Ideas worth spreading:
How does network position influence the spread of research topics?

Allison Morgan
University of Colorado, Boulder

with Dimitrios Economou, Samuel Way, Aaron Clauset
How do research ideas spread within a discipline?

How does network position affect the spread of new ideas?
Prestige and Publication

Professional Standing and the Reception of Scientific Discoveries

Stephen Cole
State University of New York at Stony Brook, and Bureau of Applied Social Research, Columbia University

American Journal of Sociology 76(2), 286-306 (1970)

DEPARTMENTAL EFFECTS ON SCIENTIFIC PRODUCTIVITY

Paul D. Allison
University of Pennsylvania

J. Scott Long
Indiana University

Am. Soc. Rev. 55, 469-478 (1990)
Prestigious universities are better connected

- Average Path Length ($\langle l \rangle$)
- Universities Sorted by Prestige ($\pi$)
- MIT
- University of Colorado, Boulder
- New Mexico State University

Slope: 0.0163
Methods

How much does an idea's origination location matter for how far it spreads?

First, we need to know how ideas spread.

Then, we can use simulation to measure the consequences of prestige.
Data

Faculty hiring network

Publication records


Data

Faculty hiring network

Education and employment history for faculty at 205 U.S. and Canadian CS depts.

Node $u$ represents an institution with unique prestige.

Edge $(u, v)$ represents a PhD candidate from $u$ who got an assistant faculty position at $v$. 

(Source: Science Advances 1(1), e1400005 (2015))
Data

Publication records for 2659 tenure-track faculty.

Includes title, author list, venue, and date for each pub.

Use first assistant professorship start dates to identify faculty who started a research area at their university.
Do faculty bring research with them?

University A

University B

Comics by Jorge Cham: http://phdcomics.com/
Research ideas spread across hiring

Compare real hiring infection rate to a null model where faculty randomly choose research topics.

“topic modeling”: $p = 0.01 \pm 0.01$

“incremental computing”: $p = 0.01 \pm 0.01$

“deep learning”: $p = 0.2 \pm 0.01$

Faculty hiring network shapes spread of ideas.
What role might prestige play in the spread of new ideas?

Seed an epidemic at a single university with unique prestige.

Simulate an SI epidemic on the network.

Examine resulting epidemic size as a function of prestige (network location) and quality of idea.
Network position affects epidemic size

Increasing Prestige

University Prestige ($\pi$)

Infection Rate ("Idea Quality")

- 0.1
- 0.3
- 0.5
- 0.7
- 0.9

Fraction of Network Infected
Network position affects epidemic size

For a fixed infection rate 0.1, increasing prestige by 10 units ($\Delta \pi = +10$) infects 7.5% more of the whole network.
Conclusions

Researchers appear to carry some research ideas from PhD to first assistant professorship.

Under a model where ideas entirely spread via hiring, higher prestige universities have large influence.
Future Work

Better approximate the spread of research by obtaining full text of publications.

Explore more sophisticated models of idea-spreading.
Thanks!

Collaborators: Dimitrios Economou, Samuel Way, Aaron Clauset

@alliecmorgan
allisonmorgan.github.io
allison.morgan@colorado.edu