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

Allison Morgan, Dimitrios Economou, Samuel Way, Aaron Clauset
Science is a meritocracy... right?
Yet, we know that some scientists and institutions are far more influential than others.
Three explanations

(1) genuine differences in merit

(2) non-meritocratic social processes

(3) non-meritocratic structural factors

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(2) non-meritocratic social processes
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Faculty hiring as a mechanism

**R1:** Are research ideas carried by faculty hiring?

**R2:** Does the structure of the faculty hiring network affect the spread of ideas?
Data

Education & employment for faculty from 205 U.S. and Canadian CS departments
- Institution (node) $u$ with unique prestige $\pi$
- Edge $(u, v)$ represents a PhD candidate from $u$ who got an assistant faculty position at $v$

Over 200K publication records for 2.6K tenure-track faculty
- Title, author list, venue, and date
- Matched with employment start dates

Faculty hiring networks

Publication records


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For each department that has adopted a research idea, either:

(a) the department hired a scientist who works on that idea [hiring], or
(b) some scientist at the department begins working on the idea [non-hiring]
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<table>
<thead>
<tr>
<th>topic</th>
<th>2/3 of research topics were significantly more likely to be transmitted via hiring than at random</th>
</tr>
</thead>
<tbody>
<tr>
<td>deep learning</td>
<td>❌</td>
</tr>
<tr>
<td>topic modeling</td>
<td>✓</td>
</tr>
<tr>
<td>incremental computing</td>
<td>✓</td>
</tr>
</tbody>
</table>
R2: Does the structure of the faculty hiring network affect the spread of ideas?
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To simulate the diffusion of ideas, use a Susceptible-Infected (SI) model.

Seed an epidemic at a single university with unique prestige \( \pi \) (network location).

Varying the transmissibility \( p \) (quality of an idea).

Measure the fraction of universities which have adopted the idea.
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![Graph showing the relationship between university prestige and the fraction of network infected. The trend line is expected to decrease as prestige increases.]
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Great ideas can spread regardless of starting place.
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![Graph](image)

Great ideas can spread regardless of starting place.

Good ideas spread more easily from high-prestige universities.
Conclusion

Ideas spread in academia via faculty hiring. The structure of this network privileges elite institutions.

Good ideas can spread further and faster from prestigious universities, but great ideas can spread from any university.

Future work should consider other (non-meritocratic) mechanisms, as well as the full text of research papers or other research ideas.

Remaining questions: How should we address this inequality?
Thanks!

Collaborators: Dimitrios Economou, Samuel Way, Aaron Clauset


Code: github.com/allisonmorgan/epistemic_inequality
R1: Are research ideas carried by faculty hiring?

Topic Modeling
- Up to 2000
- 2000 to 2004
- 2005 to 2011

Incremental Computing
- Up to 1990
- 1990 to 1999
- 2000 to 2011

Deep Learning
- Up to 1990
- 1990 to 1999
- 2000 to 2011
R1: Are research ideas carried by faculty hiring?

<table>
<thead>
<tr>
<th>topic</th>
<th>$h_o$</th>
<th>$h_e$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>deep learning</td>
<td>0.34</td>
<td>0.30</td>
<td>0.16 ± 0.01</td>
</tr>
<tr>
<td>topic modeling</td>
<td>0.33</td>
<td>0.22</td>
<td>0.01 ± 0.01</td>
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<tr>
<td>incremental computing</td>
<td>0.39</td>
<td>0.19</td>
<td>0.01 ± 0.01</td>
</tr>
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</table>

**topic_modeling_keywords** = ["probabilistic latent semantic analysis", "plsa", "latent dirichlet allocation", "latent semantic analysis", "latent semantic indexing", "topic model", "probabilistic topic modeling"]
