What are the major research and evaluation questions cogent to increasing diversity in physics graduate education?

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Goals of this Session

- Highlight some existing research that informs on diversity in graduate physics and on improving graduate physics generally
- Engender a discussion about how to move forward

Research on Graduate Education

- Barbara Lovitts studied graduate attrition and completion across graduate programs.
- She noted that a "student deficiency model" is often assumed to explain student completion and attrition; that is, the presumption is that deficiencies in students' backgrounds explain their failure to complete doctorates in a timely manner.
- Instead, she found two departmental factors to be the most important in explaining the variance in student attrition:
  - The effort & resources committed to integrating graduate students into the department, and
  - The effort made toward students' development and understanding of the formal and informal structures of the graduate programs and research cultures.

Lovitts, B. *Leaving the Ivory Tower: The Causes and Consequences of Departure from Doctoral Study*, 2001.

Research on Graduate Education

- Nettles & Millett noted that mentoring (distinct from research advising in their language) was related to research productivity and completion of students' programs, despite the fact that 30% of doctoral recipients in their sample reported not having a mentor at all.
- Women and URM students were more likely to have mentors of the same gender/ethnicity, which could lead to a significant disadvantage in departments with few such faculty members.

Nettles, M. T. & Millett, C. M. *Three magic letters: Getting to PhD*, 2006.
Bowen, W. G. & Rudenstine, N. L. *In pursuit of the PhD*, 1992.

The importance of mentoring and support

- Terrell Strayhorn and others have repeatedly identified two factors that can positively contribute to the persistence and success of URM students in STEM:
  - Effective mentoring (often from URM faculty)

    . . . by serving as teachers, facilitators, coaches, confidants, and mentors who developed a vested interest in the success of the student, who cared about his/her development as a young, emerging professional, and with whom the student had developed trust.

  - Sociocultural supports
- Factors that can pose barriers include:
  - Encountering negative stereotypes or negative classroom experiences
  - Lack of peers from similar backgrounds

Strayhorn, T. L. Social Barriers and Supports to Underrepresented Minorities' Success in STEM Fields, Frontiers in Education Conference Proceedings, 2010.

Something that matters: motivation

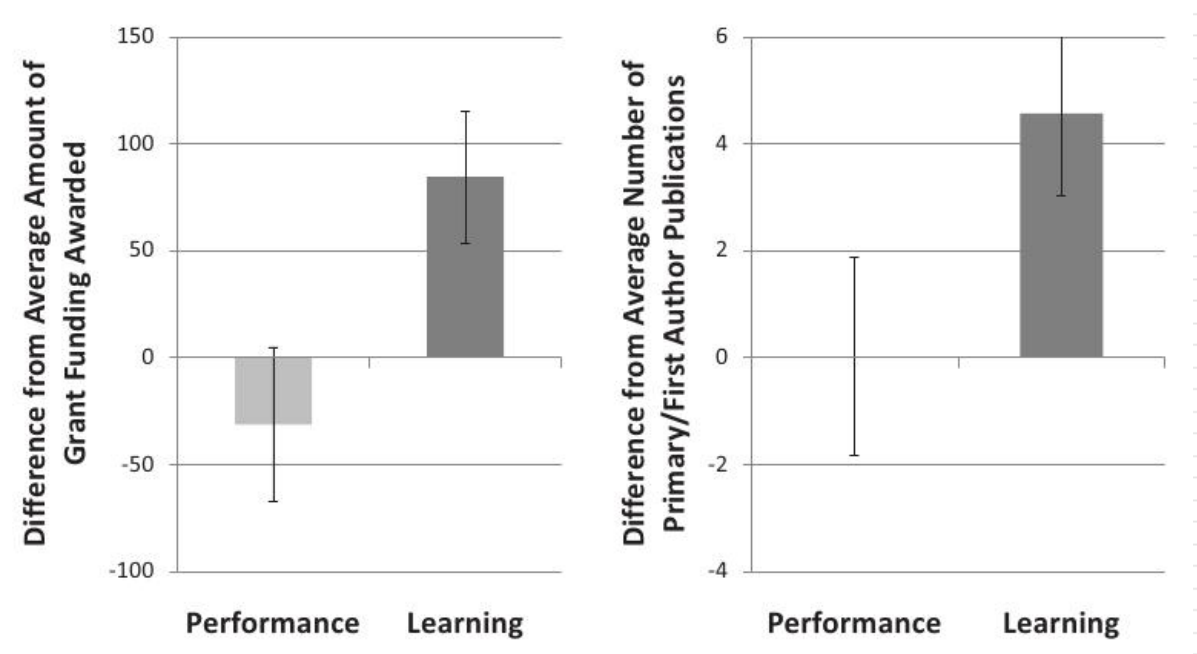
Research from Project Crossover

- Individuals' initial graduate school motivations are predictive of their career productivity:
  - Those who entered graduate school because they "enjoyed thinking about science" produce more primary/first-author papers in their (total) careers, and garner more research funding.
  - Those who entered graduate school because they "received good grades" or were "awarded scholarships/fellowships" were no more productive than average.
- It is sometimes assumed that all students have the "right" motivations, rather than thinking that this is something to be cultivated and developed, even in graduate school.

Z. Hazari, G. Potvin, R. H. Tai, & J. Almarode. For the love of learning science: Connecting learning orientation and career productivity in physics and chemistry. Phys. Rev. ST Phys. Educ. Res., 6(1):010107, May 2010.

Something that matters: motivation

Research from Project Crossover



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Stereotype threat

Why departmental/institutional practices matter

- Repeated experiments show that implied or commonly-held stereotypes about a group of people can negatively impact the performance of individuals exposed to the threat of the stereotype.
- The performance/test must be challenging not trivial – like most things we ever ask graduate students to do.
- The “introduction” of the stereotype can be very, very minimal, such as: asking students to identify their race/ethnicity/gender before the test!
- This effect is not dependent on students’ capabilities, though it will appear to depress their performance.

Steele, C. A threat in the air: How stereotypes shape intellectual identity and performance, American Psychologist, 52(6), 613, 1997.
Dar-Nimrod, I. & Heine, S. J. Exposure to scientific theories affects women’s math performance, Science, 314(5798), 435–435, 2006.

Takeaways

- Lovitts points out the weakness of focusing on students' "deficits": we'll miss potentially more influential, and fixable, things (e.g. departmental practices).
- Stereotype threat gives a concrete example of how we might come to underrate a student for spurious reasons.
  - Steele points out that stereotype threat may become a bigger issue as students move up the academic ladder.
- Departmental commitment to integrating and supporting students is important.
- Mentoring and other social support can particularly (and positively) impact otherwise marginalized students.

Caution: groups of students are not monolithic

- Intersectionality theorists point out that it is unfair to group all women together, or all people of color, etc. (Pawley, 2013)
- One lesson of this work to keep in mind is that we are talking about individuals, who have their own motivations, career goals, and experiences. In some ways, it is unfair to lump people together and talk only about “averages”.

Alice Pawley, “Learning from small numbers” of underrepresented students’ stories: Discussing a method to learn about institutional structure through narrative, Proceedings of ASEE Annual Conference, 2013.

Challenges to progress

- Research doesn't always translate to practice
  - Lack of a conversation between researchers and practice
  - How, specifically, practices get implemented can be really important
- The difficulty of small numbers
- Other factors that are as yet unknown

Henderson, C., Beach, A., & Finkelstein, N. Facilitating change in undergraduate STEM instructional practices: An analytic review of the literature, *Journal of Research in Science Teaching*, 48(8), 952–984, 2011.

Challenges to progress

Henderson, Beach, & Finkelstein (2011):

> *Two commonly used change strategies are clearly not effective: developing and testing "best practice" curricular materials and then making these materials available to other faculty and "top-down" policy-making meant to influence instructional practices. Effective change strategies: are aligned with or seek to change the beliefs of the individuals involved; involve long-term interventions, lasting at least one semester; require understanding a college or university as a complex system and designing a strategy that is compatible with this system.*

Henderson, C., Beach, A., & Finkelstein, N. Facilitating change in undergraduate STEM instructional practices: An analytic review of the literature, *Journal of Research in Science Teaching*, 48(8), 952–984, 2011.

Discussion activity

- Write down 2 questions that you think still need to be answered in order to improve the representation problems in graduate physics.
- Write down 2 factors that you think may impede implementation of reform.