Who Majors in STEM: Psychological Measures that Predict Major Choice

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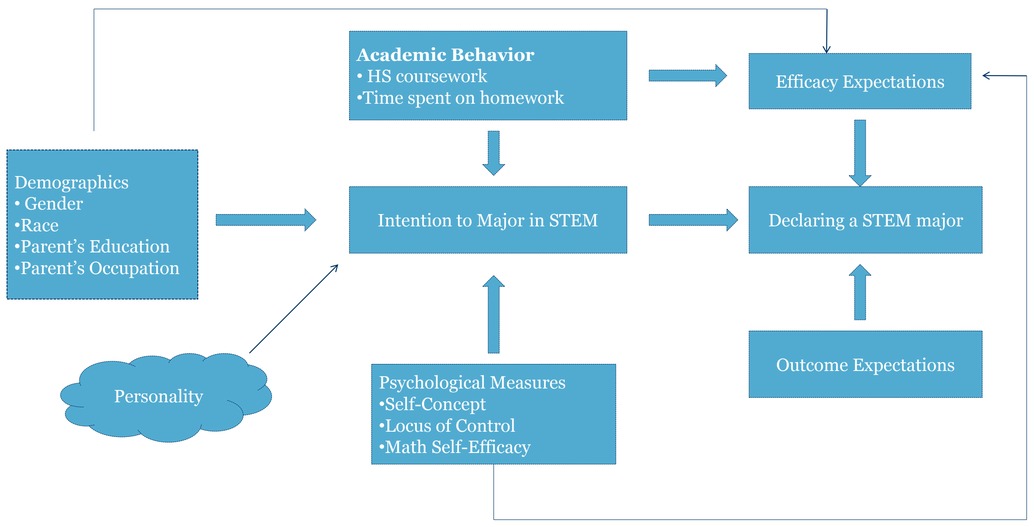
BACKGROUND

- Women and girls continue to be underrepresented in fields such as physics, engineering and technology (Brotman & Moore, 2007)
- Previous studies indicate that precollege math and science achievement is an influential factor in later persistence in the pipeline through college.
  - Thus, precollege years are a critical period for encouraging women to enter STEM fields at the post-secondary level.
- The majority of research in math and science has focused on cognitive factors such as ability and intelligence-qualities that are considered innate and stable across an individual's lifetime (Chang, Singh & Mo, 2007)
  - A recent body of research on pre-college achievement focuses on the importance of self-efficacy, self-concept, locus of control

THEORETICAL FRAMEWORK

- Efficacy Expectations: The belief about a person's ability to perform a particular action.
- Relationship between efficacy expectations (self-efficacy) and outcome expectations: An individual who has high self-efficacy tends to have more positive outcome expectations.
- Example: Heidi believes that she is capable of doing well in her pre-calculus class. Heidi believes that receiving high grades in math will increase the likelihood that she will declare an engineering major.

CONCEPTUAL MODEL



RESEARCH QUESTIONS

- What factors influence a student's decision to choose a STEM major versus a student who chooses a non-STEM major?
- How do self-efficacy, locus of control and self-concept affect a student's decision to choose a STEM major versus a student who chooses a non-STEM major?
- Are the effects of self-efficacy, locus of control and self-concept different by gender and race?

SAMPLE & DATASET

- Dataset: NELS:88 and Follow-up 1 and 2
  - The first wave of NELS:88 data was collected in the spring of 1988
  - NELS is a nationally representative sample of nearly 25,000 eighth grade students at 1,052 high schools
  - Follow-up 1 and 2: Students in 10th and 12th grade
- The dataset includes information collected from students, parents, school administrators, and teachers
  - Our study used variables from the student questionnaire in the base year, follow up 1 and follow up 2.
- Sample size:
  - Total Sample: 14,893 cases (10,858 missing cases and one outlier were removed)
  - Final Sample 4,035

STATISTICAL METHOD

- A logistic regression model technique was used because of the dichotomous dependent variable
  - $\log (p_i/1-p_i) = \alpha + \beta X_i + \delta Y_i + \gamma Z_i + \varepsilon_i$

VARIABLES

- Outcome Variable: Intended field of study
  - STEM major vs. Non STEM (Binary 1=STEM 0=Non-STEM)
- Independent Variables:
  - Model 1- Block of Demographic Variables (female, dummies of race/ethnicity, standardized SES)
  - Model 2- Model 1 + Block of Academic Ability (Amount of coursework in calculus, pre-calculus, trigonometry, biology, physics, chemistry and standardized science and math test scores)
  - Model 3- Model 2 + Block of Psychological Variables (Standardized locus of control, Standardized self-concept, Math self-efficacy)
    - Proxy for math self-efficacy: f1s63d- Math is one of R's best subjects

RESULTS

Predicted Probabilities of choosing a STEM major			
	White	African American	Difference
Male	0.2	0.41	0.21
Female	0.09	0.2	0.11

Predicted probabilities of selecting a STEM Major by level of Self-efficacy

Self Efficacy Level	Pr
Very low	0.072
Low	0.090
Middle low	0.112
Middle high	0.139
High	0.171
Very high	0.209

DISCUSSION

- Our study confirms that increases in math and science test scores is associated with increases in the probability of majoring in STEM.
- Despite the higher odds ratios of African American men and women, these students are still underrepresented in STEM fields.
- Low SES students have also greater probability of selecting a STEM major, perhaps due to perceived economic returns in STEM fields.
- Our proxy for math self-efficacy was significant.
  - Educational initiatives should include self-efficacy concepts in the design of programs that encourage students to study mathematics and science.
- Our variables for locus of control and self-concept were insignificant.
  - This was inconsistent with the literature and our hypothesis.
  - Perhaps these constructs are less important after controlling for ability, self-efficacy and demographics