Statistical Reasoning Improvements in Underrepresented Minority and Non-Minority Students in an Undergraduate Quantitative Psychology Course

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BACKGROUND

- US policymakers claim that the US is not producing enough STEM degree-holders to keep up with economic and global growth (Williams, George-Jones, & Hebl, 2018).
- Between 2012 & 2022, US jobs will grow in almost all areas of science, math, and technology (Doerschuk et al., 2016).
  - However, US bachelor's degrees earned have remained steady (Doerschuk et al., 2016).
- Rates of completion of STEM degrees are notably lower in African-American, Latinx, and Native American students (Williams, George-Jones, & Hebl, 2018).
- Underrepresented minority (URM) college students are interested in STEM majors, but leave at a higher rates (Williams, George-Jones, & Hebl, 2018).
- White and Asian students are more "college ready" compared to Black, Latinx, and Native American students (Strayhorn, 2014).
- The achievement gap between minorities and non-minorities starts as early as kindergarten and becomes wider in higher education and academia (Qian et al., 2017).

PURPOSE & HYPOTHESES

To investigate the difference in statistical reasoning gains between underrepresented minority (URM) and non-minority students in a quantitative psychology course.

- ***HYPOTHESIS 1***: URM students will have smaller gains in statistical reasoning over the semester compared to non-URM students.
- ***HYPOTHESIS 2***: URM students will also have lower baseline basic arithmetic scores as well as lower overall grades in the class.

METHOD

N=107

Fall 2018 (2 sections) & Spring 2019 (3 sections)

Demographics

- Age: *M*=21.69, *SD*=3.60
- 81.3% Female
- 58.9% First Gen, 60.7% Commuters, 55.1% Transfers, 99.1% full-time

Measures

- General Statistical Reasoning Quizzes x3 (7-9 items)
- Baseline Arithmetic Assessment (10 items)

URM students experience smaller statistical reasoning gains over the semester compared to non-URM students

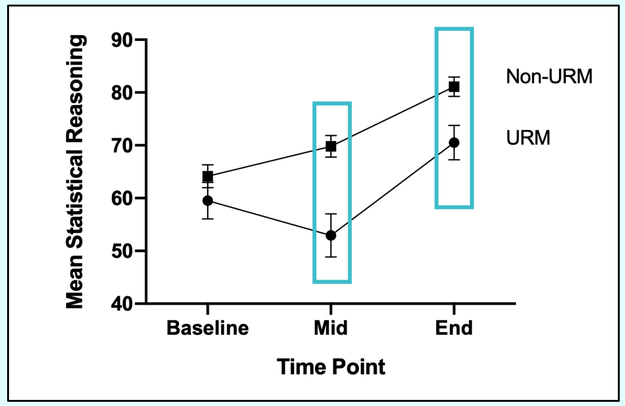

Figure 1. Comparison of statistical reasoning scores in URM and non-URM groups at baseline, mid-semester, and end-of-semester. There was a significant interaction between time and URM status [F(2, 210)= 4.15, p=.017, eta squared=.038] such that there was no significant difference in reasoning scores at baseline, but URM students performed significant worse at mid- and end-of-semester (*p*<.01).

URM students have lower pre-course arithmetic scores and lower final course grades

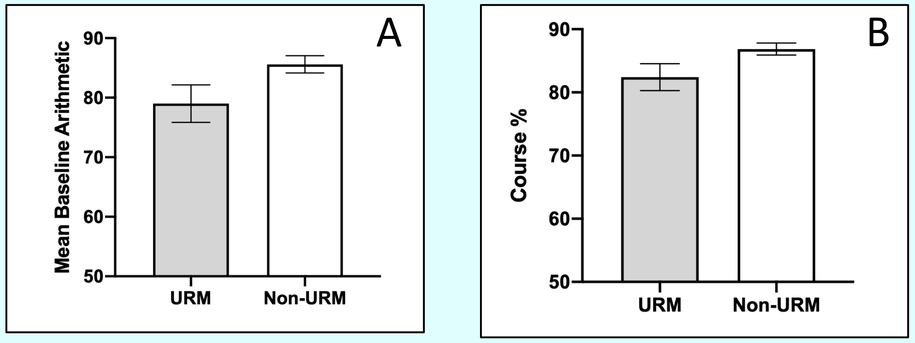

Figure 2. Comparison of baseline arithmetic scores and course percent grade in URM and non-URM students. URM students scored significantly lower on baseline arithmetic assessment (A) and final course grade percent (B), *p*<.05.

Ethnicity Group	n (%)
Non-URM	
White/Caucasian	75 (70.1%)
Asian/Asian-Am.	2 (1.9%)
URM	
Hispanic/Latinx	18 (16.8%)
Black/African-Am.	10 (9.3%)
Native American	1 (0.9%)
Multiracial	1 (0.9%)

RESULTS

HYPOTHESIS 1 (Figure 1)

a) URM students scored significantly lower compared to non-URM students, F(1, 105)= 11.89, p=.001, partial eta square=.102. This indicates a **moderate** effect of ethnicity.

b) URM students showed smaller statistical reasoning gains over the semester compared to non-URM students, *F*(2, 210)=4.15, *p*=.017, partial eta squared=.038, indicating a **small to moderate** interaction effect.
   - No significant difference at baseline [*t*(105)=1.131, *p*=.260, *d*=.24]
   - Significant difference at mid-semester [*t*(105)=4.065, *p*<.001, *d*=.83] and at the end of the semester [*t*(105)=2.963, *p*<.01, *d*=.62]. This indicates a **moderate to large** effect of ethnicity at these time points.

HYPOTHESIS 2 (Figure 2)

a) URM students scored significantly lower on a pre-course arithmetic assessment, *t*(103)=2.18, *p*=.032, *d*=.30. This indicates a **small** effect.

b) URM students scored significantly lower on final course grades, *t*(105)=2.197, *p*=.030, *d*=.54. This indicates a **moderate** effect.

DISCUSSION

Conclusions

- URM students experience smaller gains in statistical reasoning over the course of a semester in a quantitative psychology course.
  - No significant difference at baseline.
  - By the middle and end of the semester, URM students score significantly lower.
- URM students score lower on a pre-course arithmetic assessment, indicating a potential difference in mathematical readiness.
- URM students also score lower on final course grades, indicating that these discrepancies may also be playing a role in the known achievement gap.

Limitations

- Researcher-created measures for reasoning & arithmetic.
- Did not control for first-generation status.

Future directions

- Investigate other factors related to achievement gap (e.g. first generation, college preparedness, etc.).
- Confirm achievement gap in other STEM courses.
- Validate measures for reasoning & arithmetic.

REFERENCES

- Doerschuk, P., Bahrim, C., Daniel, J., Kruger, J., Mann, J., & Martin, C. (2016). Closing the gaps and filling the STEM pipeline: A multidisciplinary approach. *J Sci Educ Technol, 25*, 682-695.
- Qian, X., Nandakumar, R., Glutting, J., Ford, D., & Fifield, S. (2017). Gender and minority achievement gaps in science in eighth grade: Item analyses of nationally representative Data. *ETS Research Report Series, No. RR-17-36.*
- Strayhorn, T. L. (2014). Modeling the determinants of college readiness for historically underrepresented students at 4-year colleges and universities: A national investigation. *American Behavioral Scientist, 58*(8), 972-993.
- Williams, M.J., George-Jones, J., & Hebl, M. (2019). The face of STEM: Racial phenotypic stereotypicality predicts STEM persistence by—and ability attributions about—students of color. *Journal of Personality & Social Psychology: Interpersonal Relationship and Group Processes, 116*(3), 416-443.