The Reliability of Testimonial Norms in Academic Communities

Conor Mayo-Wilson

Models and Simulations
July 9th, 2013

Dependence in Academic Communities

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- How should we determine who to trust and what to believe on the basis of their testimony?

Experts

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- Which one(s) should I trust if there is disagreement?

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- Goldman (2011): Do not poll. There are a variety of procedures to determine which experts are most reliable.
- Of course, there are a number of other issues surrounding expert testimony ...

The Hoi Polloi

- We often learn from **non**-experts - for example:
  - Newspapers,
  - Magazines,
  - Blogs,
  - High-school teachers,
  - College Professors (philosophers excluded, of course).

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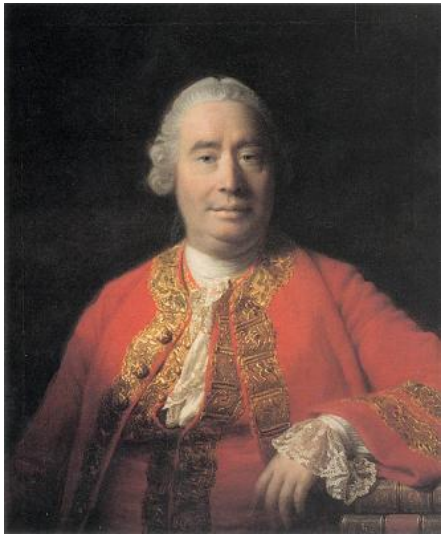
- Who should we trust?

Reductionists

Trust testimonial evidence only if there is positive evidence for speaker's reliability and honesty.



Reductionists

> *[B]elieving what one is told, depends on believing the teller trustworthy . . . belief in the teller's trustworthiness needs to be empirically grounded. There is no general epistemic entitlement to trust any teller.*

Elizabeth Fricker. "Second-Hand Knowledge."

Non-reductionists

Trust testimonial evidence in absence of negative reasons to doubt it.

Non-Reductionists

[E]ven if you do not have the opportunity to rationally persuade me of the truth of what you believe, and even if I have little or no information about your evidence, abilities, circumstances or history of reliability and hence have no basis for granting you specialized authority, it is nonetheless reasonable for me to regard your opinions as having a measure of prima facie intellectual credibility.

Richard Foley. "Universal Intellectual Trust."

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- Call such rules testimonial norms.

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- **The Reductionism Debate:** Motivated by the recognition that the former norm is reliable in some contexts but not others. Similarly, the latter norm might prohibit one from learning in contexts in which individuals are honest and reliable.

Testimonial Norms

Similar remarks apply to debates concerning expert testimony.

Central Questions

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Central Thesis: Evaluation of various testimonial norms ought to pay close attention to

- the possibility of miscommunication
- the social structure of epistemic communities, which dictate how information is disseminated.

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   - If not, how well do they avoid error?

Outline

Overview of Model

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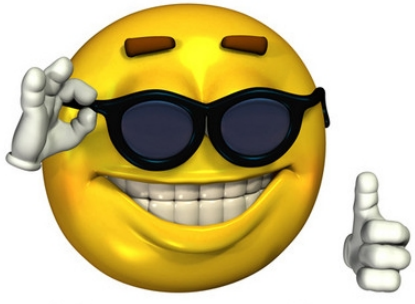

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- Each scientist studies only one drug (due to financial constraints, time constaints, specialized training, etc.).
- Scientists must learn about the efficacy of some drugs from others.

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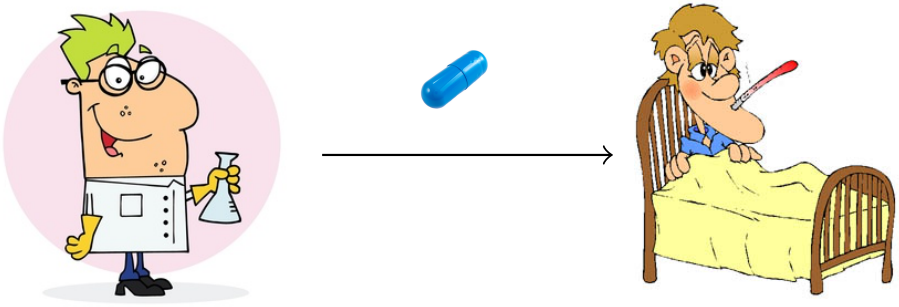
- They learn from data (about their own pill)
- They learn from others (about other pills).

Learning from data



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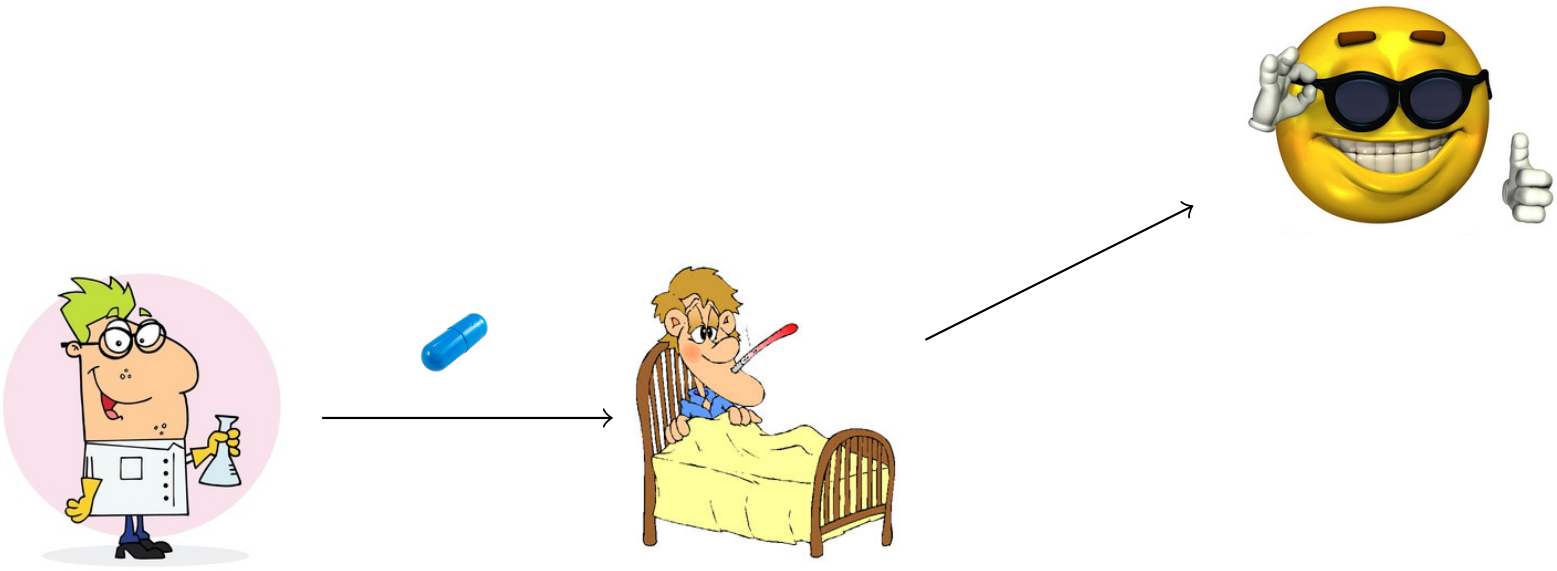

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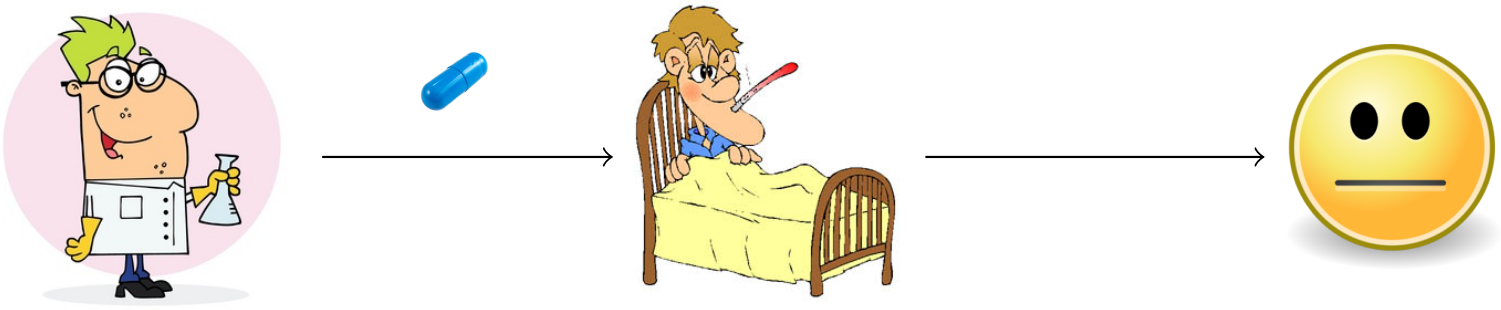

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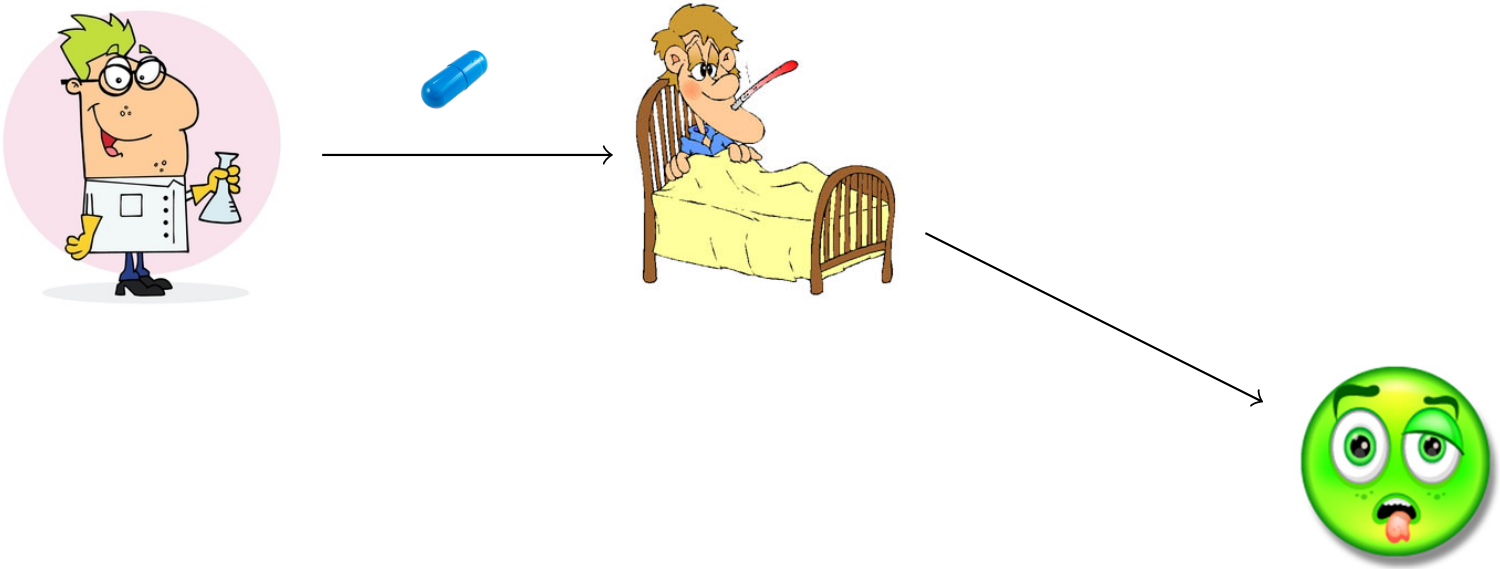


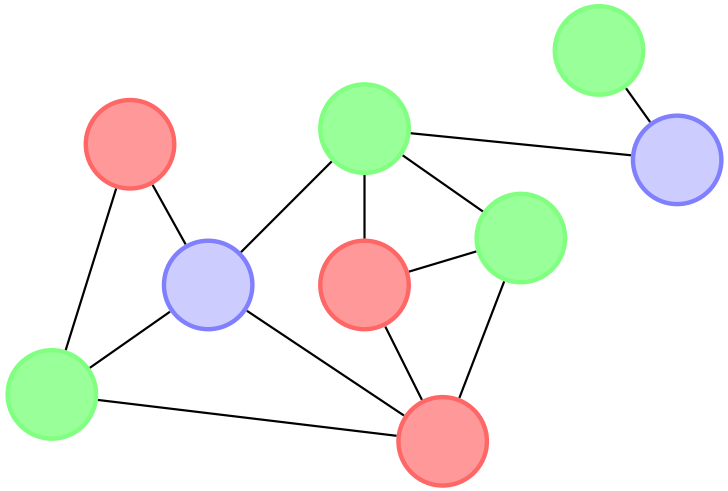
- Formally - Each scientist draws a sample point from a normal distribution with unknown mean μ_i and unknown variance σ_i^2.

Updating Beliefs

Within her own field: Each scientist uses a significance test to determine whether the drug she studies is effective.

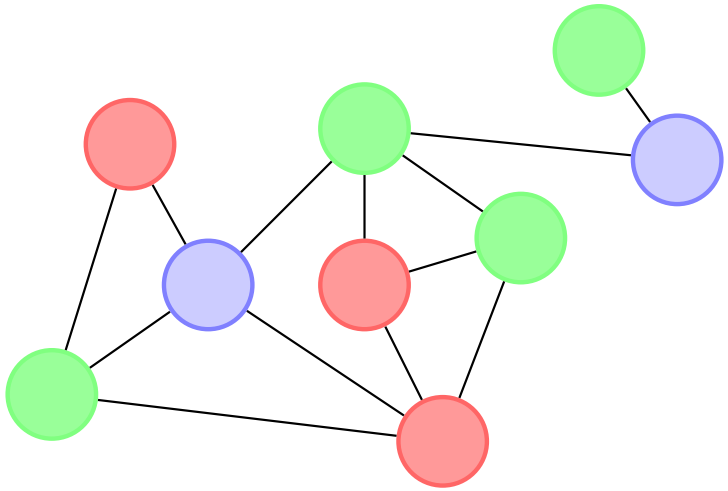
Scientists use all available data, including that acquired from their peers who study the same drug.

Communication



Nodes = Scientists

Communication



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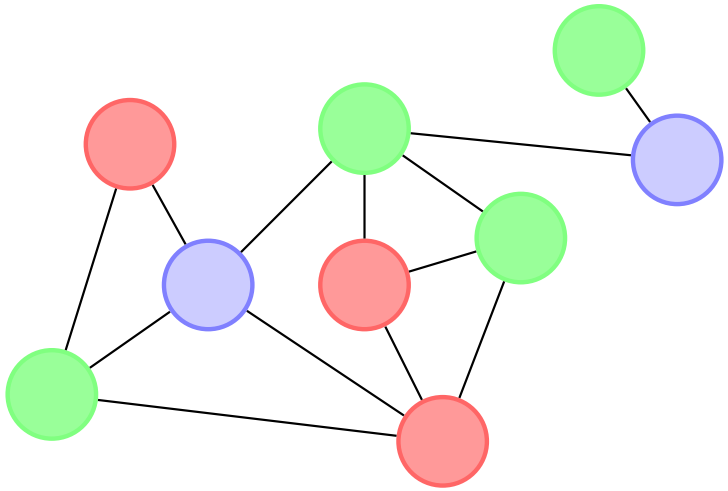
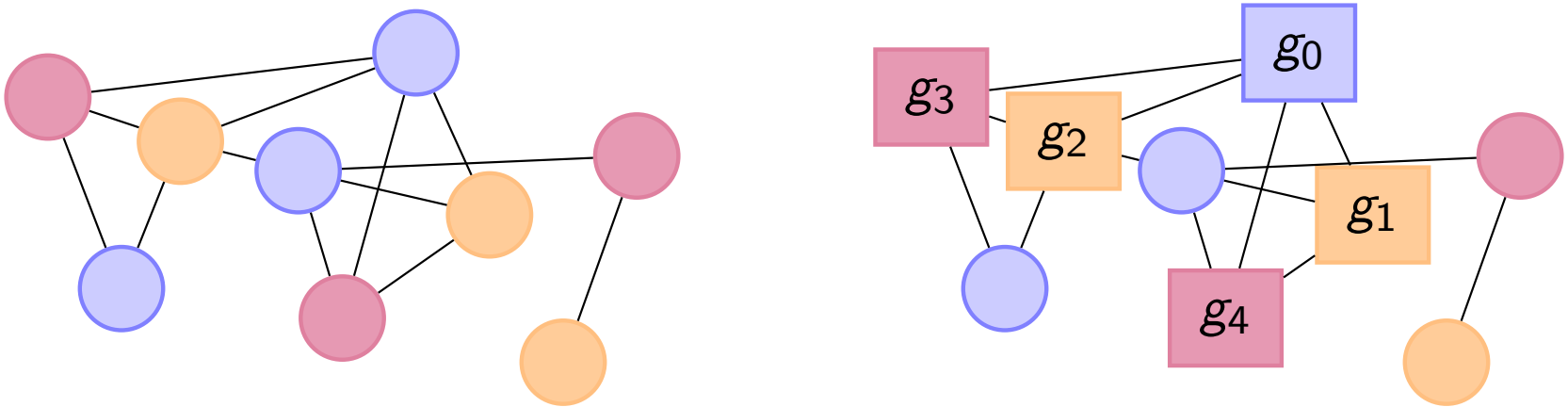


Nodes = Scientists
Colors = Pill the scientist studies
Edges = Which scientists can share information.

Neighborhoods



g_0's neighborhood

Communication

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- Otherwise, they can share only their qualitative beliefs concerning which drugs are effective.

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- Agents employ different testimonial norms to learn from qualitative information, where a testimonial norm is simply a (random) function from what is said by one's neighbors to beliefs.
- A group testimonial norm (GTN) specifies a testimonial norm for each agent in a network.

Example testimonial norms

Outside of one's field:

- Reidian - Adopt the belief of a randomly chosen neighbor.
- Expert Truster - Adopt the belief of an expert neighbor if one exists. Otherwise, trust a random neighbor.
- Proximitist - Adopt the belief of a neighbor who is least distant from an expert in the network.

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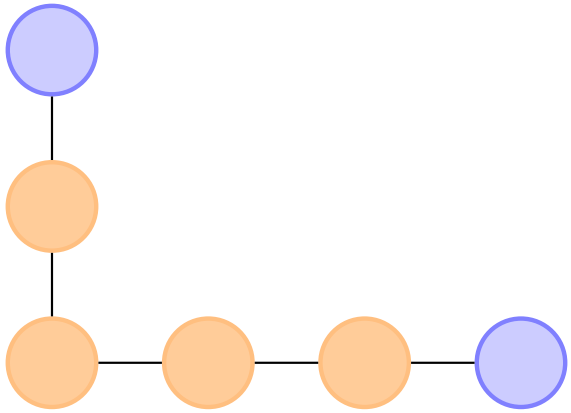

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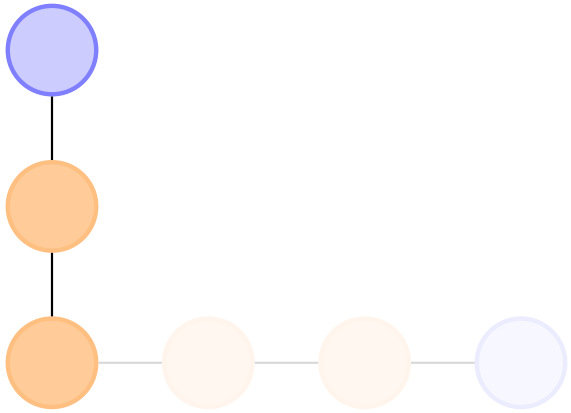

"Get it from the source"

Proximitists try to "get information from the source."

Example testimonial norms

Outside of one's field:

- Majoritarian Reidian - Poll all neighbors.
- Majoritarian E-Truster - Poll all expert neighbors if any exist. Otherwise, poll all neighbors.
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Example testimonial norms

	Single Agent	**Majoritarian**
Reidian	Random	Poll All
E-Truster	Expert	Poll Experts
Proximitist	Proximate Neighbors	Poll Proximate Neighbors

Outline

Epistemic Goals

- Truth - Which GTN, if adopted, lead researchers to develop all and only true beliefs about the world?

Convergence

Say an GTN is convergent if

- whenever a network employs said GTN,

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- whenever a network employs said GTN,
- and whatever the truth happens to be,
- with probability one,
- there is some stage of inquiry at which every agent has all and only true beliefs, and
- their beliefs remain true from that stage onward.

Theorem

Any mixture of Reidianism, e-trusting, proximitism, and majoritarian proximitism is convergent. No mixture containing either of the other two are convergent.

Convergence

In fact, almost any realistic norm satisfying basic rationality requirements converges.

Finite Memory

Say an agent g is employing a testimonial norm with finite memory if there is some finite number n such that g's beliefs depend only the last n stages.

Minimal Normative Adequacy

Suppose an agent g has finite memory of length n.

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- If there has been consensus in g's neighborhood that φ for n stages, then g believes φ with probability one.

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Suppose an agent g has finite memory of length n.

Say g employs a sensitive testimonial norm just in case

- for any area of expertise, there is some $\epsilon > 0$ and some set of g's neighbors who are more proximate to an expert such that, if every agent in the set believes φ, then g's probability of believing φ is at least ϵ.

Convergence

Theorem

If a GTN *is any mixture of finite-memory norms that are stable and sensitive, then it is convergent.*

Convergence

In other words, GTNs converge as long as they satisfy basic conditions of

- realism (i.e., finite memory)
- normative adequacy (i.e. stability and sensitivity)

Moral: If one's goal is to eventually obtain true beliefs, then one has a variety of testimonial norms from which to choose.

Epistemic Goals

- Which GTNs are convergent?

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- Which GTNs are convergent?
- Which GTNs converge quickly?

Simulations

- Varied
  - Number of scientists
  - Number of edges
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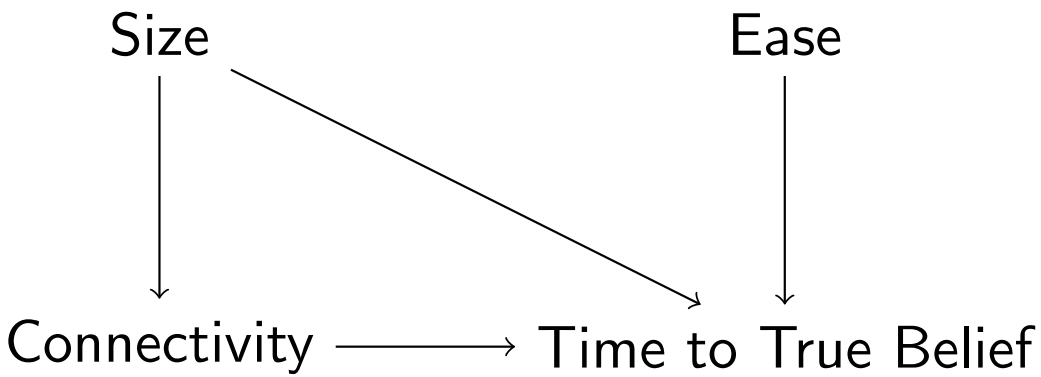
- Recorded
  - Number of elapsed stages before all agents' beliefs were true (and remained true for 15 stages).
- Analyzed the data using a series of statistical tests (ANOVA)

Simulation Results



Use of Testimony

Dissemination and Discovery

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- Time for discovery of principles of flight $\approx$ 2500 years.
- Time to disseminate such knowledge $\approx$ 1 year.
- $2500 \ggg 1$.

Dissemination and Discovery

- Testimonial norms only influence dissemination.

Dissemination and Discovery

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- So testimonial norms have only a trivial influence on total convergence time when the problem is difficult.

Summary Thus Far

1. Most intuitively plausible policies are convergent.

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2. Use of testimony is independent of speed of acquisition of true belief.

Idealizations

But I have ignored miscommunication entirely . . .

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- Imagine agents mishear, mispeak, or misunderstand their neighbors with some fixed probability $\epsilon > 0$

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- Which testimonial norms are convergent?

Theorem

No mixture of finite memory norms is convergent.

Evaluating testimonial norms

However, evaluating various testimonial norms is not hopeless ...

Miscommunication

Fix a network, an GTN, and a set of true answers.

- Let e_n be the expected proportion of all researchers' beliefs that are erroneous on stage n.

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Fix a network, an GTN, and a set of true answers.

- Let e_n be the expected proportion of all researchers' beliefs that are erroneous on stage n.
- On first glance, the number e_n could fluctuate wildly from one stage of inquiry to the next.

Miscommunication

Fix a network, any mixture of the six GTNs, and a set of true answers.

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Call e the error rate of the fixed GTN in the fixed network.

Evaluating testimonial norms

In the presence of miscommunication, we can evaluate GTNs by comparing their error rates in various networks.

Error Rates of Various testimonial norms

Theorem

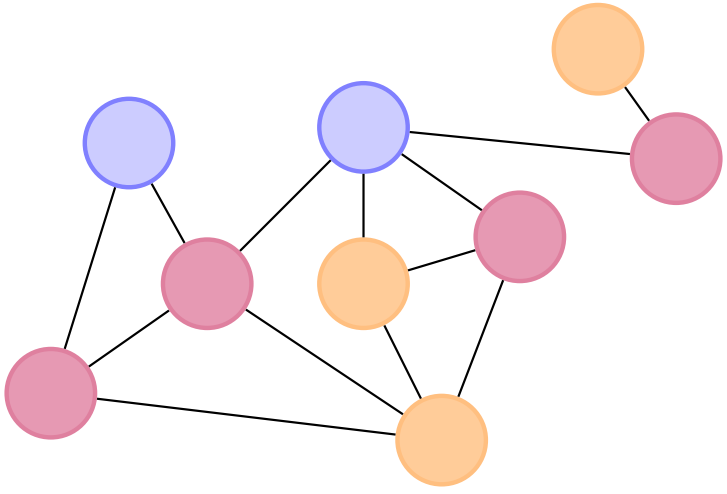
In every network, for questions of any level of difficulty, the error rates of the four convergent testimonial norms are ordered (not necessarily strictly) from highest to lowest as follows:

1. *Reidianism*
2. *E-trusting*
3. *Proximitism*
4. *Majoritarian Proximitism*

Error Rates and Social Structure

However, the error rates are not constant across all network structures.

Insularity



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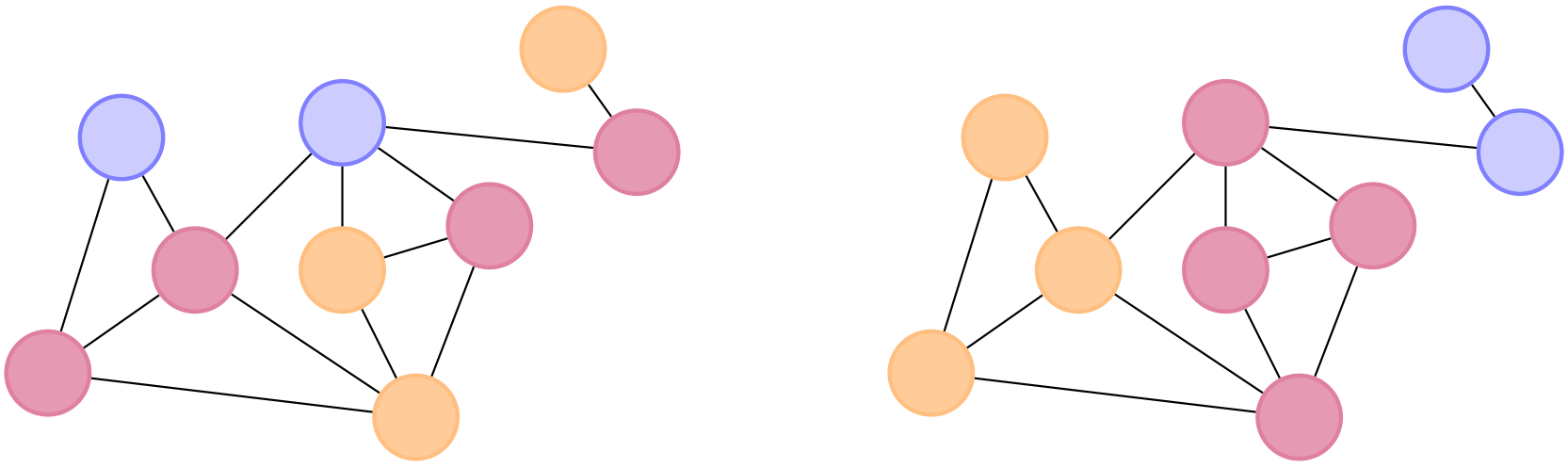
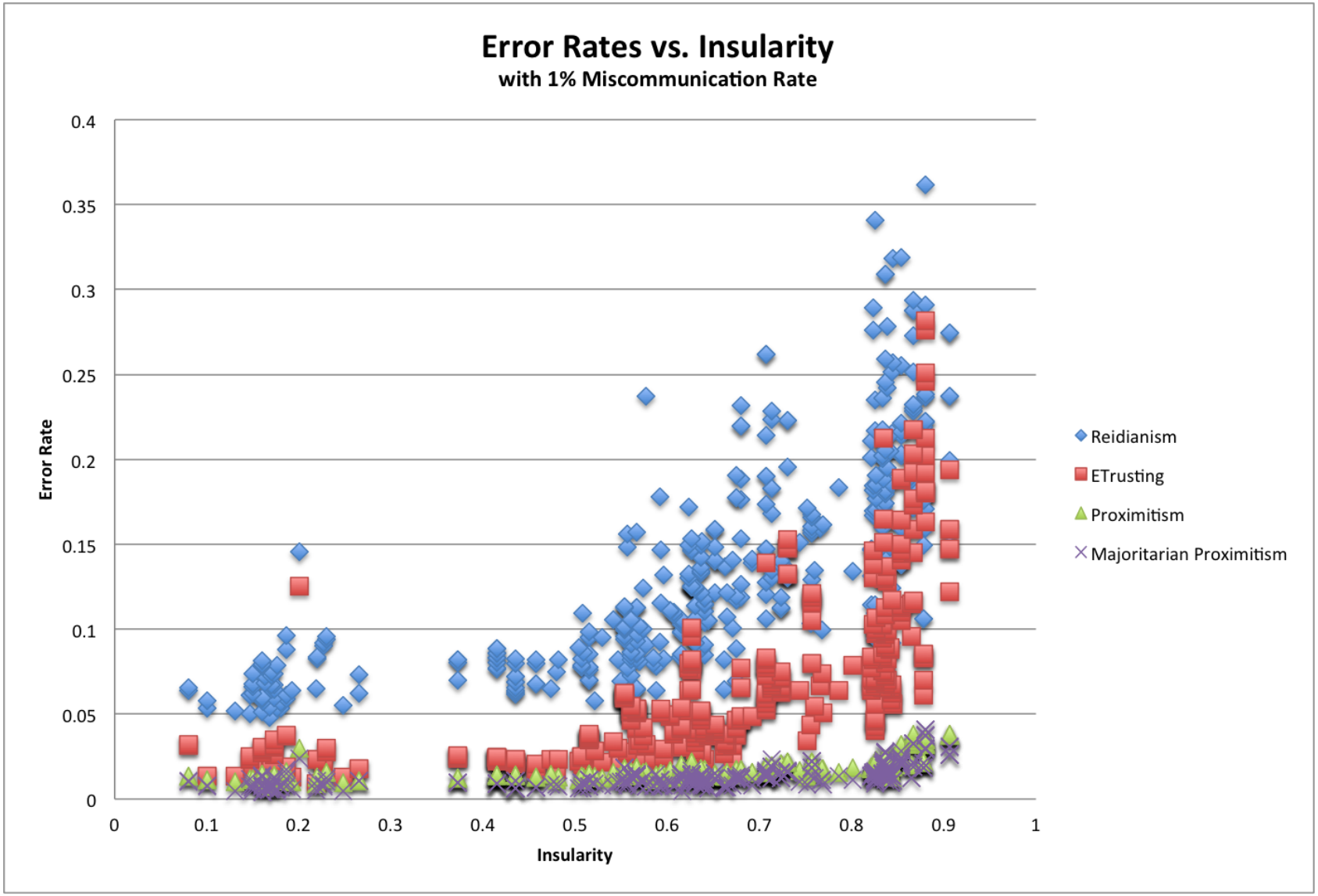


Left: A Non-Insular
Right: An Insular Network
Called **homophily** by economists and sociologists - Golub and Jackson [2012], Young [2011]

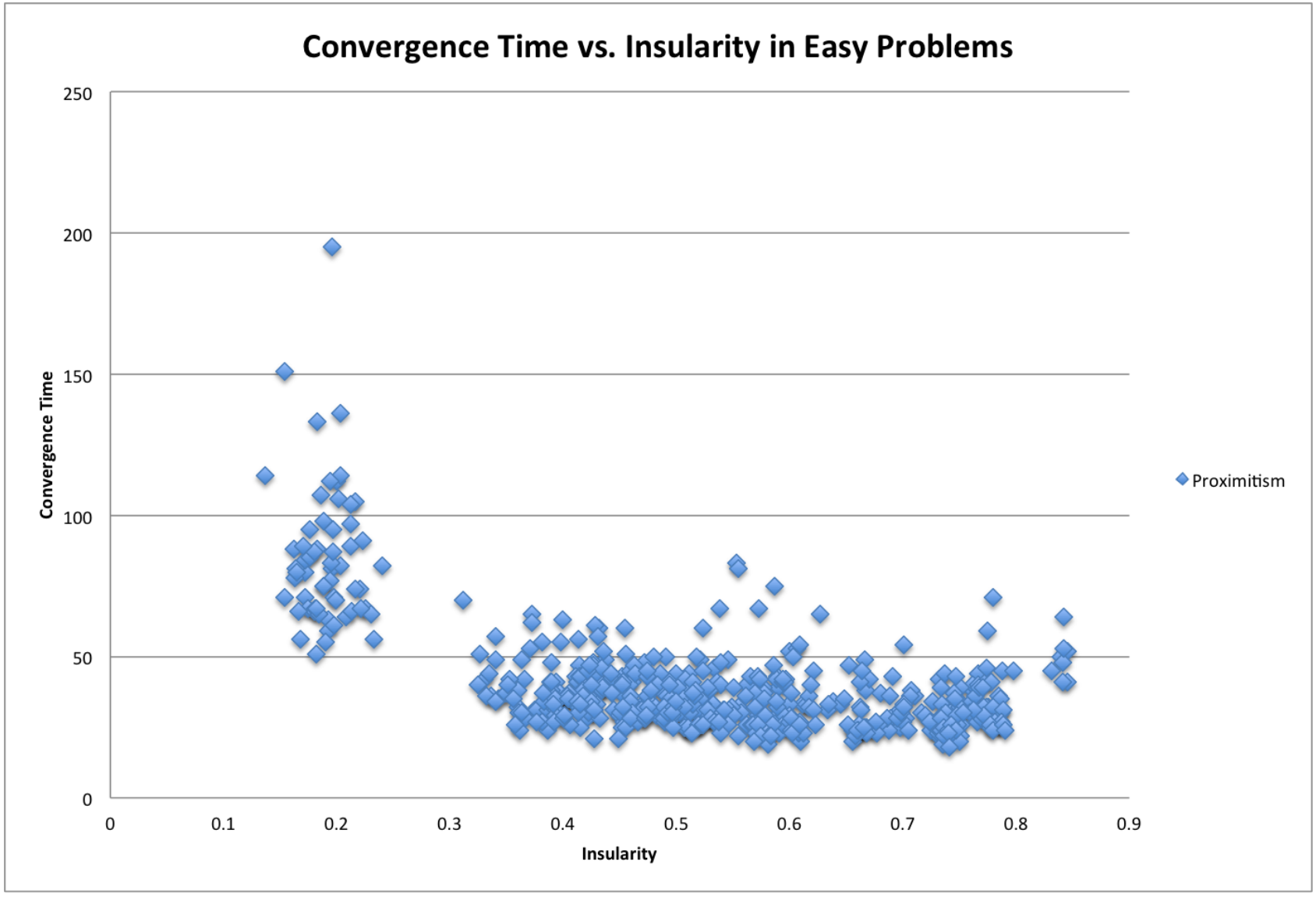
Insularity

- **Agent insularity** = the proportion of her neighbors of the same color.
- **Network insularity** = average agent insularity

Error Rates and Social Structure



Speed of Discovery and Social Structure



A Tradeoff

Moral: Insular scientific communities make discoveries more quickly, but the dissemination of such knowledge is often less reliable.

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(At least for the testimonial norms studied here . . .)

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- **Objection:** Wait Conor! You assume that scientists can identify the experts in their neighborhood.
- It's not like scientists wear little green hats that say "I am a green pill expert."
- Identifying who is an expert can be very difficult.

Misidentifying Experts

Suppose that all, on stage n, each agent correctly identifies which of her neighbors are experts (or are most proximate to an expert) with some probability $p_n \leq 1$.

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Suppose that all, on stage n, each agent correctly identifies which of her neighbors are experts (or are most proximate to an expert) with some probability $p_n \leq 1$.

Theorem

Suppose that the sum $\sum_{n \in \mathbb{N}} p_n^k$ diverges for all natural numbers k. Then in the absence of miscommunication, any mixture of Reidians, e-trusting, proximitism and majoritarian proximitism is convergent. Neither majoritarian Reidianism nor majoritarian e-trusting is.

Misidentifying Experts

Theorem

In the presence of constant miscommunication and constant expert misidentification, all sensitive finite memory norms still have some asymptotic error rate.

Upshots

- Expert misidentification has no effect on the convergence results, even if agents' ability to recognize experts decreases (and approaches zero accuracy!) as time goes on (e.g. let $p_n = \frac{1}{\log n}$ in the previous theorem).

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- Expert misidentification has no effect on the convergence results, even if agents' ability to recognize experts decreases (and approaches zero accuracy!) as time goes on (e.g. let $p_n = \frac{1}{\log n}$ in the previous theorem).
- Whether or not the error rates are ordered in the same way remains to be tested: I conjecture they are if expert misidentification is sufficiently rare.

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  - Most intuitively plausible policies converge to true belief.
  - Use of testimony is independent of speed of acquisition of true belief.
- In the presence of miscommunication,
  - Most testimonial norms do not converge to true belief.
  - Testimonial norms interact with social structure to determine error rate.

Conclusions

- In the absence of miscommunication,
  - Most intuitively plausible policies converge to true belief.
  - Use of testimony is independent of speed of acquisition of true belief.
- In the presence of miscommunication,
  - Most testimonial norms do not converge to true belief.
  - Testimonial norms interact with social structure to determine error rate.
  - Insularity of network increases error rate by the "telephone-game" effect.

Questions for Future Research

- Dissemination of arguments and not just single propositions [Betz, 2012].

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  - $\Rightarrow$ Model more complex and nuanced testimonial norms.
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- Dynamic networks - What is "dynamic insularity"?

Thanks

Questions?

Comments?

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