Where do instructors come from? An analysis of influential institutions on current and future faculty.

Daniel Z. Grunspan[1,2,3], Anna Abraham[2,3], Sara Etebari[2,3], Samantha Maas[2,3], Julie Roberts[2,3], and Sara E. Brownell[1,2,3]
[1]Center for Evolution and Medicine, [2]Biology Education Research Lab, [3]School of Life Sciences, Arizona State University

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Background

- Pedagogical reform at a large scale is a slow process.
- We are interested in understanding routes to expediting this reform.
- Our approach considers that past educational experiences may influence current faculty practices.
  - This includes exposures and experiences as an undergraduate student, a graduate student, and faculty.
- Institutions responsible for training future faculty might have an influence on how they teach.
- We are studying patterns in where current physics faculty received their undergraduate and graduate degrees.
- This information can indicate both opportunities and barriers for large scale pedagogical reform.
- Previous research uncovered an imbalance in the production of faculty by doctoral universities[1].
- We follow up on this work and a prior model of pedagogical change in academia[2] by examining the balance of faculty production by undergraduate universities

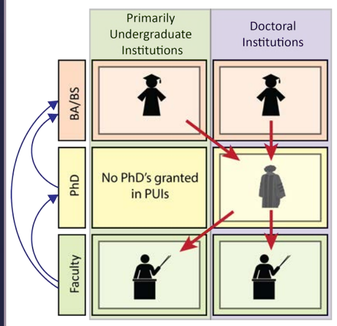
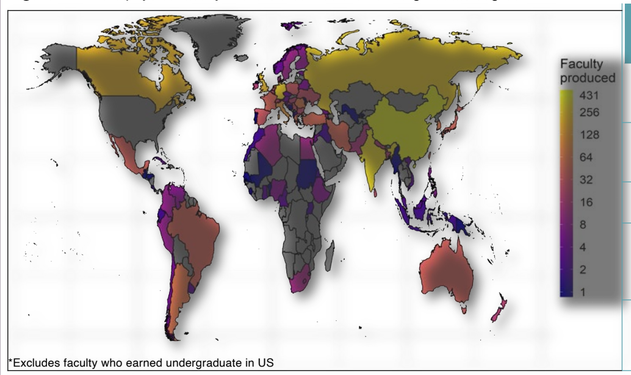


Figure A: All faculty experience college classrooms from the perspective of their own undergraduate and graduate school experiences before they ever teach their own college course. What these faculty experience during these periods of professionalization has implications for how they go on to teach. These experiences are shaped by where they earned their degrees and the professors and graduate student instructors that taught them (curved purple arrows). Not all universities train the same number of future professors. First, many universities do not have PhD programs, though they must hire faculty who came from other universities that do. Second, some universities may train more future faculty than others.

Non-US institutions train a large number of faculty

Figure B: Where physics faculty in the US earned their undergraduate degree

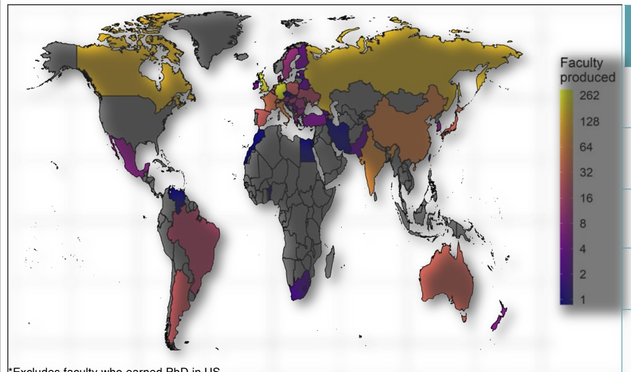


*Excludes faculty who earned undergraduate in US

Table 1 Most Common Non-US Undergraduate-Granting Institutions

Country			
	Moscow Institute of Physics and Technology	91	Cornell University (89)
	University of Science and Technology of China	80	University of Chicago (76)
	Peking University	69	Yale University (69)
	University of Cambridge	56	University of Illinois at Urbana-Champaign (55)
	Lomonosov Moscow State University	45	University of Wisconsin-Madison (46)

Figure C: Where physics faculty in the US earned their PhD

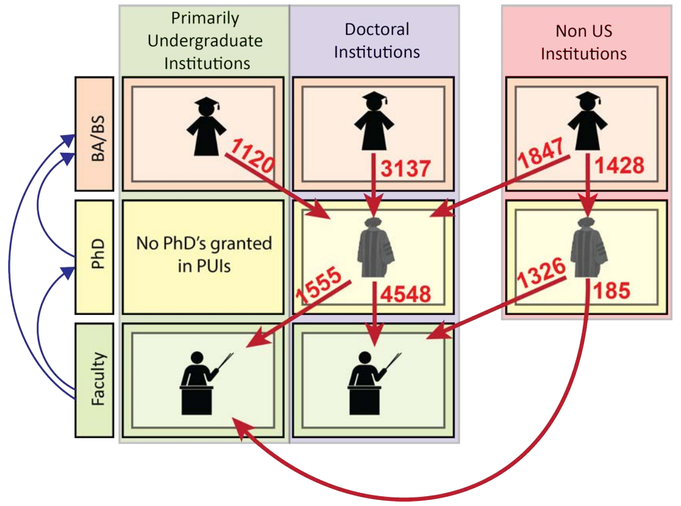


*Excludes faculty who earned PhD in US

Table 2 Most Common Non-US PhD-Granting Institutions

Country			
	University of Cambridge	69	Pennsylvania State University-Main Campus (73)
	Russian Academy of Sciences	67	Purdue University-Main Campus (60)
	University of Oxford	48	University of Virginia-Main Campus (49)
	University of Toronto	39	Rutgers University-New Brunswick (40)
	Lomonosov Moscow State University	26	Lehigh University (26)

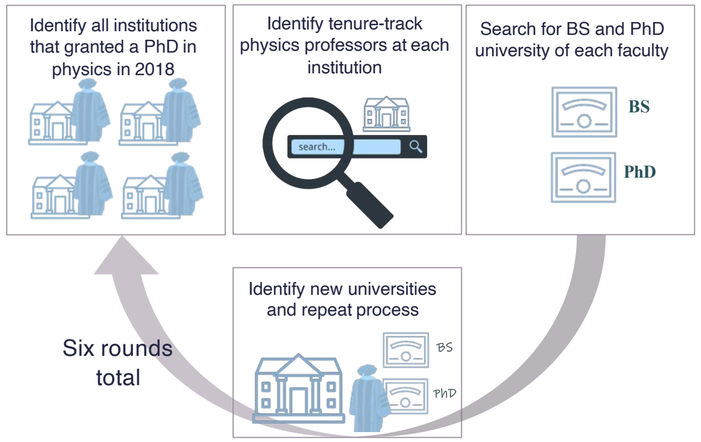
Figure D



- Around 40% of all TT faculty in physics had their first experiences with undergraduate classrooms occur in institutions outside of the US.
- We originally conceptualized a model of pedagogical influence and change that assumed a closed and insular system.
- However, this assumption is inappropriate given the large number of faculty who received their training outside the US.
- Understanding how the undergraduate and graduate experiences of these faculty integrate into their own teaching beliefs and practices will be an important step toward improving higher education.

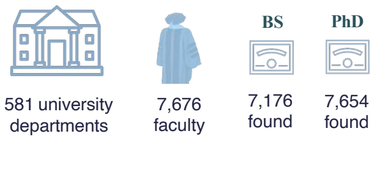
Methods

Data collection



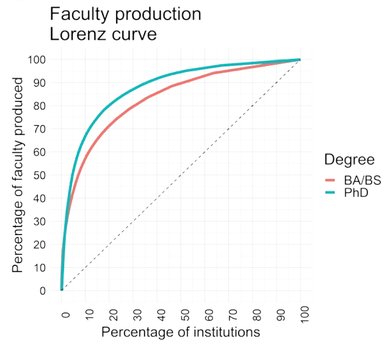
Dataset

Round	Universities	Faculty
1	175	5631
2	262	1916
3	111	602
4	26	117
5	4	12
6	2	12



Faculty production

Figure E



Most of the 7,676 TT faculty in the US were trained by a small fraction of universities.

The PhD line shows what percent of universities awarded what percent of these faculty their PhD degrees. The percent of universities is out of 594 US and Foreign universities that granted a PhD to at least one TT faculty in the dataset. The Gini coefficient for PhDs is 0.76.

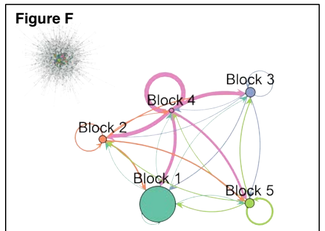
The BA/BS line shows what percent of universities awarded what percent of these faculty their undergraduate degrees. The percent of universities is out of 1,220 US and Foreign universities that granted an undergraduate degree to at least one TT faculty in the dataset. The Gini coefficient for BA/BS is 0.66.

A Gini coefficient of 0 = perfect equality; 1 = complete inequality.

University networks

Undergraduate → Faculty

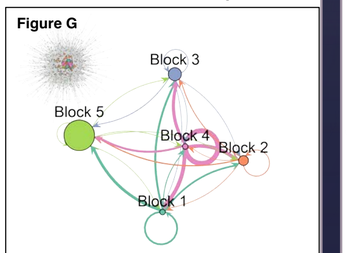
Figure F



Block	# of Uni's	Description
1	1114	Smaller and less elite US and foreign programs
2	32	Large elite US programs
3	60	Large less elite US programs
4	6	Most elite US programs
5	54	Small elite US programs and elite foreign programs

PhD → Faculty

Figure G



Block	# of Uni's	Description
1	12	Very large and elite US programs
2	58	Large elite US programs
3	121	Smaller less elite US programs
4	12	Most elite US programs
5	832	Small less elite US programs and foreign programs

The professionalization networks included many universities (Undergrad→Faculty: 1,266; PhD→Faculty: 1,035). Block modeling was used to reduce the complexity in these networks, uncover structural patterns, and highlight roles different universities play in the professionalization of faculty. Universities were clustered by structural equivalence using Euclidean distance. Even though this method clusters universities only using their shared connections in the network, the blocks that were formed included universities that shared many characteristics.

Discussion and future directions

- Most faculty earn their degrees at the same set of elite institutions that are densely connected to one another and core central to all other universities.
  - The imbalance at the level of undergraduate degrees mirrors current and previous findings at the level of graduate degrees[1].
- Because experiences as a student influence future teaching decisions[3], this handful of universities that make up this core may be key to future pedagogical reform.
  - For example, requiring all students at universities that produce the majority of future faculty to graduate with a baseline knowledge of evidence-based pedagogy may expedite pedagogical reform.
- The large number of TT faculty whose undergraduate and graduate experiences come from non-US institutions illustrate that this is an "open-system."
- We are now interested in exploring:
  - How pedagogical experiences differ by where one went to school.
  - Whether and how instructors from different cultural backgrounds integrate past experiences into their US classroom.

Citations

1. Clauset, A., Arbesman, S., & Larremore, D. B. (2015). Systematic inequality and hierarchy in faculty hiring networks. *Science advances, 1(1),* e1400005.
2. Grunspan, D. Z., Kline, M. A., & Brownell, S. E. (2018). The Lecture Machine: A Cultural Evolutionary Model of Pedagogy in Higher Education. *CBE—Life Sciences Education,* 17(3), es6.
3. Oleson, A., & Hora, M. T. (2014). Teaching the way they were taught? Revisiting the sources of teaching knowledge and the role of prior experience in shaping faculty teaching practices. *Higher Education,* 68(1), 29-45.