Influences of a Student’s Race and Sex on Confidence and Performance in Introductory Statistics

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Introductory Statistics class (AEM 2100) has three 50-minute lectures and 12 two-hour discussion sections per week. Students came from a variety of disciplines and academic backgrounds, although they are predominately Applied Economics and Management (AEM) majors.

The course is supported by a staff of approximately 16 undergraduate Teaching Assistants (TA’s).

Women and Minority students are still underrepresented in the STEM fields, including Statistics.

This fall-only class is required for AEM majors, and has primarily freshmen and sophomores. It is also a service course for the College of Agriculture and Life Sciences.

The female instructor has over 25 years of teaching experience and a Ph.D. in Statistics. The instructor is also the Director of Business Inclusion and Diversity Programs.
Background:

- The differences between male and female students attitudes toward math widens as students age (Hyde et al. 2006)
- Less research has focused on racial differences in attitudes toward statistics, explicitly in the USA.

Verhoeven and Tempelaar (2014) focused on cultural diversity in statistics education using Hofstede’s research on cultural dimensions (1986).

Background:

For their empirical study, data from student surveys held in 2012/2013 and 2013/2014 at a Dutch University (Maastricht) were used (N = 1,985).

One instrument used was the Survey of Attitudes Towards Statistics, SATS-36 (Schau 2003).
SATS Subsections:

- Affect – attitude toward statistics
- Cognitive Competence – ability to succeed
- Value – utility of statistics education
- Difficulty – attitude toward the complexity of the topic
- Interest
- Effort

Verhoeven and Tempelaar Results:

Dutch and Scandinavian students scored high in Affect, Cognitive Competence, and lack of difficulty.

Asian students showed the opposite results, exhibiting low scores in most of their attitudes, except for their willingness to exert a lot of effort.

Experiment:

- In the Fall 2012, 2013 and 2104 Introductory Statistics classes we asked all students to take the SATS Survey. We focused on the four main components: Affect, Cognitive Competency, Value and Difficulty
- The survey was given the first week of classes, before any graded work was collected. The response rate was n = 611 students.
Experiment:

✓ In addition to demographics, we included the following question:

What grade do you expect to receive in this class?

Demographic Information:

✓ 51.1% female and 48.9% male, 49.3% White

<table>
<thead>
<tr>
<th>Race</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asian</td>
<td>6.71%</td>
<td>13.09%</td>
<td>19.80%</td>
</tr>
<tr>
<td>African American</td>
<td>5.89%</td>
<td>5.24%</td>
<td>11.13%</td>
</tr>
<tr>
<td>Latino</td>
<td>6.38%</td>
<td>3.76%</td>
<td>10.15%</td>
</tr>
<tr>
<td>White</td>
<td>24.71%</td>
<td>24.55%</td>
<td>49.26%</td>
</tr>
<tr>
<td>Other</td>
<td>5.24%</td>
<td>4.42%</td>
<td>9.66%</td>
</tr>
<tr>
<td>Total</td>
<td>48.93%</td>
<td>51.06%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Analysis of SATS:

✓ Significant differences between males and females in all categories except Value.

<table>
<thead>
<tr>
<th>Category</th>
<th>Male</th>
<th>Female</th>
<th>p - Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Affect</td>
<td>28.95</td>
<td>26.98</td>
<td>0.0001</td>
</tr>
<tr>
<td>Cognitive Competence</td>
<td>31.79</td>
<td>29.74</td>
<td>0.0004</td>
</tr>
<tr>
<td>Difficulty</td>
<td>27.93</td>
<td>26.90</td>
<td>0.0047</td>
</tr>
<tr>
<td>Value</td>
<td>49.93</td>
<td>50.79</td>
<td>0.1169</td>
</tr>
</tbody>
</table>

Analysis of SATS:

✓ No significant differences between racial/ethnic groups in any category.

✓ No interaction between racial/ethnic group responses and gender in any category.
Analysis of “Expected Grade”:

- There was a significant difference in expected grades between the sexes (p = 0.0002).
- The average grade male students expected was 3.88 while the average grade female students expected was 3.78.

2014 class survey data:

- That year we added an identifying question, which allowed for a comparison of each student’s “expected” versus “actual” grade.
- Among both male and female students, there was a significant difference between expected and actual grades (males and females: p < 0.0001).

Confidence Gap

2014 class survey data:

- Though both groups overestimated their grades on average, male students did so to a significantly larger degree than female students (p = 0.0026).
- The average difference between expected grades and actual grades was 0.74 GPA points for males while it was 0.43 GPA points for females.
2014 class survey data:

✓ For all races except Asian there was a significant difference between students’ expected and actual grades.

<table>
<thead>
<tr>
<th>Race</th>
<th>Average Expected Grade</th>
<th>Average Actual Grade</th>
<th>P - Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asian</td>
<td>3.99</td>
<td>3.82</td>
<td>0.1107</td>
</tr>
<tr>
<td>African American</td>
<td>3.81</td>
<td>2.99</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Latino</td>
<td>3.78</td>
<td>2.93</td>
<td>0.0007</td>
</tr>
<tr>
<td>White</td>
<td>3.79</td>
<td>3.22</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Other</td>
<td>3.70</td>
<td>2.95</td>
<td>0.0007</td>
</tr>
</tbody>
</table>

Educational Insights:

✓ Though female students initially felt less confident in their statistical ability than male students, there was no difference in their final grades.

✓ Students from all but one racial group (Asian) underperformed relative to their expectations, as measured by the difference between the grade they expected to receive and the one they actually received.

Student Focus Groups:

✓ Subsequent to the data analysis, two focus groups of students in the fall 2015 class were held. One group consisted of 12 female students and the other group consisted of 11 male students.

✓ These sessions were held two months into the course, before the students received their final grades.

✓ The purpose of these sessions was to delve deeper into the reasoning behind some of the student responses.

Student Focus Group Questions:

✓ How did they determine their expected grade?

✓ How would they rate their ability in quantitative subjects in comparison with the average Cornell student?

✓ Do they plan to take additional quantitative courses (beyond those required by their major)?
Student Focus Group:

- How did they determine their expected grade?

  Male students said that they wrote down what grade they wanted to get but not necessarily the one they thought they would get. Many of them saw it as a goal setting exercise and wanted to establish a high standard for them.

  Female students based their expected grade on previous grades they received in quantitative classes.

- How would they rate their ability in quantitative subjects in comparison with the average Cornell student?

  All of the male students said their abilities were average or above with none rating themselves below average.

  The majority of female students rated their abilities as average with a few students rating themselves above average and a few below average.

Student Focus Group:

- Do they plan to take additional quantitative courses (beyond those required by their major)?

  The majority of the male group said they had taken or plan to take quantitative courses beyond their basic requirements, while the majority of female students said they would not take these courses.

Suggested Interventions and Strategies:

- One possible strategy for improving students’ confidence in statistics is showing testimonials from teaching assistants and former students who struggled with the course material but ultimately earned a good grade in the course.

- An “it gets better” message could give students hope that they could improve their grade even if they performed below their initial expectations. Students in the focus group responded positively to this suggestion.
Suggested Interventions and Strategies:

- Additional research shows simple social-psychological interventions in education can have a profound impact. Walton and Cohen performed work in 2007 in which they studied the impact of one-hour sessions aimed to help African American students improve their sense of social belonging. These sessions resulted in increased GPAs and reduced the African American-White GPA gap by half.

- Another study performed by Cohen et al. (2009) aimed to curb stereotype threat (Steele, 2011) by having college physics students write down values that were personally important to them. A second group was kept as a control and was asked to write down attributes that were generally important, but not necessarily important to them. As a result of the intervention, the GPAs of female students in the treatment group increased by 0.33 points. Both of these interventions were designed to make students more comfortable in the classroom and increase their confidence, thus showing the influence of simple interventions.
Suggested Interventions and Strategies:

✓ Students in the focus group responded fairly positively to this suggestion. While some of them did not think it would affect them, others said it might have a positive subconscious effect.

Future Research:

✓ Both the video and this written intervention would be piloted in subsequent offerings of the course and their effects documented.

References:


Steele, C.M. (2011) *Whistling Vivaldi: How Stereotypes Affect Us and What We Can Do*, W. W. Norton & Company

