

Student Perceptions of Their Abilities and Learning Environment in Large Introductory Computer Programming Courses

Under-Represented Minorities

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Motivation

- Large research university
- Large intro computer programming courses (~700-800 students/semester... and rising!)
- Previous study (ASEE 2018) showed minimal significant differences between men and women in measures of self-efficacy, intimidation, and inclusion.

Motivation

- Now, want to analyze Under-Represented Minority (URM) students vs. Non-URM students
- Same measures:
 - Self-efficacy
 - Intimidation
 - Inclusion

A Quick Definition

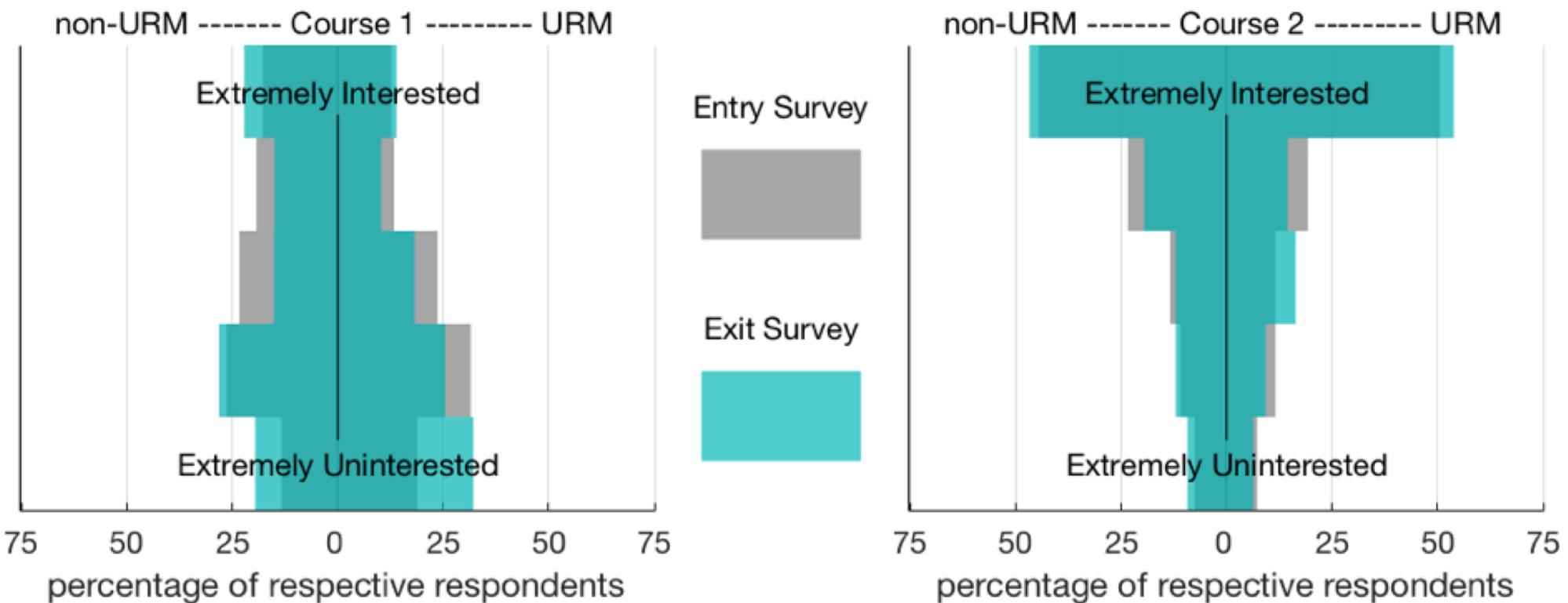
As stated in the paper:

- To classify students as URM vs. non-URM, we started with the definition used by our institution, which in turn relies on the NSF definition of URM students.
- Our institution defines URM students as persons that identify as African-American/Black, Hispanic, and Native American.
- In our analysis, we categorized all students who identified as solely “White” or solely “Asian” as non-URM students and all other students as URM students.

Background: Class Comparison

Course	Sequence	Typical Enrollment	Required?	Type of Students
1	CS1	~650	yes for all engineering students	first year engineering students
2	CS2	~900	yes for some majors (engineering and non-engineering); no for most other engineering majors	majority are engineering students; mostly 2 nd year, good number of 1 st year (second semester)

Background: Interest Levels



Obstacles to URM Diversity

Obstacle	Description	Affects
stereotyped traits	assumed traits of a computer scientist are appealing only to “typical” CS students, usually non-URM	recruitment
perceived abilities	society does not see URM students as academically suited to CS	recruitment & retention
learning environment	isolation, harassment, etc. in the classroom drive URM students to different majors	retention

Interventions in CS1 and CS2

- Balanced teaching staff in terms of gender and race (visual representation is critical)
- Staff training on implicit bias, stereotype threat, etc.
- Various student activities related to implicit bias (CS1) and imposter syndrome (CS2)
- Personalized messaging via an electronic coaching system

Term-By-Term Assessment Plan

Hypotheses

Indicator	Hypothesis
self-efficacy	URM students have lower self-efficacy in our programming courses, as compared to their non-URM peers, but show improvement between the start of term and the end of term.
intimidation	URM students are more intimidated by programming in our programming courses, as compared to their non-URM peers, but are less intimidated by the end of term.
inclusion	URM students feel less welcome in our programming courses, as compared to their non-URM peers, but feel more welcome by the end of term.

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most interested in the *change* in perception, because we have some hope of affecting change during the term

Term-By-Term Assessment Plan

Data

Indicator	Entry Survey	Exit Survey	Type
self-efficacy	How confident are you in your ability to be successful in this course?	Do you think you were successful in this course?	linear scale
intimidation	I find computer programming intimidating.	I find computer programming intimidating.	linear scale
inclusion	I believe that other students in computer programming courses will be welcoming of me.	I believe that other students in computer programming courses will be welcoming of me.	linear scale

Term-By-Term Assessment Plan

Analysis

Indicators	Within-Subjects	Between-Subjects
	Repeated Measures	
self-efficacy	start of term	URM
intimidation	end of term	non-URM
inclusion		

Term-By-Term Assessment Plan

Analysis

Indicators	Within-Subjects Repeated Measures		Between-Subjects
	start of term	end of term	
self-efficacy			URM
intimidation			non-URM
inclusion			



woo!! mixed-mode
ANOVA time!



Survey Response Rates

Terms 1-3 of 5-Year Plan:
Fall 2017, Winter 2017, Fall 2018

Course	Enrollment	Respondents	Total #	Total Rate	URM		Non-URM	
					Respondents	#	Respondents	#
1	2085	932	44.7%	165	17.7%	767	82.3%	
2	2907	1766	60.8%	208	11.8%	1558	88.2%	
Total	4992	2698	54.0%	373	13.8%	2325	86.2%	

Want more results? Read the paper. I only got 15 minutes here.

STATISTICALLY-SIGNIFICANT RESULTS

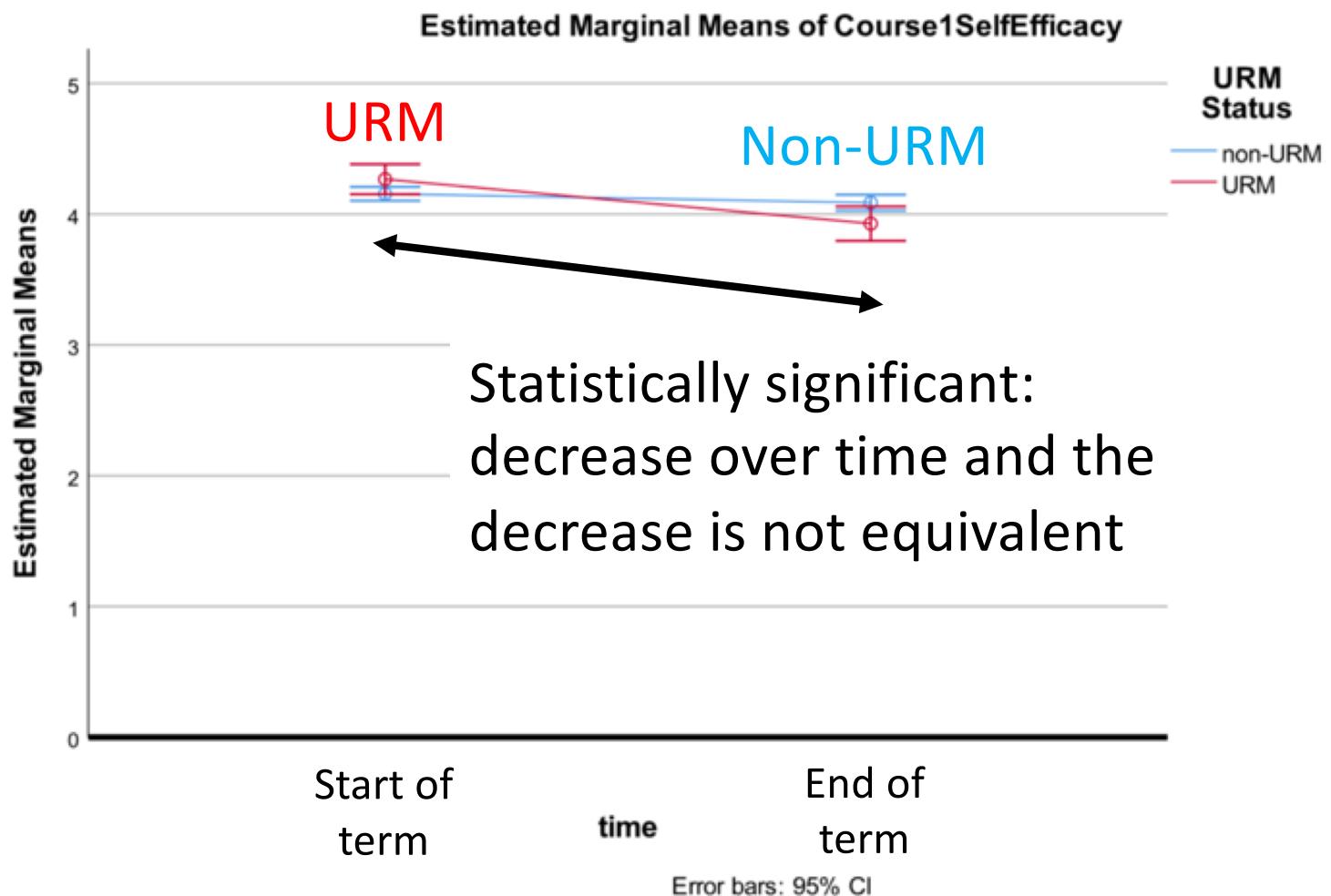
Course 1

Hypothesis 1: Self-Efficacy

BUT!
The decrease is slight, and the raw ratings are still high overall for both groups!

Cannot reject null hypothesis because URM vs. Non-URM is not significant.

...wait, isn't that a good thing?



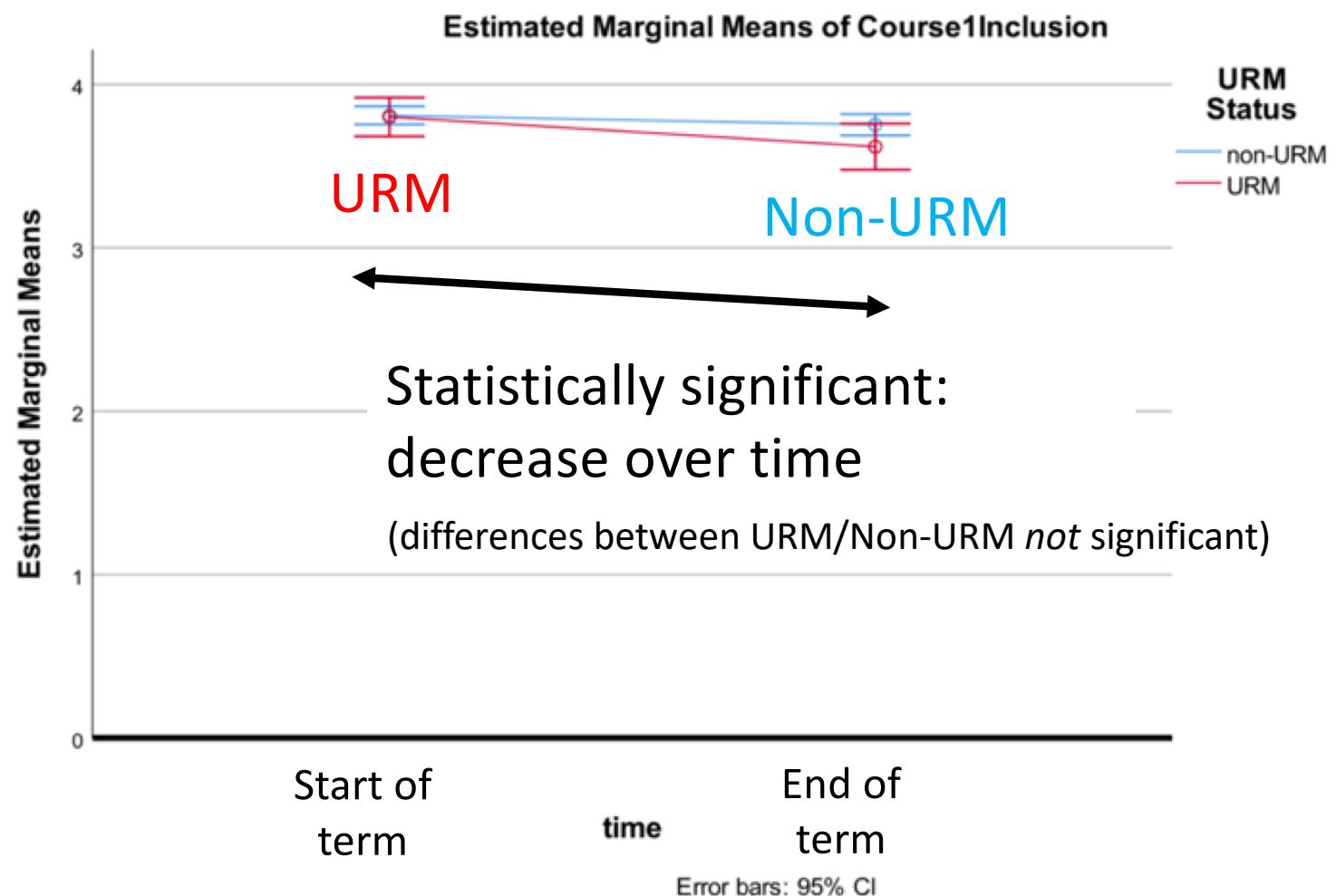
Course 1

Hypothesis 3: Inclusion

BUT!
The size of the
effect is small
and raw ratings
aren't *terrible*.

Cannot reject
null hypothesis
because URM
vs. Non-URM is
not significant.

*...wait, isn't that
also a good thing?*



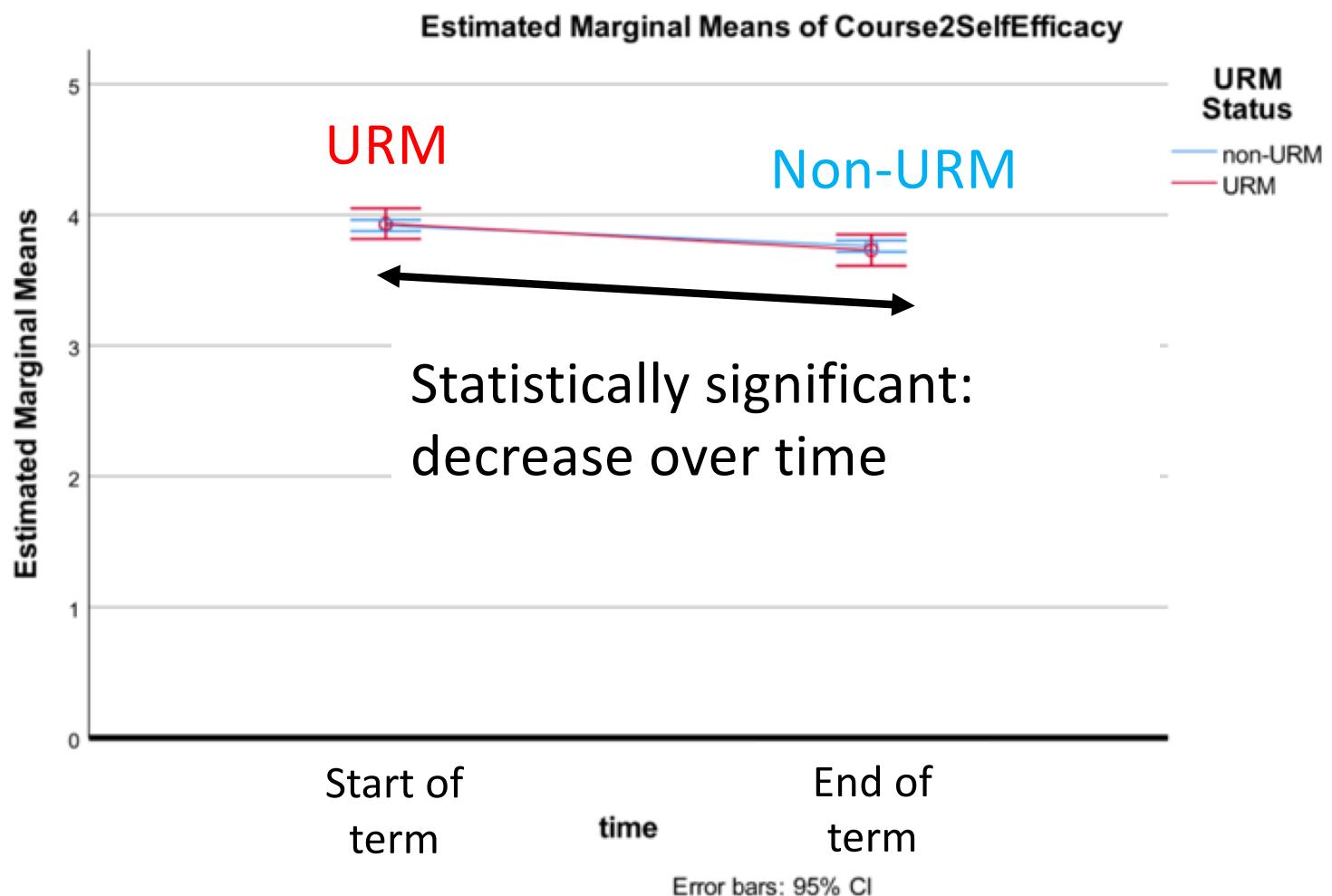
Course 2

Hypothesis 1: Self-Efficacy

BUT!
The size of the
effect is also
small.

Cannot reject
null hypothesis
because URM
vs. Non-URM is
not significant –
there's almost
no difference!

*...wait, this is sort of
a good thing, too?*



no other results were significant

At first, we were disappointed...



Summary

- Can't reject any of the null hypotheses
 - These particular indicators do not show significance within-subjects (URM vs. Non-URM), which we are most interested in
- Things that *are* significant have small effect size, and the raw ratings are generally not terrible:
 - Slight decreases in self-efficacy (both courses)
 - Slight decreases in inclusion (CS1)

Summary

Overall, these findings indicate
URM and Non-URM students have similar perceptions
on self-efficacy, intimidation, and inclusion
at our university.

We argue this is a *good* thing!

Interpretation

- Hopefully, our interventions (balanced teaching staff, activities the students do on implicit bias and imposter syndrome, etc.) are helping to level the playing field for URM students.
- We have a rigorous admissions process – it's possible that our students are so resilient that they are overcoming obstacles regardless of the learning environment.
- These are general statistics -- the results do not apply to any single, individual student! All students may be at-risk for low self-efficacy, high intimidation, and low inclusion.

Limitations

- Survey was voluntary with 54% response rate.
- Students self-selected and therefore may not represent the entire population.
- These results only represent the students at our institution. More findings are needed before the results could be generalized.
- No control group: interventions apply to all students
 - Within-subjects (time) does attempt to capture before/after intervention effects

Going Forward

- Disaggregate by multiple social groups (e.g. race/ethnicity + gender + sexual orientation)
- Try to capture the entire population (would require course credit for the survey, likely)
- Determine which interventions have highest impact

Acknowledgements

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THANK YOU FOR YOUR TIME!

Send me an email if you want to talk more: laura.alford@umich.edu