Theory Choice
Epistemic lessons from simple artificial agent models?

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SSPS - Simulating the Social Processes of Science
Lorentz Center, Leiden
How to choose between theories?
(or any ideas)

• Better tools and practices not always easy to pick
• Logic, induction, inference (etc) were created to work (and correct) at the individual level: one cognitive agent.
• What other tools might be needed at an aggregate macroscopic level?
A problem in recursion?

- Open problem: different points of views on best practices.
- Do we need the answer to know we got the best answer?
Social effects in Science

- Peer review, certainly, but not only
- Mechanisms of convincing
- Majority decisions
- New ideas
- Crowd effects
Limits

- Human rationality: we are much dumber than we think (biases, heuristics, etc.) (my own take on it at www.unbindprometheus.blogspot.com)

- Unexpected interaction effects
  - Reasoning is always limited: finite amount of extra knowledge can be harmful sometimes
Views on Scientific Knowledge

A caricature

• **Natural Scientists**
  • Knowledge can be objective.
  • Science is self-correcting and the only way to obtain reliable knowledge.
  • Scientific knowledge is determined by Nature.

• **Social Science**
  • Knowledge is completely subjective.
  • Science is another form of knowledge, as acceptable as any other.
  • Scientific knowledge is simply a social construct.
Incomplete views?

• Scientific knowledge works better
• But social effects exist and are unavoidable for many reasons:
  • Social pressure
  • Finite individual abilities
  • Funding
  • Political preferences

• What is really going on?
How to decide?

- Each person might have a different opinion on this matter.
- How to decide who is right?
How to decide?

• Each person will have a different opinion on this matter.
• How to decide who is right?
• We should check under which circumstances can people be expected to get closer to the Truth and when will that fail.
How to decide?

• Each person might have a different opinion on this matter.
• How to decide who is right?
• We should check under which circumstances can people be expected to get closer to the Truth and when will that fail.
• To decide who will get us closer to truth, we need to know where it is **BEFOREHAND**?
We need to be

• Good at knowing the real truth
• Obtain evidence on which strategy will get us closer
• Decide on these strategies, to make Science better.
We need to be

- G
- O
- D
We need to be

• GOD

• Can we?
Not in the real world, but...

- In artificial, simulated societies, it is the programmer who decides what is true and what is not.
- Some questions are much easier to test:
  - Which behaviors are more likely to lead the agents to the best explanation?
  - Are there circumstances where social effects are crucial and others when their influence is smaller?
Scientists and Beliefs

- Opinions on a theory can be described as a subjective probability a scientist assigns to the assumption that the theory is true (or the best available one).
- If theories make predictions about the world, we can use results of experiments to update the subjective probability: Bayes Theorem (this assumes rationality!).
Confirmation Theory

• It might be a decent approximation, but it is descriptively wrong
  – Psychological biases (PT, confirmation biases, heuristics, bare rate neglect, just to name a few)
  – Prior problems

• A decent normative framework, though.
My toy model for Social Effects

• Besides observing the world, people influence each other.
• Opinion Dynamics: spread of opinions.
• We can use a Bayesian inspired formalism to account for social influence (Continuous Opinions and Discrete Actions model – Probabilistic Opinion Dynamics).
Scientists and Beliefs

• Framework is suited: choices AND strength of opinion
• Model might not be:
  – Too simplistic reasoning (?)
Simulating the problem

- Let $\tau$ be the proportion of experimenters in the artificial world and $\rho$ (x-axis) a measure of the importance of experimental results, relative to social effects.
- The graph shows final proportion of agents that choose best description for different initial configurations.
- Different colors correspond to different initial proportions of people with the right choice (10%, 25% and 50%)
Retirement (and Kuhn)

- Unless there are enough experimenters and social effect is not too large, better theories have difficult at invading a system where people support the previous one.
- By introducing a death (or retirement) rate $\omega$ we get better acceptance.
- Here, $\tau=1$ (everyone does experiments), different lines show different number of interactions.
Senescence and evolvability

- In evolutionary biology, aging can be beneficial by allowing faster evolvability.

Figure 4. Landscape of fitness values in the middle of a typical one run.
Questions

• In the simulation, experiments always pointed to the best choice. Real world is not so easy.
• Still, a clear division is seeing regarding the importance of social influence.
• For small social influence, agents find the truth.
• For large social influence, the truth has little influence on their opinions.
Relative effects

• The importance of social effect was relative to the force of experiments.
• Where experiments are hard, impossible, or have not very clear results (Humanities? String Theory?), should one expect that knowledge would be a social construct?
• Where experiments are clear, it seems real knowledge about the world can exist!
Questions

• For policy makers, public opinion is very important. But listening to *public opinion* means giving more importance to *social effects*!

• In problems where people always decide based on information of their peers, problems are expected to happen.
Questions

• Should we start a campaign to make researchers pay less attention to their colleagues' opinions?
• Should literature in Humanities stop using opinions of other authors and only refer to their data and very well grounded, demonstrated conclusions, mostly?
Landscape?

- **Natural Sciences:** fixed landscape
- **Humanities:** Ideas change the landscape: presence of scientists curves geometry? Something like **GR** is needed?
To remember

• This was a very simplified model. Will its features survive if we make it more realistic?
• Better networks and interactions, more detailed description of the inference process and how Science works can change the results
Checking models for epistemic problems

• **Basic data might be useless**
  – End of debate could mean failure. Or success.

• **We need meaning?**
One more question

• Should you be subject to social influence and believe what I am saying?
References

Thank you!