Accepting Uncertainty Depends on the Statistics Curriculum

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Background

Statistics is all about grappling with uncertainty.

An individual's tolerance of uncertainty (TU) is a general personality trait found to be domain-stable (Gerrity et al., 1990). Therefore, a student's statistics TU may influence their approach to statistical problems, their propensity to 'accept uncertainty', and their understanding of statistics.

This relation may be moderated by the statistics curriculum – probability-based curricula (such as the AP Stats curriculum) are often perceived by students as a 'plug and chug' endeavor (e.g., Case, 2016). In these curricula, students with low TU may perform well, but these same students may struggle in a course more focused on making sense of numbers.

Problem Statement

- Is there a relationship between students' statistics TU and their statistics understanding?
- Is that relationship moderated by the type of statistics curriculum used in their course?

Methods

Participants

- 744 students from three sections of an introductory statistics class for non-majors completed a survey
- Participants were awarded extra credit for completion
  - Response rate of 53.5%
  - no significant difference between sections
- Demographic characteristics of participants
  - gender identity: 73.3% women; 25.3% men
  - 32.5% first-generation college students
  - year in school: 62.4% freshmen; 23.8% sophomore; 8.2% junior; 5.4% senior
  - 35.5% first-generation American
  - major: 23.1% social sciences; 20% undeclared; 11.4% business; 8.6% physical sciences; 8.2% agricultural sciences; 6.3% humanities; 6.3% STEM
  - no significant differences between sections

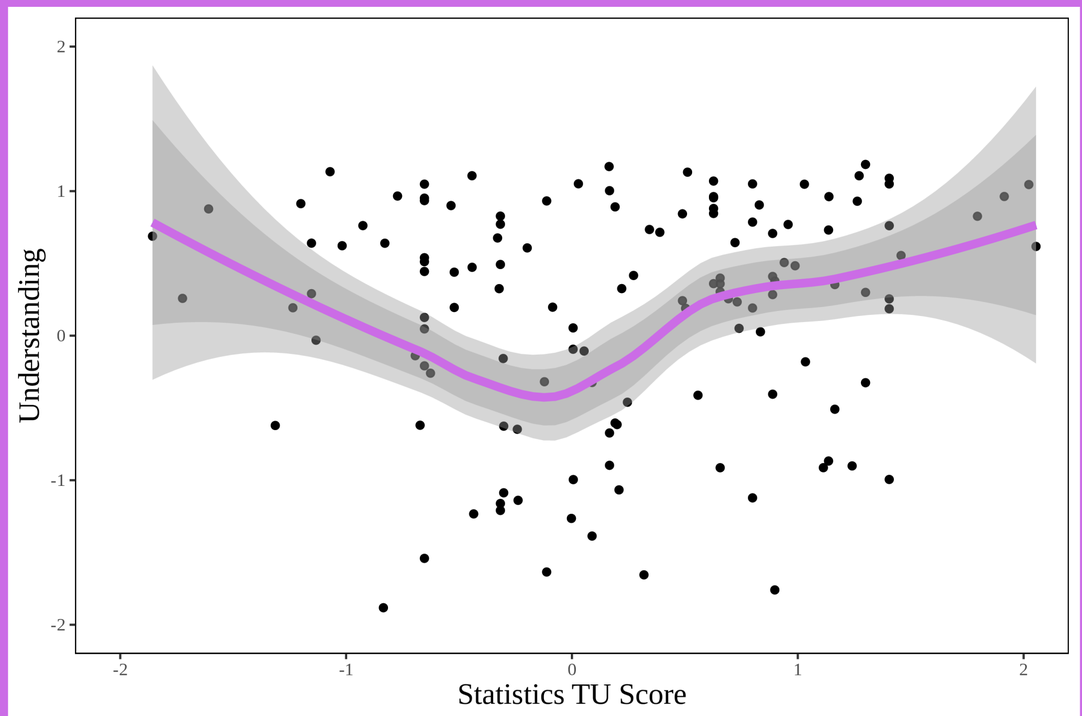
Materials

- Survey constructs and reliability
  - Statistics TU (adapted from McLain, 2009): .689
  - Understanding (measured by students' final exam)
    - 'Probability-Based' Section: .725
    - 'Making Sense of Numbers' Section: .709

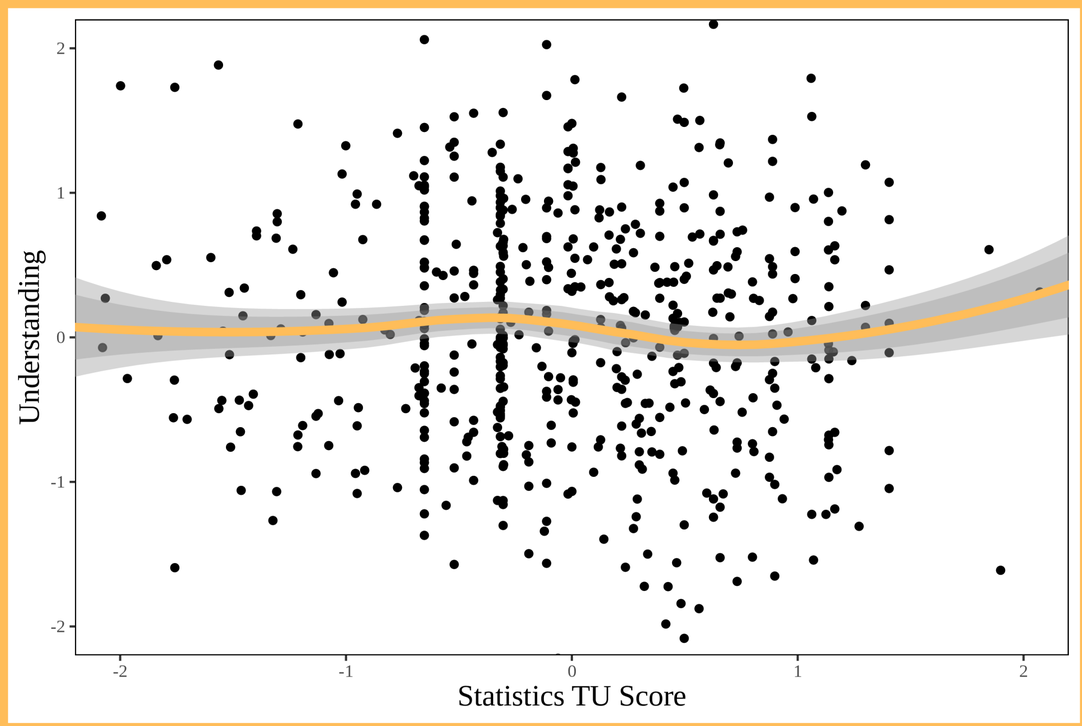
Statistical Analysis

- Item Response Theory models
  - mirt package in R (Chalmers, 2012)
  - Two Parameter Logistic model (2PL) for Understanding
  - Graded Response Model (GRM) for TU

'Probability-Based' Section



'Making Sense of Numbers' Section



Curricula

This course was taught by two different instructors, one of whom used a probability-based approach, and one of whom focused on making sense of numbers. Learning objectives were the same. Students were not aware of the pedagogical differences prior to registering for the class.

'Probability-Based' Section:

- Traditional Introductory Statistics Curriculum
- Topics include descriptive statistics, probability distributions, Central Limit Theorem, sampling distributions, significance tests, and linear regression
- Utilization of scientific calculator (e.g., TI-30)

'Making Sense of Numbers' Section:

- Newly created Introductory Statistics Curriculum
- Topics include descriptive statistics, causal inference and internal validity, sampling and external validity, interval estimates and statistical tests, linear regression models, and main and interaction effects
- Utilization of AI-based R tools

Results

'Probability-Based' Section:

- non-linear relationship (p = .017)
- students with very low and very high TU outperform students with moderate TU

'Making Sense of Numbers' Section:

- Insignificant non-linearity (p = .091)
- No linear relationship (b = -.007; p = .861)

These results highlight that curricular choices even within the same subject and course may affect and change the role that personality traits such as TU have on students' learning.

Conclusion

The relationship between students' Tolerance of Uncertainty and their statistics understanding depends on the statistics curriculum.