Further Validation of the Math and Science Stigma Scale (MASS)
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Abstract
This study provides data on the validity and predictive influence of the Math and Science Stigma scale (MASS). The MASS was developed to assess negative stereotypes associated with individuals in science, technology, engineering, and math (STEM) fields. Results of a confirmatory factor analysis indicated a single-factor, eight-item scale provided a good fit to the data. Scores on the MASS correlated in expected ways with measures of intrinsic academic motivation in math and science as well as social desirability. MASS scores significantly predicted math/science self-efficacy and goals when modeled as a proximal contextual barrier using the social cognitive career theory (SCCT; Lent, Brown, & Hackett, 1994, 2000, 2003) framework. The MASS may provide new directions for researchers in the study of the academic and career development of students in STEM fields.

Background
Deficiencies in STEM Preparation: Deficiencies exist in STEM preparation in the US, particularly for underrepresented groups such as women and students of color (National Science Foundation, 2013).

Role of STEM-related Stereotypes: Perceived dissimilarity to stereotyped representations of individuals in STEM fields has been shown to predict interest and performance estimation, particularly among women (Cheryan, Sty, Vichayapai, Drury, & Kim, 2011).

Negative Stereotypes of Individuals in STEM: Common negative stereotypes of individuals in STEM fields include poor social skills, bad hygiene, obsessiveness, and social isolation (Cheryan, Plat, Davies, & Steele, 2009). Measuring STEM-Related Stereotypes: Few options exist to measure negative stereotypes commonly associated with individuals in STEM fields.

Study Purpose: (a) To confirm the factor structure of a scale that will assess negative stereotypes of individuals in STEM fields for high school students (b) to examine STEM stereotypes as a predictor of math/science career goals using an SCCT framework.

Methodology and Design
◆ Participants: After IRB approval, a sample of 374 high school students from the Rocky Mountain region of the U.S. completed a paper-and-pencil survey.
◆ 44% female
◆ 73% Latino/a, 13.6% White/non-Hispanic, 2.1% African American, 2.7% Multiracial, 0.5% Native American, 0.3% Asian American
◆ 50% Freshmen, 48% Sophomore, 3% Juniors, 1% Seniors
◆ Average age = 15.15 years
◆ Measures: The following instruments were administered in the survey:
  ♦ Reasons for Learning Questionnaire (SRQ-L: Williams & Deci, 1996)
  ♦ Math/Science Intests Scale (MSIS; Fouad & Smith, 1996)
  ♦ Math/Science Intentions and Goals Scale (MSIGS; Fouad & Smith, 1996)
  ♦ Expended Scyles Confidence Inventory-High School (ESCI-HS, Betz & Wolfe, 2005)
  ♦ Stereotypes of Scientists Scale (SSS; Wyer, Schneider, Nassar-McMillan, & Oliver-Hoyo, 2010).
  ♦ Lie scale of Revised Children’s Manifest Anxiety Scale (Reynolds & Richmond, 1978).
  ♦ Math and Science Stigma Scale.

Math and Science Stigma Scale (MASS)

<table>
<thead>
<tr>
<th>When I think of people who work in science, technology, engineering, and math jobs, I think of people who…</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neither agree or disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. are not attractive.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2. are weird.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3. have poor social skills.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4. do not have many friends.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5. have bad hygiene.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6. spend all their time alone.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>7. are not good athletes.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>8. have a hard time making friends.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Results:
Confirmaory Factor Analysis
A confirmatory factor analysis (CFA) was conducted to determine if the single-factor structure identified in previous research for items on the MASS provided adequate fit to the data. Results of structural equation modeling (SEM) using Mplus 7.3 (Muthén & Muthén, 2008-2012) indicated the single-factor structure was an adequate fit to the data, χ² (174) = 402.47, p < .001; CFI = .96; RMSEA = .08 (90% CI = .06-.12); SRMR = .03. All items significantly loaded (p < .001) onto the single latent factor.

Math and Science Stigma Scale (MASS)


Validity Data
The MASS correlated in expected ways with measures of academic motivation (r = -.27, p < .001) stereotypes of scientists (r = -.21, p < .001), and social desirability (r = -.03, p = .51).

Structural Model
The hypothesized structural model provided an adequate fit to the data, χ² (50) = 190.01, p < .001; CFI = .959; RMSEA = .076 (90% CI = .063-.090); SRMR = .038. All paths in the structural model were statistically significant.

Discussion
◆ The MASS offers researchers the opportunity to assess endorsement of STEM stereotypes in high school students.
◆ STEM stereotypes were show to be modest, but significant predictors of math/science self-efficacy and goals.
◆ Are STEM stereotypes stronger and do they vary across (e.g., computer science vs. biology) as well as within (mechanical vs. electrical engineering) STEM subfields?
◆ What role do STEM stereotypes play in middle school students’ math/science self-efficacy, interests, and goals?
◆ Does endorsement or strength between STEM stereotypes and other variables vary by gender and/or race/ethnicity?

References

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