Understanding Diversity: Contemplating the Small N Problem

Kaye Husbands Fealing
Dean and Ivan Allen Jr. Chair
Ivan Allen College of Liberal Arts

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Concepts and Definitions

• **Invisibility**
  - Unaware that the group exists
  - Undercount of the group that is known to exist
  - Accurate accounting but still nondisclosure of the data to the public

• **Small n problem**
  - “Small numbers cannot be a rationale to stall progress. Concluding that little can be said with limited data renders underrepresented groups more invisible and creates a roadblock to meaningful change.”

• **Intersectionality**
  - Crenshaw (1991) – “the interconnected nature of social categorizations such as race, class, and gender regarded as creating overlapping and interdependent systems of discrimination or disadvantage.”
  - NCSES- WMPD (2021) – “…a Black or African American woman may face both racial discrimination and sexism, making her experience and the inequality she faces different from both that of White women and that of Black or African American men. Because of this, it is important to analyze differences in science and engineering degree awards by race, ethnicity, and sex.”
<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>2018 Econ Degrees Awarded</th>
<th>2019 % of U.S. residents b/w 18-44 years</th>
<th>POPULATION PARITY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bachelor</td>
<td>Master</td>
<td>Doctoral</td>
</tr>
<tr>
<td>White Non-Hispanic</td>
<td>60%</td>
<td>65%</td>
<td>66%</td>
</tr>
<tr>
<td>Asian Non-Hispanic</td>
<td>15%</td>
<td>11%</td>
<td>12%</td>
</tr>
<tr>
<td>Black Non-Hispanic</td>
<td>5%</td>
<td>7%</td>
<td>4%</td>
</tr>
<tr>
<td>Hispanic</td>
<td>12%</td>
<td>8%</td>
<td>5%</td>
</tr>
<tr>
<td>White Male</td>
<td>45%</td>
<td>45%</td>
<td></td>
</tr>
<tr>
<td>White Female</td>
<td>15%</td>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>Asian Male</td>
<td>9%</td>
<td>6%</td>
<td></td>
</tr>
<tr>
<td>Asian Female</td>
<td>6%</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>Black Male</td>
<td>3%</td>
<td>4%</td>
<td></td>
</tr>
<tr>
<td>Black Female</td>
<td>2%</td>
<td>3%</td>
<td></td>
</tr>
<tr>
<td>Hispanic Male</td>
<td>8%</td>
<td>6%</td>
<td></td>
</tr>
<tr>
<td>Hispanic Female</td>
<td>3%</td>
<td>3%</td>
<td></td>
</tr>
</tbody>
</table>
Figure 14
Science and engineering degrees earned by underrepresented minorities, as a percentage of degree type: 2008–18

Note(s):
Underrepresented minority groups include Black or African American, Hispanic or Latino, and American Indian or Alaska Native. Hispanic or Latino may be any race; race categories exclude Hispanic origin. Race and ethnicity breakouts and percentage calculations are for U.S. citizens and permanent residents only.

Source(s):

https://ncses.nsf.gov/pubs/nsf21321/data-tables#group1
Dr. Panchanathan/AAAS News Article

Addressing the “missing millions” — people who are capable of succeeding as scientists and engineers but do not have access to pathways that lead into those careers — is a key step toward enabling the American STEM enterprise to thrive in the coming decades.” Finding the “missing millions,” or “the gap between the demographics of the research community and the demographics of the whole nation,” is paramount, Panchanathan said. The scientific community must rapidly double the number of women, more than double the number of African Americans, triple the number of Latino Americans and quadruple the number of Native Americans in STEM careers, he said. In all, this effort would amount to adding 4 million new voices to the U.S. research enterprise. https://www.aaas.org/news/nsf-director-lays-

Jane E. June & O’Leary/Chronicle of Higher Education

“At public and private nonprofit four-year colleges in the fall of 2019 — the most recent year for which federal data are available — there were 251,921 tenured associate and full professors. Of those, 5,221, or 2.1 percent, were Black women.” (Data are self-reported). See https://www.chronicle.com/article/how-many-black-women-have-tenure-on-your-campus-search-here
“…there was no statistical linkage between the size of the pool of URM talent, and the number of URM assistant professors hired in basic science departments of medical schools…. in the presence of the 0.25% transition rate, the model predicted that in 2080 fewer than 10% of assistant professors would be URMs, no matter the number of positions available…."

Gibbs, Basson, Xierali, Broniatowski (2016), used Survey of Earned Doctorates & faculty records in the Association of American Medical Colleges’ Faculty Roster for their simulations.
Table 1

<table>
<thead>
<tr>
<th>Professional group</th>
<th>White males</th>
<th>White females</th>
<th>African Americans</th>
<th>Hispanics</th>
<th>Asian Americans</th>
<th>American Indians</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1968–1989</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biologists</td>
<td>1.28</td>
<td>0.72</td>
<td>0.37</td>
<td>0.65</td>
<td>1.93</td>
<td>0.60</td>
</tr>
<tr>
<td>Chemists</td>
<td>1.49</td>
<td>0.34</td>
<td>0.64</td>
<td>0.94</td>
<td>1.74</td>
<td>0.39</td>
</tr>
<tr>
<td>Medical doctors</td>
<td>1.40</td>
<td>0.28</td>
<td>0.48</td>
<td>1.33</td>
<td>2.57</td>
<td>—</td>
</tr>
<tr>
<td><strong>1990–2009</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biologists</td>
<td>1.09</td>
<td>0.88</td>
<td>0.52</td>
<td>0.56</td>
<td>2.09</td>
<td>0.95</td>
</tr>
<tr>
<td>Chemists</td>
<td>1.44</td>
<td>0.51</td>
<td>0.76</td>
<td>0.47</td>
<td>2.10</td>
<td>0.56</td>
</tr>
<tr>
<td>Medical doctors</td>
<td>1.36</td>
<td>0.49</td>
<td>0.62</td>
<td>1.06</td>
<td>2.04</td>
<td>0.93</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>1968–1989</strong> to <strong>1990–2009</strong></td>
<td>-0.15</td>
<td>0.22</td>
<td>0.42</td>
<td>-0.15</td>
<td>0.08</td>
<td>0.58</td>
</tr>
<tr>
<td><strong>1990–2009</strong></td>
<td>-0.03</td>
<td>0.53</td>
<td>0.18</td>
<td>-0.50</td>
<td>0.21</td>
<td>0.45</td>
</tr>
<tr>
<td><strong>1990–2009</strong></td>
<td>-0.03</td>
<td>0.77</td>
<td>0.29</td>
<td>-0.20</td>
<td>-0.21</td>
<td>—</td>
</tr>
</tbody>
</table>

*R* All ratios are significant at the 5% level, two-tailed test, except those in italics.

*1 Data available from 1966 to 2009.
*2 Data available from 1988 to 2009.
*3 Data available from 1972 to 2009.
*4 Too few observations to compute three-year moving averages (or, therefore, percentage change).

\[P^k = \text{probability of employment as chemist, chemical engineer, chemical technician, chemistry instructor in kth group}\]

\[P = \text{prob. of employment as chemist etc for all groups}\]

\[R^k = \frac{P^k}{P} = \text{representation ratio for the kth group}\]

“…all groups do not benefit equally from diversity initiatives and that competition across related fields can confound efforts to increase diversity in medicine.”

“Increases in the receipt of post-baccalaureate education within [white male and Asian] groups result in an increase in these groups’ representation in the profession. The impacts of increases in post-baccalaureate education for blacks, white women, and Hispanics do not increase their representation in the profession, holding constant all other factors.”


<table>
<thead>
<tr>
<th></th>
<th>Elasticity of representation ratio with respect to expected wages</th>
<th>Elasticity of representation ratio with respect to post-B education</th>
</tr>
</thead>
<tbody>
<tr>
<td>White males</td>
<td>-0.166</td>
<td>-0.017</td>
</tr>
<tr>
<td>White females</td>
<td>-0.228</td>
<td>-0.187</td>
</tr>
<tr>
<td>Hispanics</td>
<td>0.703</td>
<td>0.112</td>
</tr>
<tr>
<td>Blacks</td>
<td>-0.024</td>
<td>0.097</td>
</tr>
<tr>
<td>Asians</td>
<td>—</td>
<td>-0.153</td>
</tr>
</tbody>
</table>

Source: Authors’ computations from IPUMS-CPS March Supplement, 1968–2012
What problems are we trying to solve?

• Improving outcomes in education and labor markets for underrepresented and underserved groups

• Having the data to determine which intervention works best for a given group
  • Enhancing substantive knowledge and technical skills
  • Mentoring programs
  • Providing and sustaining a comprehensive networks of support: financial, academic, professional, and social
  • Addressing “chilly climate issues”
  • Changing the curriculum to be more inclusive
  • Providing bridge experiences to facilitate transition from one education milestone to another
  • Extensively and intensively tracking program participants—including faculty and mentors
  • Implicit bias training
  • Many other programs

• Improving data sources for developing clean energy, water and sanitation solutions, reducing health disparities, and improving urban and rural infrastructure
What data do we have?

• Questionnaires, surveys and administrative records from organizations and academic institutions—American Economic Association’s Universal Academic Questionnaire; individual or groups of colleges and universities; individual or groups of professors (e.g., data on all assistant professors hired at top-50 economics departments);

• Surveys from federal agencies—National Center for Education and Statistics’ Integrated Postsecondary Education Data System; National Center for Science and Engineering Statistics’ Survey of Earned Doctorates; American Communities Survey; and

• Web sources (e.g., online curricula vitae of economists; online class ratings)
Conclusion

• Develop **standards** for data collection, privacy and sharing that are communicated not only to data users but also to those who are captured in the data.

• Incentivize the development of **methodologies**—including blended quantitative and qualitative techniques—for dealing with the small n problem, including creating frameworks and methodologies that can be used by researchers and policy-makers.

• Create a **clearinghouse** on STEM fields and the workforce that:
  - curates knowledge from various areas of study related to understanding and assessing underrepresentation;
  - curates data, metrics and statistics from various areas of study related to assessing underrepresentation;
  - curates knowledge from various areas of study assessing educational attainment, contextualizing educational access, opportunities and outcomes, and identifying critical causes of underrepresentation;
  - curates knowledge from various areas of study for identifying workforce dimensions and dynamics, contextualizing occupational access, opportunities, and outcomes, and investigating recruitment, retention network inadequacies leading to underrepresentation.
Thank you!
Questions?
What are the biggest lessons, takeaways?

1. Avoid pipeline metaphor; embrace pathways
2. Demand side, not just supply side
3. Understand that climate matters
4. Not one size fits all
5. Scalability matters
6. Must wrestle with intersectionality*
7. Leadership for effective change
8. Engagement and networks matter
9. Effective policy and political processes
10. Effective incentives

*Intersectionality is defined as the interconnected nature of social categorizations such as race, class, and gender regarded as creating overlapping and interdependent systems of discrimination or disadvantage.
SoBP Research Agenda

Frameworks

• Curated knowledge from various areas of study related to understanding and assessing underrepresentation in STEM fields.

Measures

• Curated data, metrics and statistics from various areas of study related to assessing underrepresentation in STEM fields.

Education

• Curated knowledge from various areas of study assessing educational attainment, contextualizing educational access, opportunities, and outcomes, and identifying critical causes of underrepresentation in STEM fields.

Workforce

• Curated knowledge from various areas of study for identifying workforce dimensions and dynamics, contextualizing occupational access, opportunities, and outcomes, and investigating recruitment, retention network inadequacies leading to underrepresentation in the STEM workforce.

(Source: Fealing & McNeely, 2016; NSF Awards 1551904 & 1551880)
SoBP Conclusions and Directives
SoBP Conclusions and Directives
Lack of diversity in STEM, particularly in the Economics profession