.37 |
| Math in Real World | 0.10 | 0.21 |
| Persistence | 0.25 | 0.37 |
| Sense Making | 0.15 | 0.25 |
| Formulas | 0.21 | 0.27 |
| Nature of Math | 0.18 | 0.19 |

# Conclusion

- Three main results in our math courses
  - On average, students in courses that require more math background have more expert-like attitudes.
  - In differential calculus course we generally observed shifts towards more novice-like attitudes from the start to end of the term.
  - Expertise level of attitudes correlates positively with course performance.