Race, Learning Attitudes and Achievement: An Inequitable Triad

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2015 California STEM Symposium
Latino Struggles Dramatization

Courtesy of Novelas Educativas and the National Council for Community and Education Partnerships (2011)
https://www.youtube.com/v/N9lC7aczAaE?version=3&start=169&end=280&autoplay=1&hl=en_US&rel=0
The Problem

(Cohn and Passel, 2013; President’s Council of Advisors on Science and Technology, 2012)

“(Future STEM students will need a) deeper understanding of academic content, the ability to apply knowledge to new problems, and a set of strategies to enable students to 'learn how to learn', be creative, and take control of their own learning” (Stewart, 2012)
As of June of 2012 . . .

- 19% of Latinos 26 or older have college degrees, compared to 40% of all adult US citizens
- The U.S. is ranked 12th in the world in percent of adults with college degrees
- If 60% of U.S. Latinos obtain college degrees, the net tax revenue increase is estimated to increase $3,000,000,000/year

1) To what degree do psychosocial variables that affect mathematics achievement differ between Hispanic and non-Hispanic high school students?

2) How well do psychosocial attitudes related to mathematics and race predict academic achievement for high school sophomores?
External Factors – *Out of Student Control*
- English language acquisition (Gasbarra & Johnson, 2008)
- Inadequate academic instruction (Kawell, 2008)
- Inequitable/rigid course assignment policies (Allen, 2002)
- Limited parent involvement (Greer, 2009)
- Low family socioeconomic income (Gándara, 2009)
- Contrasting sociocultural identity (Crisp, 2012)

Internal Factors – *In Student Control*
Epistemology – General
“the endeavor to determine the indubitable foundations of our claims to knowledge” (Cooper, D.E., 1999)

Marcia Baxter–Magolda (Miami University)
• Model of Epistemological Reflection (1992)
  • Ways of knowing are “socially constructed”
• Theory of Self–Authorship (2008)
  • Epistemological development was intertwined with (subject’s) development of their sense of self and relationships with others
Epistemological Framework

- epistemology
- theoretical perspective
- methodology
- methods

(Crotty, 1998)
“A quantitative measure of (epistemological data) has the potential to address a number of theoretical questions emerging from the research about self-authorship” (Creamer, Baxter Magolda and Yu, 2008)

**Instrument**: Education Longitudinal Study of 2002 (NCES)
- 45-minute, self-administered survey
  - demographic characteristics
  - high school experiences
  - work experiences
  - future plans

**Participants**: Stratified, national probability sample
- 16,197 students from 1,015 public and private high schools

**Timeframe**
- 2002: sophomores
- 2004: seniors
- 2005: transcripts obtained
- 2006: 2 years out
- 2012: 8 years out
Statistical Analyses

- Correlation
- T-Tests
- Chi-Square
- ANOVA
- Hierarchical Linear Modeling
- Regression
Results of Data Analysis (Correlation) – all participants

Table 1.6

Correlation Summary Table Comparing Math Attitude Variables (N = 11294)

<table>
<thead>
<tr>
<th>Variable</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Gets totally absorbed in math</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>2.49</td>
<td>.808</td>
</tr>
<tr>
<td>2. Thinks math is fun</td>
<td>.501*</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>2.79</td>
<td>.840</td>
</tr>
<tr>
<td>3. Mathematics is important</td>
<td>.456*</td>
<td>.682*</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>2.51</td>
<td>.890</td>
</tr>
<tr>
<td>4. People can be good at math</td>
<td>.236*</td>
<td>.275*</td>
<td>.308*</td>
<td>--</td>
<td>--</td>
<td>2.04</td>
<td>.690</td>
</tr>
<tr>
<td>5. Have to be born with math</td>
<td>-.013</td>
<td>-.027*</td>
<td>-.062*</td>
<td>-.305*</td>
<td>--</td>
<td>2.78</td>
<td>.826</td>
</tr>
</tbody>
</table>

*p < .05  **p < .01

<table>
<thead>
<tr>
<th>Correlation Coefficient Value/Range</th>
<th>Relative Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Perfect</td>
</tr>
<tr>
<td>0.7-0.9</td>
<td>Strong</td>
</tr>
<tr>
<td>0.4-0.6</td>
<td>Moderate</td>
</tr>
<tr>
<td>0.1-0.3</td>
<td>Weak</td>
</tr>
<tr>
<td>0</td>
<td>Zero</td>
</tr>
</tbody>
</table>
## Results of Data Analysis (t-tests)

Table 1.1a

Comparison of Survey Responses of Hispanic and non-Hispanic Students Regarding Attitudes about Mathematics and Personal Mathematics Efficacy ($n = 1540$ Hispanic participants and $n = 10,134$ non-Hispanic participants)

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>SD</th>
<th>t</th>
<th>df</th>
<th>p</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most people can learn to be good at math</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanics</td>
<td>1.76</td>
<td>1.521</td>
<td>-2.787</td>
<td>11672</td>
<td>.005</td>
<td>-0.1</td>
</tr>
<tr>
<td>non-Hispanics</td>
<td>1.88</td>
<td>1.539</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have to be born with ability to be good at math</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanics</td>
<td>2.61</td>
<td>1.837</td>
<td>1.055</td>
<td>11672</td>
<td>.303</td>
<td>.04</td>
</tr>
<tr>
<td>non-Hispanics</td>
<td>2.55</td>
<td>1.780</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thinks math is fun</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanics</td>
<td>2.70</td>
<td>.824</td>
<td>-4.472</td>
<td>11672</td>
<td>.000</td>
<td>-0.1</td>
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<tr>
<td>non-Hispanics</td>
<td>2.80</td>
<td>.842</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mathematics is important</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanics</td>
<td>2.29</td>
<td>1.512</td>
<td>-3.945</td>
<td>11672</td>
<td>.000</td>
<td>-0.1</td>
</tr>
<tr>
<td>non-Hispanics</td>
<td>2.44</td>
<td>1.357</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
## Results of Data Analysis (t-tests)

Table 1.1b

*Comparison of Survey Responses of Hispanic and non-Hispanic Students Regarding Attitudes about Mathematics and Personal Mathematics Self-Efficacy (n = 1540 Hispanic participants and n = 10,134 non-Hispanic participants)*

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>SD</th>
<th>t</th>
<th>df</th>
<th>p</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can do excellent job on math tests</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanics</td>
<td>1.96</td>
<td>2.479</td>
<td>-3.606</td>
<td>11672</td>
<td>.001</td>
<td>-0.1</td>
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<tr>
<td>non-Hispanics</td>
<td>2.18</td>
<td>2.250</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Can understand difficult math texts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanics</td>
<td>1.74</td>
<td>2.592</td>
<td>-3.392</td>
<td>11672</td>
<td>.001</td>
<td>-0.1</td>
</tr>
<tr>
<td>non-Hispanics</td>
<td>1.96</td>
<td>2.322</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Can understand difficult math class</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanics</td>
<td>1.48</td>
<td>3.290</td>
<td>-2.709</td>
<td>11672</td>
<td>.007</td>
<td>-0.1</td>
</tr>
<tr>
<td>non-Hispanics</td>
<td>1.71</td>
<td>3.026</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Can do excellent job on math assignments</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanics</td>
<td>1.37</td>
<td>3.661</td>
<td>-2.950</td>
<td>11672</td>
<td>.003</td>
<td>-0.2</td>
</tr>
<tr>
<td>non-Hispanics</td>
<td>1.65</td>
<td>3.375</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Results of Data Analysis (Chi-Square Analyses)

Student Highest Math Course Taken versus Race

\[ \chi^2 = 463.43, \text{ df } = 12, \text{ N } = 12,964, p = .000 \]

**Interpretation:** Students of different races are being differentially prepared in mathematics.
Results of Data Analysis (ANOVA)

- The mean value for highest level of mathematics course taken for at least one semester
- Based on:
  - 1 = Pre-algebra, general or consumer math
  - 2 = Algebra I
  - 3 = Geometry
  - 4 = Algebra II
  - 5 = Trigonometry, pre-calculus, or calculus
- 5.44 for Asians
- 5.16 for Whites
- 4.95 for African Americans
- 4.81 for Hispanics

- \( F(3, 12960) = 109.23, \ p = .000 \)
- Statistically significant!
The mean value for transcript grades for sophomore participants taking Geometry is:
- 6.91 for Hispanics
- 6.62 for African Americans
- 6.54 for Whites
- 6.32 for Asians

\[ F(3, 4588) = 5.588, \ p = .001 \]

**Interpretation:** when Hispanic students are “on track”, they achieve at higher levels than their non–Hispanic classmates.
### Results of Data Analysis (Hierarchical Linear Modeling)

#### Example

Identifying as an Latino (Hispanic) became less and less a contributing factor when also considering math attitudes, but became more a factor when including work habits and forecasting ones educational attainment were considered. As these additive factors compiled, they became less statistically significant.

#### Factors That Contribute to Highest Mathematics Course Completed (N=8972)

<table>
<thead>
<tr>
<th>Step</th>
<th>Variable entering</th>
<th>Block 1 – Demographic Characteristics</th>
<th>Beta at Step*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Asian</td>
<td>1.00</td>
<td>.067</td>
</tr>
<tr>
<td>2</td>
<td>African Amer.</td>
<td>1.00</td>
<td>.021*</td>
</tr>
<tr>
<td>3</td>
<td>Hispanic</td>
<td>1.00</td>
<td>.023*</td>
</tr>
<tr>
<td>4</td>
<td>White</td>
<td>1.00</td>
<td>.070</td>
</tr>
<tr>
<td>5</td>
<td>Gender</td>
<td>1.00</td>
<td>.008*</td>
</tr>
<tr>
<td>6</td>
<td>Parent educ.</td>
<td>1.00</td>
<td>.015*</td>
</tr>
<tr>
<td>7</td>
<td>SES</td>
<td>1.00</td>
<td>.146</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step</th>
<th>Variable entering</th>
<th>Block 2 – Math Attitudes</th>
<th>Beta at Step*</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>Gets absorbed</td>
<td>1.00</td>
<td>.031**</td>
</tr>
<tr>
<td>9</td>
<td>Math is fun</td>
<td>1.00</td>
<td>-.043*</td>
</tr>
<tr>
<td>10</td>
<td>Math is import.</td>
<td>1.00</td>
<td>-.058**</td>
</tr>
<tr>
<td>11</td>
<td>People learn math</td>
<td>1.00</td>
<td>.014*</td>
</tr>
<tr>
<td>12</td>
<td>Born with math</td>
<td>1.00</td>
<td>.014*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step</th>
<th>Variable entering</th>
<th>Block 3 – Work Habits</th>
<th>Beta at Step*</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>Screentime</td>
<td>1.00</td>
<td>-.043**</td>
</tr>
<tr>
<td>14</td>
<td>Homework time</td>
<td>1.00</td>
<td>.049**</td>
</tr>
<tr>
<td>15</td>
<td>Employment hrs.</td>
<td>1.00</td>
<td>-.068**</td>
</tr>
<tr>
<td>16</td>
<td>School activities</td>
<td>1.00</td>
<td>.079**</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step</th>
<th>Variable entering</th>
<th>Block 4 – Education Forecast</th>
<th>Beta at Step*</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>Est. educ. Attain.</td>
<td>1.00</td>
<td>.187**</td>
</tr>
</tbody>
</table>
Results of Data Analysis (Regression)

- Highest mathematics course taken = 2.428 (Constant)
  - + .397 Asian
  - + .147 Black
  - + .219 Hispanic
  - + .427 White
  - - .238 Gender
  - - .006 ParentEdu
  - + .310 SES
  - + .012 Absorbed
  - - .072 MathFun
  - - .091 MathImportant
  - + .053 PeopleLearn
  - + .010 BornWMath
  - - .030 Screentime
  - + .011 Homework
  - - .084 Employment
  - + .112 Activities
  - + .388 EducAttain

For example, as SES is increased by one unit, a sophomore's highest mathematics course completed for at least one semester increases by 0.310, holding everything else constant.

\[ F(17, 8972) = 46.761, \quad p < .000, \quad \text{adjusted } R^2 = .08. \]

Statistically significant!

(Socioeconomic status combines mother’s education, father’s education, mother’s occupation, father’s occupation, and family income)
Epistemological Self-Authorship – “the capacity to take ownership of (student’s) own internal authority” (Kegan, 1994; Baxter-Magolda, 2004)

“Theoreticians have defined Latino/a reality using an epistemology created out of the experience of Whites . . . as if such an epistemology wasn’t based on living experiences” (Hidalgo, 2005)
Math attitudes are important, but not everything (race, SES, forecasting *as well as* instruction, curriculum, materials, environment, etc.)

Ameliorative Considerations
- Mentor/Mentee Relationships – Forecasting
- Summer instruction for underrepresented minorities to advance tracks in mathematics
  (The Jaime Escalante Math Program, 1990)

The Effects of Tracking
- How do we know if URMs have reached their full potential in math given a reduced set of courses?
Suggestions for Further Studies

- Longitudinal comparisons with the same students as they matured in age (e.g. how many students changed their minds about “math being fun”) based on ethnicity/race, SES, family composition, parent educational attainment, etc.
- Comparisons of student “math attitudes” to those of their parents, teachers, administrators and counselors
Thank You!

- Any Questions?
Sample Characteristics: Gender

- Male: 7,653
- Female: 7,717
Sample Characteristics: Regions

Northeast (19%)
- Rural: 416
- Suburban: 1,651
- Urban: 899

Midwest (25%)
- Rural: 834
- Suburban: 1,895
- Urban: 1,302

South (37%)
- Rural: 1,385
- Suburban: 2,529
- Urban: 1,967

West (20%)
- Rural: 312
- Suburban: 1,689
- Urban: 1,318
Data Characteristics: School Types

* Source: NCES (http://nces.ed.gov/programs/digest/d12/tables/dt12_005.asp); Total Numbers/10
Characteristics: Race/Ethnicity

- Nonrespondent (4%): 648
- Survey legitimate skip (2%): 305
- White, non-Hispanic (54%): 8,682
- More than one race (5%): 735
- Hispanic, race specified (8%): 1,221
- Hispanic, no race specified (6%): 996
- Black or African American (12%): 2,020
- Asian, Hawaii/Pac. Islander (9%): 1,460
- Amer. Indian/Alaska Native (1%): 130
- Survey legitimate skip (2%): 305
Previously *qualitative* was used for studies with epistemological (self–authorship) theoretical framework


“relate your approach to your personal understanding and training” (Creswell, 2012, p. 20)
Immersion

http://www.snagfilms.com/films/title/immersion#