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Seeds of Science

Peer Review Comments on *Seeds of Science* articles (2021-2022)

Ted D. Wade[1]

Reviewed articles (links to comments below)

1. Copies and Random Decision: a proposal to peacefully solve the conflict around looted art
2. The Prospect of Extracting Brain-Region-Specific Exosomes in the Human Bloodstream
3. On Scaling Academia
4. Market Failures in Science
5. The Cult Deficit: Analysis and Speculation
6. What does it mean to represent? Mental representations as falsifiable memory patterns

1. Copies and Random Decision: a proposal to peacefully solve the conflict around looted art (article)

- Author: Bruno S. Frey
- Date: October, 2021

The authors are much too glib about whether we can make high fidelity 3-D copies out of atoms and not bits. The two references on copying did not begin to address this. Even a miracle-level 3D copy machine would not be able to reproduce the chemical subtleties that evidence the age and provenance of materials, let alone subtleties like brush technique, or invisible palimpsests. Further, I personally think that no hard-headed lawyer or politician would accept the process. And, if you could make one good-enough copy then you could make a million, so there is very reduced satisfaction in holding a copy, or maybe even the original. However, I vote yes on publication. The paper could stimulate research on the philosophical nature of identity, or on some aspect of behavioral economics. It might also lead to defining a “consolation prize” for the loser in an ownership conflict. E.g., one could sue for a perpetual right for the latest

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and best available digital scan, authenticated with a digital non-fungible token, accompanied by some money to print a copy for public display.

2. The Prospect of Extracting Brain-Region-Specific Exosomes in the Human Bloodstream (article)

- Authors: Evan Yang, Andrew Neff
- Date: November, 2021

As far as I can tell, the biology of extracellular vesicles, and their smallest variety, exosomes, is a hot topic, albeit with many, many open questions. We might be a long way yet from translating this basic research into clinical applications, but the prospect of biochemical probes directly into the living human brain is definitely a high reward. Reliance on the L1CAM protein as a first step in enriching samples is apparently controversial, and might represent the bulk of risk in the proposed approach. The exosomes also have to survive through the second filtering step, which could mean that the entire assay technique might be quite tricky. One of the references (Saeedi et al) has already proposed exosome use for personalized mental health applications, so the basic idea has already surfaced. That said, relating exosome contents to mental function might need to go beyond correlations with macro brain regions or specific transmitters. Some more powerful theories now deal with the activity of multi-regional neural circuits/networks, which can now be studied in vivo in real time. To correlate such activity with exosomes would have to resolve temporal differences in the occurrence and sampling of the two measures. That seems challenging.

3. On Scaling Academia (article)

- Author: Jan Hendrik Kirchner
- Date: April, 2022

This paper is original, clear, and thoughtful, with promising suggestions and a good reference list for how to improve scientific culture. I can't speak to the novelty of its ideas separately, but it seems possible that their combination under the theme of scalability might be.

One of the paper's topics, prediction markets, sometimes seems like a panacea (like blockchains!) for the rationalist community, as the gadget that can solve many kinds of problems. There are interesting issues in how such markets might help science. Consider their use, as the paper suggests, for evaluation metrics. Prediction markets are only as good as their questions, which are only as good as timely verifiability of their resolution criteria. Arguably, whether a scientific issue is resolved or not is a matter of predominant opinion, and often opposition opinions never go away (look at current climate science).

In that case, a prediction resolution criterion might have to say something like: on <date> at least <X>% of <domain practitioners> agree that <some assertion is true>. Even if we can specify who the domain practitioners legitimately are, this does not get us away from a possible bandwagon effect.

Perhaps we should focus scientific efforts on posing questions that do have a solid resolution criterion. In essence, we are already trying to do that in every grant application and research plan, but it's very hard and a realistic attitude leads one to waffle.

Investigators have an incentive to provide resolution criteria for their research questions, and a new trend is to do this with pre-registration of hypotheses. Generally they predict the outcome of individual experiments. The truth value of a broader hypothesis, or of a higher-level theory is much harder to reduce to a simple criterion. Also, a lot of research is exploratory, working down a branching tree of possibilities, with no crisp resolution criteria available. Is exploratory research valuable? Very much. It can lead to breakthroughs and is a big source for new ideas. Exploration can also devolve into p-hacking.

In a better science workflow, then, prediction market evaluation might be more useful for more mature lines of inquiry. Another workflow issue is the timing of when a bet on a prediction gets resolved. This can't happen before the research is executed, so it can't be used for funding decisions. But you could make grant peer reviewers bet. If they refuse to bet on a proposal, then they are not referees for it.

The paper mentions better employment for niche experts as a side effect. Going beyond that, being a general contrarian scientist-predictor could be a career if the prediction markets pay in money. That might be a good thing. Gadflies are useful.

If markets pay only in prestige, might that lead to runaway concentration of power like the current prestige-dominant system?

Academic science workloads are notoriously high. Adding a duty to evaluate and bet on prediction markets would just make workload worse. How would that play out with different payment schemes? Would it fail if treated as unpaid labor, like peer review is now?

We know that the public generally misunderstands, and all too often mistrusts, the scientific process. Would that improve if we were seen betting on outcomes? Language to describe the practice would need to avoid implications of gambling, betting, or (!) corruption.

4. Market Failures in Science (article)

- Author: Milan Cvitkovic
- Date: April, 2022

This paper's strengths are how the market failures are smartly categorized, cleverly and concisely stated along with concrete examples, and likely to resonate with most scientists except the big winners. These virtues are perhaps enough to justify accepting it.

It also references other similar critiques and meta-science studies. There appear to be lots of diagnoses of sciences' ills available now, as well as bottom-up attempts to cure it. The framework used in the paper is the common one from economics that blames mis-aligned incentives for pretty much anything and everything that goes wrong in the world. The paper makes some suggestions of ways that alignment can be improved, and cites some examples of attempts in that direction.

There is some creative use of punctuation and incomplete sentences. These contribute to the easy, informal tone of the paper, but might be tightened somewhat.

I disagree with "Someone invented the existing way we do science." That's too casually stated. It was very many someones, in a broader cultural and historical context.

I would like to know more about "escrow-until-approval." Also, how one finds a "false-positive rate cutoff that new protocols can *prove* they are below." That sounds like an invitation to wishful thinking, or maybe it's that I am 40 years behind in inferential statistics. Maybe a reference would do?

5. The Cult Deficit: Analysis and Speculation (article)

- Author: Roger's Bacon
- Date: May, 2022

The paper responds to 2 popular speculations about an apparent drop in the incidence of new cults over the last few decades. The data offered to support this might be considered pilot data, but there is no reason to believe that sampling from the population of all cults is adequate to make a conclusion about real trends. Given this, there is little gained by some of the hypotheses offered to account for the incidence data, although the discussion of these is interesting.

Douthat claimed (perhaps channeling Thiel, himself a priest of the Free Markets cult) that "Today, many fewer Americans 'take unorthodox ideas seriously'". That might have barely had traction in 2014, but post-2016 it seems absurd, the opposite of the truth. This also undercuts a cult-ish argument about innovation. One could convincingly argue that belief in stupid things is negatively correlated with creatively solving real problems.

The cultural tightness/looseness idea, on the other hand, seems plausible, with some scholarly support, and could stand alone as one determinant of cultural creativity. It could serve as a causal variable for both religious and economic experimentation, perhaps causing them to be positively correlated across different cultures. Changes in cultural tightness might also explain changes in within-culture creativity over time.

6. What does it mean to represent? Mental representations as falsifiable memory patterns (article)

- Authors: Eloy Parra-Barrero, Yulia Sandamirskaya
- Date: May, 2022

I have a feeling that there are a lot of open, unexplored currents here from philosophy, cognitive science and AI. That and the connection from theory to practice make the paper worthwhile.

I have a couple of issues.

The paper gives its worked examples in cases where representations are basically like so-called ”concrete nouns”, whose corresponding objects are identifiable through the senses. The inferred latent structures are sort of like attributes or properties of the representation, and the examples use some properties (like “salty”) that can be determined through the senses. So, in the theory representations are *of a different kind* from latent structure properties.

But, surely representation is not just restricted to representing concrete objects. Don’t we also have to “represent” other kinds of things, like processes or actions (warming, decay, tasting, looking) and attributes (saltiness, whiteness)? And can’t some of these representations *also be* latent structure properties?

This becomes more of an issue when we talk about using representations in memories or counterfactuals, when direct sense impressions are not available. Don’t we then have to rely on representations of tasting and saltiness? And the same would be true if it were someone else’s sense impressions being used as evidence for/against the applicability of a representation.

I admit much ignorance of the ways in which representation has been defined and argued in the fields relevant to this paper. However, it might be helpful to explain to readers how the paper’s definition of a representation is not circular in the sense of defining a representation in terms of more representations.

My second concern is whether “checking for things out of the ordinary” has been sufficiently explained. Given the size of the set of un-ordinary things, how do we decide that a new observation is actually relevant to the use of a representation? For a concrete object like a pile of salt, some relevance can be signaled by physical and temporal co-location of the pile and unexpected sensations, like a color change, a smell, or dissolving in water. What if a pile of salt kills grass, or stains cloth and then gets washed away before we see it? Are there other or competing signals of relevance besides co-location, and if so, how could the theory incorporate them?