

The assembly of prestige and status in networks featuring: academia, online dating, social support, birds, and sports

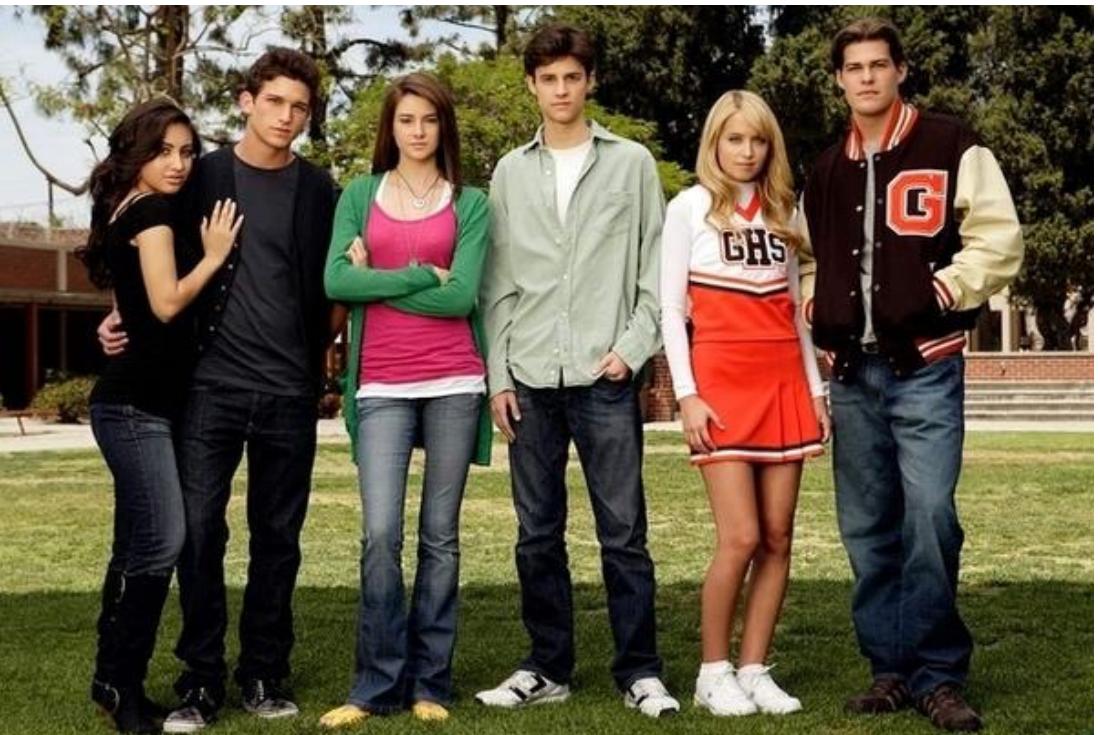
Daniel Larremore
BioFrontiers Institute & Dept. of Computer Science

15 August 2018
SICSS

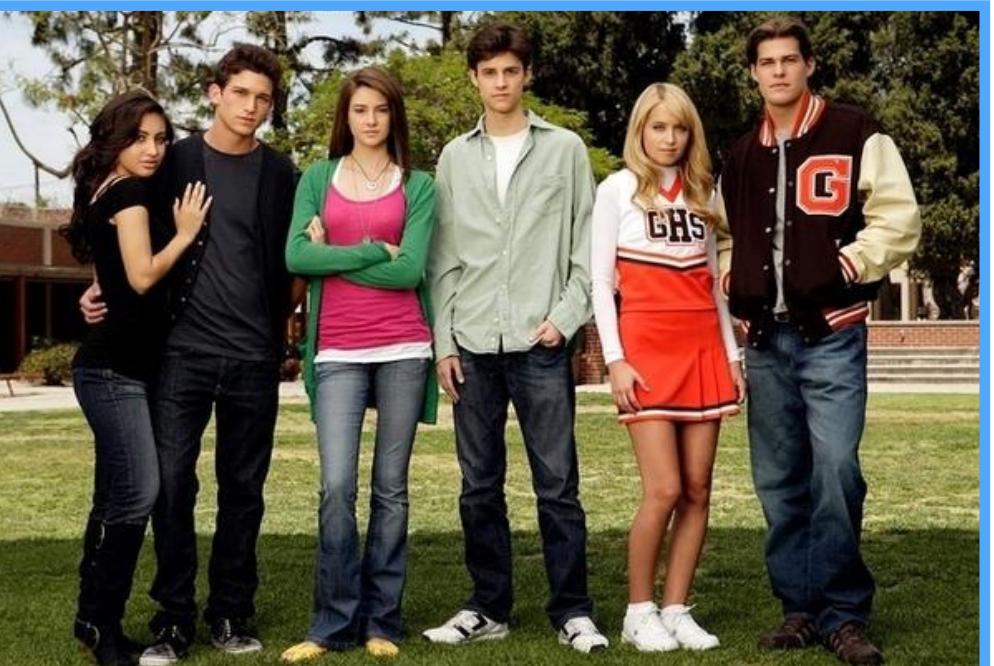
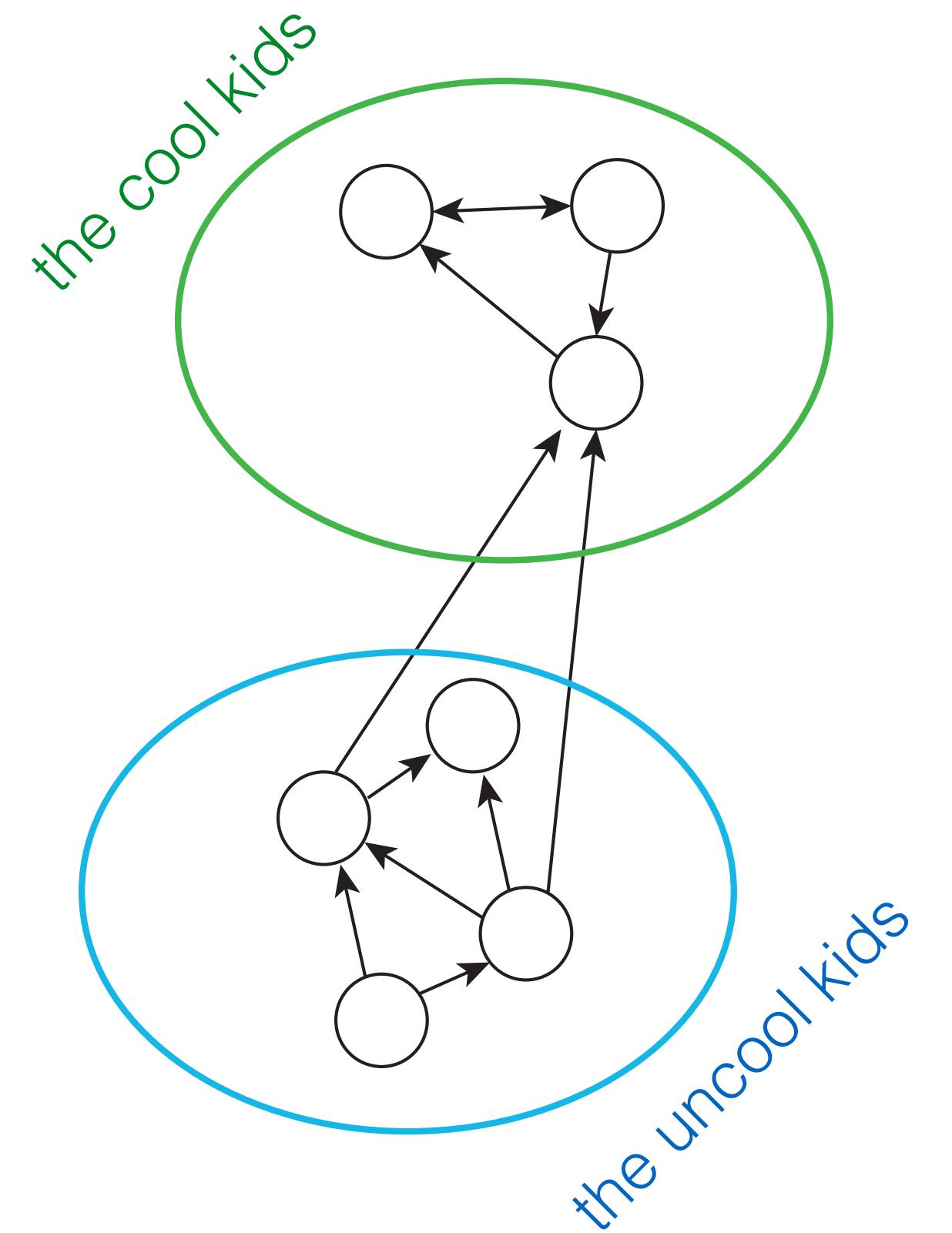


University of Colorado **Boulder**

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@danlarremore



Groups, status, prestige,
and rank emerge
from our social ties.



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and rank emerge
from our social ties.

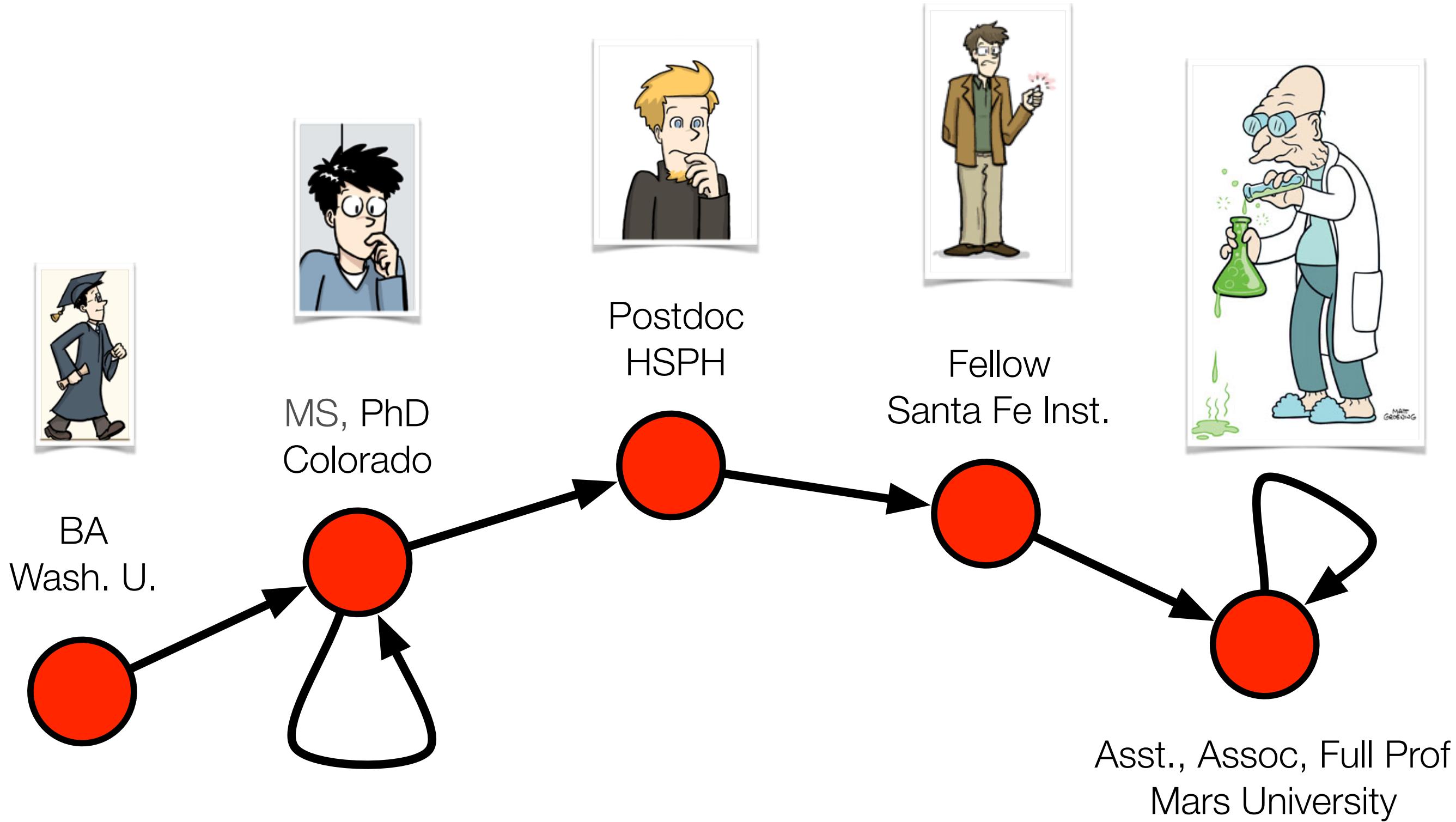
How do these structures form?

How can we automatically identify them in noisy data?
What do they mean for systems and individuals?

Faculty hiring networks



Trajectories of individuals form a network



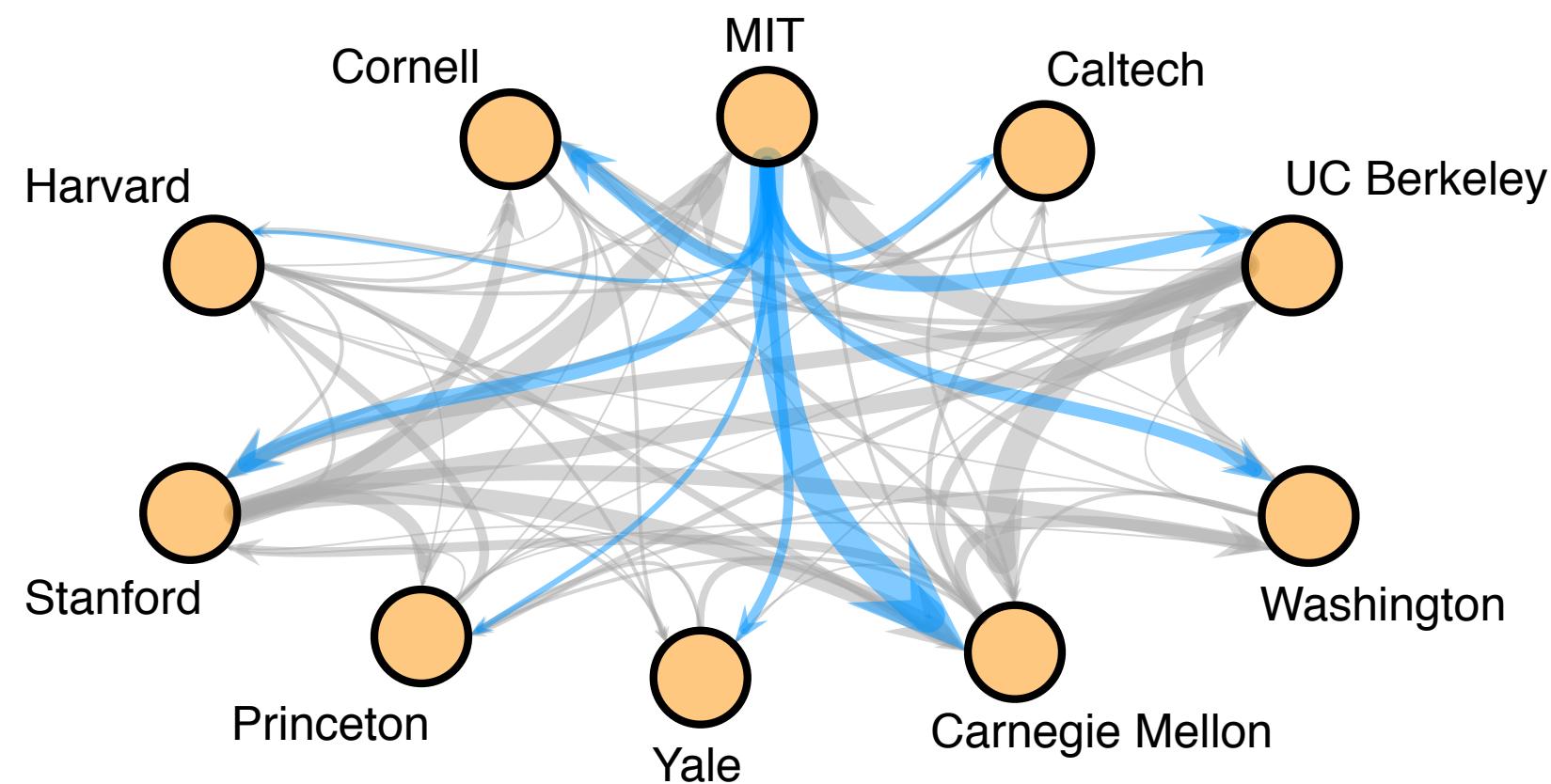
Collect the data (by hand 😭)

CVs of all US & Canadian tenure-track faculty in CS, Business, History: 2011-2013.

	Computer Science	Business	History
institutions	205	112	144
tenure-track faculty	5032	9336	4556
mean size	25	83	32
female	15%	22%	36%

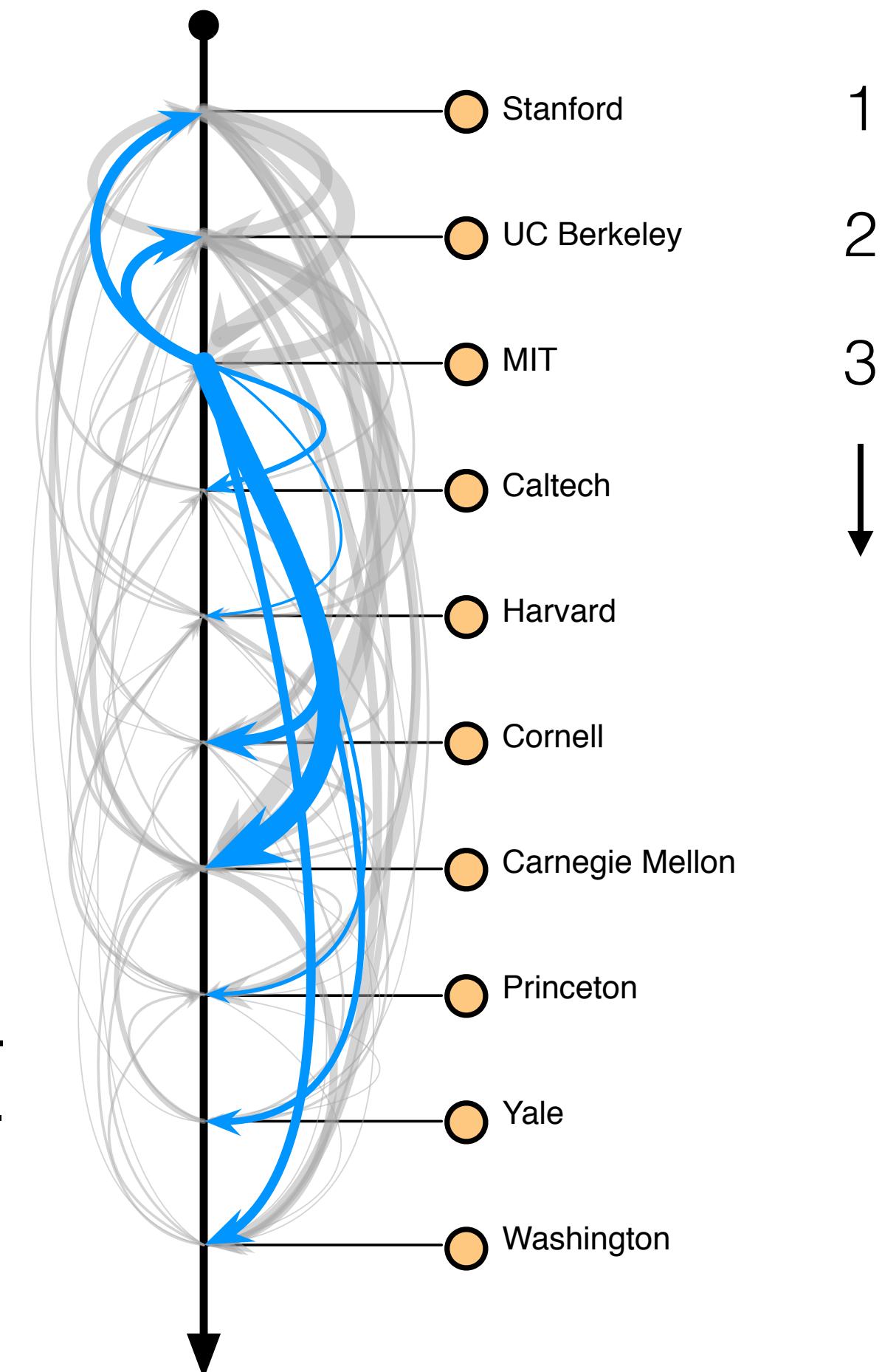
total: **18,924** CVs

Faculty hiring networks



Premises:

1. Each hiring committee wants to hire the best.
2. Entire network reveals **collective preferences**.



Faculty hiring networks

systematic

90% of hiring movement
is “down” the hierarchy

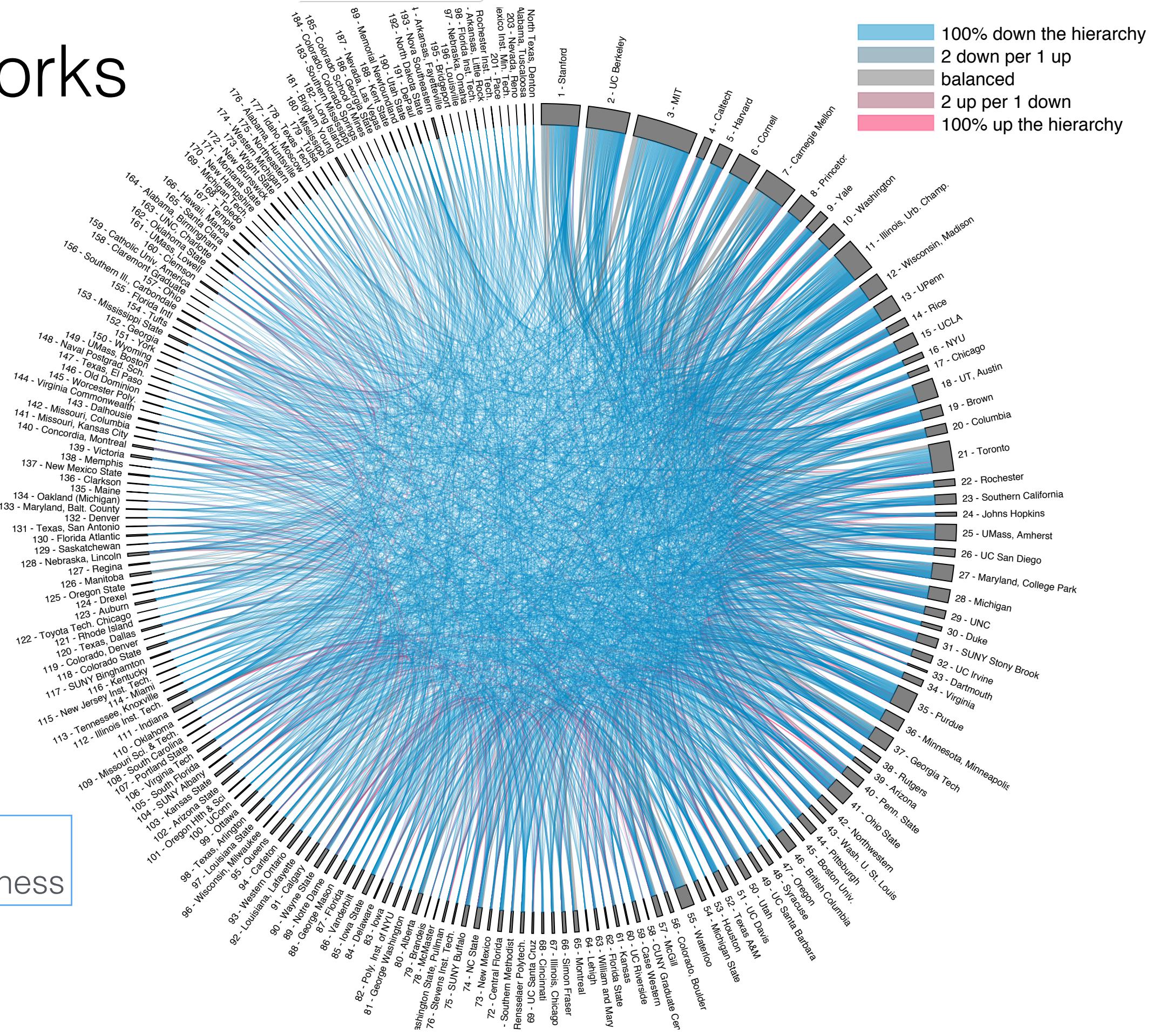
steep

< 7% of faculty have PhD
from lower 75% of universities

biased

median change for women
~3 ranks worse than men

danlarremore.com/faculty/
explore 19,000 hires for History, CS, Business



What else explains movement in this labor market?

Generative model:

prestige
productivity
postdoc experience

gender
geography

candidates

Cornell

MIT

Caltech

UW

openings

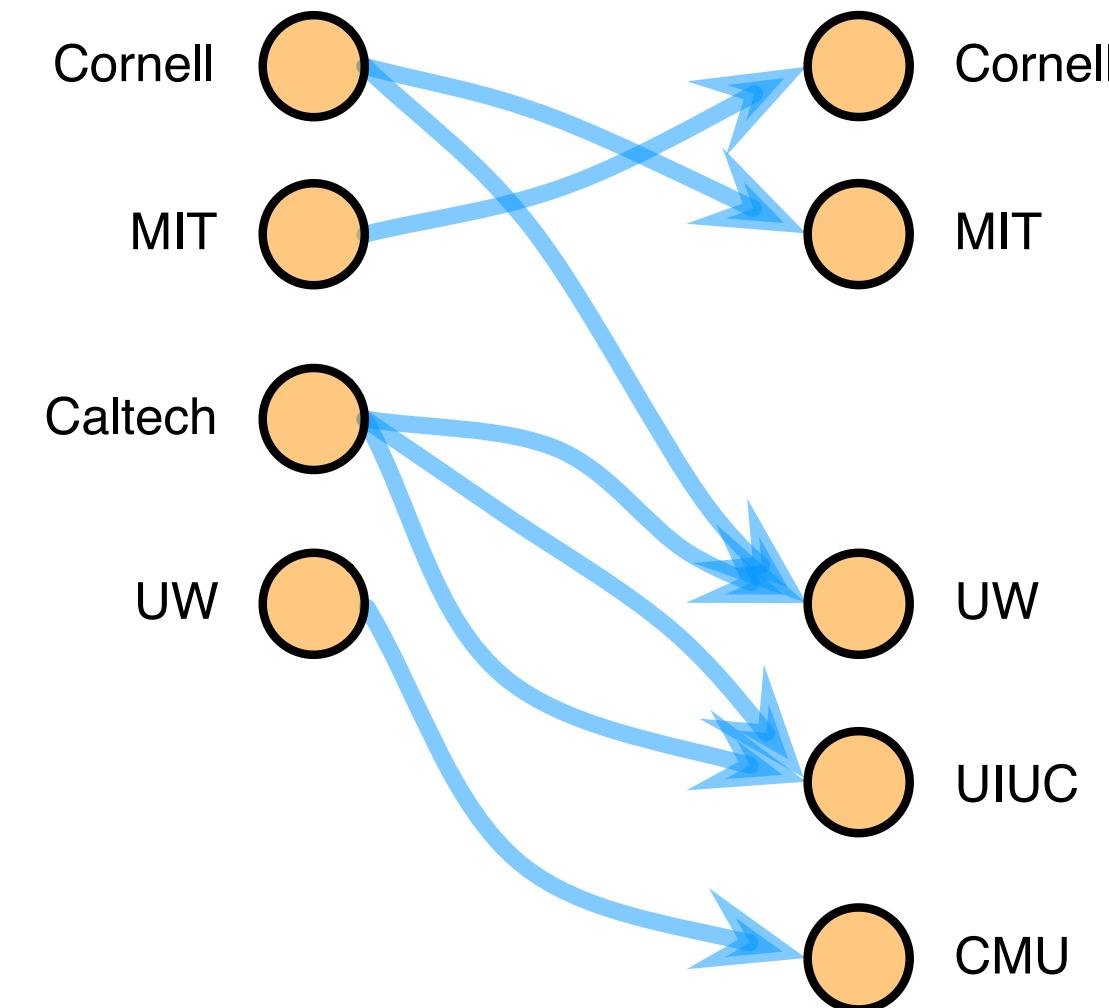
Cornell

MIT

UW

UIUC

CMU

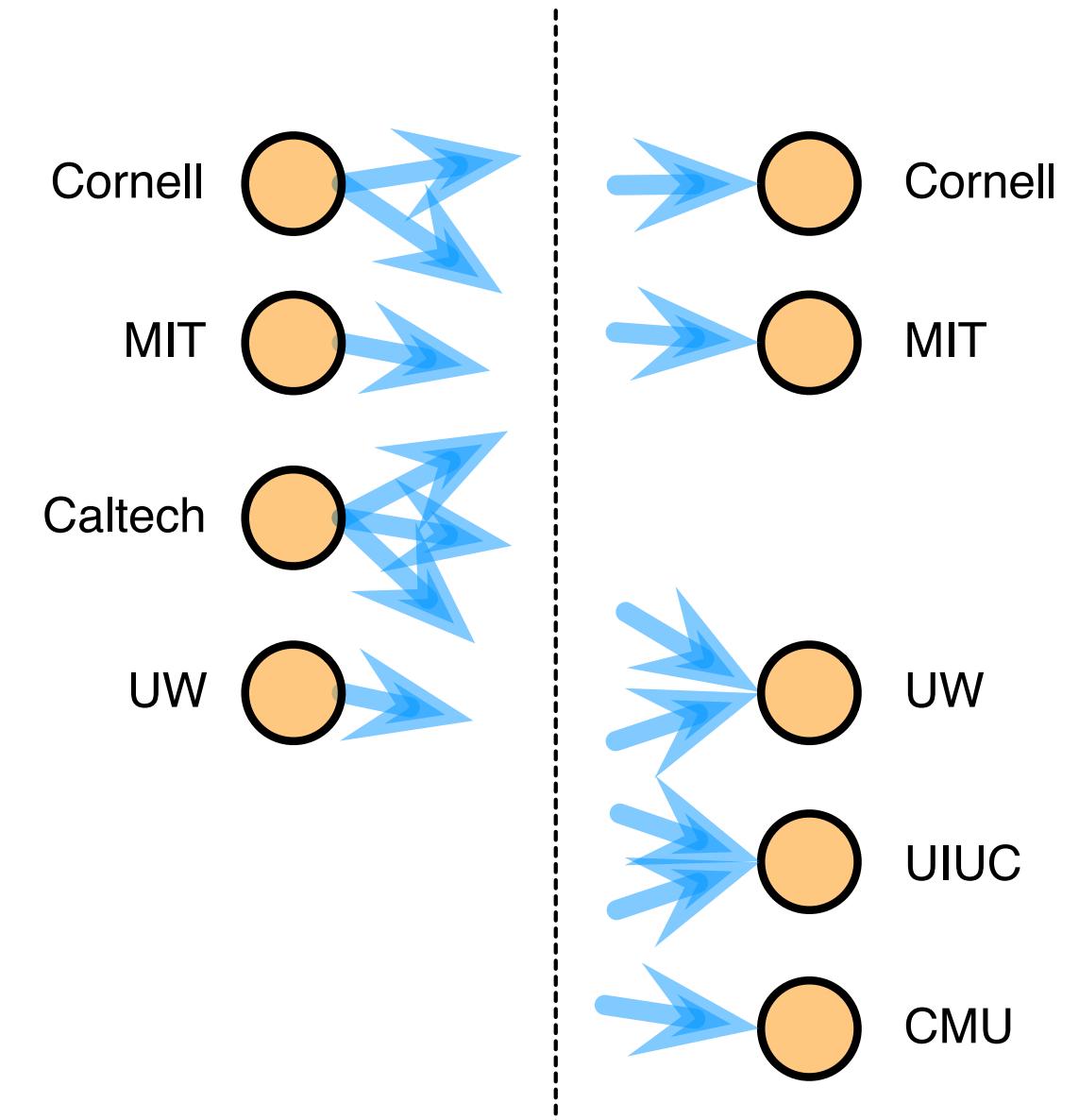


What else explains movement in this labor market?

Generative model:

prestige
productivity
postdoc experience

gender
geography



accurately generate the links!

What else explains movement in this labor market?

1. **Prestige difference:** Faculty Job vs PhD

2. **Productivity**

3. **Prestige of Faculty Job**

4. **Postdoc experience + geography** (together)

5. **Gender.**

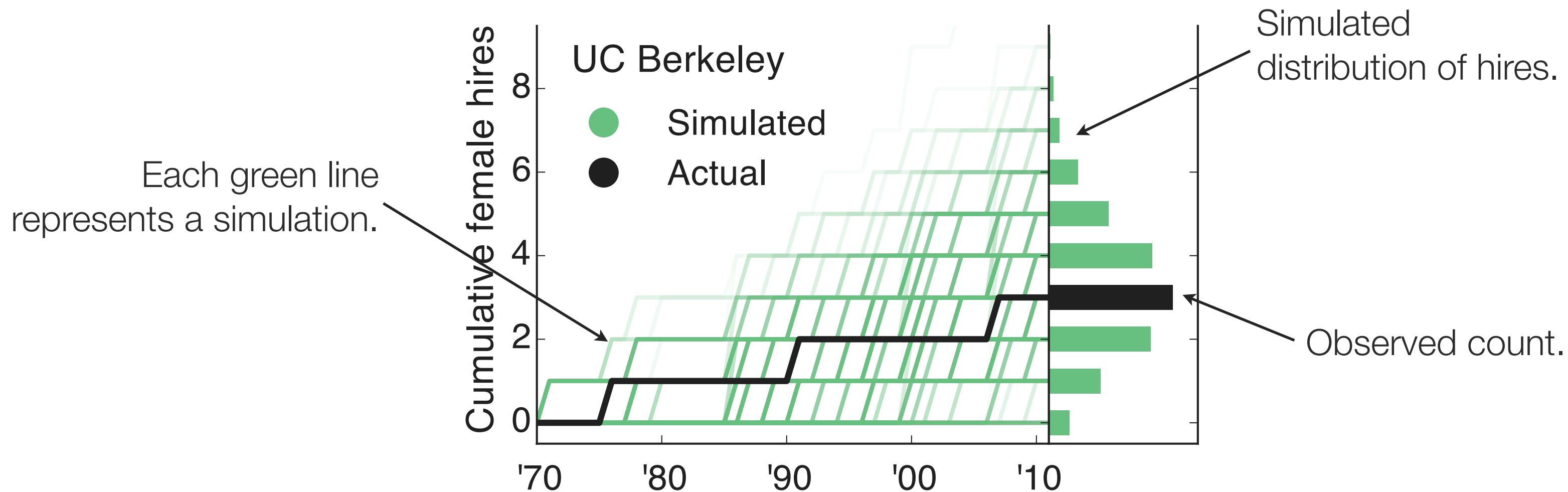
Gender bias is not uniformly, systematically affecting all hires. But...

a woman on the job market must have published ~1 additional paper to be placed the same as an equally qualified man.

Institution-level results

Using 40 years of actual hiring data, simulate hiring patterns for each institution.

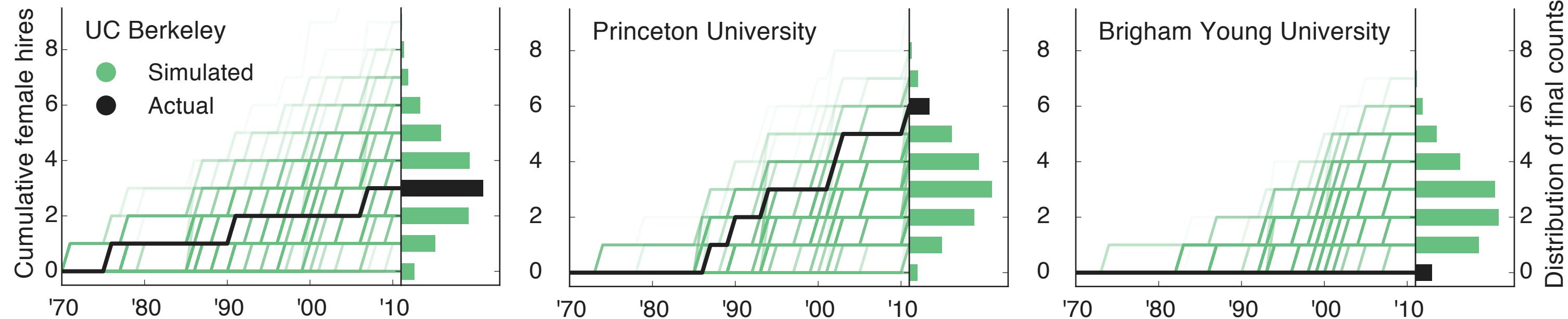
Compare actual vs. expected number of female hires.



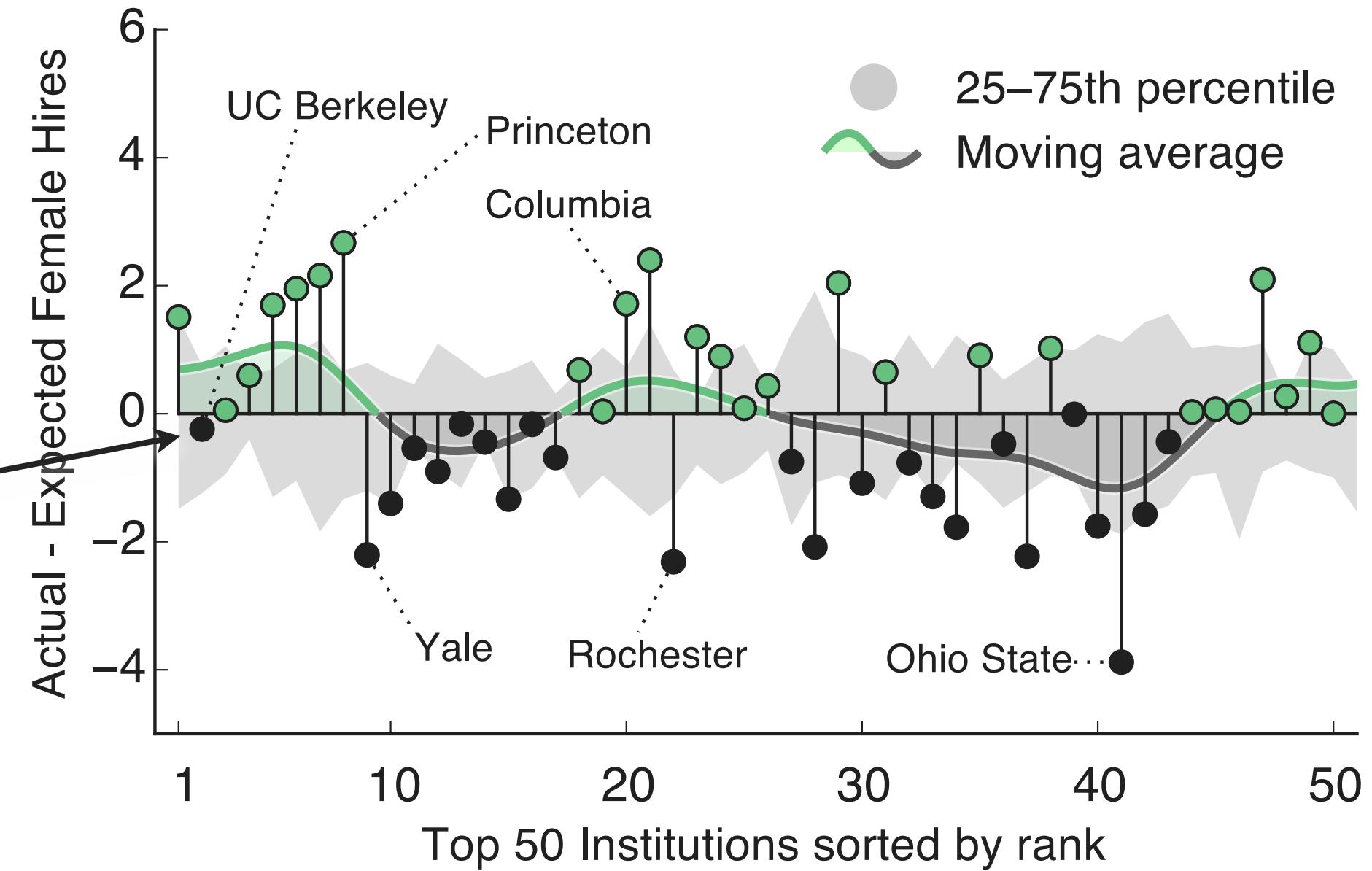
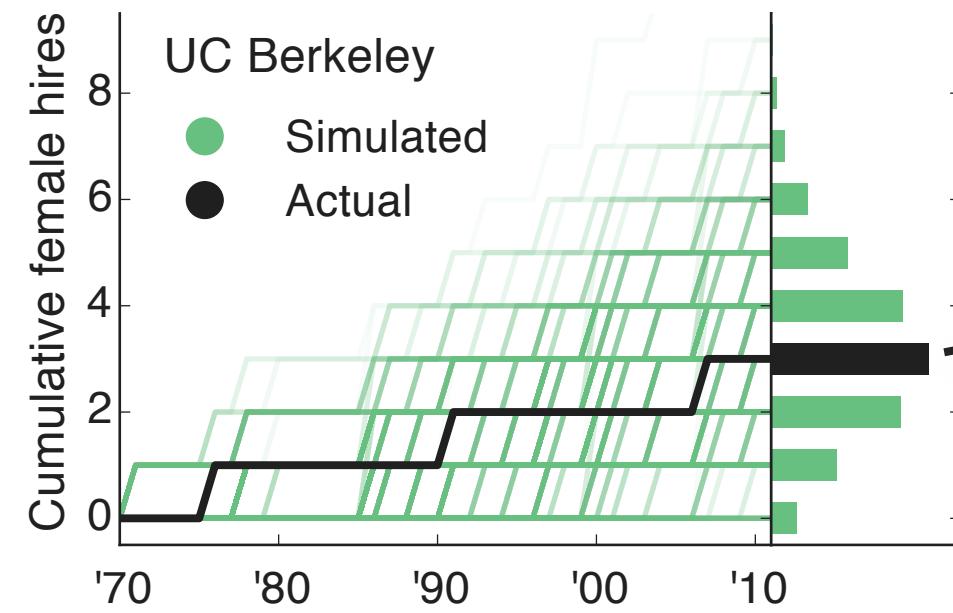
Institution-level results

Using 40 years of actual hiring data, simulate hiring patterns for each institution.

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Institution-level results



Institution-level results

For the top 50 institutions,
we see an oscillation.

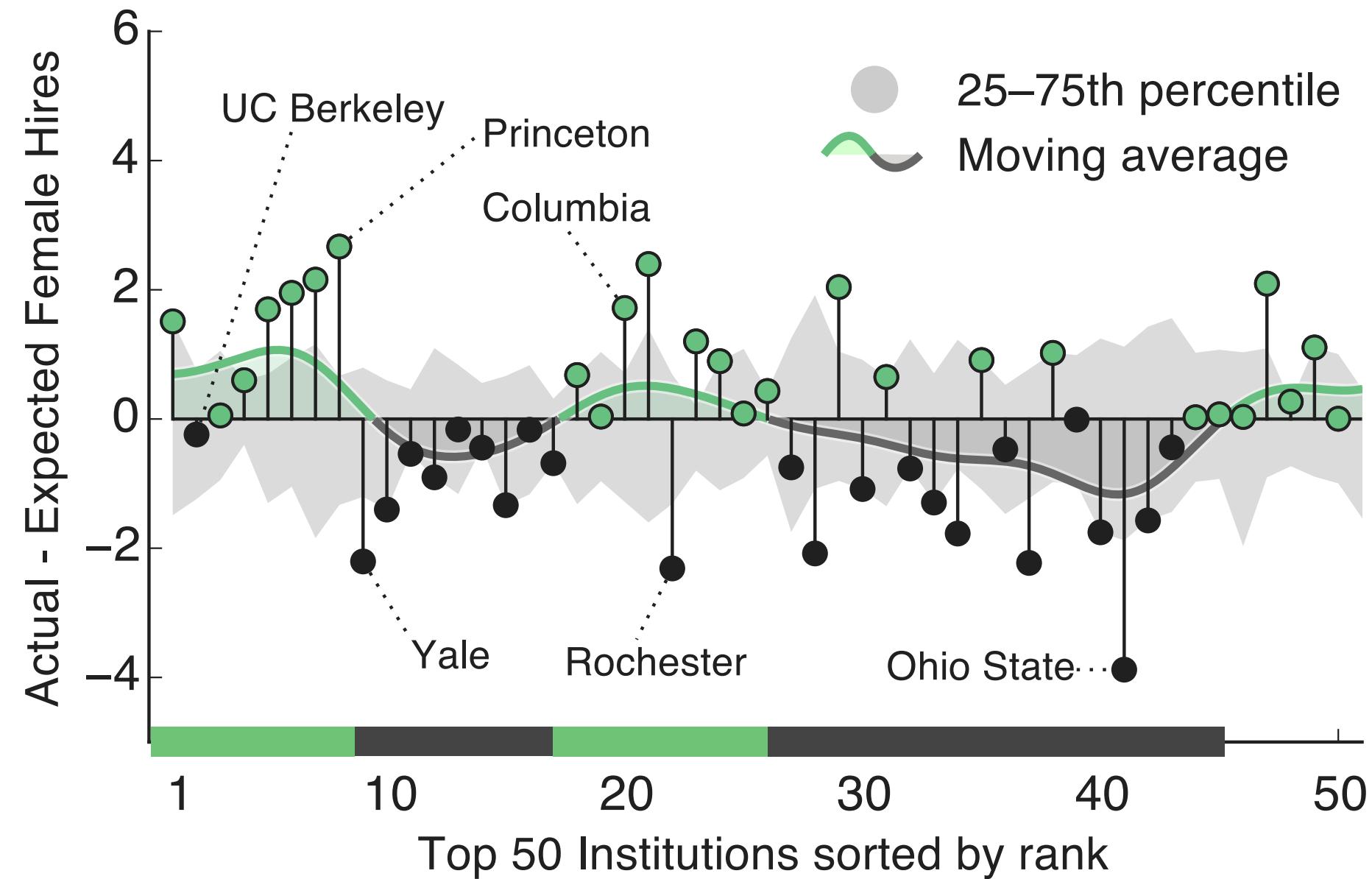


Why?

An interference effect?

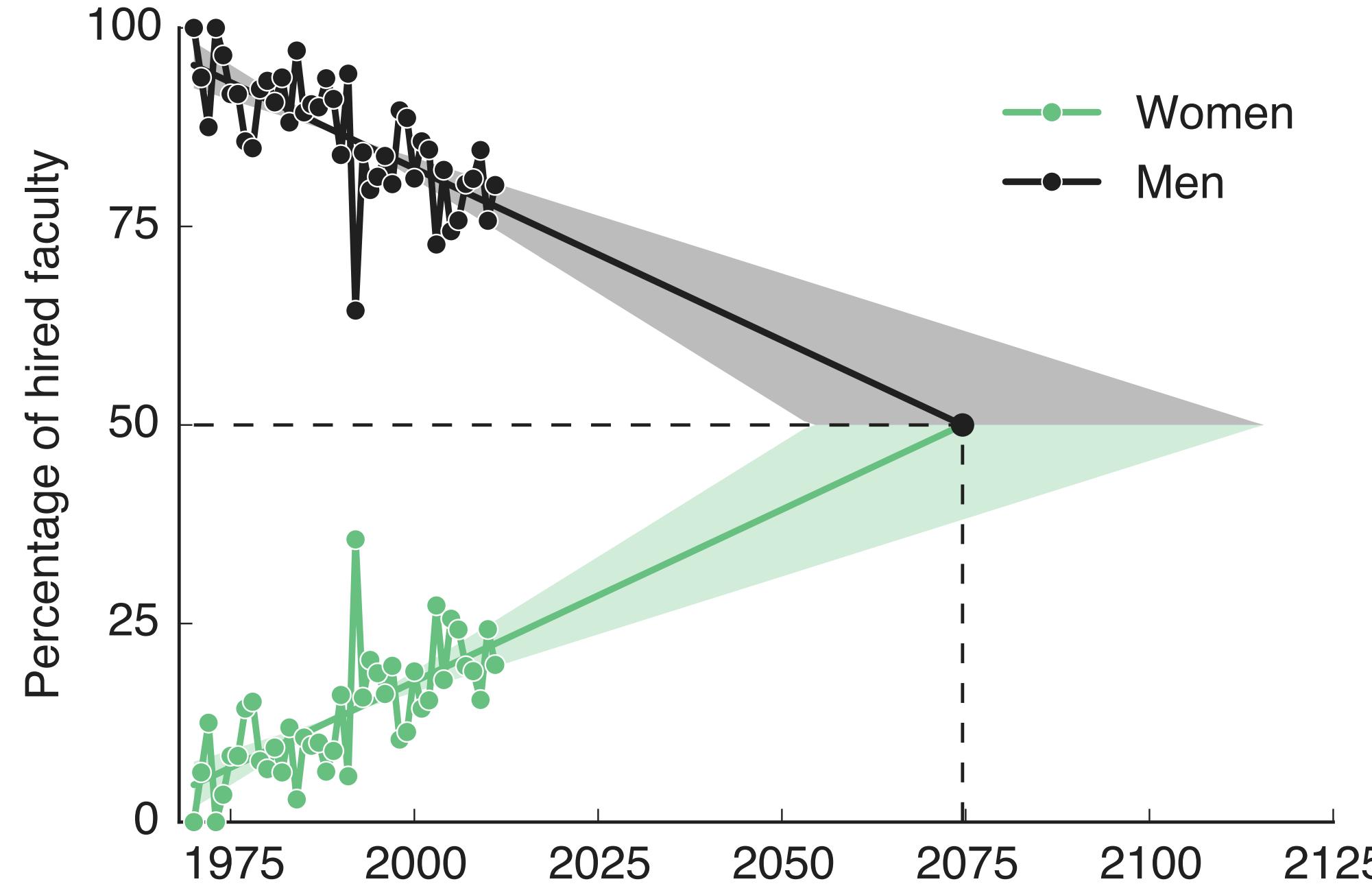
Two distinct candidate pools?

Is it real?



Looking ahead . . .

CS hiring parity in 2075?



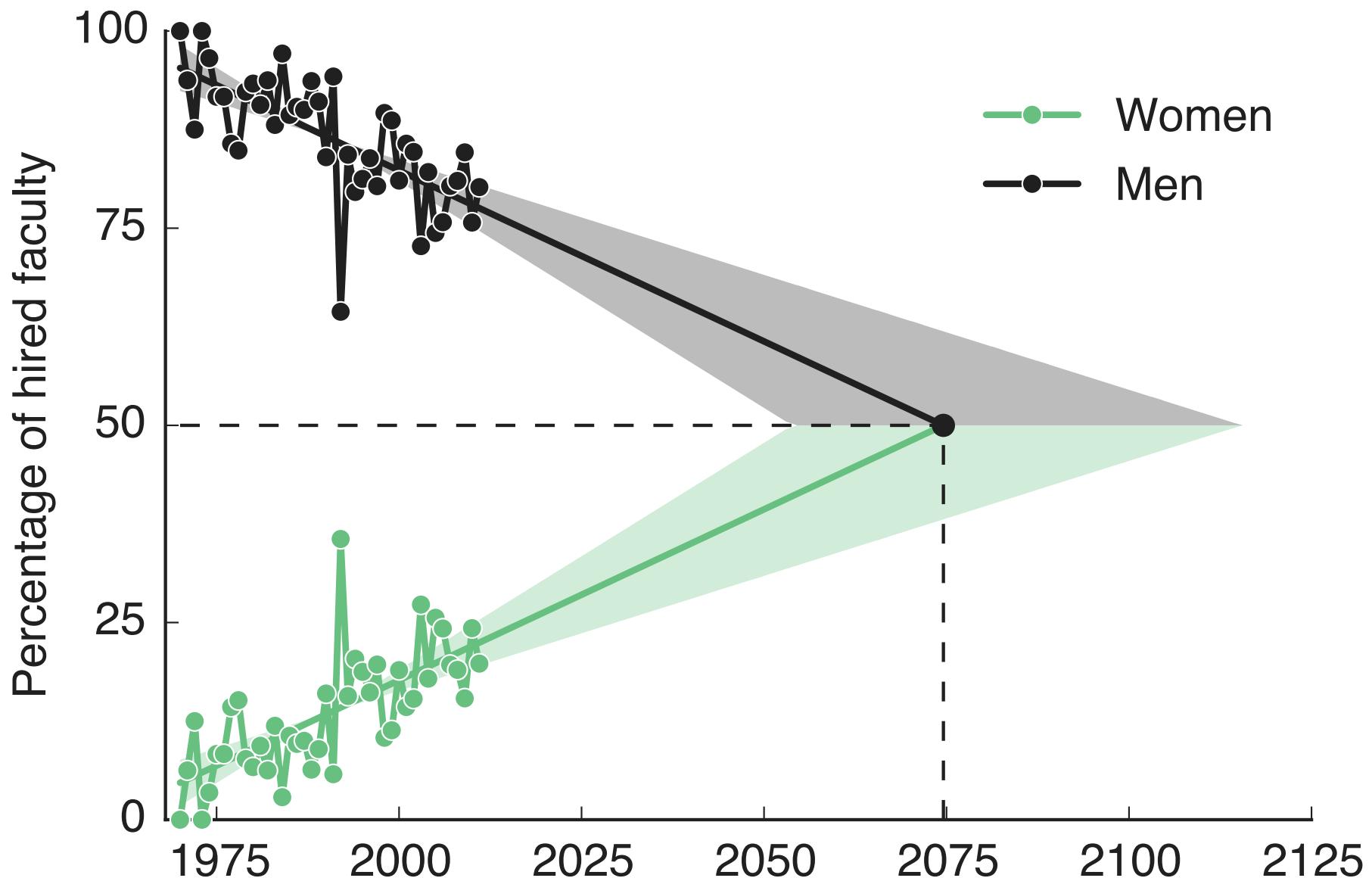
Looking ahead . . .

Likelihood-based models?

What can we learn by comparing fields and other underrepresented groups?

Revisit faculty now (7 years later) to learn about retention?

CS hiring parity in 2075?

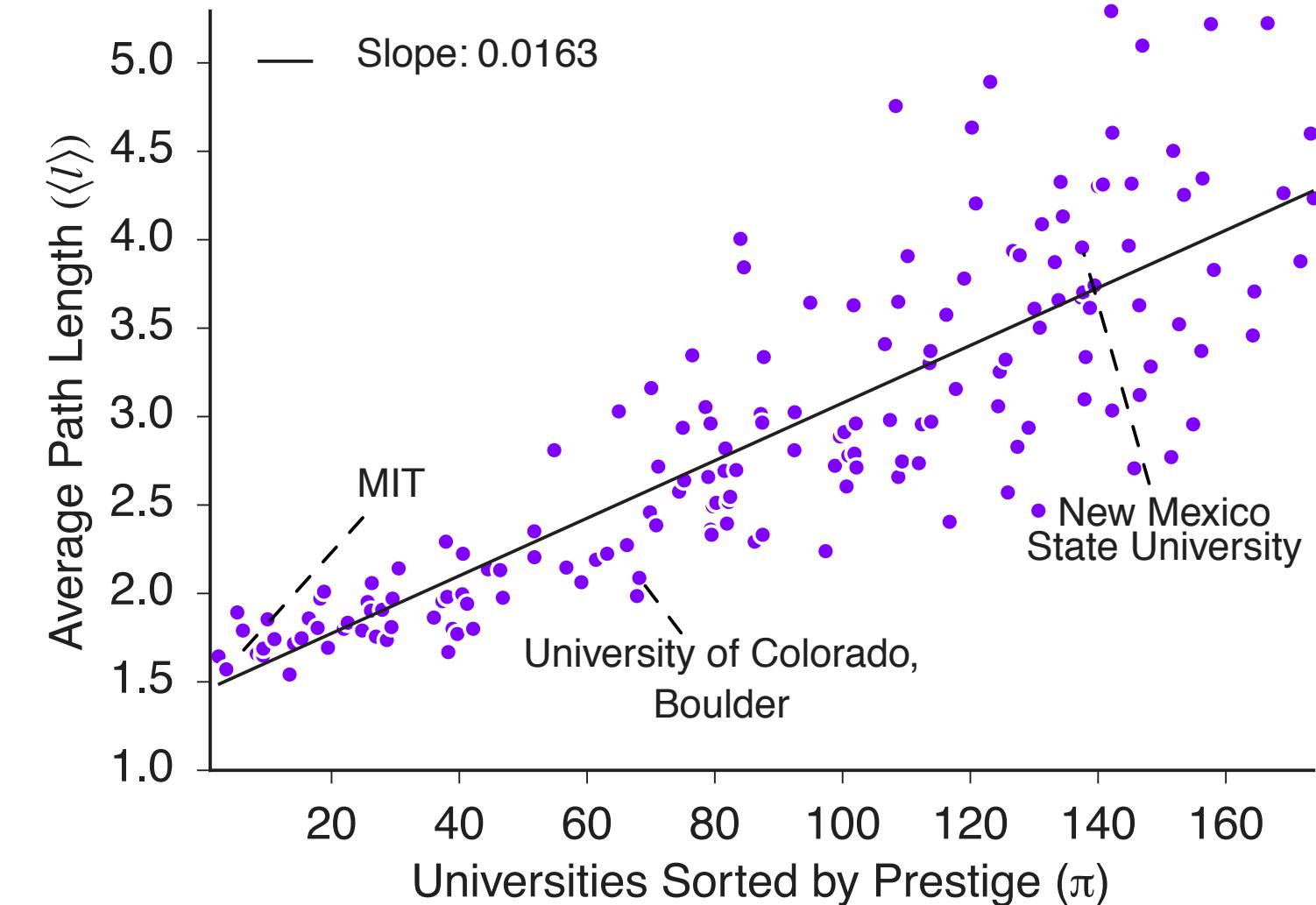


Does the structure of this network affect *ideas*?

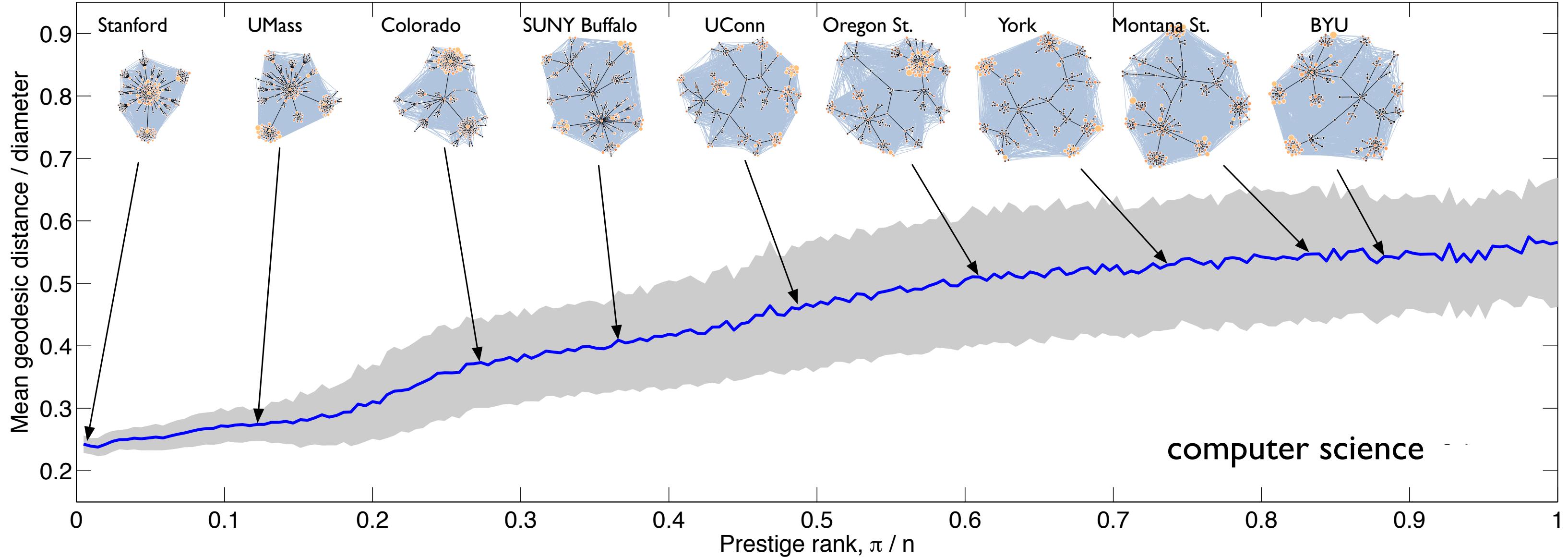
Prestigious institutions are **closer** to all other institutions.

What implications does this have for the **exchange & filtration** of ideas?

Does the prestige hierarchy lead to **epistemic inequality**?

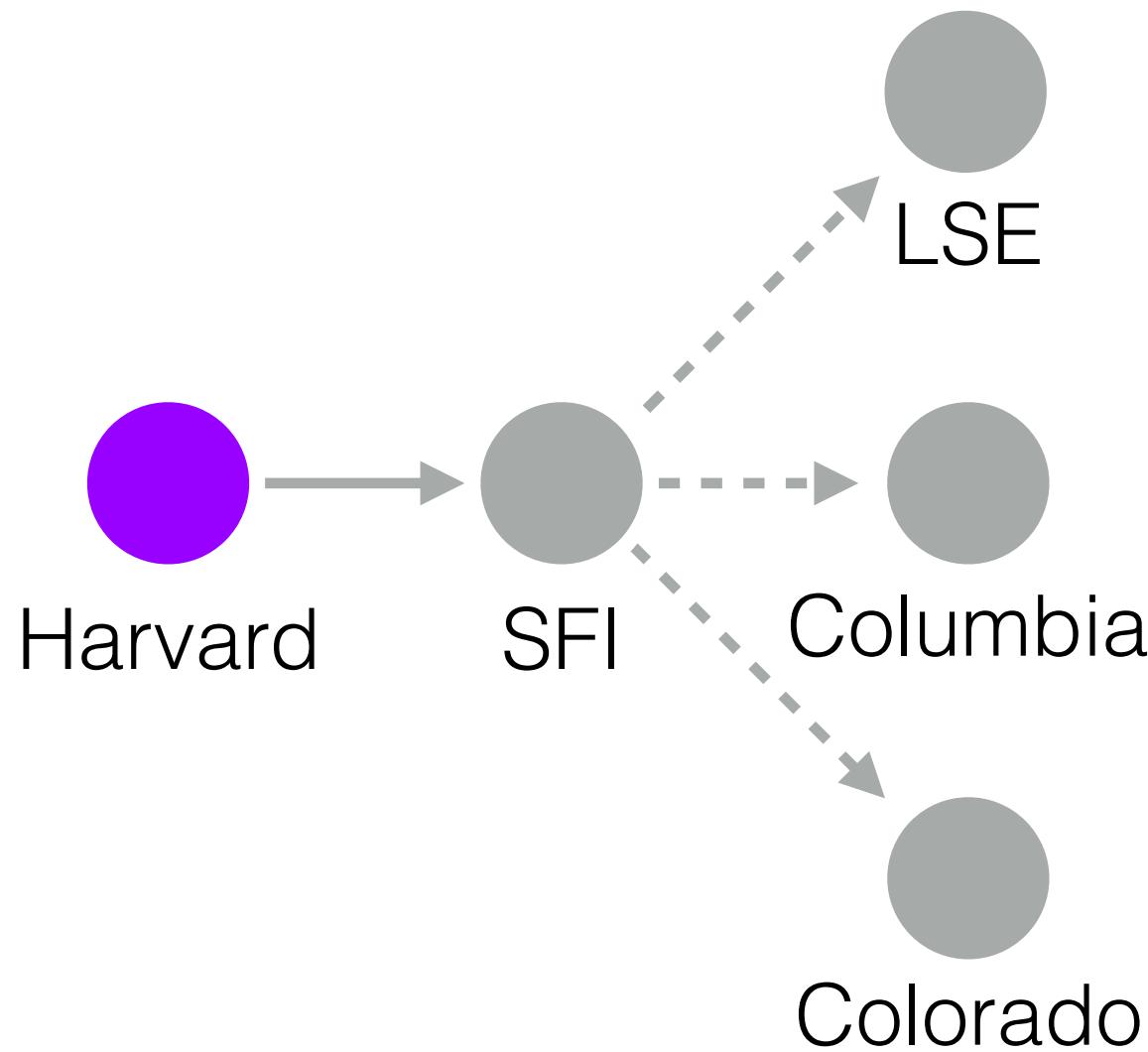


Core-periphery position changes with rank



What are the implications for the spread of ideas? “Epistemic inequality?”

New hires as vectors for infectious ideas?



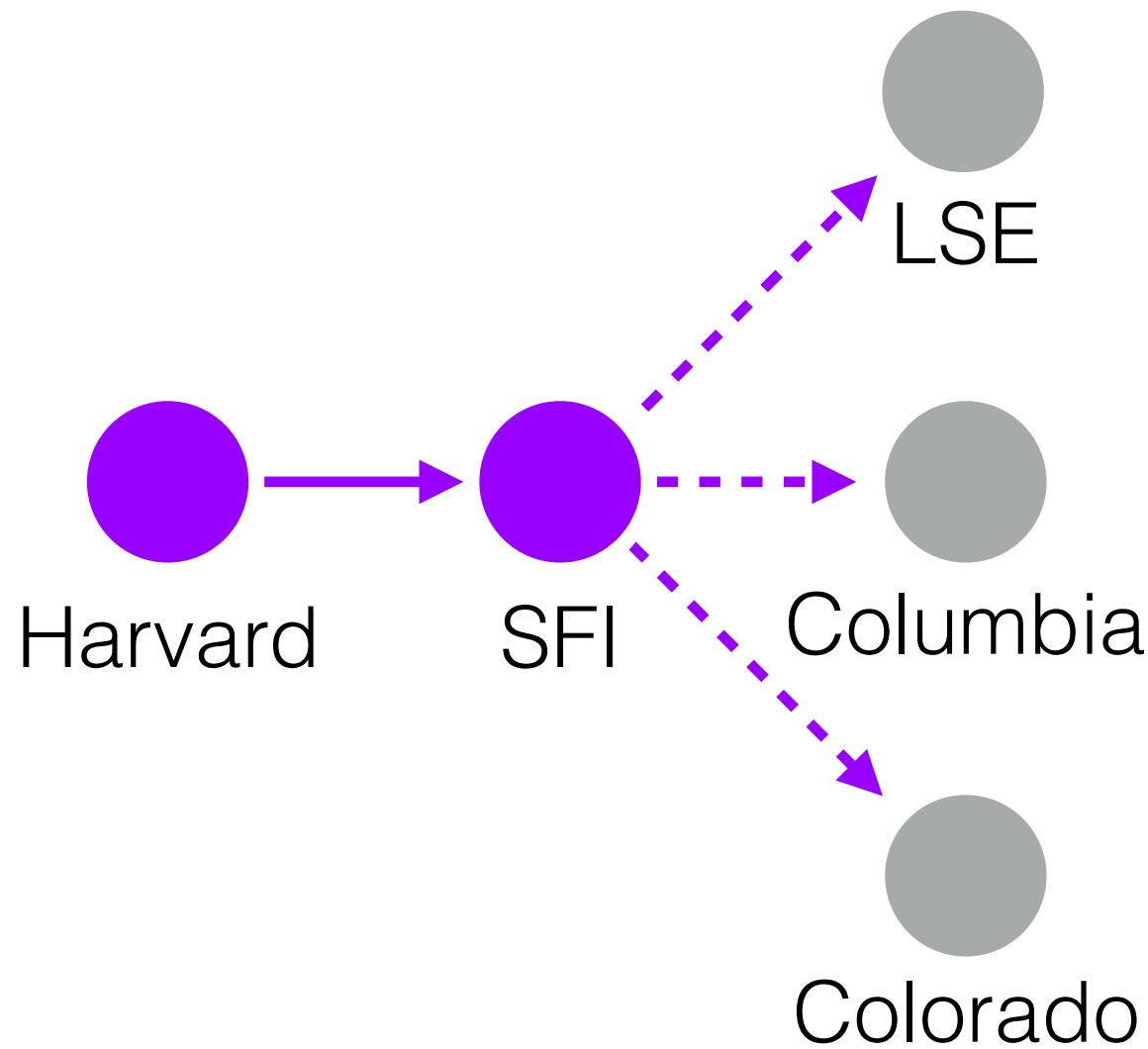
Do new hires *actually* bring ideas with them?
[or would popular topics get there anyway?]

Are some universities better idea exporters?

Epidemic model: treat the idea as an infection,
and a new hire as “infectious.”

The probability that a hire transmits the idea to
an uninfected university: p [idea quality]

New hires as vectors for infectious ideas?



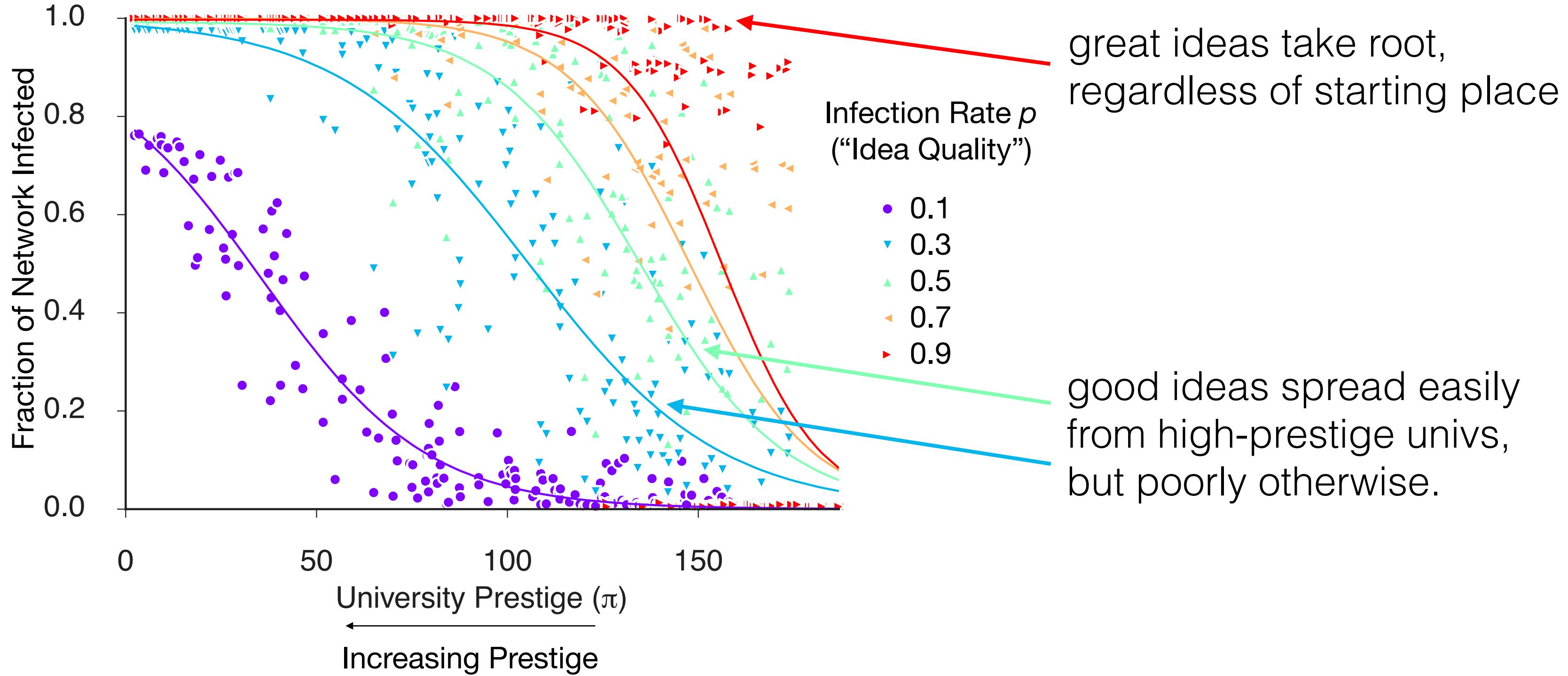
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Network position & the spread of ideas



Do *real* ideas spread along hiring links?

Analyzed over 200,000 computer science publications and over 2,500 hires.

Flagged publications on topic modeling, incremental computing, deep learning.

Identified faculty who brought [topic] with them when they were hired.

Identified faculty who began working on [topic] only 2+ yrs after being hired.

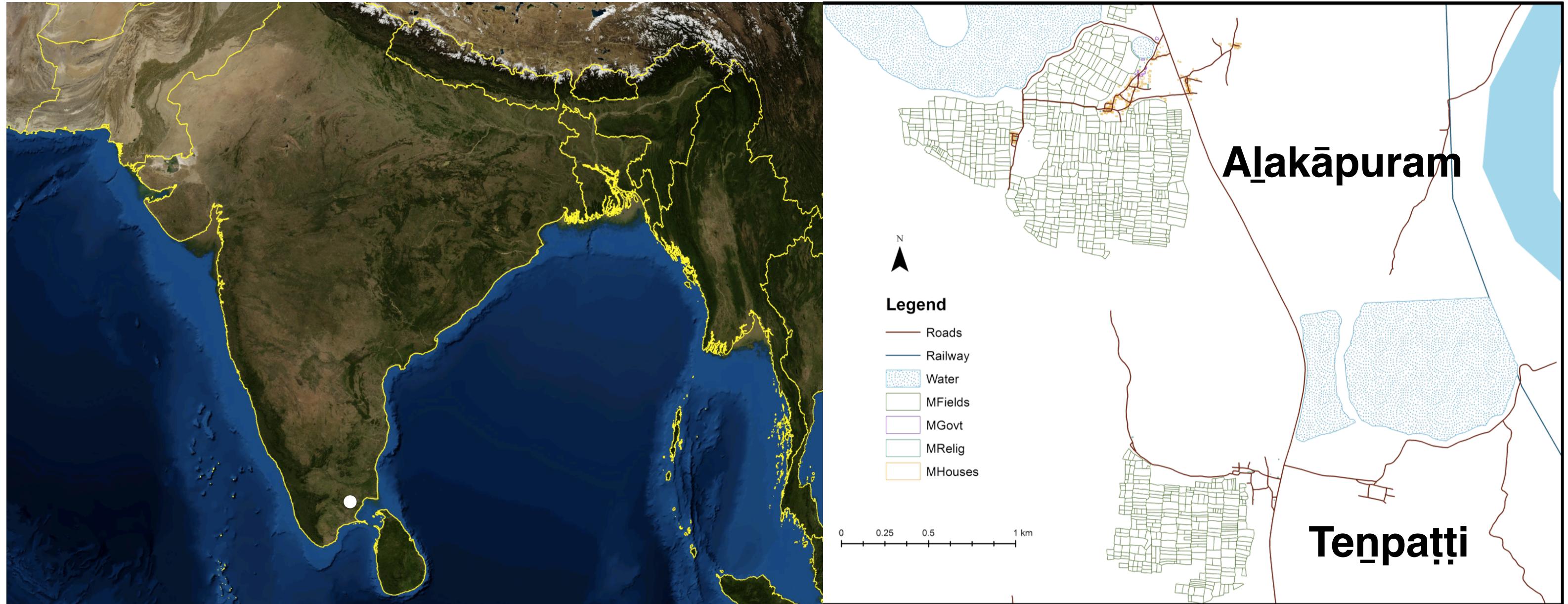
Compared relative rates of hiring-link spread vs spontaneous spread. (vs random)

Spread of **topic modeling ($p=0.01$)** & **incremental computing ($p=0.01$)** significantly tied to infection via hiring. Spread of deep learning ($p=0.2$) *not* significantly linked to hiring.



Groups and ordered structures

South Indian networks: Tenpatti and Alakāpuram

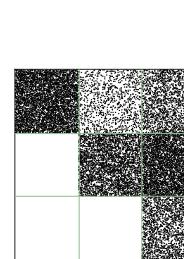


1964 question of Srinivas and Béteille: beyond ethnographic investigations?

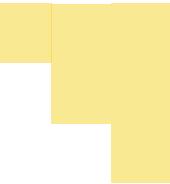
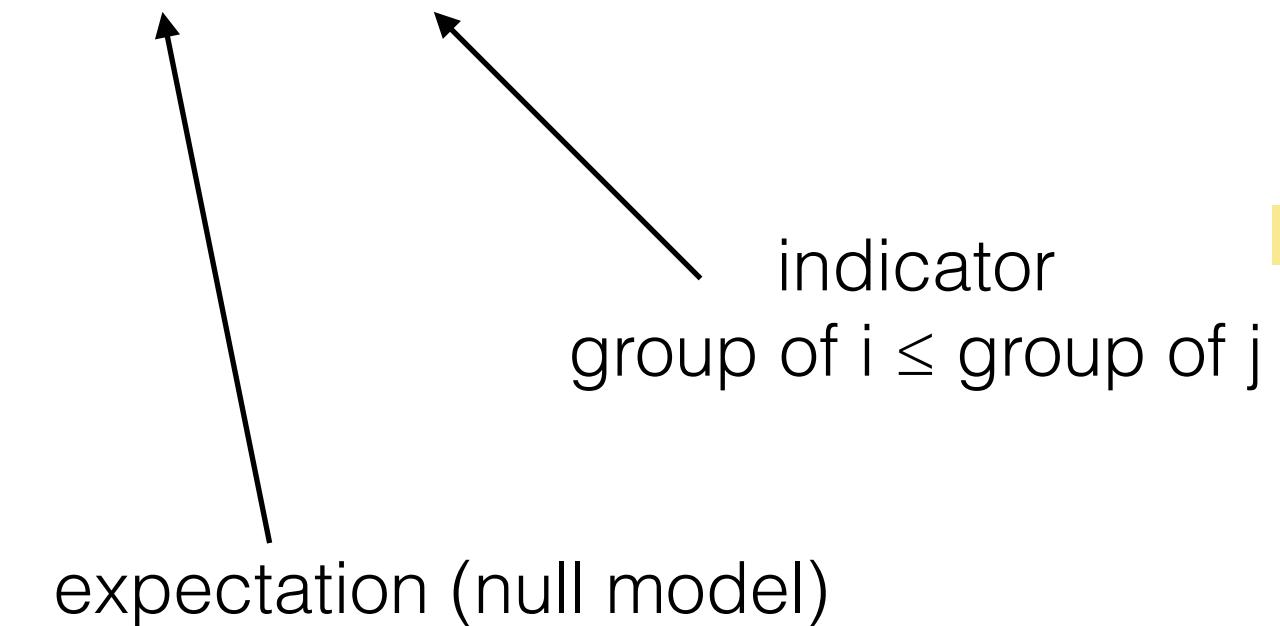
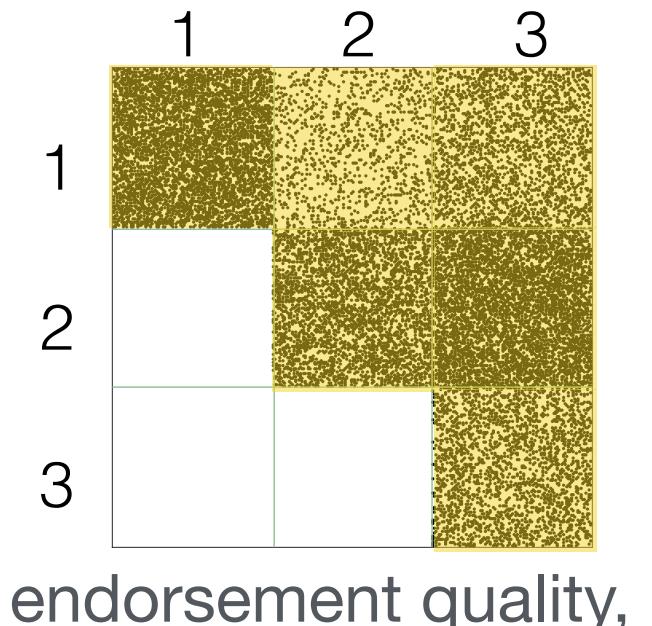
Ranked order quality, R

We propose to measure the **quality** of a ranked ordering by R

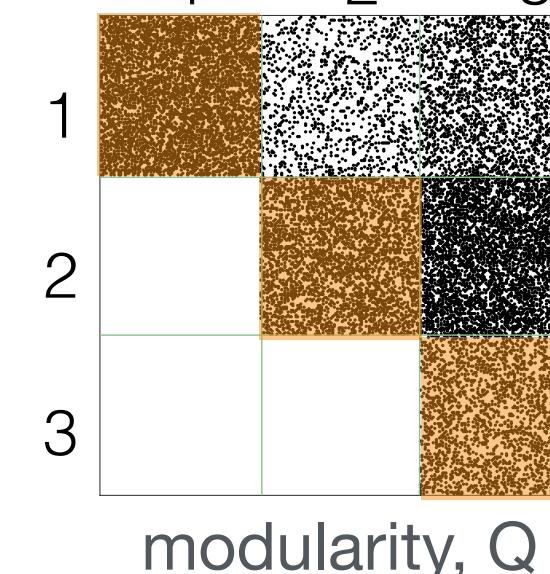
$$R = \frac{1}{m} \sum_{ij} (A_{ij} - E_{ij}) \mathbf{1}_{g_i \leq g_j}$$



links
network adjacency matrix

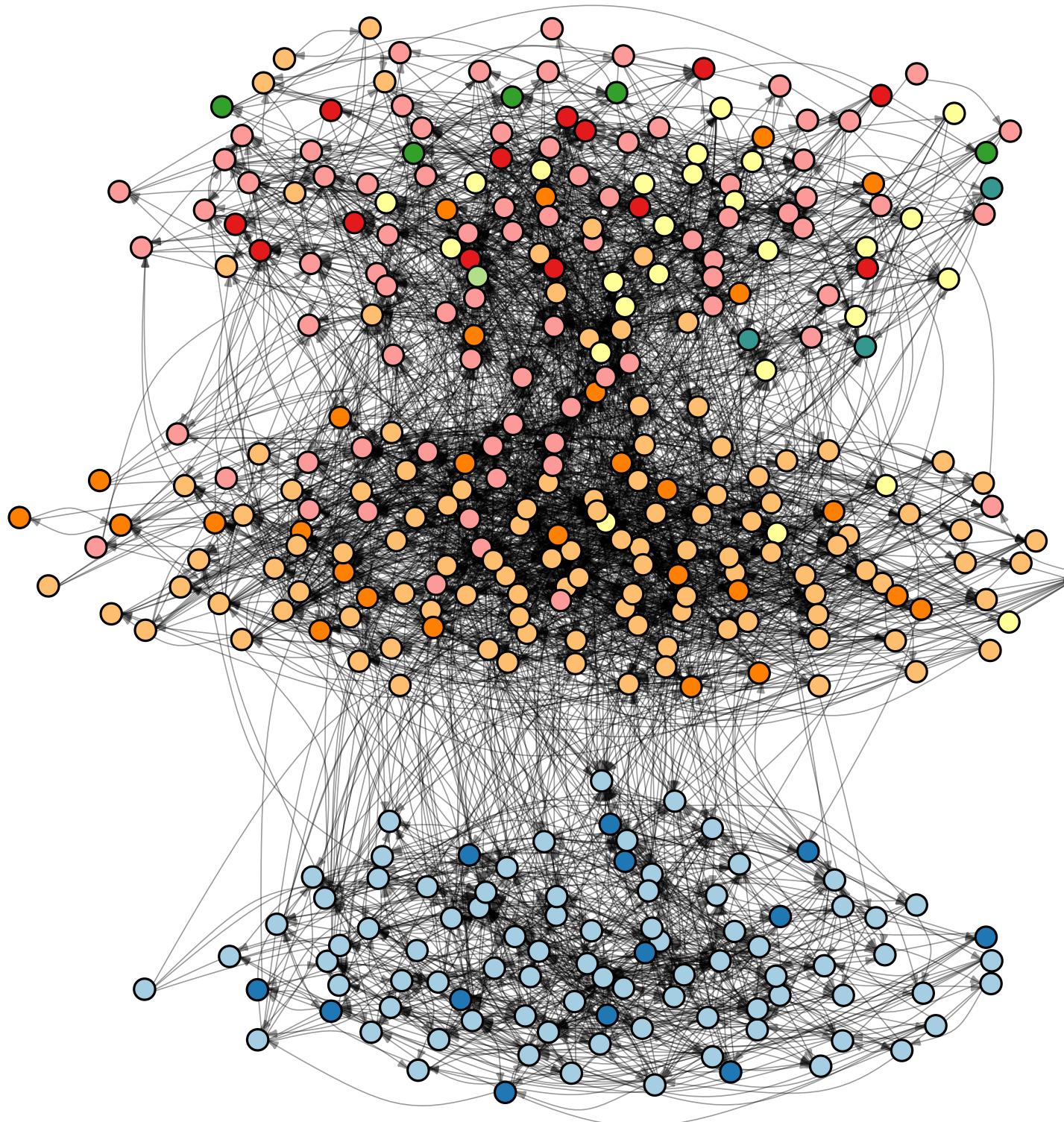


indicator
group of $i \leq$ group of j



Tenpatti

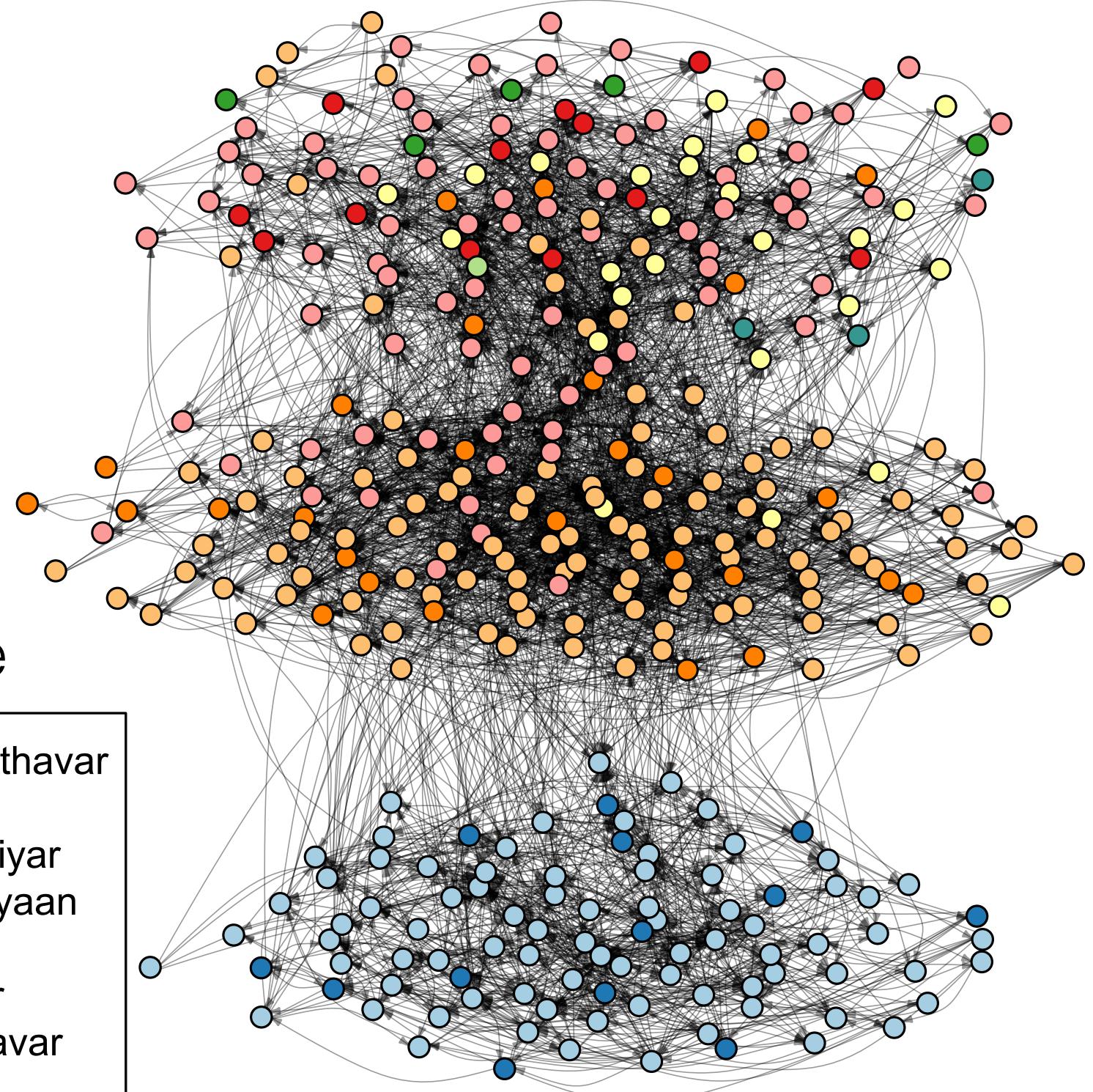
Caste



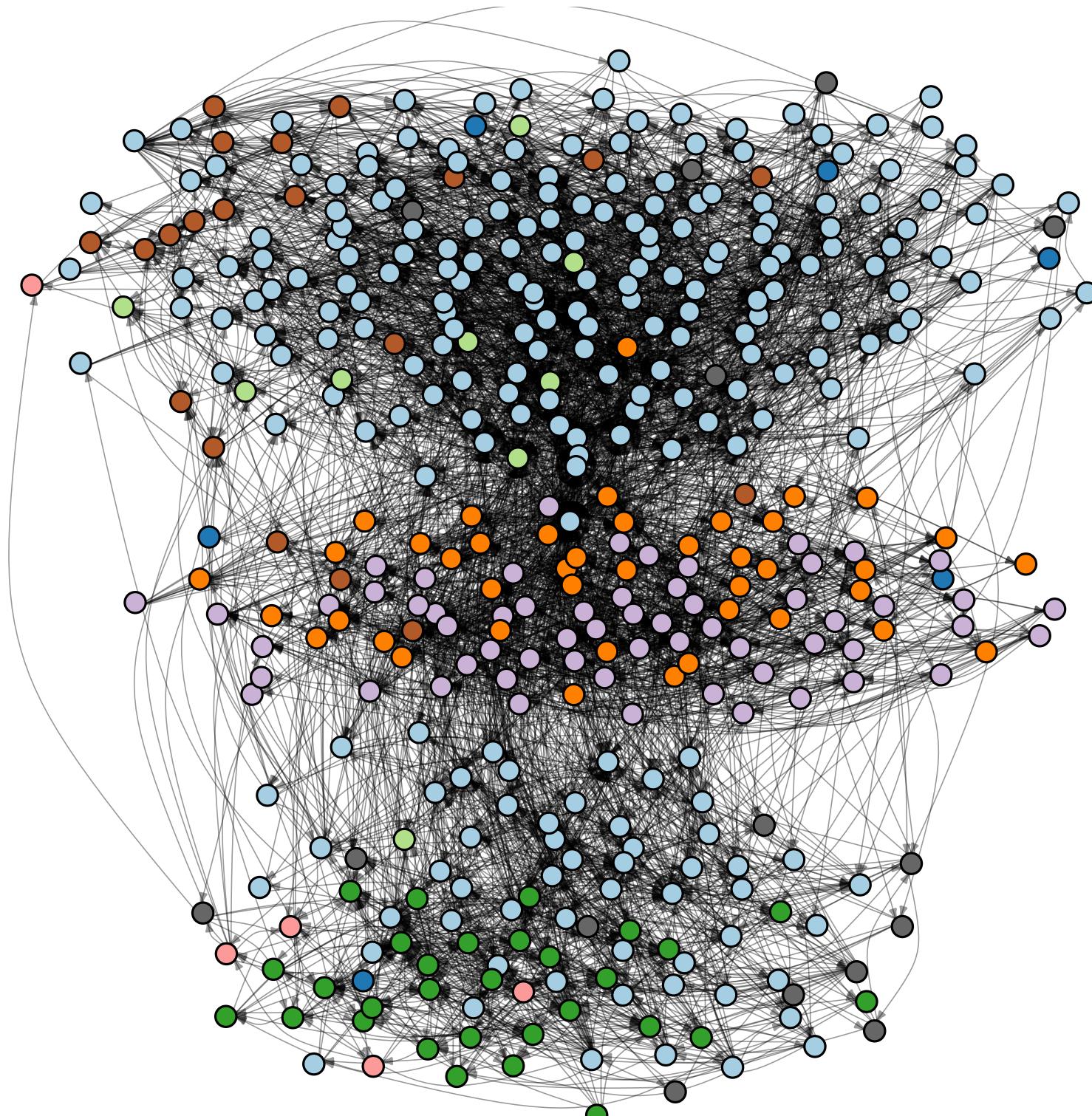
Scheduled castes—*dalit*
“untouchable”

Tenpaṭṭi

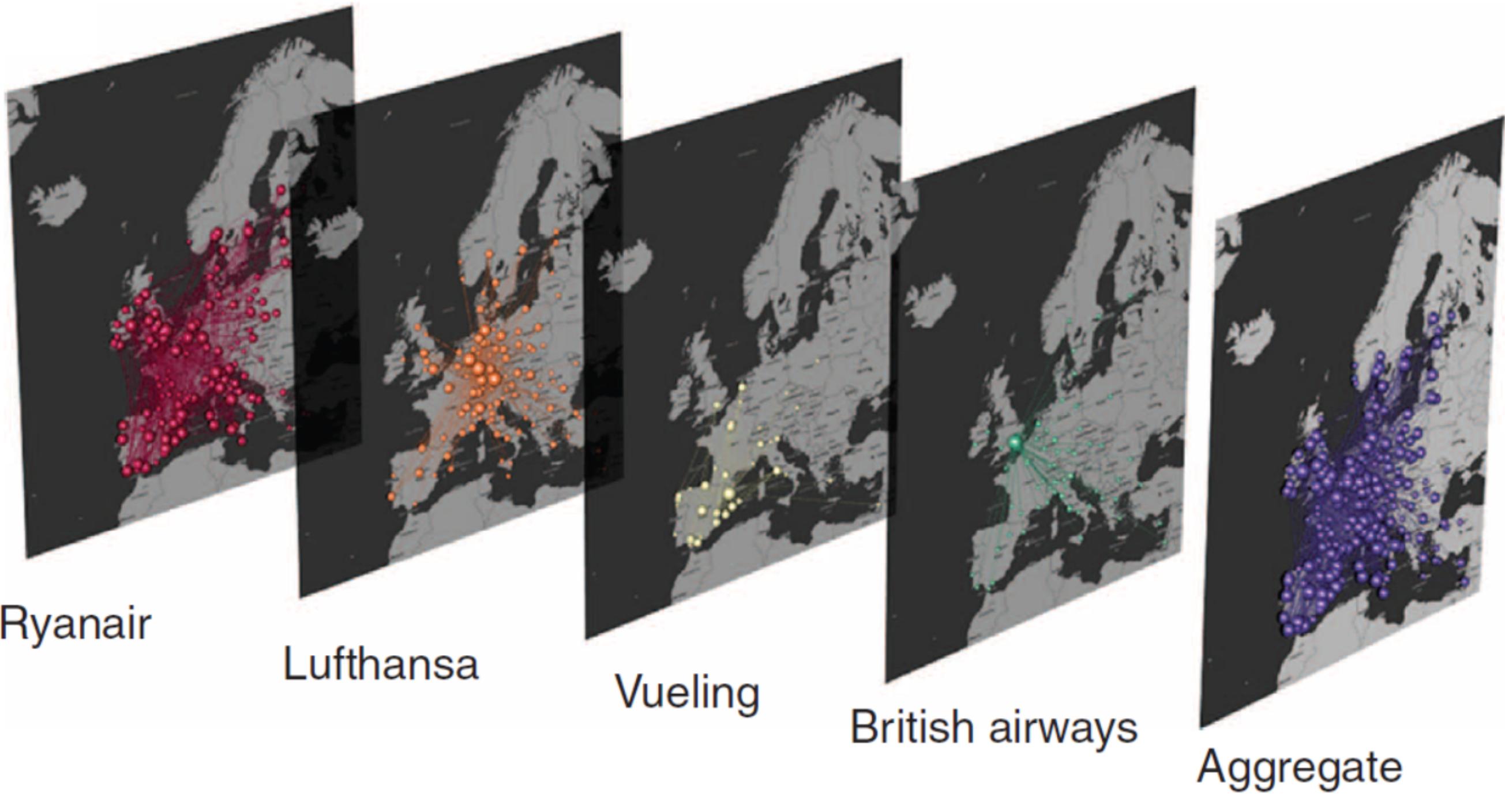
Caste



Alakāpuram



Multilayer network: air travel



Multilayer network: South Indian social support

There are separate layers for:

Who would you go to for **work**?

Who do you see has holding a good **position** in the community?

Who would you go to if you needed

... someone to **babysit**?

... a **loan**?

... **advice** ?

... to **talk**?

... advice on an **important issue**?

... someone to run an **errand**?

... to **borrow** household stuff?

... a little **cash** (smaller than a loan) ?

and more! traditional: booking with airline

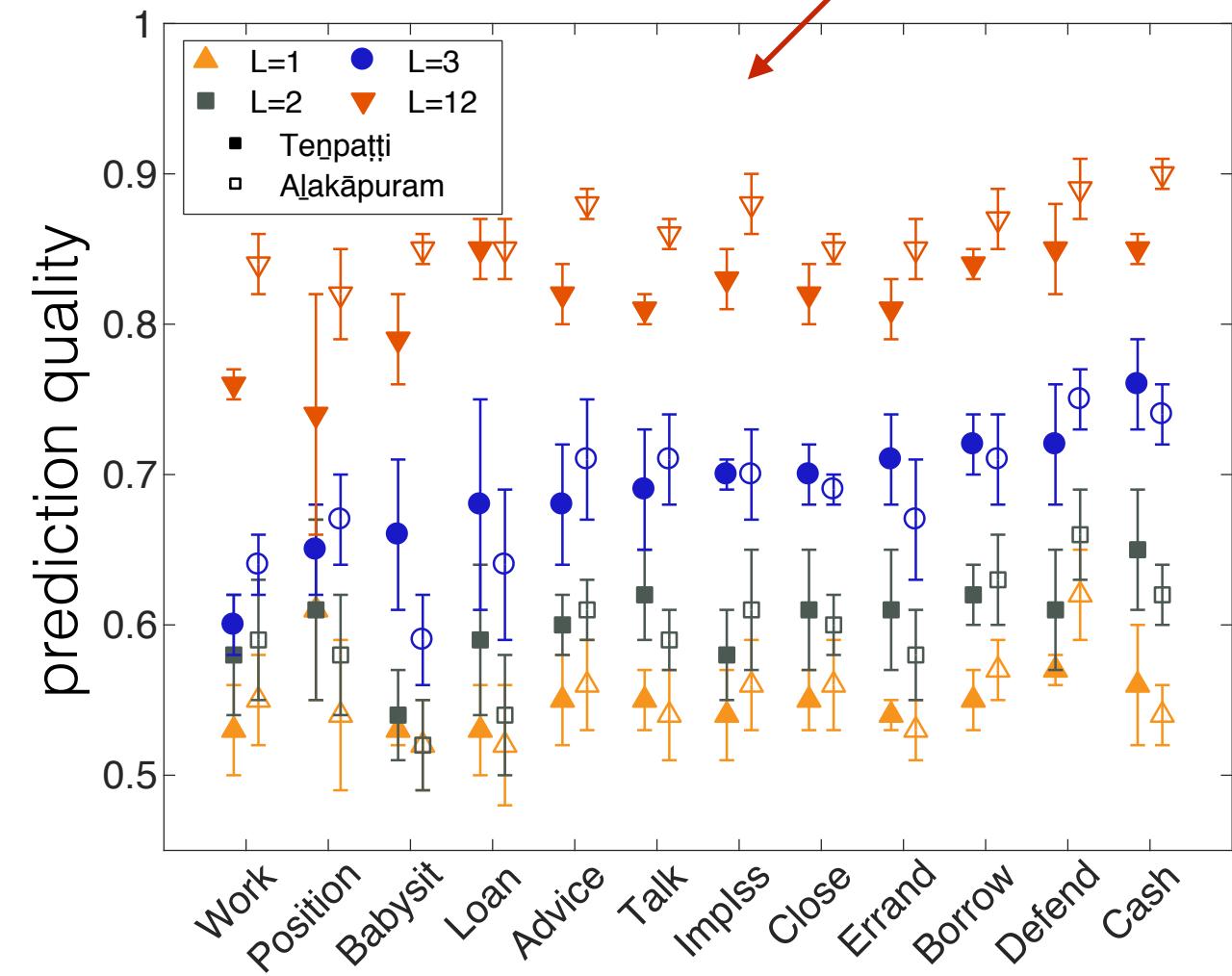
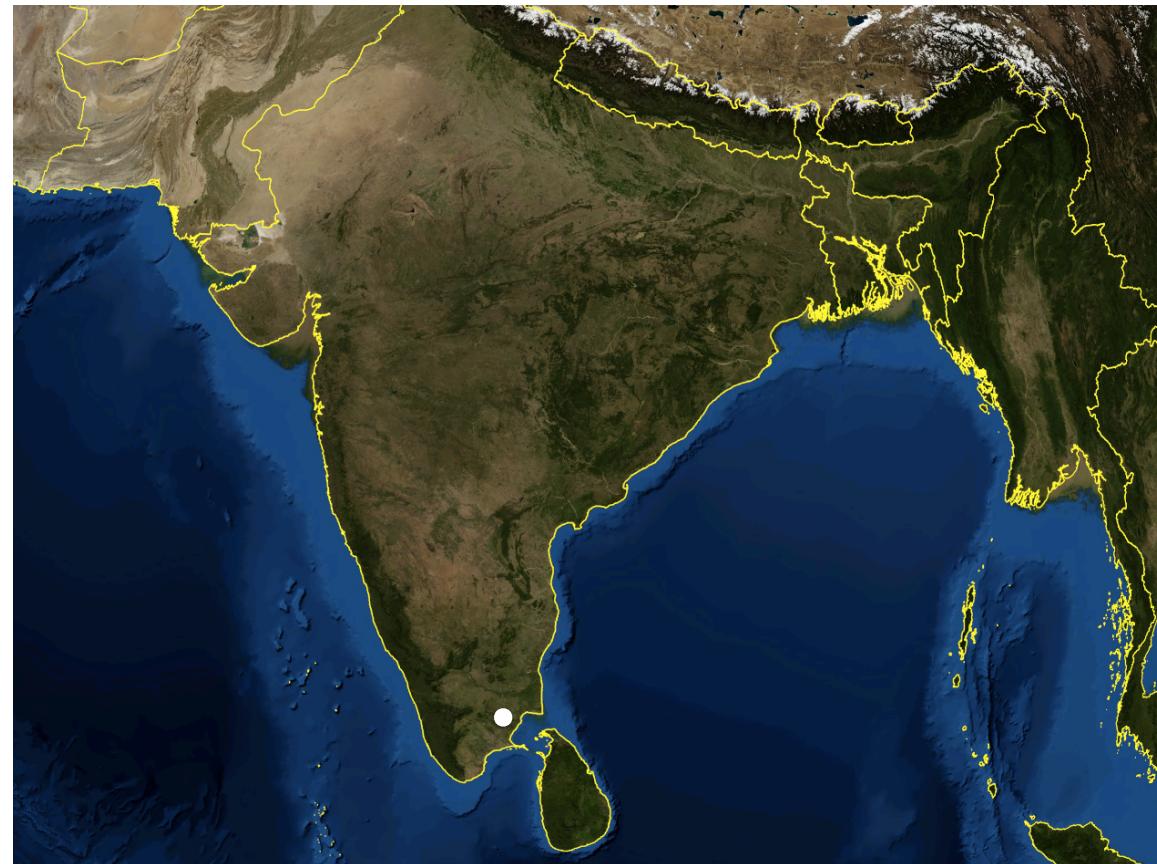
disrupted: booking with kayak, expedia, etc

Layer interdependence

more layers = better performance
(layer structure generated by same social mech.)

Are layers structurally similar? Complementary? Neither?

“Learn” a SBM from m layers; try to predict links of $m+1$.

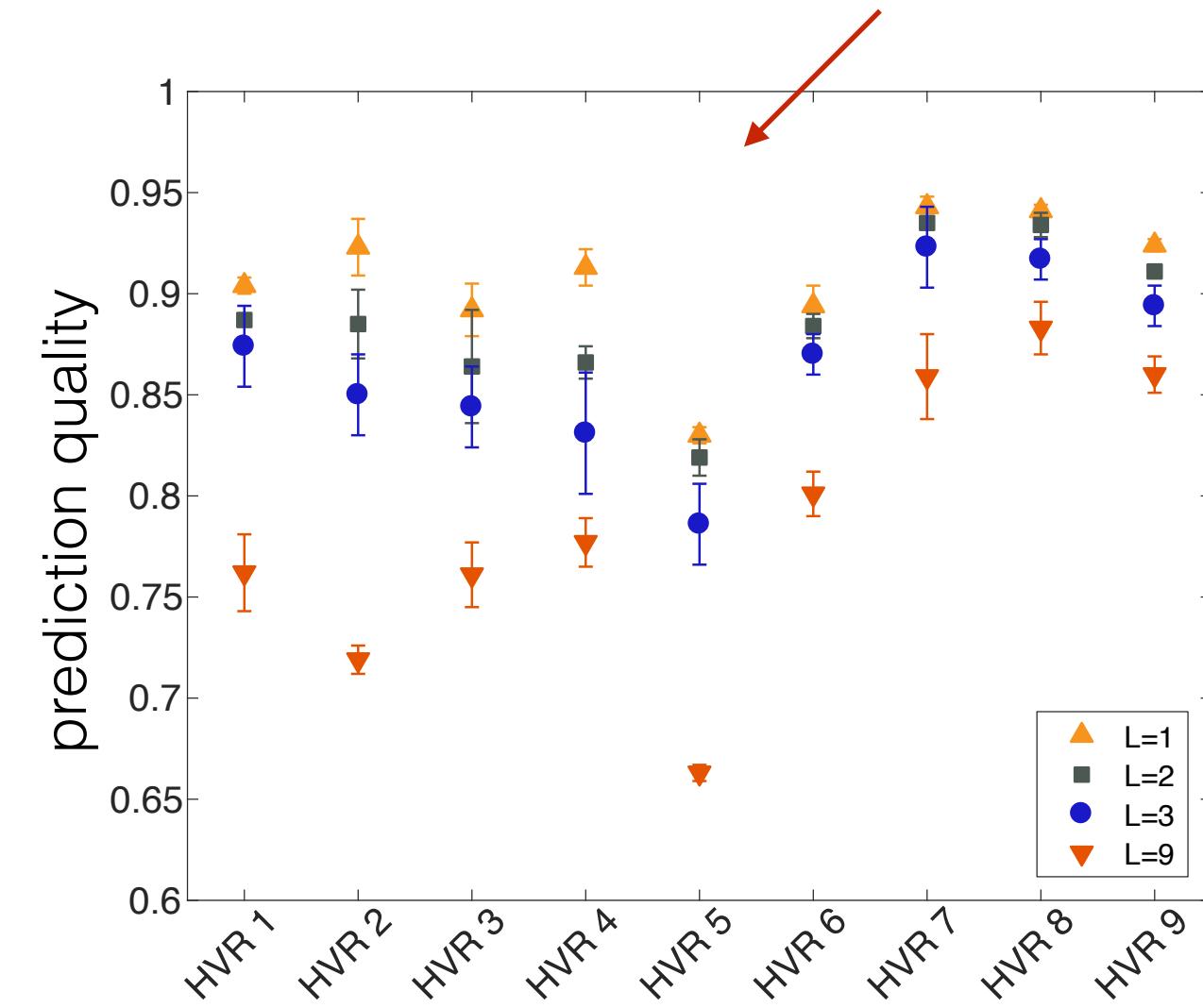


12 layer social support network across 2 villages in South India.

Layer interdependence - malaria



more layers = worse performance
(layer structure generated by different biol. mech.)



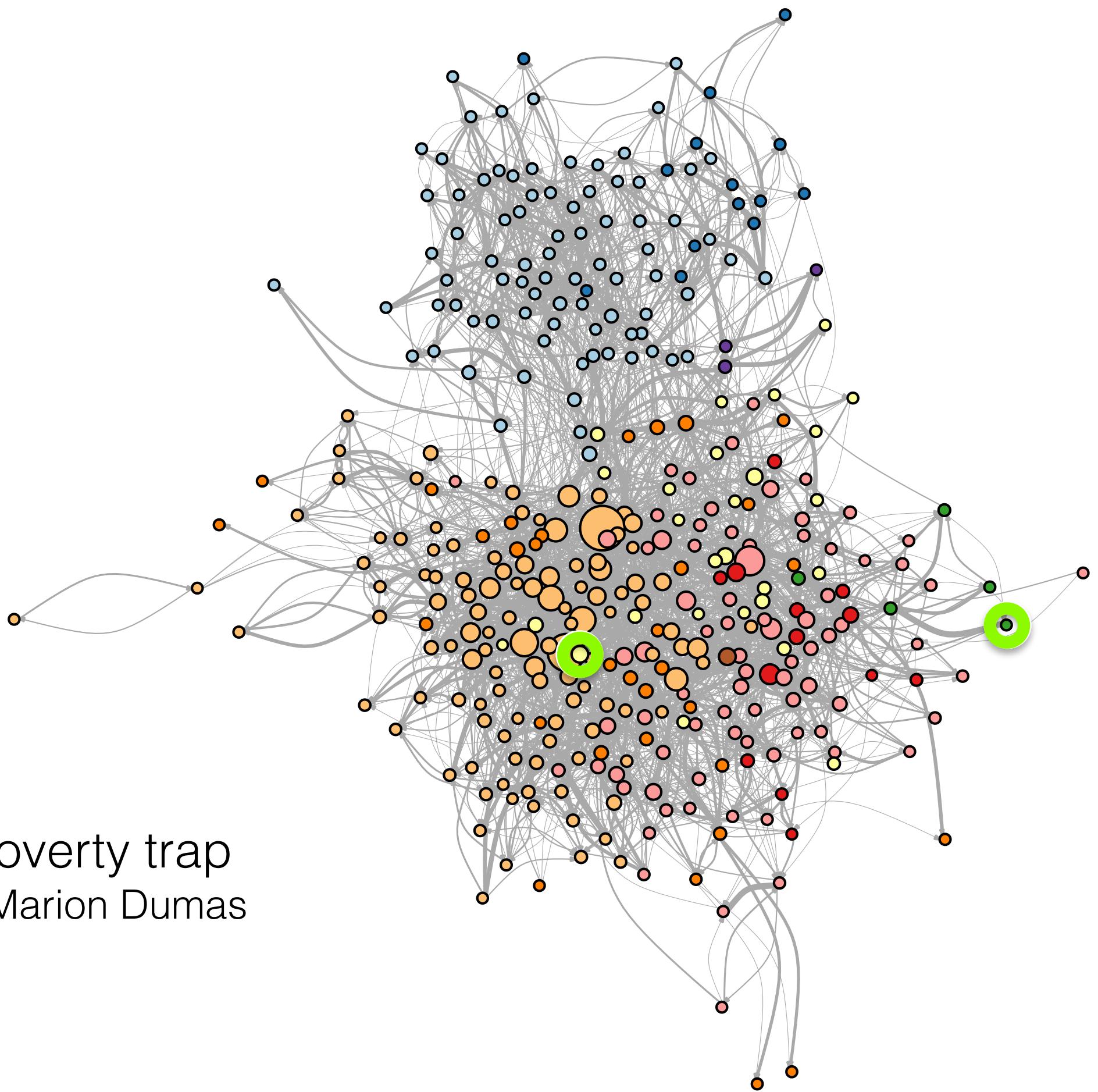
cannot predict the structure of one region in the immune-evasion genes
by using other regions; layers are unrelated!



Photo: Eleanor A. Power



Photo: Eleanor A. Power



The reputational poverty trap
Eleanor Power & Marion Dumas

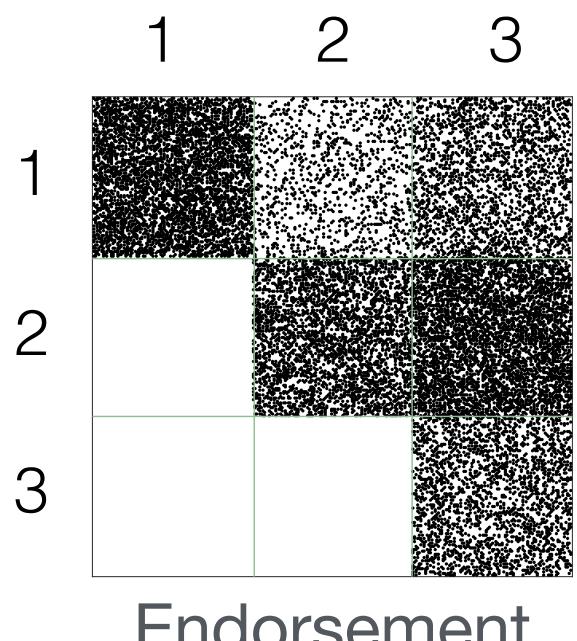
A fundamental difference for groups:

status from **endorsement** || status from **dominance**

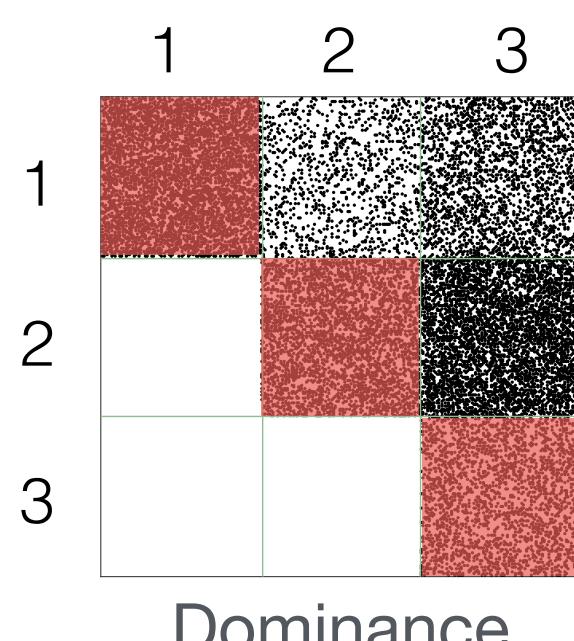
Endorsement vs Dominance



Directed edges
have meaning.



We must encode our beliefs about the
meaning of edges
in the algorithms we use to identify groups.



Ranked order quality, R

We propose to measure the **quality** of a ranked ordering by R

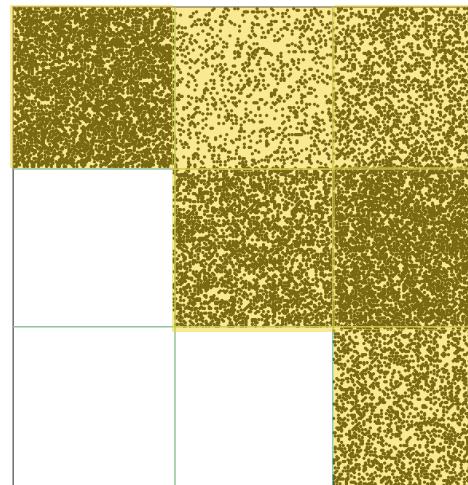
$$R = \frac{1}{m} \sum_{ij} (A_{ij} - E_{ij}) \mathbf{1}_{g_i \leq g_j}$$

links

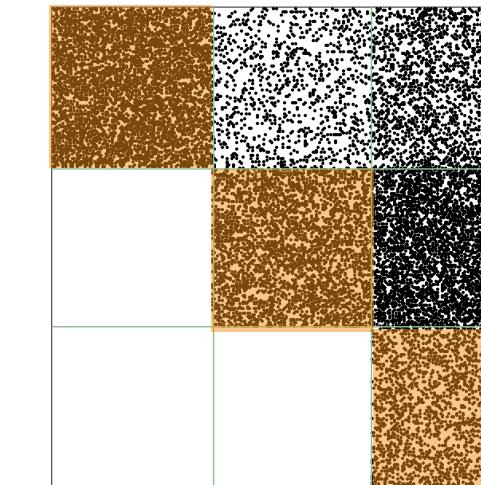
network adjacency matrix

indicator
group of $i \leq$ group of j

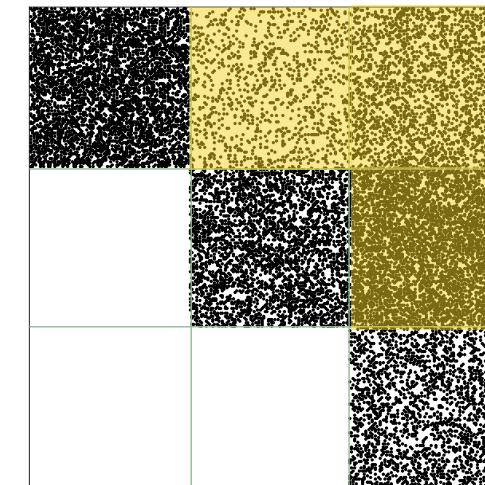
expectation (null model)



endorsement quality, $R \leq$



modularity, Q



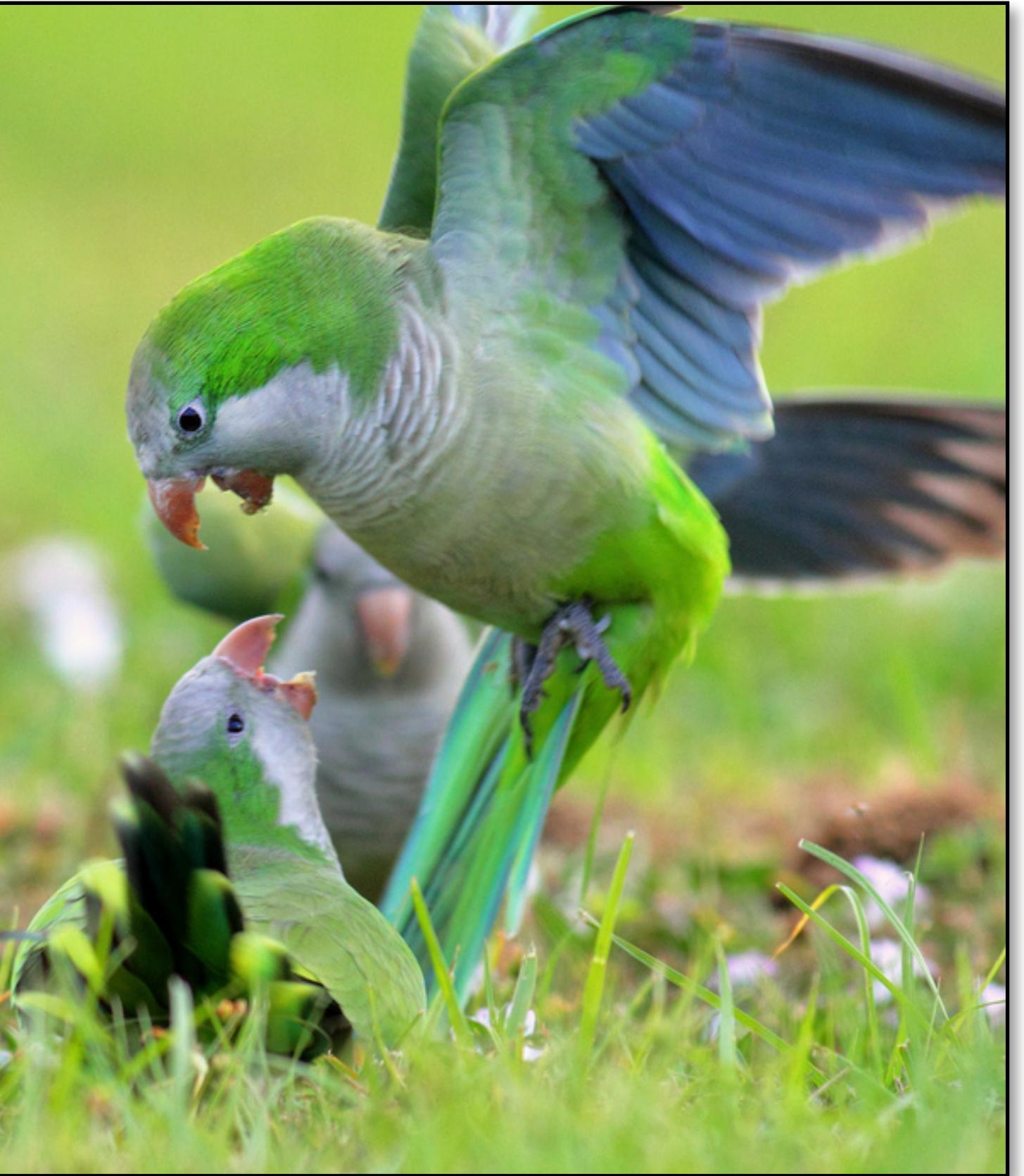
dominance quality, $R <$



Hierarchy and cognition

What are the mechanisms that create large-scale patterns from many small interactions?

Confront models with data to reveal cognitively-accessible social mechanisms in parakeets.





1

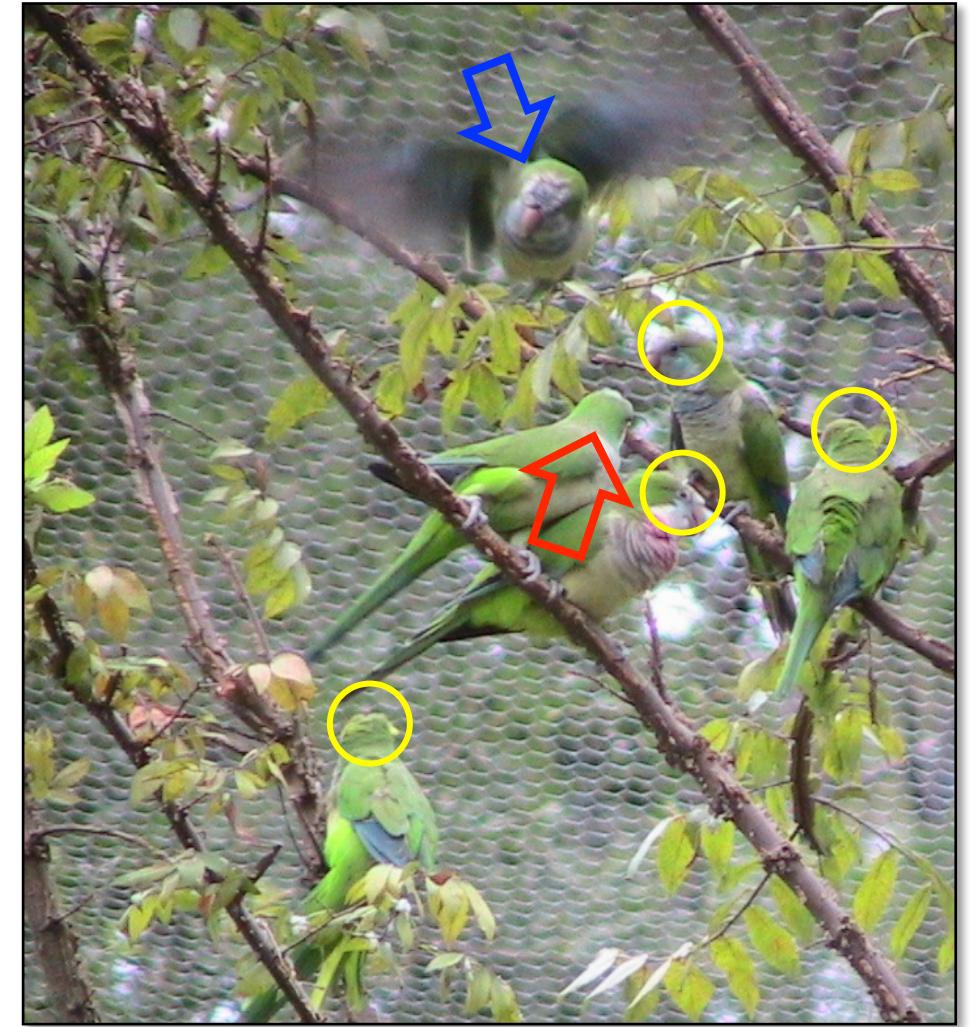
→ aggressor (winner)

→ target (loser)

○ gawking, staring, shameless witnesses!

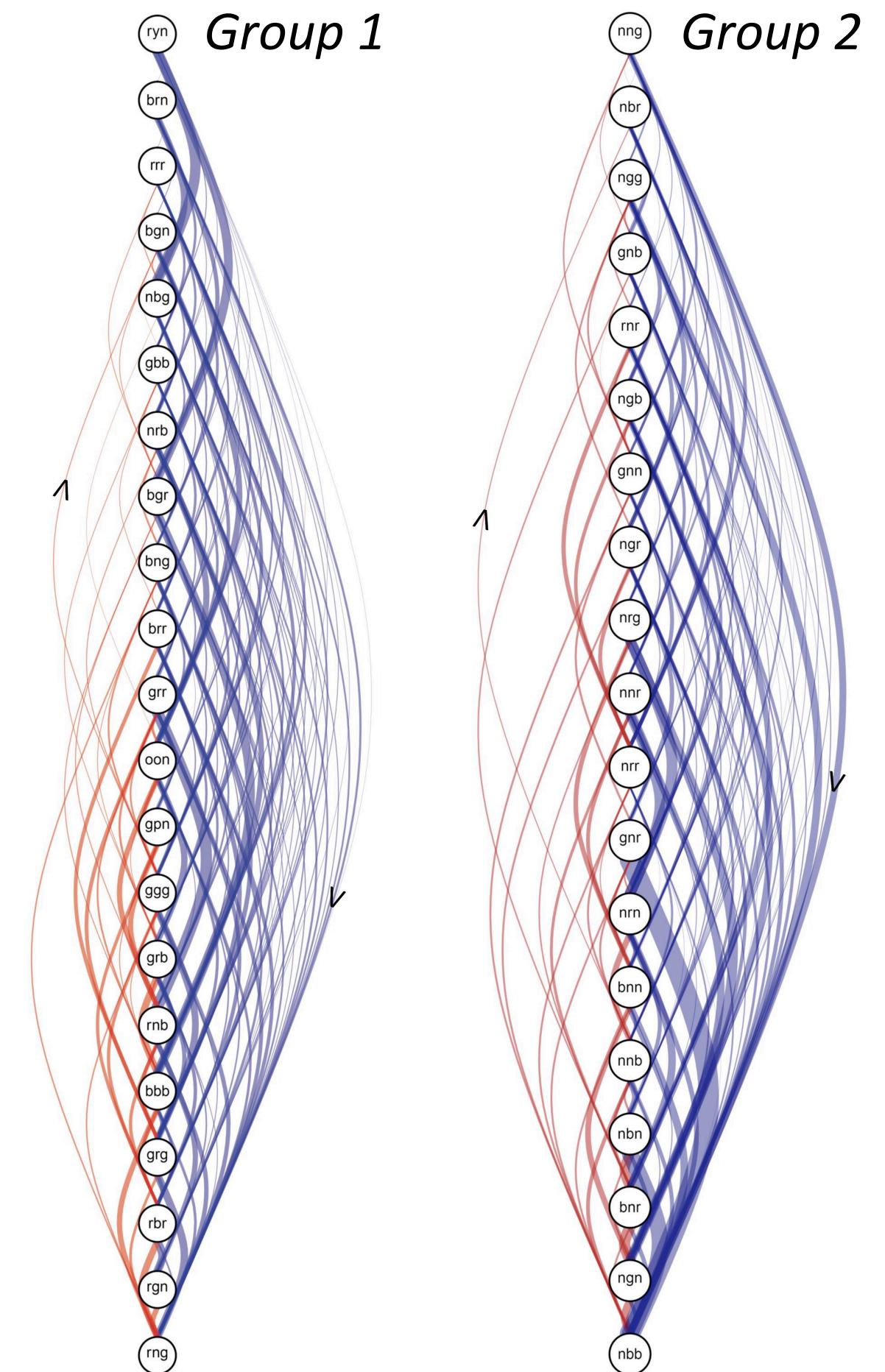


2

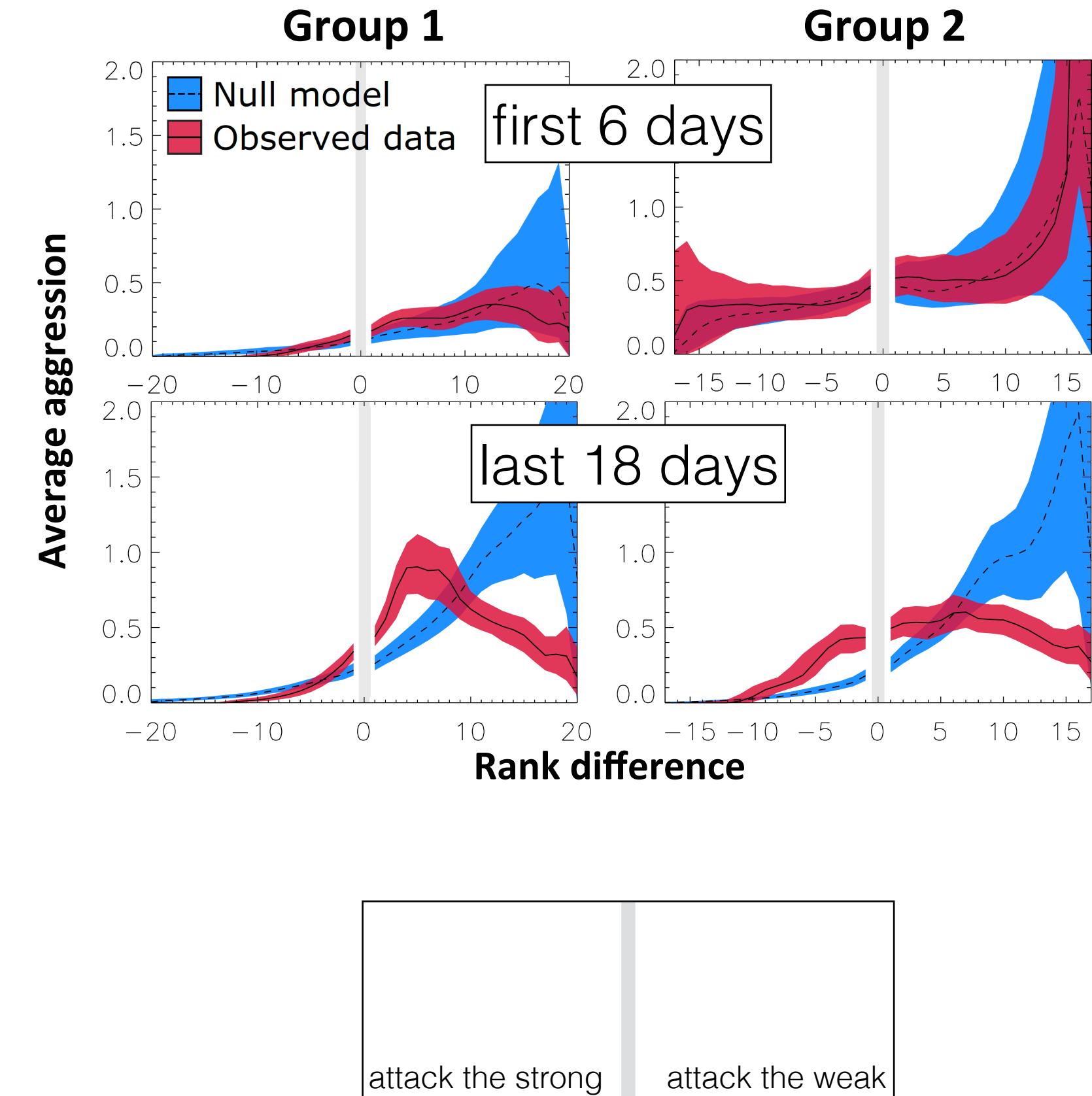
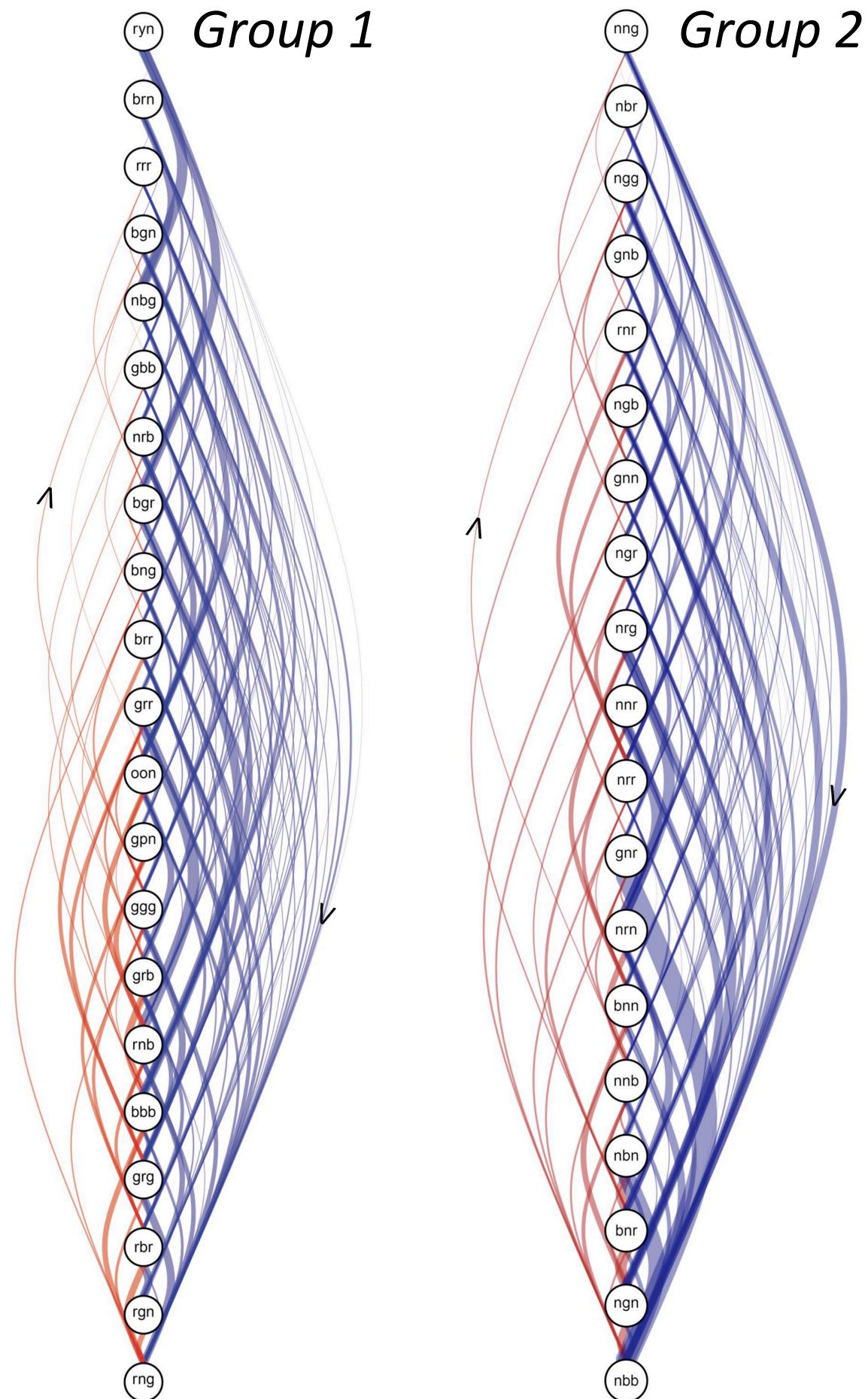


3

elapsed time < 1 second

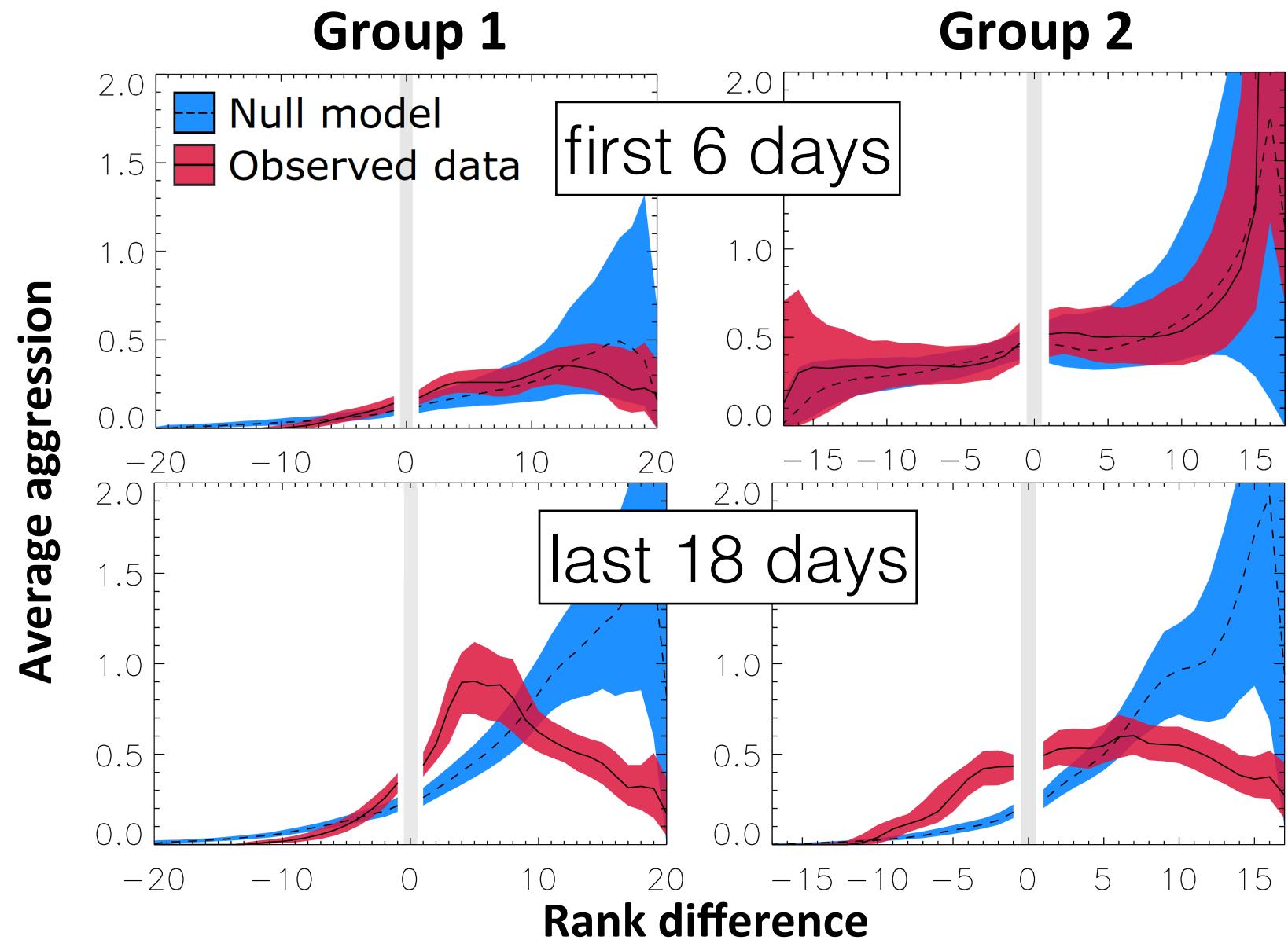


attack the strong attack the weak



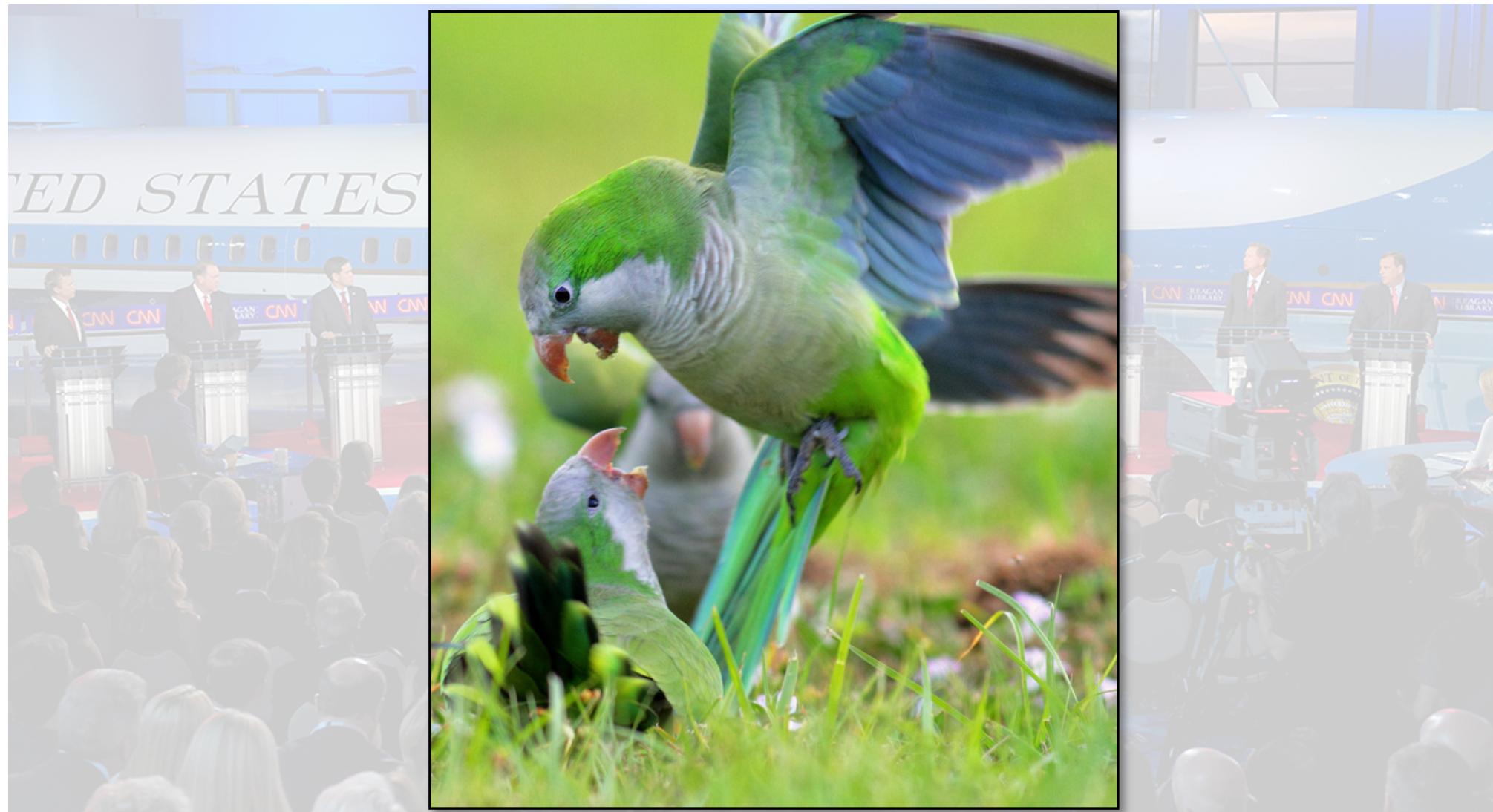
Parakeets know which individuals are ranked above and below themselves.

Parakeets know their own rank and the ranks of others.



Confronting models, which incorporate different complexities of bird-knowledge, with meticulous data, reveals clues about mechanisms of hierarchy formation.

Complex models reveal complex behaviors



Pile-on

Target the most recent loser.

[kick 'em while they're down]

Pass-along

Target lower-ranked after losing.

[hurt people hurt people]

Opportunism

Target a recent loser of higher rank.

[now's my chance!]

Beyond cognition & linear dominance,
what about cognition & group dominance?



hockeyfights.com

POWERED BY VIOLENT GENTLEMEN

Home Fight Log Players Teams Leagues Videos News Community Games Blog

Sam Bennett vs Ryan Johansen

Feb 21, 2017 2pd 06:27

2016-2017 Regular Season

Date / Time	Away / Home Team	Away / Home Player
Feb 21, 2017	Calgary Flames	Sam Bennett
2pd 06:27	Nashville Predators	Ryan Johansen

Your vote

You must sign in to vote.

You can [sign up](#) for free if you do not have an account already.

Results

Sam Bennett		92.9%
Ryan Johansen		5.4%
Draw		1.8%

From 56 votes with an average rating of 5.6

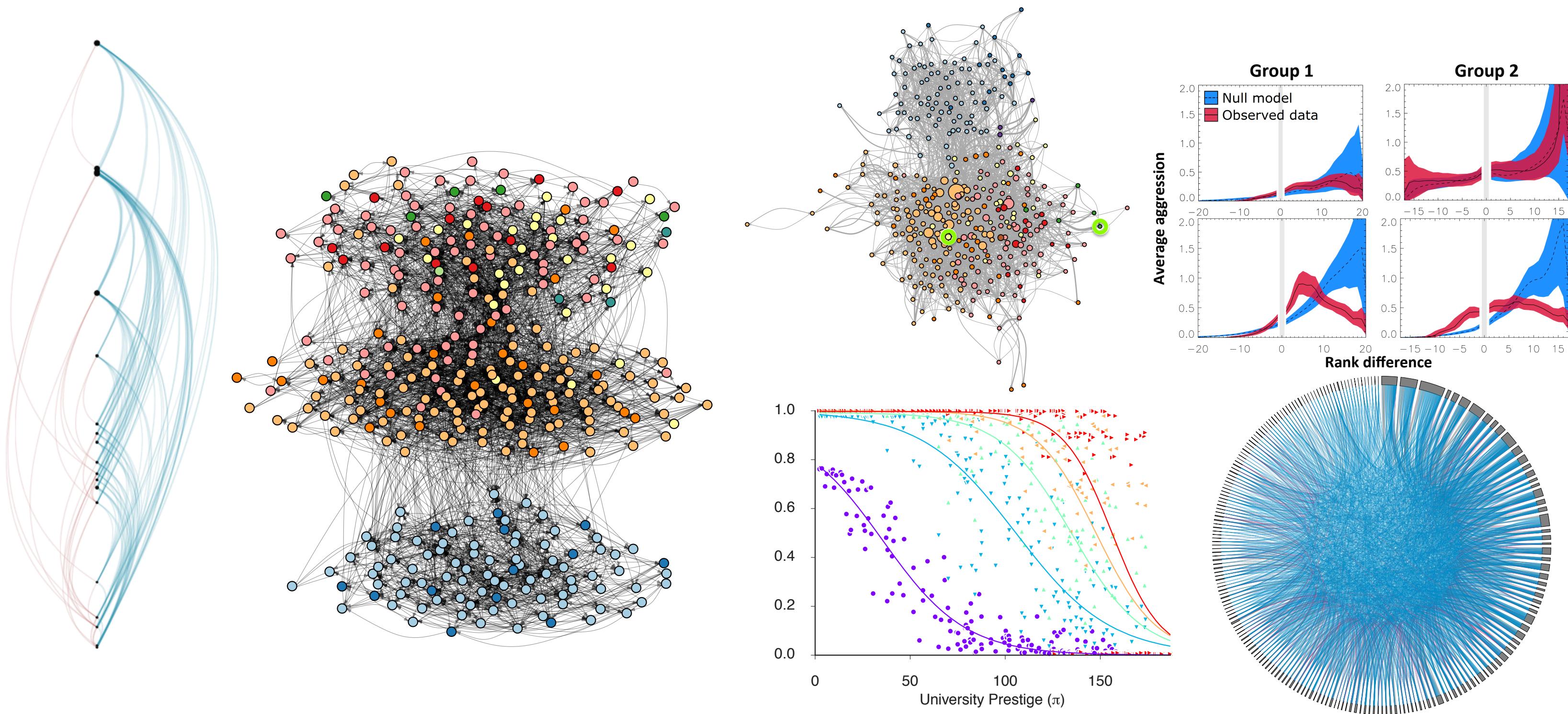


User Name User Name Remember Me?
Password Log in

Related Links

[Sam Bennett](#)

2016-2017 Regular Season:



Prestige and status structures emerge in networks & we can identify them.

Beyond pictures: these things matter.
traps, formation, ideas, & inequalities.

Research in progress

Which systematic patterns are consistent across academic fields?

Do people have an accurate perception of prestige and mobility in real systems?

How do policies & culture affect the formation & maintenance of structure?

How can we identify and dispel reputational poverty traps?

Which mechanisms create linear hierarchies and ranked groups?

How can we identify linear hierarchies embedded in complex networks?



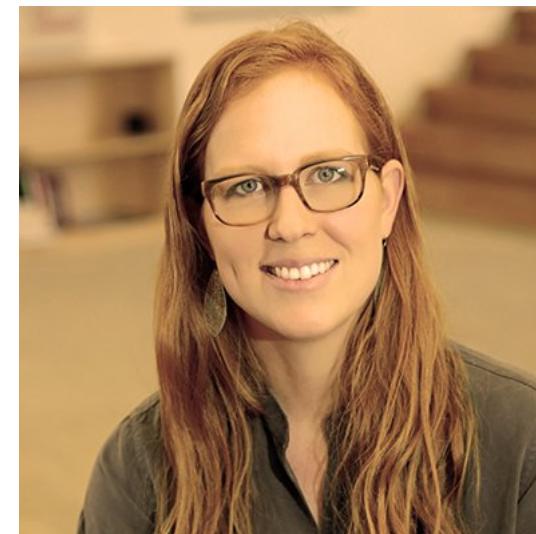
Aaron Clauset
Colorado, SFI ext.



Mirta Galesic
SFI



Caterina De Bacco
Columbia, Max Planck



Eleanor Power
LSE



Elizabeth Hobson
SFI, ASU



Cris Moore
SFI

But if you like the questions and topic...

SCIENCE ADVANCES | RESEARCH ARTICLE

SOCIAL SCIENCES

Aspirational pursuit of mates in online dating markets

Elizabeth E. Bruch^{1,2*} and M. E. J. Newman^{2,3}

Romantic courtship is often described as taking place in a dating market where men and women compete for mates, but the detailed structure and dynamics of dating markets have historically been difficult to quantify for lack of suitable data. In recent years, however, the advent and vigorous growth of the online dating industry has provided a rich new source of information on mate pursuit. We present an empirical analysis of heterosexual dating markets in four large U.S. cities using data from a popular, free online dating service. We show that competition for mates creates a pronounced hierarchy of desirability that correlates strongly with user demographics and is remarkably consistent across cities. We find that both men and women pursue partners who are on average about 25% more desirable than themselves by our measures and that they use different messaging strategies with partners of different desirability. We also find that the probability of receiving a response to an advance drops markedly with increasing difference in desirability between the pursuer and the pursued. Strategic behaviors can improve one's chances of attracting a more desirable mate, although the effects are modest.

A large, abstract graphic on the left side of the slide features several overlapping circles in light blue and white. Inside these circles are stylized representations of classical Greek architecture, including columns with spiral bases (Spiral fluting) and triangular pediments with horizontal stripes. The graphic is composed of thin lines and filled shapes.

Thank you

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