

# Increasing Student Success Rates in Mathematics Courses for Non- Mathematics Majors

A preliminary case-control study in a  
general education math course

# Design and Setting

- Two sections of Math 121 (Functions & Graphs), one the treatment group, the other the control group, taught by the same instructor in the same semester, using a department-standard syllabus for the course.
- The treatment section received a two-day seminar on math anxiety and how to be successful at college math.

# Measurement

- A common pre- and post-test of course content was administered to each section.
- A common, 21-question Math Anxiety Questionnaire (MAQ) was administered online, also at the beginning and end of the semester.
- Several axes within and between these assessments were analyzed and correlated, along with the final (percentage) course grade.

# The Math Anxiety Questionnaire

- There are three types of questions corresponding to three indicators of math anxiety:
  - Preconceptions: ideas about math, its purpose, usefulness, and accessibility, that may indispose the student to successful study.
  - Dispositions: beliefs about the role or efficacy of math in the student's life and/or chosen career.
  - Competency: beliefs (self-assessment) regarding the student's own capacity for learning math.

# Questionnaire examples:

- **Preconception:** “Math is a dead subject, cut and dried,” “I believe math is difficult to learn unless you have the brain for it,” “After arithmetic, math is pretty much a subject for specialists.”
- **Disposition:** “I like math,” “Math is something I expect to use often in daily life,” “Knowing math is really important for understanding how the world works.”
- **Competency:** “I generally feel competent to handle ordinary math problems,” “I have little to contribute in a math classroom,” “When in a math classroom, I am reluctant to ask questions.”

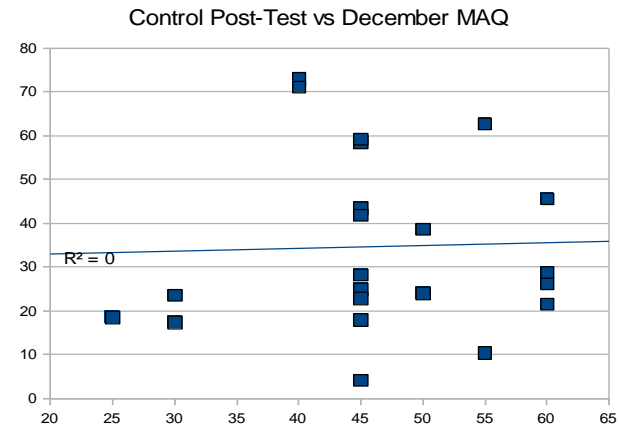
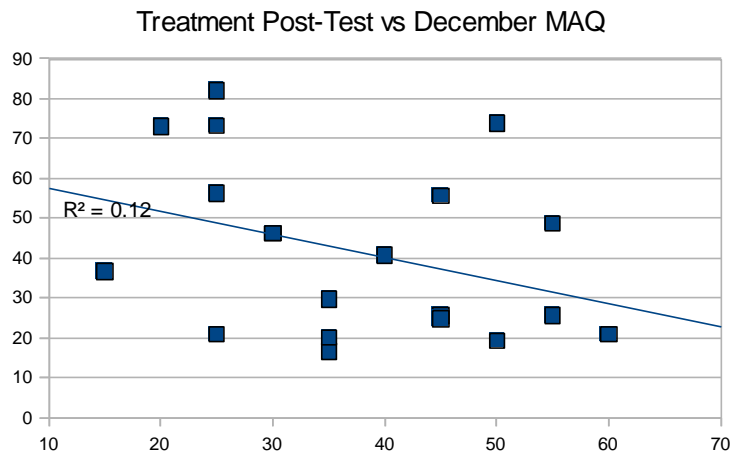
# Scoring the MAQ

- Students respond to each statement in the questionnaire with a numerical score:
  - 1 Strongly disagree
  - 2 Disagree
  - 3 No opinion
  - 4 Agree
  - 5 Strongly agree

Depending on the question, a score that is higher than 3 (on some, lower than 3) is an indicator response. The proportion of questions eliciting an indicator response in each category was recorded.

# Correlating Math Anxiety and Performance

Previous studies have shown that math anxiety is not strongly correlated with individual assessment outcomes at the post-secondary level, owing to confounding variables. Results for this preliminary investigation were similar.



# Calculating MAQ Differentials

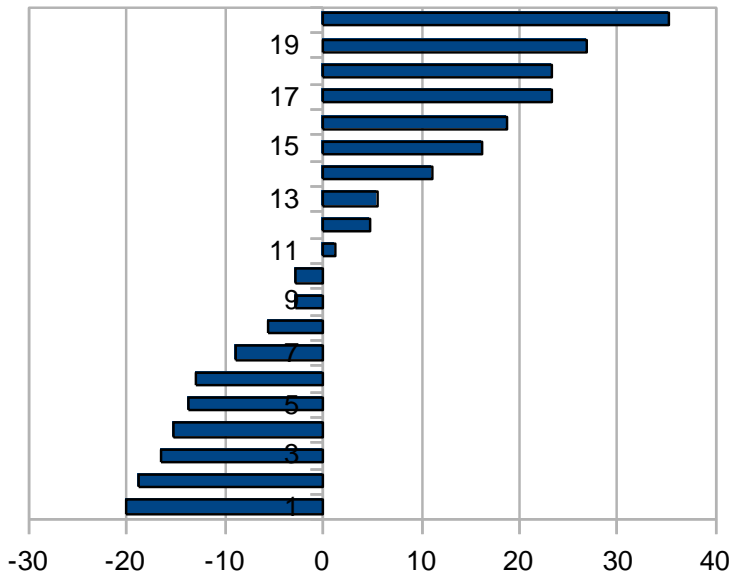
To calculate changes in anxiety indicators, the proportion of indicator responses in each category in August was subtracted from the proportion of indicator responses in the corresponding category in December. In addition, an aggregate differential was calculated for each student by summing the differentials for the categories and normalizing the result.



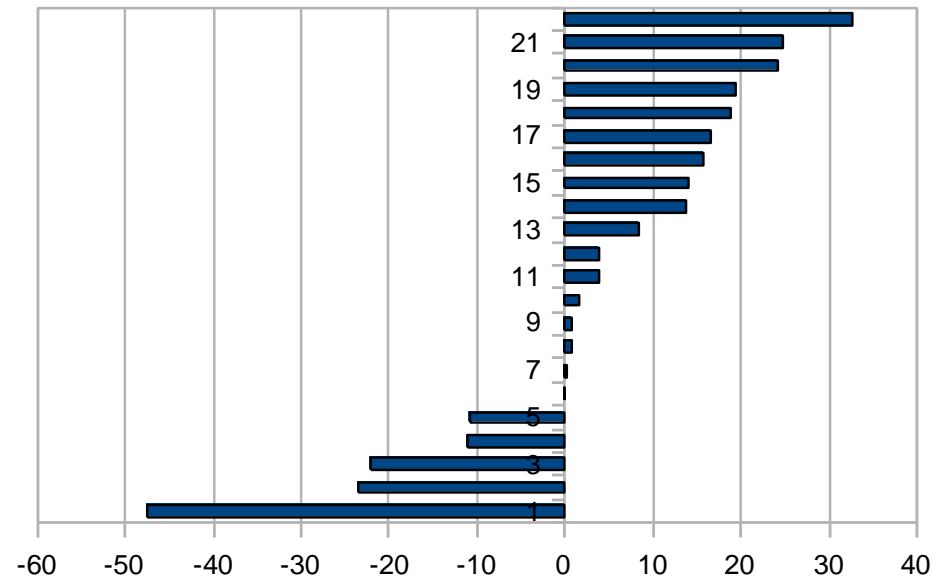
# MAQ DIFFERENTIALS (aggregate)

In the Treatment Section, approximately as many students showed a higher number of indicators in December as showed a lower number.

Treatment Group MAQ Differential



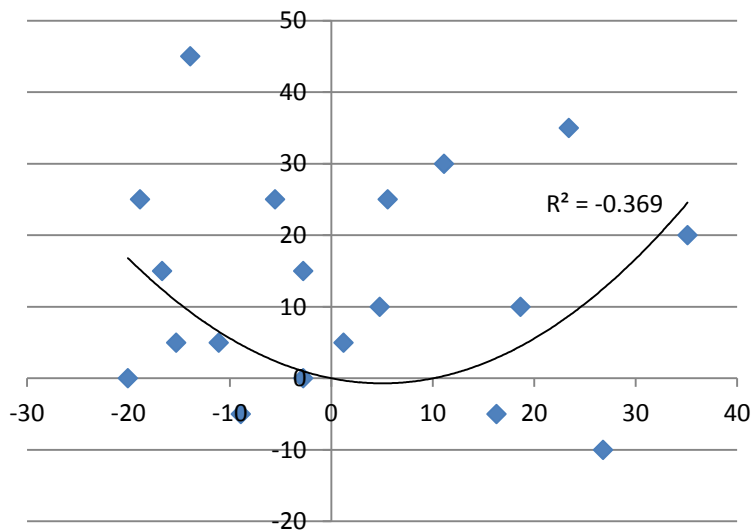
Control Group MAQ Differential



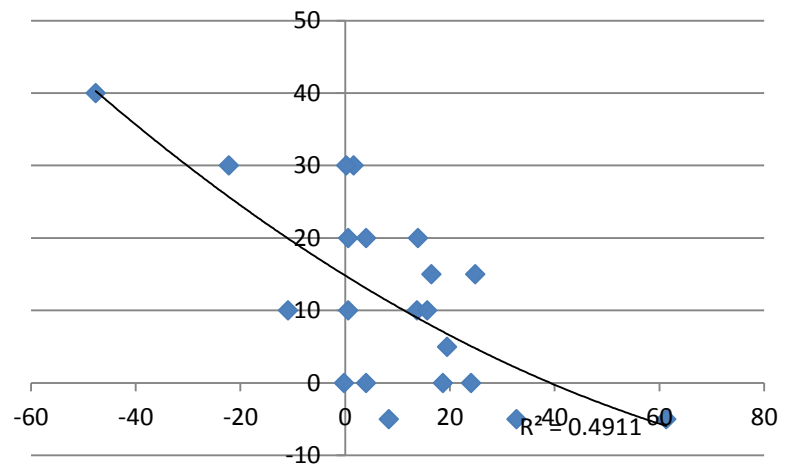
In the Control Section, many more students showed a higher number of indicators in December than showed a lower.

# Correlating Pre- and Post-Test Differentials and MAQ Differentials

Treatment Section



Control Section



For the Treatment Section, a quadratic trend line suggests that both markedly decreased and markedly increased anxiety indicator responses correlate with greater improvement on course content assessment from the pre-test to the post-test. In the Control Section, the correlation is more linear.

# Interpreting the Results

- Some studies of school-age children (e.g., Wang, et al., in *Psychological Science*, 2015) have indicated that levels of math anxiety do not correlate linearly with performance. In part, this is because moderate levels of anxiety can be a motivating factor for students.
- This study's preliminary results suggests that math anxiety plays a similarly complex role at the post-secondary level, and that addressing the various aspects of math anxiety with students modifies that role.
- For these reasons, it will not be efficacious merely to attempt to reduce student anxiety levels. Rather, the (multi-faceted) role that anxiety plays in their learning dispositions must be addressed.

# Future Research

- When doing the research that led to the publication of *Math & Me; Embracing Success*, I got similar results to those here; correlations yes, but not simple ones. When I presented those research results earlier, a colleague asked how he could be persuaded to adopt these methods into his mathematics classroom. These data demonstrate that one won't be persuaded if all one is looking for are higher test scores for all.
- It would be interesting to see if the pre-post MAQ could be administered to different general math courses and analyzed to find how the students' anxiety indicators are affected by the course.
- My prior research study mentioned above also looked at the effect of a curriculum that influenced the pre-conceptions and dispositions of students in general education math courses. Future studies might be considered that aim to tweak the curriculum in a math course to address observed anxiety indicators.