Deciding what to value and how to measure it: A psychological perspective

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Here we will focus on the problem of identifying good science from a psychological perspective, taking for granted that the people doing the science are human. The tendency to forget this is pointed out by Diener when he says, ‘I ask scholars to consider that the laws of psychology apply to them’ (p. 912, Diener, 2016). Let’s begin.

The point of measuring merit

Probably most important when designing metrics is the goal of the enterprise. The goal here seems to be to help universities, funders, and readers divvy up their limited resources (e.g., money, attention, time) most efficiently. This drive is essentially similar to researchers who worked to identify the intelligence of school students in the early 1900’s (Spearman, 1904).

Similar to Spearman, the point should not be to identify good students at the end of their lives, but rather to find and support them as early as possible, such that they can do more. There is a conflict here in that later career awards, based on more datapoints, are more likely to be accurate, but that we then wait too long (Simonton, 2016). For finding eminent people, this is good, but not for helping science be more efficient.

Deciding what to value

Assuming we are not satisfied with the current state of affairs (why we are having this conversation); there is the opportunity to use the knowledge of psychology to help design better metrics. Such can include, for instance, our knowledge on latent trait measurement (most bibliometrics examines only correlations between raw metrics; Bornemann, 2015), multilevel modelling (to take journals and authors into account), or it can be our theoretical knowledge, understanding what drives people to share information or ask a question in the first place (Festinger, 1951).

There are already many metrics designed to measure a scientific impact or quality (e.g., the h-index; Ruscio, 2016); in fact there is an entire field and several journals dedicated to this enterprise (e.g., *Scientometrics*). Any serious attempts should look into the literature, at a minimum to avoid reinventing the wheel, but also because there is little reason why psychological citation processes would function fundamentally differently from e.g., communication citation processes (Rice, Borgman, & Reeves, 1988).

When creating new metrics, one can also aim to measure Scientific Merit as a single construct, like Intelligence, or one can try to conceptualize the largest differences between papers, like Personality researchers (Buttliere & Buder, 2017). There is space for both types of metrics, depending on the goals and such faceted would also allow for the Varieties of fame Roediger (2016) speaks of.

Utilizing more of the available data

Citations and citation derivatives were for a long time the most efficient way to track how papers were being interacted with. The Internet, though, makes available much more, both about the content of the paper (including even the data and analysis code) and people's responses to the paper (view counts, comments on social media). It is conspicuous that only one of the original contributions to the section on merit really mentioned these data, as people are going to continue using these metrics no matter what they mean. Rather than simply developing more metrics, our suggestion would be to combine and integrate them as aspects of an entity (Spearman, 1904). In any case, the data the internet make available are likely the future of both bibliometrics and psychology.

The paper and its environment

Psychologists know context matters, also in science. Research suggests who writes a paper matters (Okike, Hug, & Kocker, 2016), so does how they say it, and who to (Byrne,

1961). In this sense multilevel modelling is useful, taking authors, topics, and other variables into account, allowing examinations of people (Simonton, 2016) or departments (Diener, 2016), also helping our understanding of persons and environments more generally.

There are also intrinsic and extrinsic properties and measurements of the papers themselves (Kruglanski, 1990). Things within the paper, like the number of words in the title, the power of the statistical tests, or who authors it, are intrinsic. Conversely, how many people viewed the paper or how many comments were made are more externally determined. Interestingly, most of the suggested metrics of Merit (e.g., recommendations, citations; Sternberg, 2016) are extrinsic factors, others' reactions to the work. These metrics though are more like asking others how intelligent someone is, rather than directly measuring the student (Spearman, 1904). Intrinsic differences likely also make clearer recommendations on how to do good work, as others' reactions are uncontrollable. Finally, finding intrinsic differences across e.g., departments or authors (e.g., number of words/ sentiment in title, power) would be interesting.

If the goal of psychology is to produce e.g., tasks or manipulations that produce reliable results across times and contexts, some estimates of contextual sensitivity and expertise could be valuable for gauging what studies students might be expected to replicate on their own.

The role of cognitive conflict in scientific progress

Many scientists have also studied the creation and exchange of knowledge; and essentially all implicitly or explicitly discuss the role of cognitive conflict. Piaget (1954) and Vygotsky (1967), for instance, clearly demonstrate that cognitive conflict is necessary before an individual can learn something. If there is no feeling of lack or challenge, if we have not

mispredicted, then there is nothing to learn (Piaget, 1954). This applies both for the first instance of creating knowledge or of persuasion generally (Festinger, 1951; Cialdini, 1987).

Theories of how science functions best also highlight the role of cognitive conflict. For instance, the Socratic Method, the pinnacle of scientific thought, relies on actively creating cognitive conflict, exposing the weaknesses, with the aim of finding real truth. Kuhn (1962) describes extraordinary research as involving, “the proliferation of competing articulations, the willingness to try anything, the expression of explicit discontent, the recourse to philosophy and to debate over fundamentals,” (p. 91). Maslow highlights that, “This pulling and hauling between individuals is paralleled by a similar conflict within each individual.” (p. 26, Maslow, 1967). Popper’s (1935) Falsificationism and Platt’s (1964) Strong inference similarly call for essentially creating and approaching cognitive conflict (i.e., pitting theories against each other until one dies).

Surveys of Nobel Prize winners and narrative reviews empiricize Gandhi’s suggestion that, “First they ignore you, then they laugh at you, then they fight you, then you win” (Barber, 1961; Campanario, 2009; Stent, 1972). Ultimately, “Individuals in science or other fields who make the most difference are those who defy the crowd” (p. 212, Sternberg, 1998).

Building metrics of cognitive conflict created

This conflict can probably be operationalized both intrinsically and extrinsically. For instance, the keywords, titles, and abstracts of conflict creating papers might contain different linguistic markers. Really impactful papers could reasonably be gathered and analyzed. Cognitive conflict could also be measured extrinsically, for instance by looking at linguistic indicators of surprise or disagreement in online comments about the paper. More than just disagreement though, we can also look for linguistic markers of attitude change, for instance, words like “novel”, “intriguing”, “surprisingly”, “convincing” indicate both novelty and

positivity. One could even track over time the types of words used with Nobel Prize winning papers, empirically testing Campanario (2009) and Gandhi's conclusions.

Especially if we decide to value the creation of cognitive conflict, it is important to stress that not all types of cognitive conflict are necessarily good. Fraud and failures to replicate create cognitive conflict and are reasons to cite a paper, but might not be considered scientifically productive (except to the extent that they spur new or improved methods and theories). One advantage of the linguistic approach is that 100 citations saying something is fraud are not just 100 undifferentiated citations.

Closing thoughts

Probably the most important thing is that we must make the metrics we want, and make them easily available to those who want to use them. People will not stop utilizing metrics and it is up to those that are unhappy with the status quo to change the situation (Buttliere, 2015).

Another way is to have scientists explicitly say which work they think is good or not. The problem is getting them to do it; one way we are working on achieving this is by designing a game, which presents three papers and asks scientists to indicate which paper they like best and which worst. Utilizing machine learning to present valuable papers, we can provide scientists interesting papers while gathering data that helps answer interesting questions.

In the end, a psychologically informed bibliometrics will lead to many good things. For one, a better identification of high quality research, for another suggestions of how to do such high quality research in the first place, and maybe even some further understanding of psychology in the process.

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