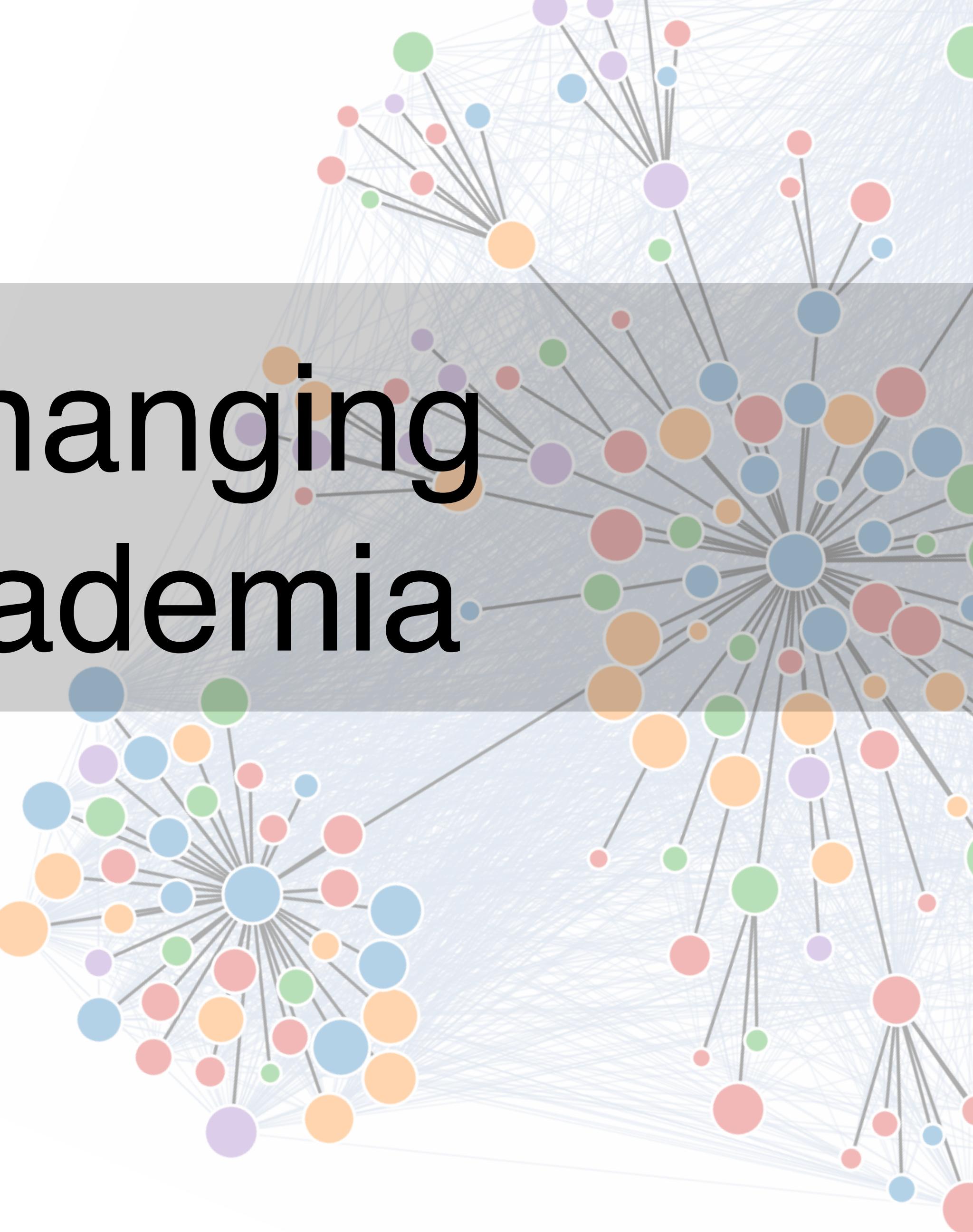


# Faculty hiring and changing representation in academia

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*"little in academia makes sense except in light of prestige"*



# this talk

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who produces the scientific workforce?



who gets to *be* faculty?



changing representation in academia



(long term) how does faculty composition shape what discoveries are made?

# who produces the scientific workforce?

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faculty are special 

- make scientific discoveries
- produce scholarship
- train future scientists
- have long, stable careers



*who hires whose graduates as faculty?*

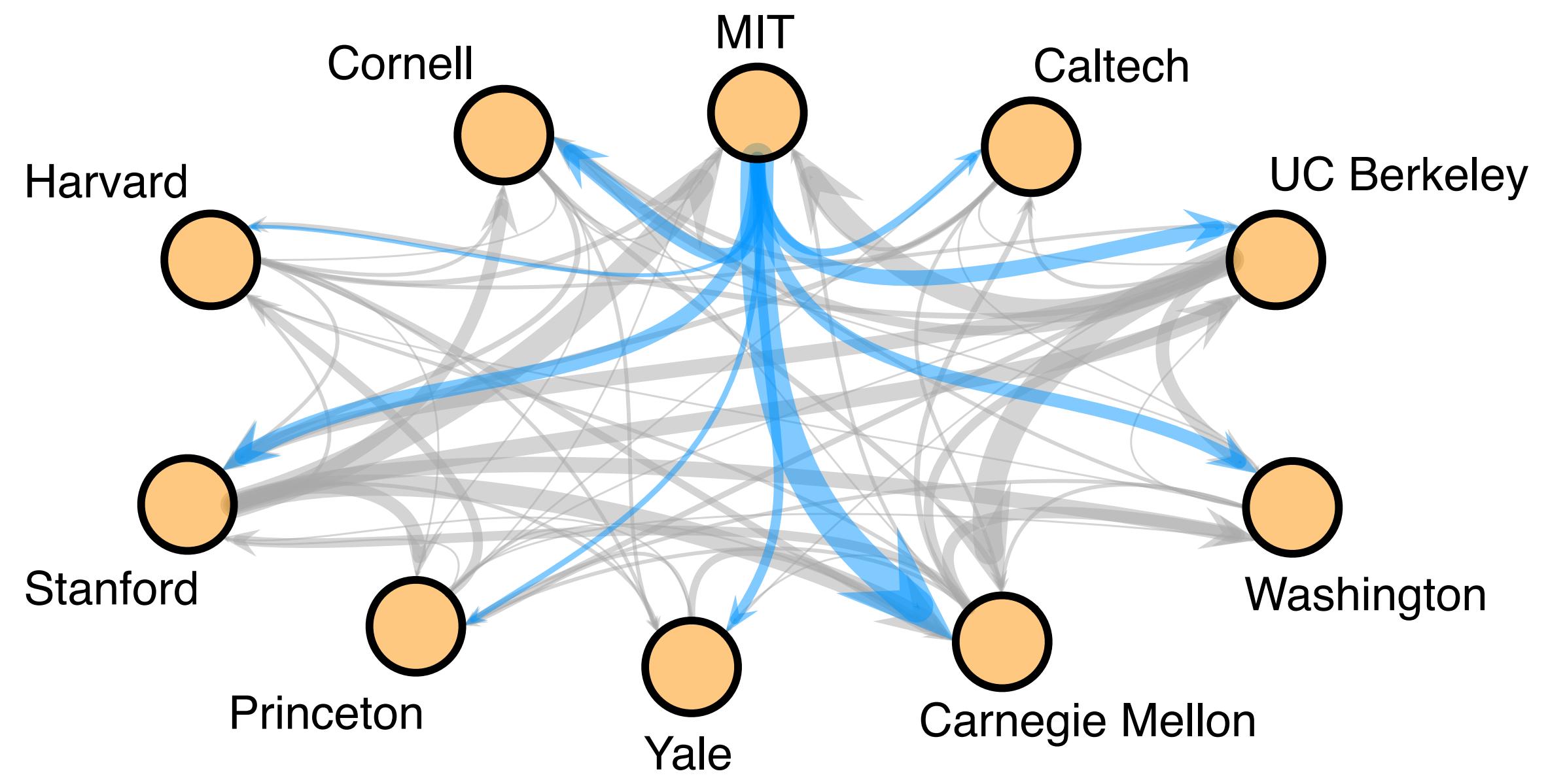
# who hires whose graduates as faculty?

faculty hiring is a *network*

- vertices are PhD-granting universities
- consumers  $\leftrightarrow$  producers
- $v$  hires from  $u$ , add an edge  $u \rightarrow v$

to investigate, we hand-collected data

- Computer Science + History + Business
- PhD  $\rightarrow$  faculty transitions for 19,000 faculty
- 461 PhD-granting departments



# who hires whose graduates as faculty?

difficult to talk about *hiring* without talking about *prestige*

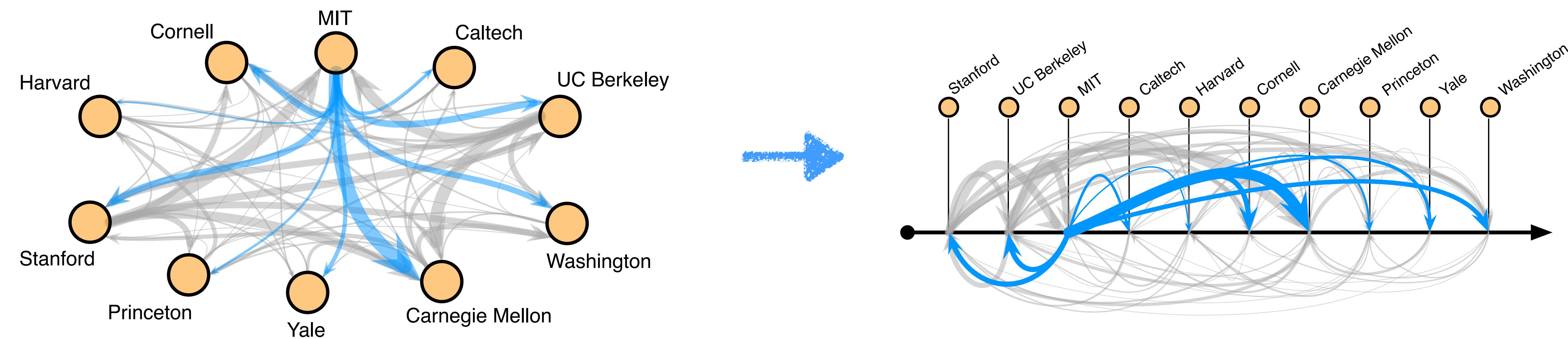
but not USNews rankings 😞

💡 we can use the network to *infer* prestige

here: minimum violation rankings, select ranking  $\pi$  that minimizes "rank violations" :

edges  $(u, v)$  where  $\pi_v < \pi_u$

interpretation: higher-ranked nodes have greater *placement power*



there are many ways to extract a ranking from a network  
Minimum Violation Rankings (MVRs) are equivalent to solving the MINIMUM FEEDBACK ARC SET problem (NP-hard)  
prestige in the sense of [Burris \(2004\)](#), as a form of social capital; many papers have analyzed faculty hiring networks since, all showing similar results

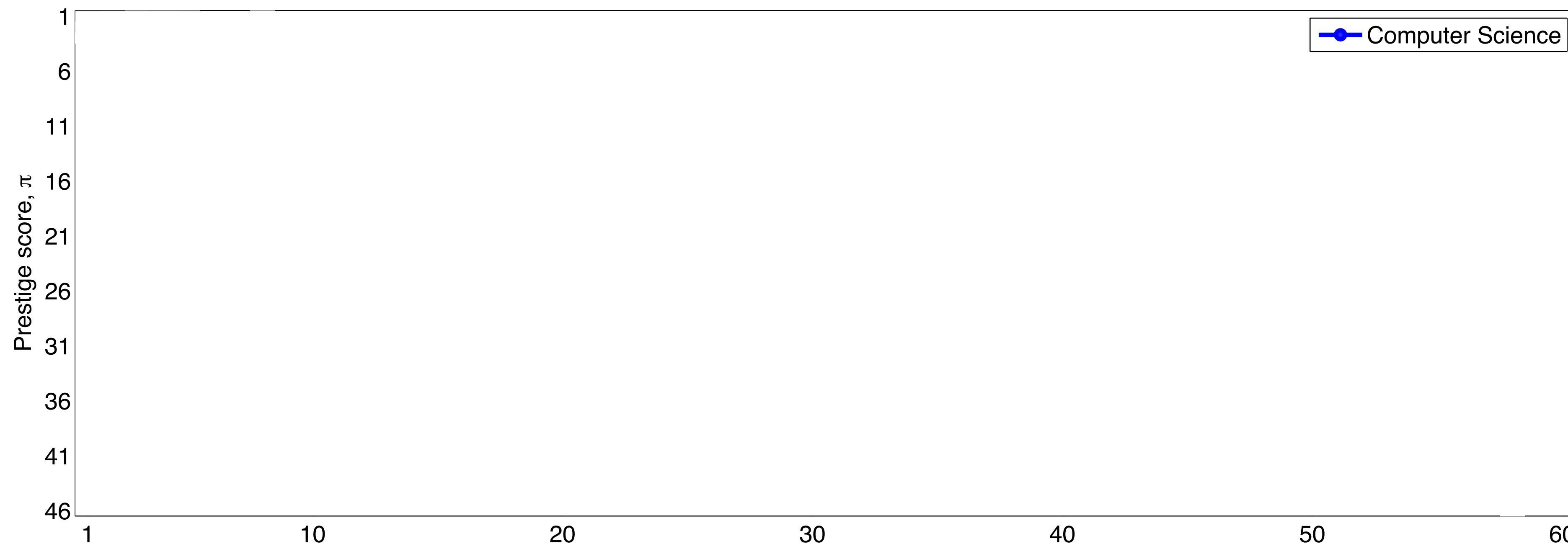
# who hires whose graduates as faculty?

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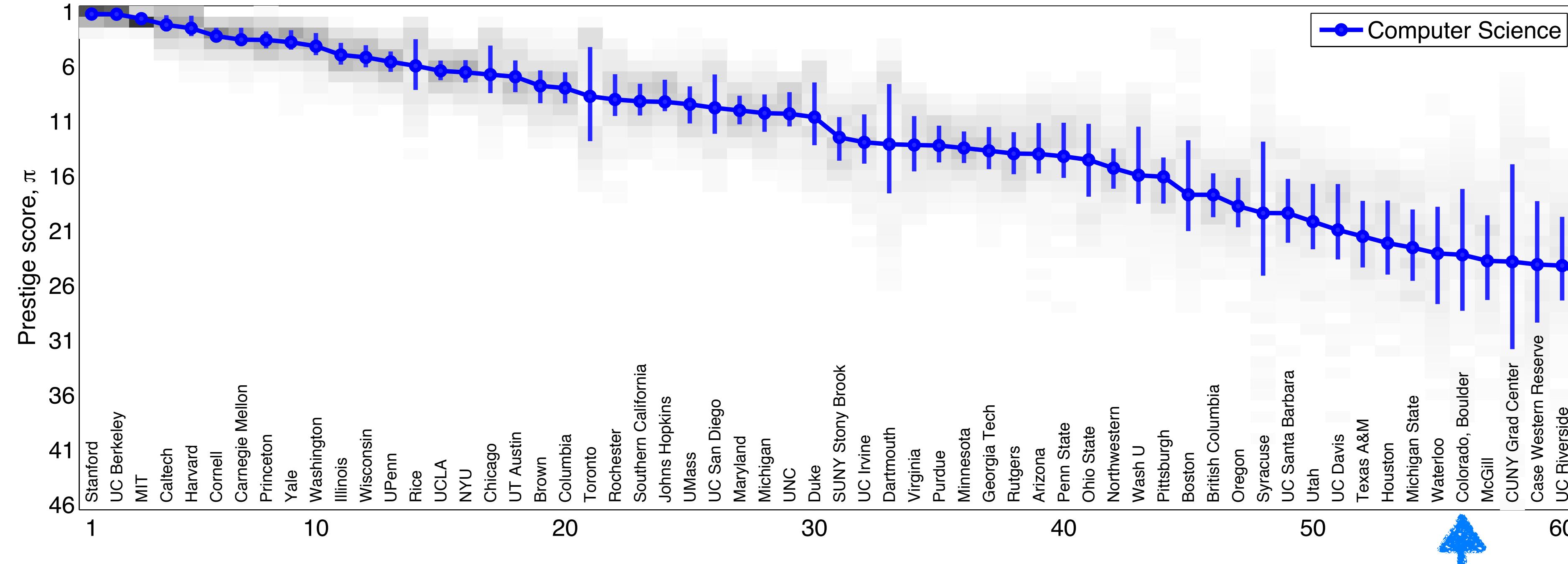
first, check that these prestige rankings are useful

then, examine faculty hiring networks through the lens of prestige...

# who hires whose graduates as faculty?



# who hires whose graduates as faculty?

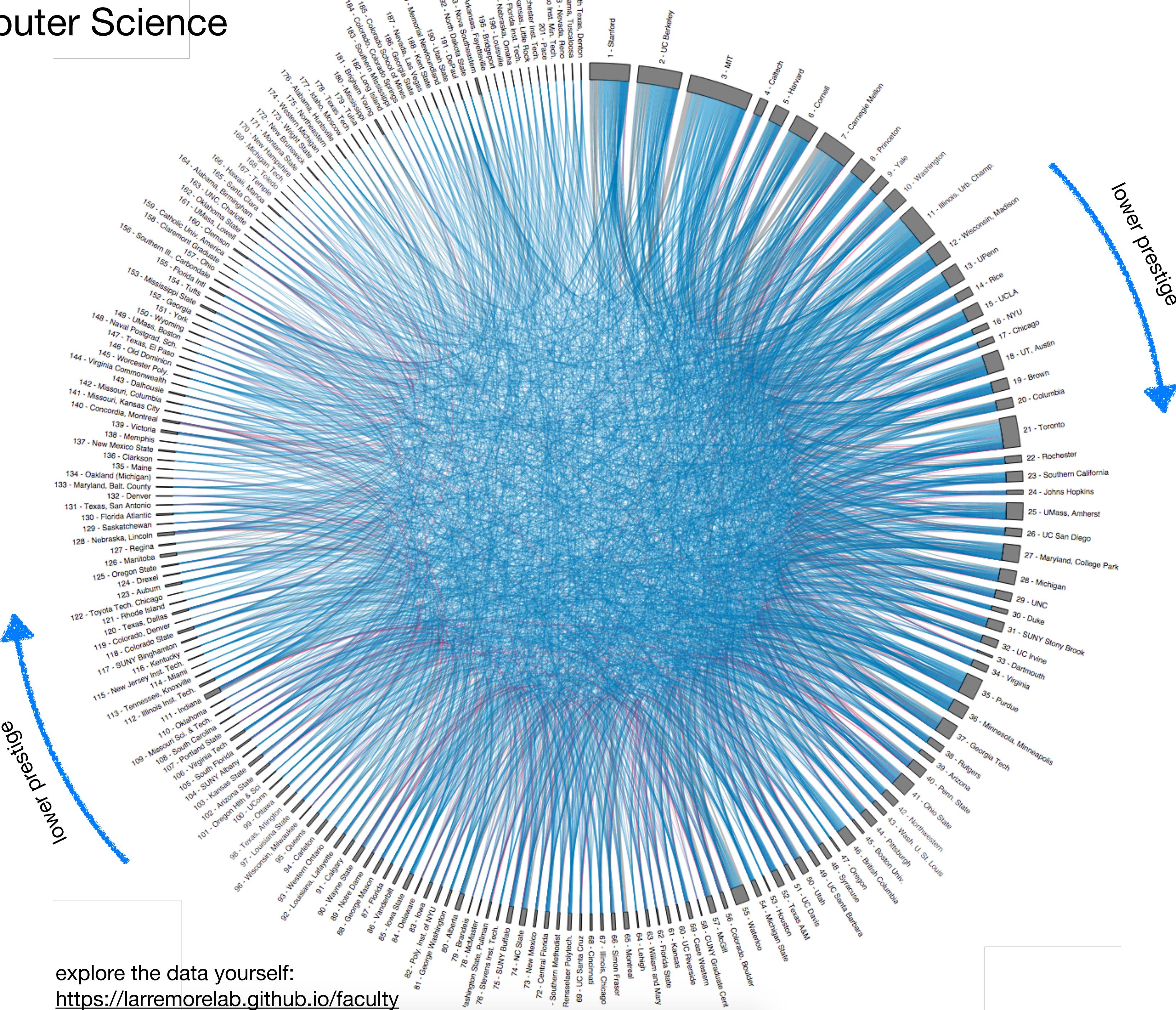


prestige  $\pi$  correlates with USNews & NRC, but is *more predictive* of placement

- ✓ correlates with underlying social dynamics that shape the field
- ✓ uncertainty lowest among highest prestige nodes
- ✓ similar results, but different orderings for *Business* and *History*

# Computer Science

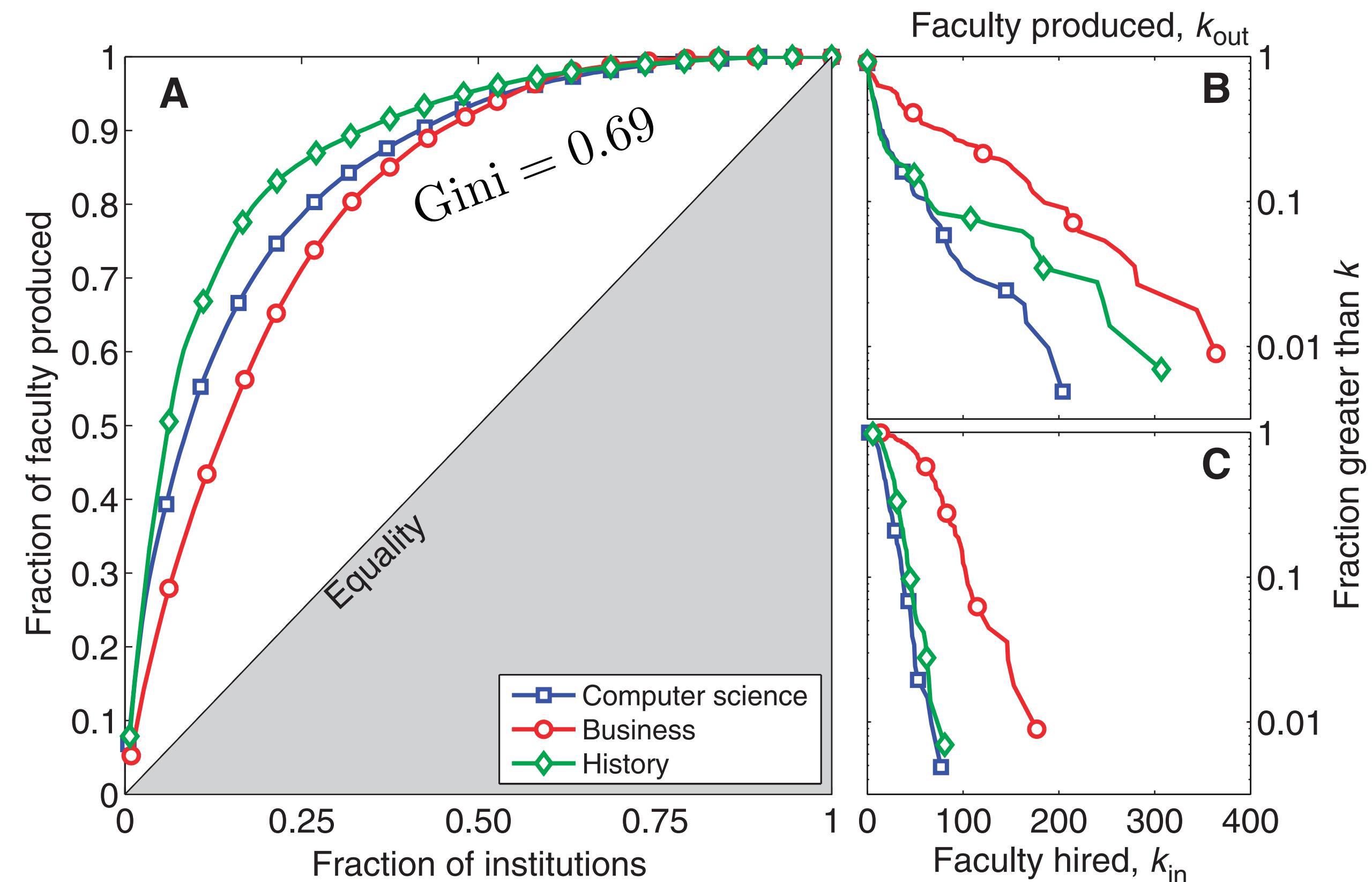
explore the data yourself:  
<https://larremorelab.github.io/faculty>



# who hires whose graduates as faculty?

across hierarchy, enormous inequalities

- faculty production *highly concentrated*
- 18 departments (9%)  50% of all faculty
- most departments (75%) are net *consumers* [more faculty hired than produced]
- top 10 departments produce  
1.6x more than depts. 11-20  
3.1x more than depts. 21-30



# who hires whose graduates as faculty?

most placements, far down hierarchy

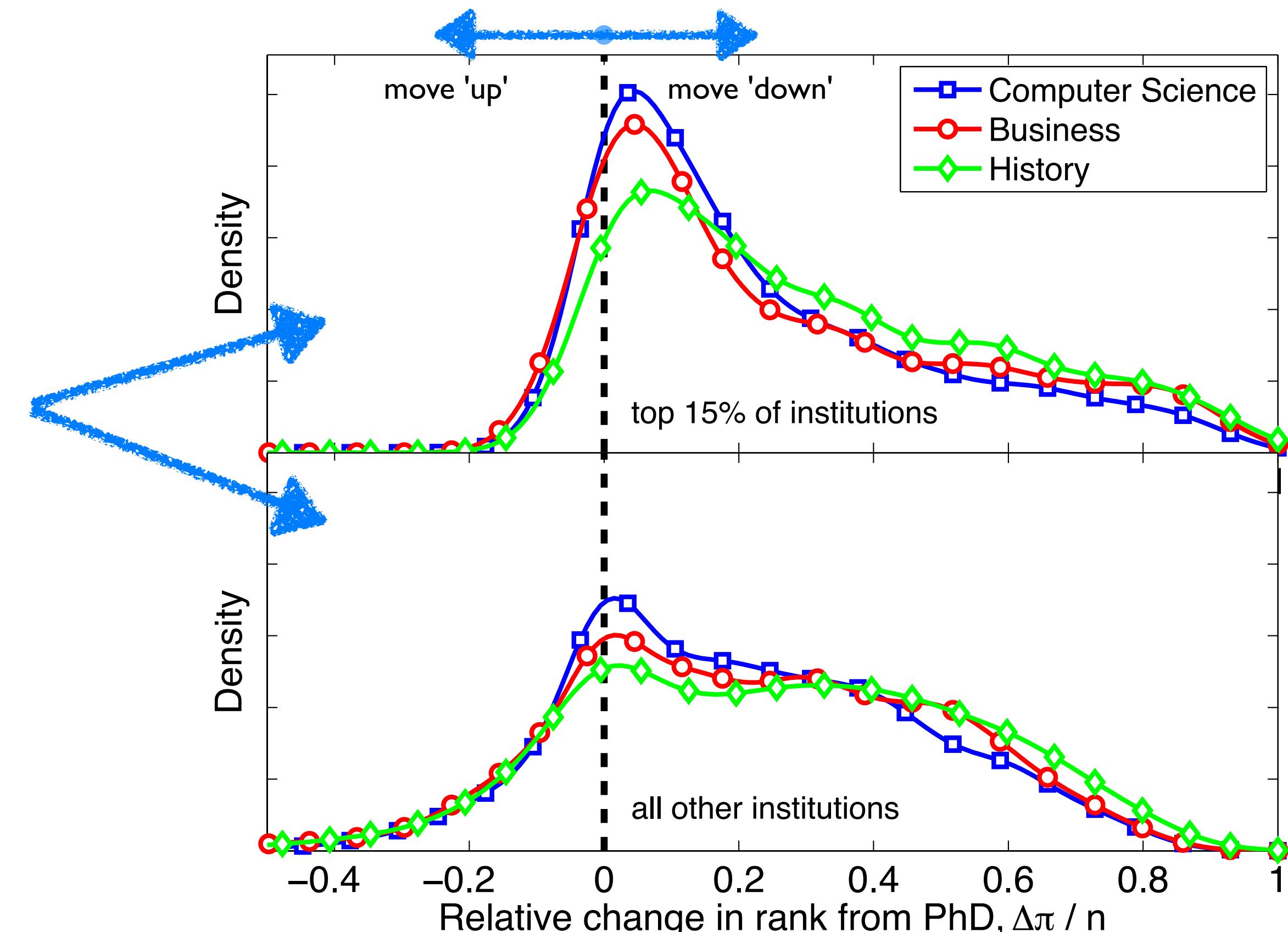
## Computer Science

- ▶ 80% move down
- 8% self-hires
- 12% move up

average = 47 steps down

a rich club:

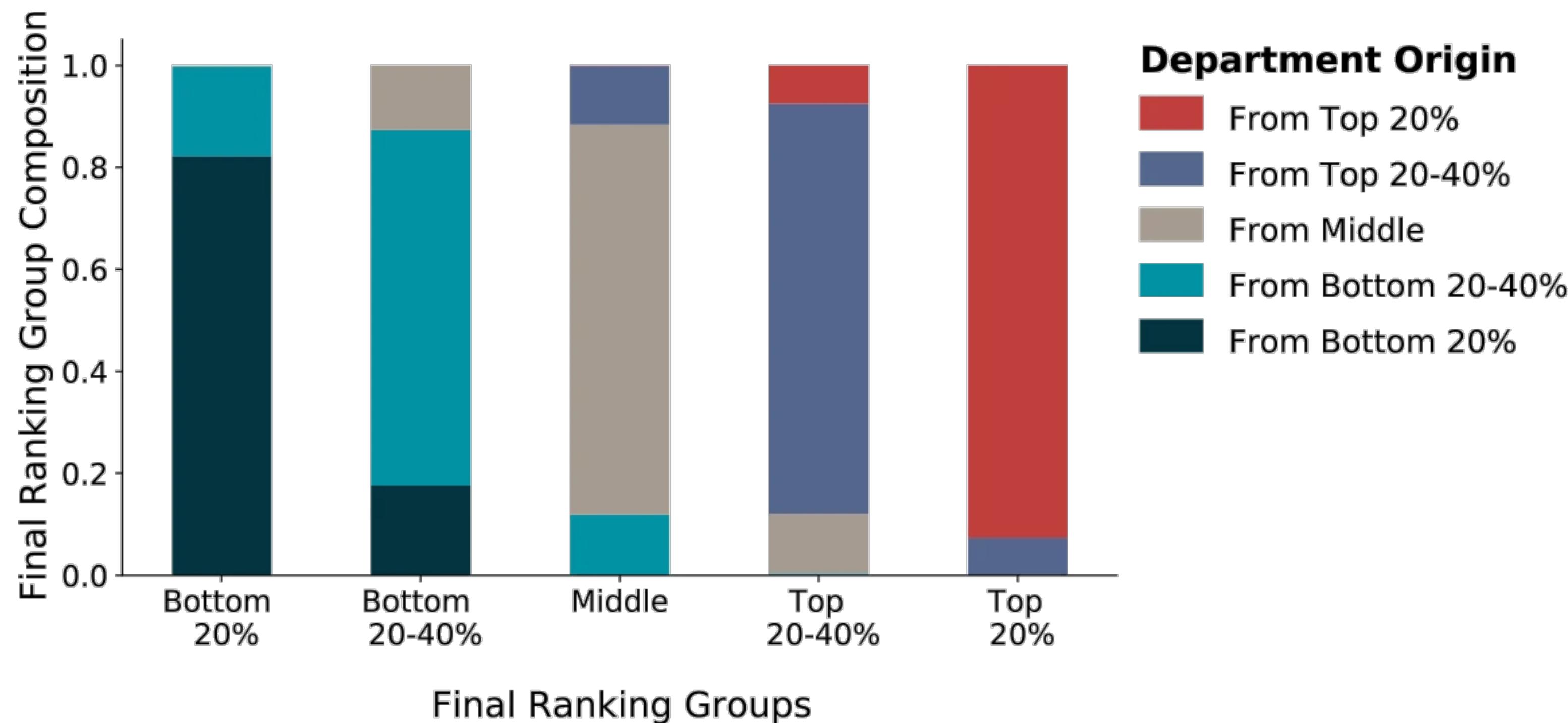
- top 15% of depts. produce 68% of their own faculty
- and hire only 7% from outside top 25% of depts.



# who hires whose graduates as faculty?

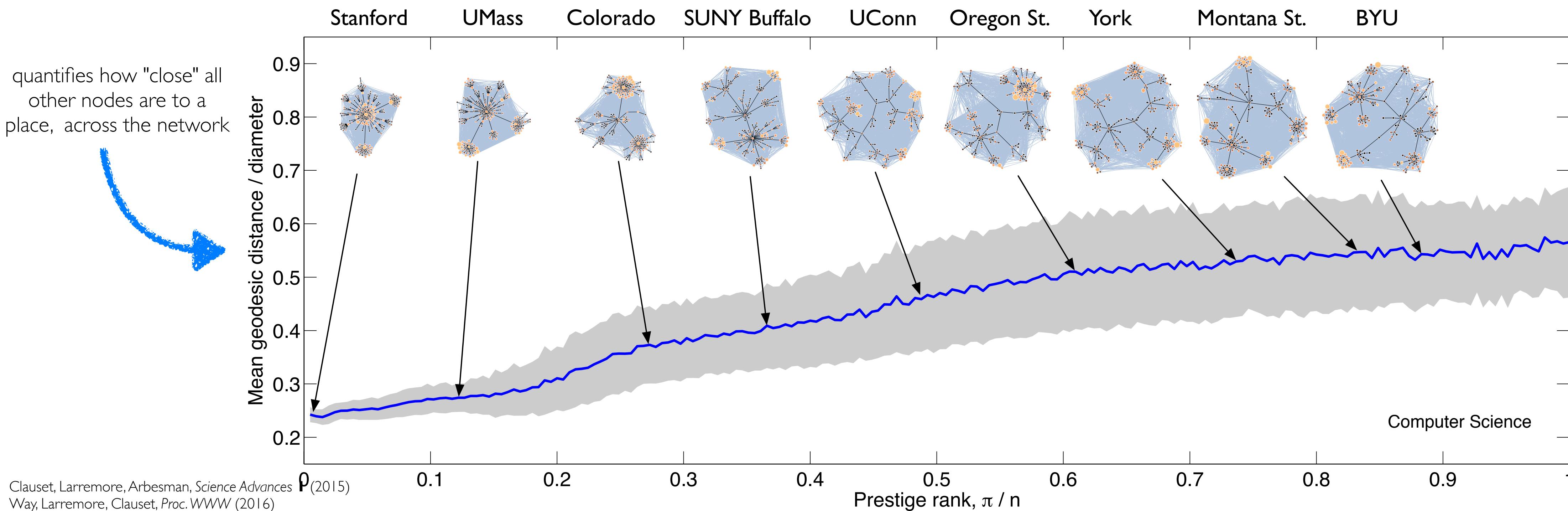
hiring hierarchies tend to be very stable over time

- ▶ model: hire noisily by hierarchy, update hierarchy, repeat; track institution prestige "drift"
- result: institutions largely fixed within their original prestige quintile



# who hires whose graduates as faculty?

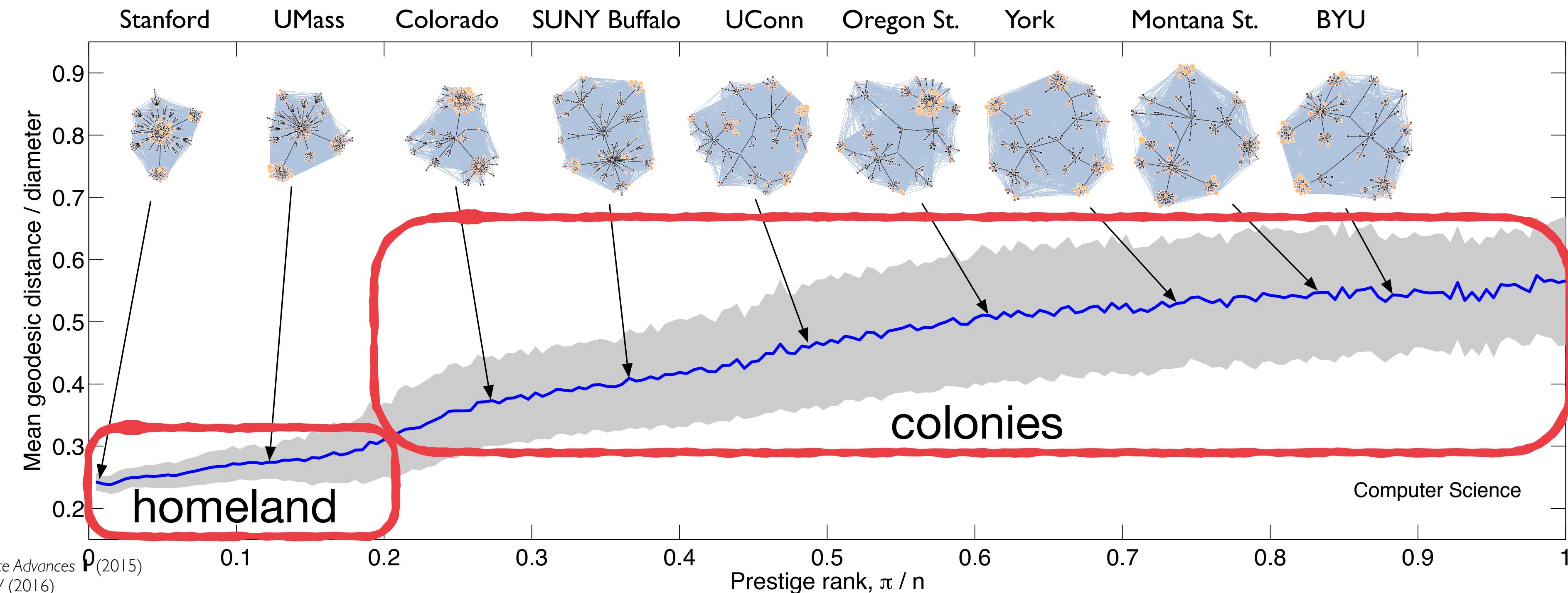
network organized as core and periphery : high ranked nodes are more central



# who hires whose graduates as faculty?

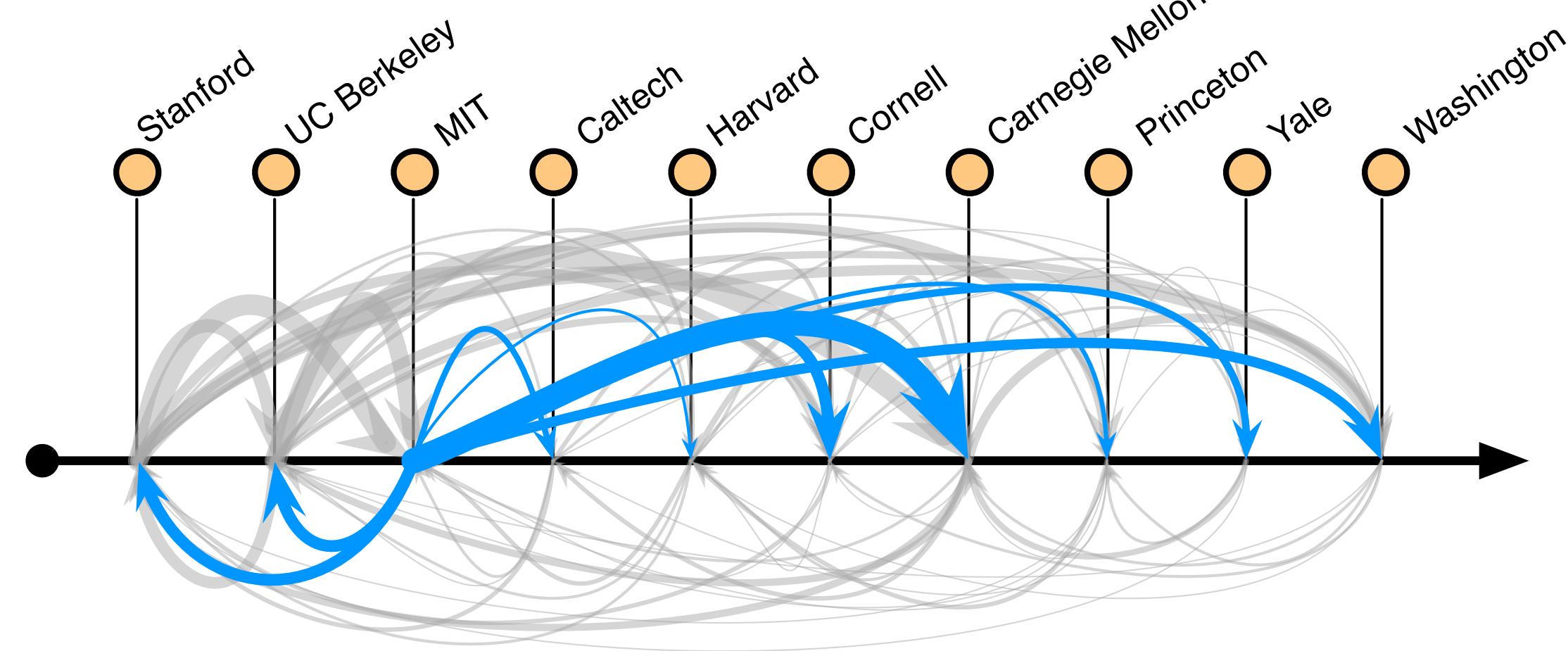
network organized as ~~core and periphery~~ *homeland* and *colonies*

prestige → *influence* via doctoral placement  
over research agendas, research communities, and departmental norms across a field



# who hires whose graduates as faculty?

- ▶ prestige is a *structural variable* in academia
- placement power  $\pi$  quantifies reputation via outcomes (not inputs)
- reveals *core-periphery* structure of academia
  - faculty flow from core → periphery ("the colonies")
  - modest fraction stays inside core ("homeland")
  - small fraction flows "upstream"
  - these hierarchies extremely stable over time
- prestige → faculty production → hierarchy



# who gets to be faculty?

U.S. academia has never been *representative* of the U.S. population  
under-representation by race and gender are well studied

- ➔ what about socioeconomic background?
- how does SES intersect with representing of other social identities?

# study design

combine information on **faculty field, institution, SES** and **U.S. population comparisons**

## ► survey (2017-2020)

- $n=7218$  tenure track faculty [a 15.4% response rate]
- U.S. research intensive institutions (PhD-granting)
- 8 diverse academic fields

- This survey is about **patterns in faculty hiring, advancement, and productivity** in the North American academic system.
- It is currently open **only for tenured or tenure-track faculty in business or history**.
- The survey has 2 parts:
  - Part 1: Questions on sociodemographic characteristics (**1-2 minutes**)
  - Part 2: Questions on your experience as faculty (**10-12 minutes**)
- There is a \$500 cash lottery for participants. The winner will be informed by email.
- Personally identifiable information will be kept confidential.
- This study is IRB approved.

## ► reference populations

- NSF Survey of Earned Doctorates (SED)
- US Census (1940-2020)

The study "**Understanding the Network Structure and Dynamics of the Academic Scientific Workforce**" (CU IRB protocol no. 16-0441) is conducted by researchers from the University of Colorado at Boulder and the Santa Fe Institute. This study is supported by the NSF programs Science of Science & Innovation Policy, and the Science of Broadening Participation (SBE award 1633791).

Your participation is voluntary and you may stop at any time. Your answers will be used only in this study, except as required by law.

## ► institutions ( $n=450$ )

- prestige (ranking)

# socioeconomic roots of faculty

faculty tend to come from highly educated families

percent faculty parents highest educational attainment

	Elementary	Some HS	HS	Some College	College	Masters	PhD
All Professors							
Anthropology Professors							
Biology Professors							
Business Professors							
Computer Science Professors							
History Professors							
Physics / Astronomy Professors							
Psychology Professors							
Sociology Professors							
Survey of Earned Doctorates (NSF)	←	25.2	→	14.0	23.1	26.0	11.8
U.S. Population (Census)	8.7	10.5	35.6	23.1	14.6	6.5	0.9

percent reference population highest educational attainment

# socioeconomic roots of faculty

faculty tend to come from highly educated families

- ▶ half (51.8%) of all faculty have parent with MS or PhD
- quarter (22.2%) have parent with PhD → 2x PhD holders, 25x US population !

percent faculty parents highest educational attainment

	Elementary	Some HS	HS	Some College	College	Masters	PhD
All Professors	2.6	2.9	13.7	9.5	19.5	29.6	22.2
Anthropology Professors	0.8	2.2	15.1	7.0	19.0	32.8	23.0
Biology Professors	3.2	3.3	14.1	11.6	19.5	26.3	21.9
Business Professors	2.3	3.3	14.5	8.4	24.1	30.9	16.6
Computer Science Professors	3.2	3.4	10.8	8.9	21.6	26.1	26.0
History Professors	1.6	1.3	10.5	8.6	17.0	34.3	26.7
Physics / Astronomy Professors	4.1	4.1	12.1	10.2	18.2	27.4	23.9
Psychology Professors	1.6	2.1	17.4	9.9	17.0	31.1	20.7
Sociology Professors	1.8	2.7	17.3	7.1	17.3	34.9	18.9
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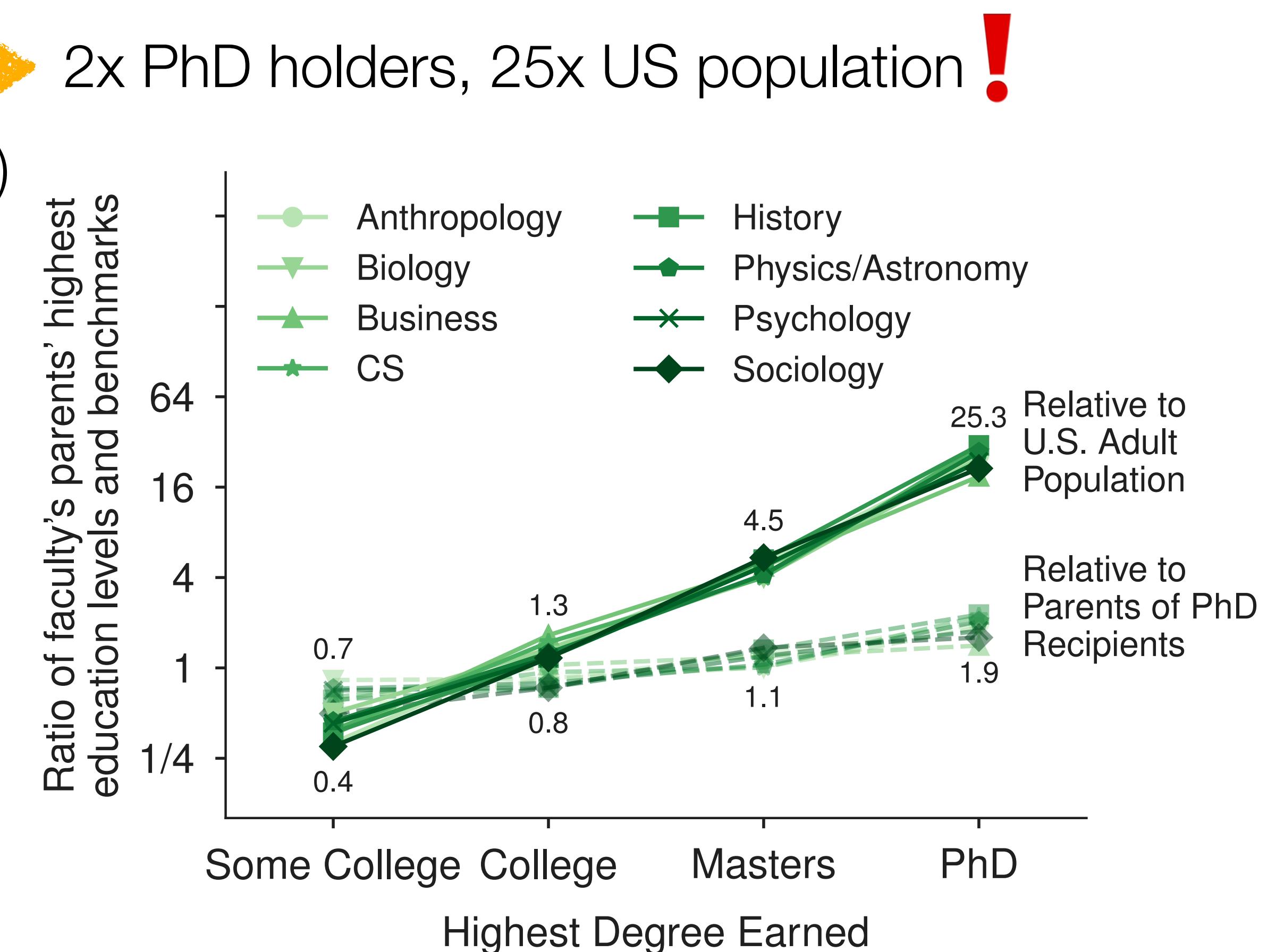
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# socioeconomic roots of faculty

faculty tend to come from highly educated families

- ▶ half (51.8%) of all faculty have parent with MS or PhD
- quarter (22.2%) have parent with PhD ➔ 2x PhD holders, 25x US population !
- it's universal (not field or domain specific)

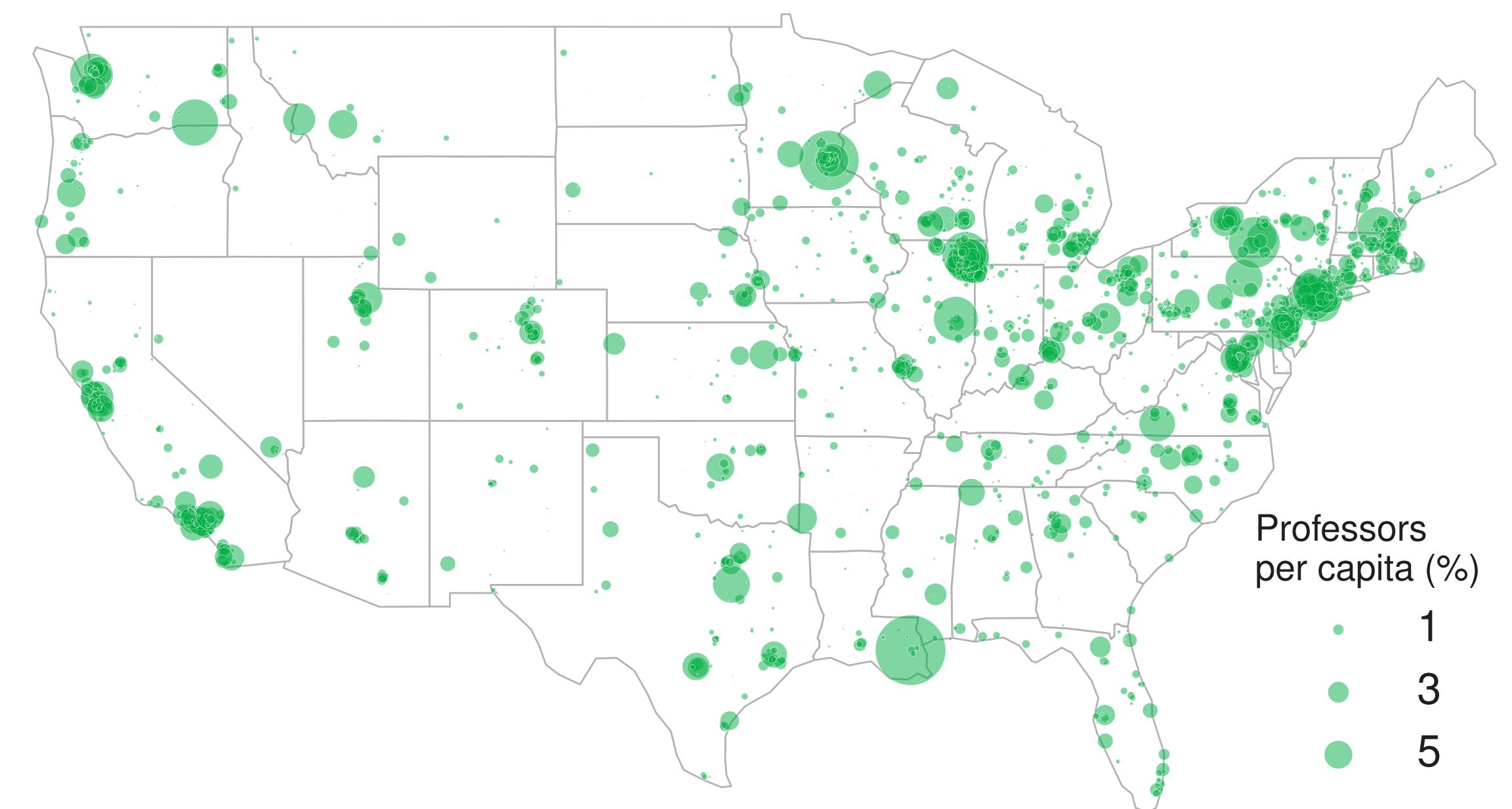
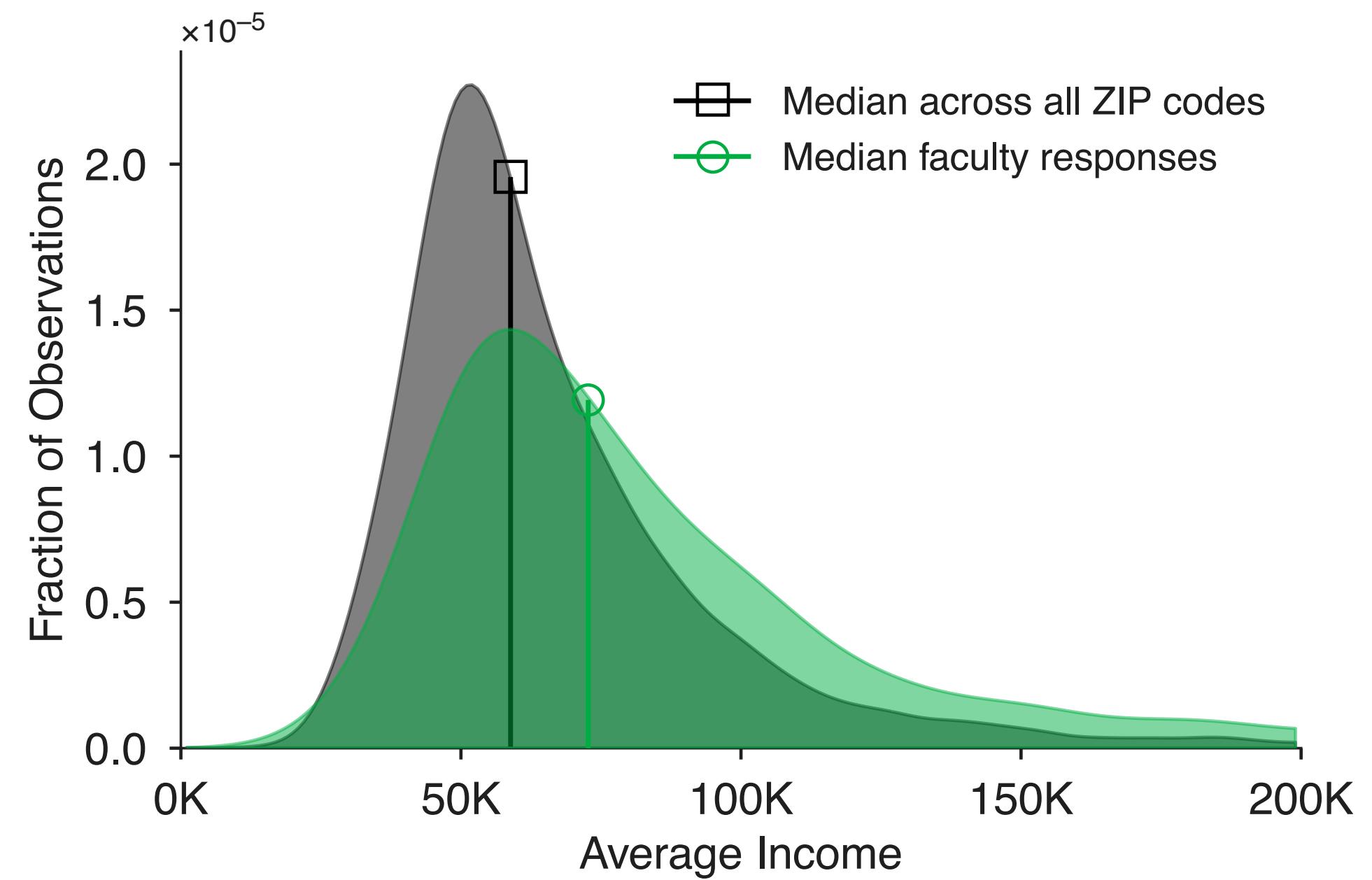
more education ➔ more likely as faculty parents



# socioeconomic roots of faculty

disproportionately from urban areas & wealthier ZIP codes

- likely caused by having higher SES parents



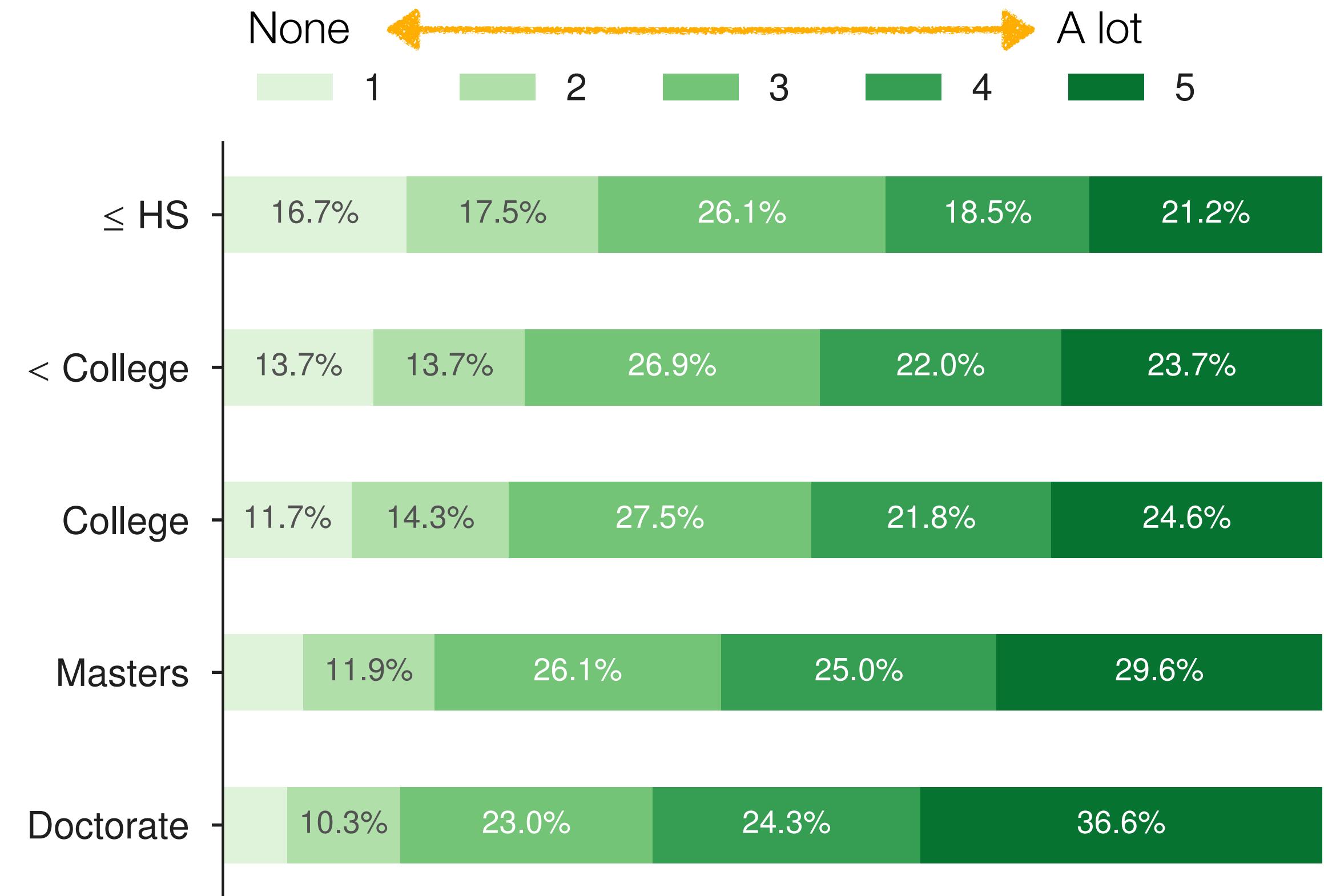
can you spot the urban centers?

# socioeconomic roots of faculty

parental education correlates with career support + encouragement

- 5-pt scale of support received from parents
- $\mu = 4.6$  (PhD parents) vs.  $\mu = 3.9$  (non-PhD parents)
- support independent of faculty gender

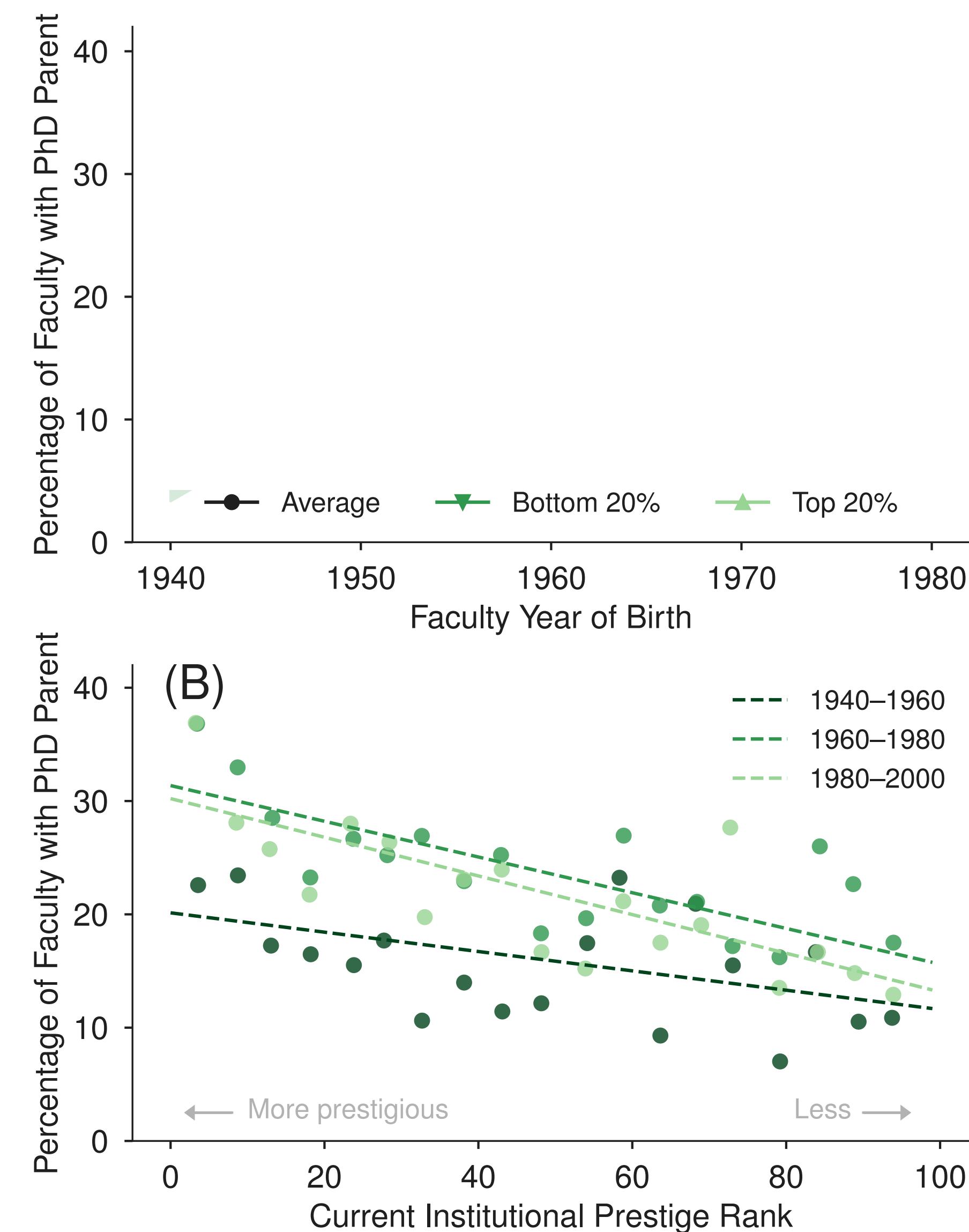
▶ social support likely *one of many* mechanisms by which SES shapes likelihood of becoming faculty



# socioeconomic roots of faculty

PhD parents correlates with more prestigious faculty jobs

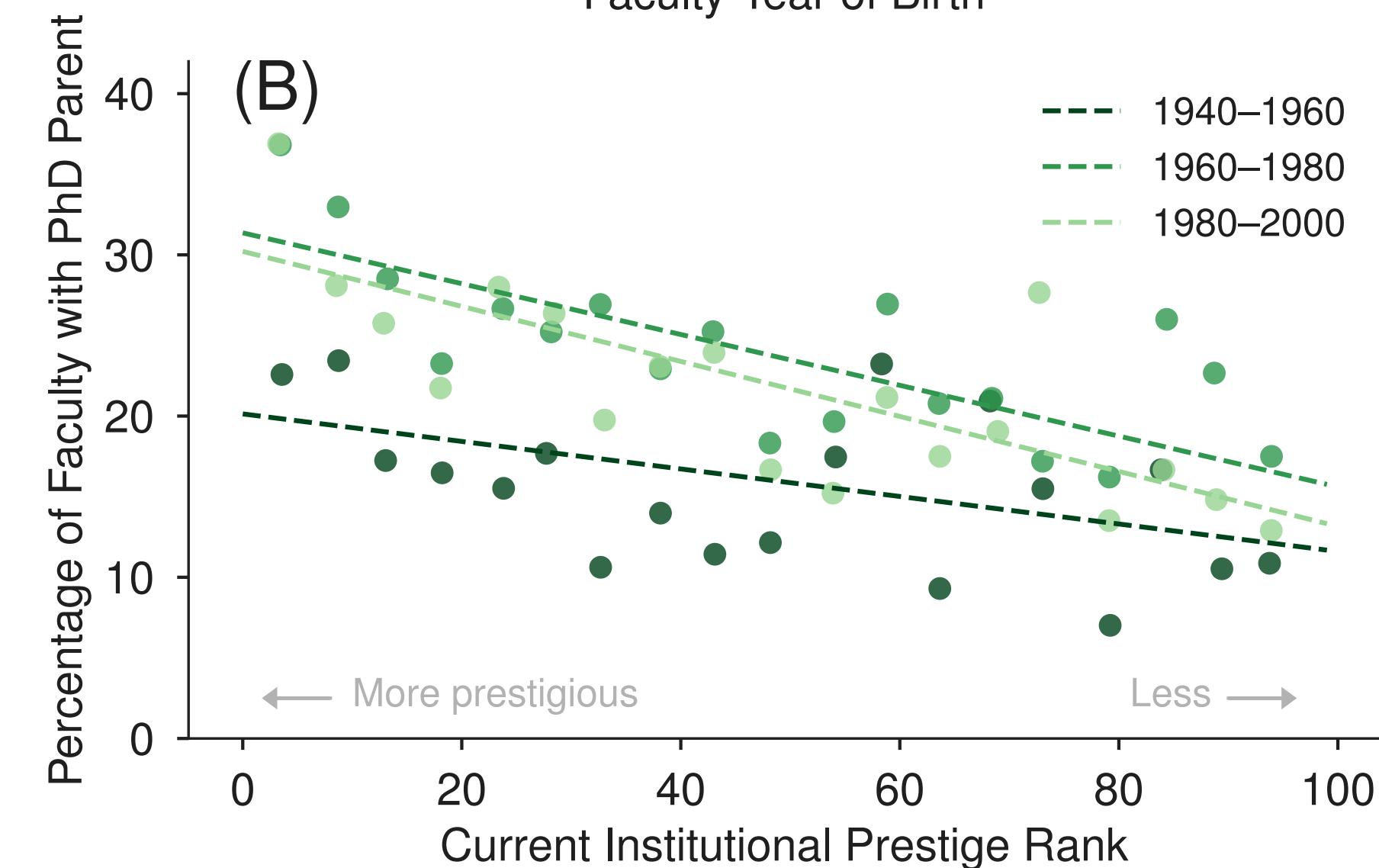
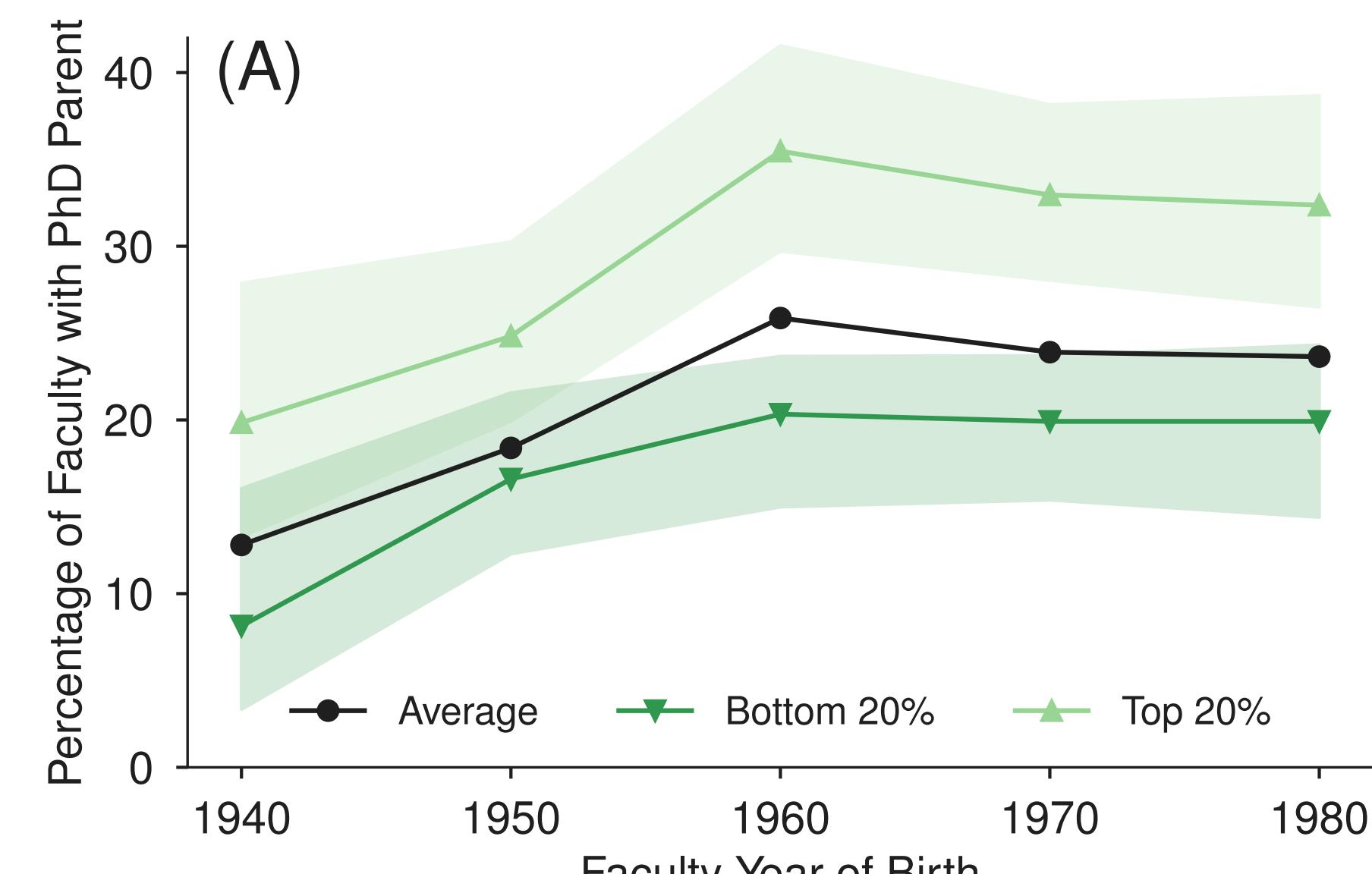
- ▶ faculty at elite universities are 2x more likely to have PhD parents than faculty *at other universities* (50x more than U.S. population!)



# socioeconomic roots of faculty

PhD parents correlates with more prestigious faculty jobs

- ▶ faculty at elite universities are 2x more likely to have PhD parents than faculty *at other universities* (50x more than U.S. population!)
- this effect has been stable for past 50 years
- 🤔 why should having PhD parents, or not, influence *how prestigious* the faculty job a person gets?



# who gets to be faculty?

"Talent is equally distributed but opportunity is not" — Leila Janah

- ▶ high SES backgrounds are *dramatically* over-represented in academia
  - faculty are  $25x$  more likely than U.S. pop to have PhD parents —  $50x$  if at elite university —  $2x$  compared to PhD holders in general
  - raised in more urban and slightly more wealthy ZIP codes
  - faculty with PhD parents receive more social support for faculty career + more likely to hold jobs at elite institutions → structural barrier to diversifying academia
  - race matters: White faculty  $1.4x$  more likely to have PhD parents than Black or Hispanic faculty → generational impediment to diversifying academia
-  *what impact is this having on our collective scholarship?*

# faculty hiring and representation

*"little in academia makes sense except in light of prestige"*

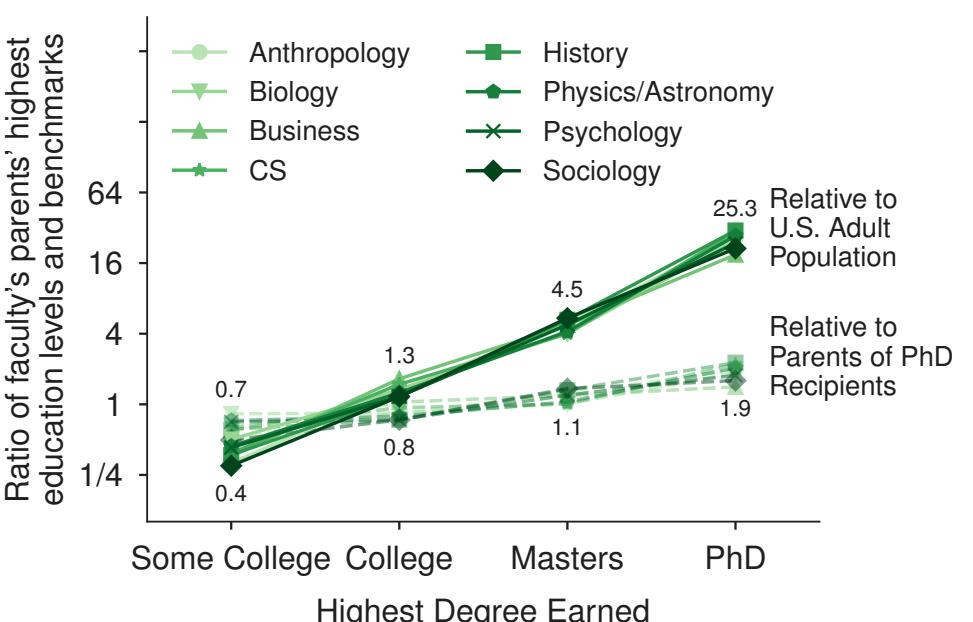
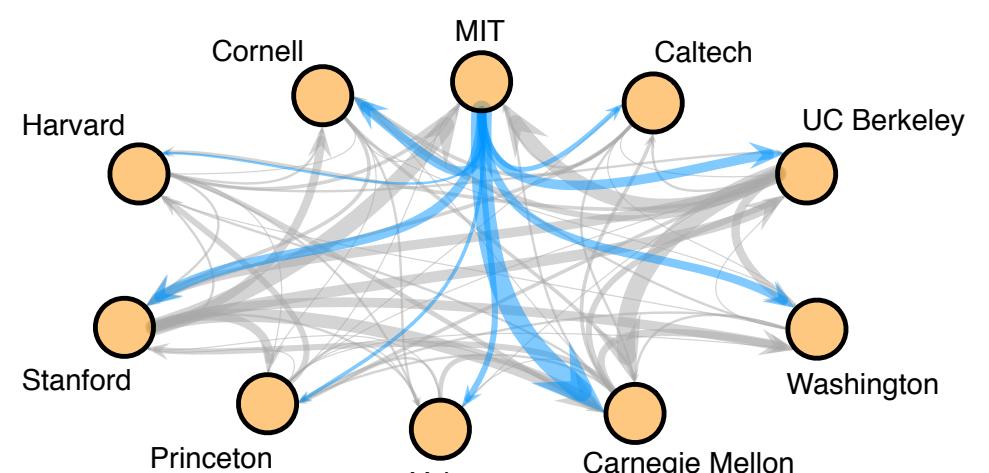


## ► faculty play a special role in science, but

- prestige drives who hires whose graduates as faculty
- top 20% of departments generate 80% of *all* faculty (universally!)
- placement power is *influence*, via doctoral placement

## ► high SES backgrounds are dramatically over-represented among faculty

- having PhD parents also correlates with more prestigious jobs
- structural and generational barriers to diversifying academia



# faculty hiring and representation

*"little in academia makes sense except in light of prestige"*



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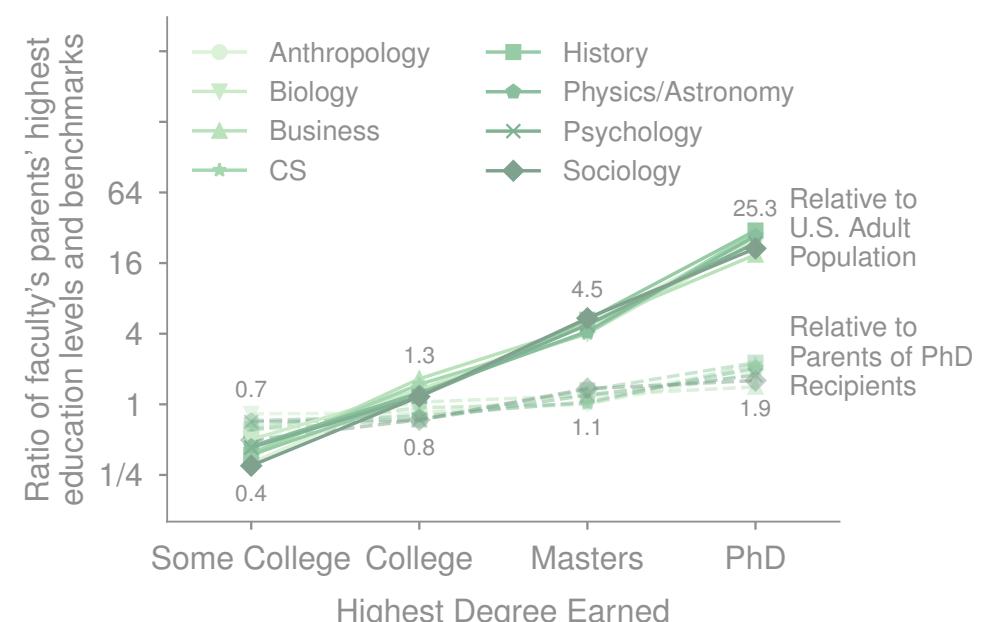
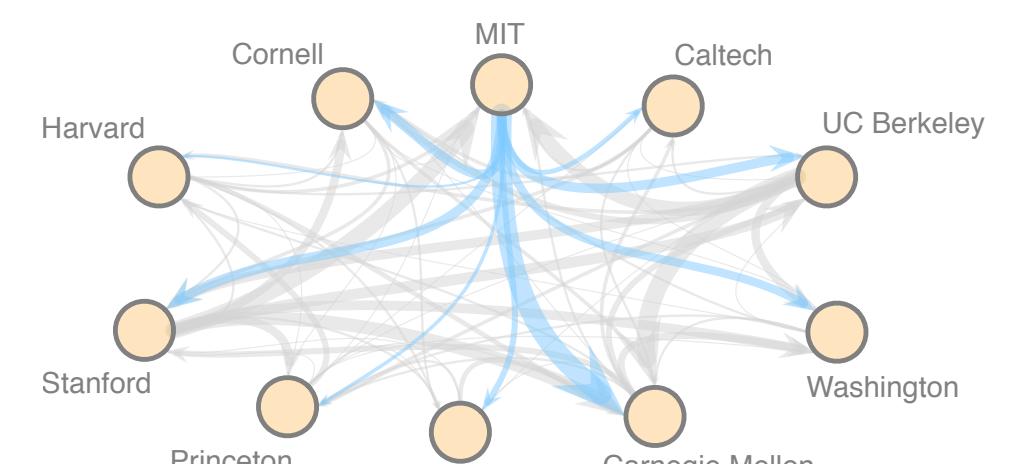
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▶ high SES backgrounds are dramatically over-represented among faculty

- having PhD parents also correlates with more prestigious jobs
- structural and generational barriers to diversifying academia

▶ but! elite department's placement power drives the composition of the field

- system-wide diversification efforts turn on who elite departments train



# references & collaborators

## NETWORK SCIENCES

### Systematic inequality and hierarchy in faculty hiring networks

Aaron Clauset,<sup>1,2,3\*</sup> Samuel Arbesman,<sup>4</sup> Daniel B. Larremore<sup>5,6</sup>

Science Advances **1** (2015)

## REGULAR ARTICLE

### The dynamics of faculty hiring networks

Eun Lee<sup>1,2\*</sup> , Aaron Clauset<sup>1,2,3†</sup> and Daniel B. Larremore<sup>1,2†</sup>

EPJ Data Science **10** (2021)

### Socioeconomic Roots of Academic Faculty

Allison C. Morgan,<sup>1,\*</sup> Nicholas LaBerge,<sup>1,†</sup> Daniel B. Larremore,<sup>1,2,‡</sup> Mirta Galesic,<sup>3,§</sup> and Aaron Clauset<sup>1,2,3,¶</sup>

<sup>1</sup>Department of Computer Science, University of Colorado, Boulder, CO, USA

<sup>2</sup>BioFrontiers Institute, University of Colorado, Boulder, CO, USA

<sup>3</sup>Santa Fe Institute, Santa Fe, NM, USA

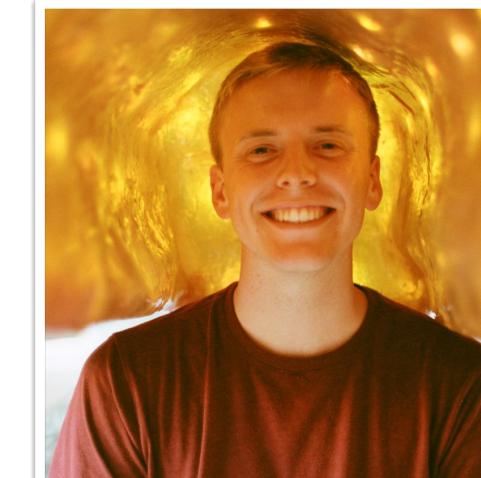
Preprint, socarxiv/6wjxc (2021)



Dr. Allison C Morgan  
(now at Twitter)



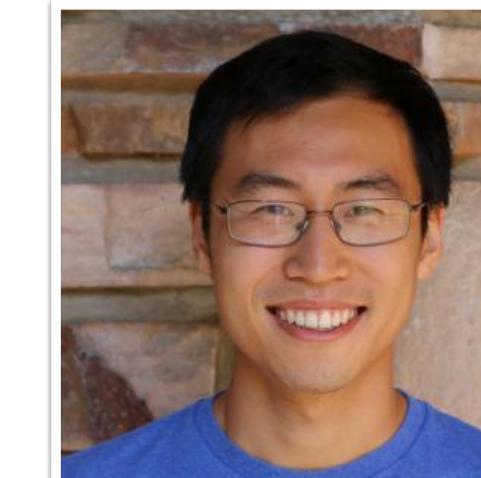
Dr. Eun Lee  
(Colorado)



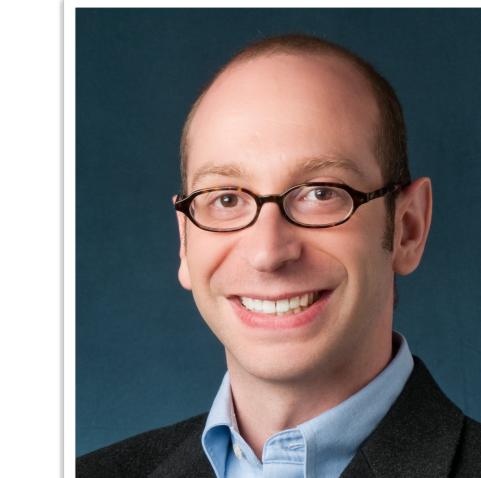
Nick LaBerge  
(Colorado)



K. Hunter Wapman  
(Colorado)



Sam Zhang  
(Colorado)



Dr. Sam Arbesman  
(Lux Capital)



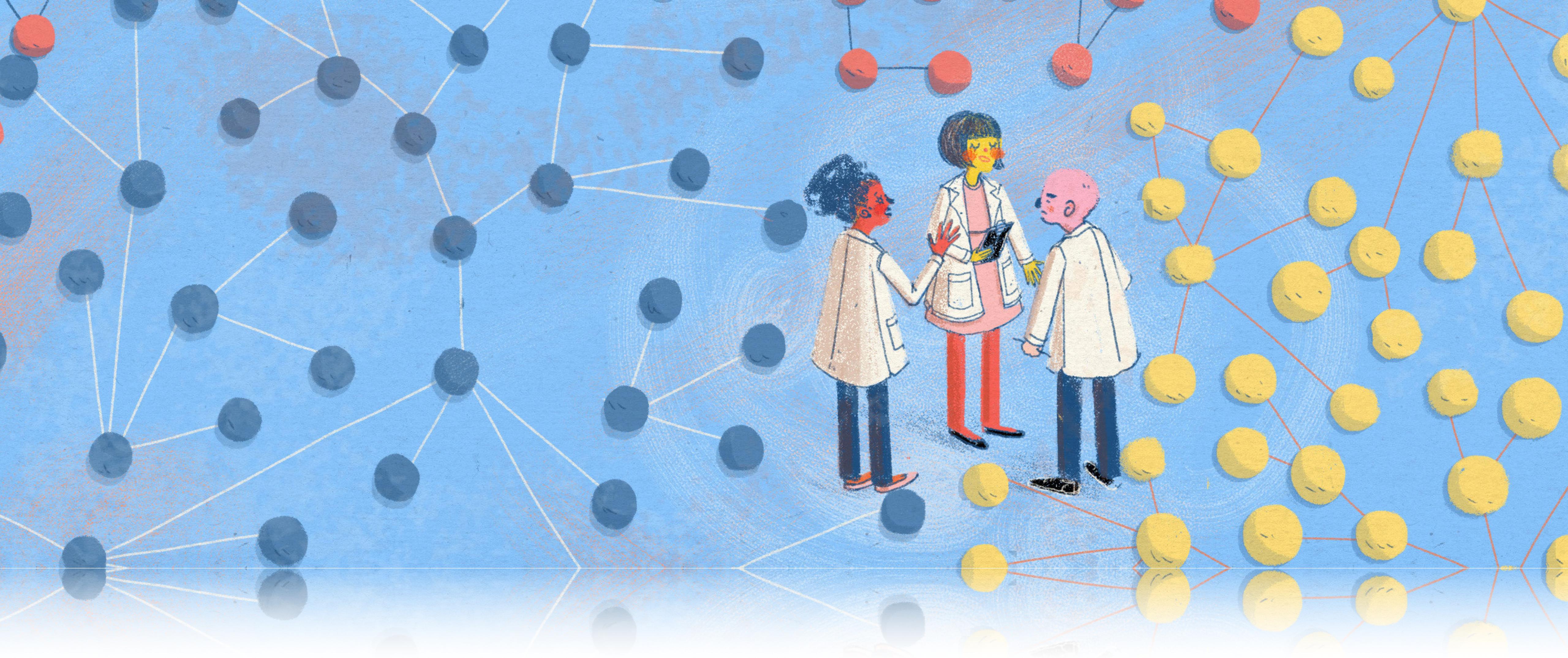
Prof. Mirta Galesic  
(Santa Fe)



Prof. Daniel B Larremore  
(Colorado)

Funding:





**fin**



**papers, code, data**

**<https://aaronclauset.github.io>**