

The theoretical crisis of trust in science is becoming science's practical crisis: Perspective through the eyes of citations

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Abstract

The claimed crisis in science has many origins that, when observed uniquely, might give the impression of a widespread problem. However, when their integrated networks are appreciated, the crisis then begins to take on a form and life of its own. This letter looks at the basis for a potential crisis in any field of research through the prism of citations, specifically the citation of articles that may become invalidated through retraction, or whose integrity may be weakened through an associated expression of concern (EoC). Fields of research, or bodies of literature of individual researchers, that are weakened by an excessive volume of retractions or EoCs face intellectual and scientific implosion.

Key words: expressions of concern; integrity; network; retractions; transparency; trust.

Dear *Journal of Clinical Medicine of Kazakhstan* Editors,

The crisis of trust in science – including as a factor of replication – has been building over the past few years, as has the evidence to support that theorem [1]. While much has been said about the crisis itself, its agents of induction, and the reasoning for why this crisis has emerged at this time in the history of science – research and publishing, even – is beyond the objectives of this brief note, but are issues that require a thoughtful debate nonetheless. Rather, in this brief note, the citation factor is highlighted. A citation, or the reliance on a paper by another document – whether it be published in a peer-reviewed outlet or in grey literature such as preprints – to support a statement or claim, serves as the bedrock upon which larger scientific, technological and socio-political decision-making frameworks are built, including the use or abuse of citation-based metrics [2].

The science of how information is connected via citations, or bibliometric analyses of citing and cited papers, allows for an appreciation of clues – via patterns – that may point towards possible ethical issues with papers, such as plagiarism, invalid authorships, or editorial

abuses [3]. When a citation's central thesis is challenged or disproved, or when complementary explanations are provided that might nullify existing concepts or theorems [4], then the work that constitutes the citation – and thus the citation itself – may become invalidated by retraction.

Building slightly on these theses, using a visually simplistic manner, I note how doubtful findings, which may lead to expressions of concern (EOCs) or retraction of the literature [5], might not impact the intellectual security of that paper alone and, through citation – and thus a physical and meta-physical link – will impact neighboring and/or surrounding papers (or citations) (Fig. 1). When a large portion of literature in a field of study becomes associated with EoC-annotated papers, then that field of study may start to become unreliable, and when the majority of the literature in it becomes unreliable (EoCs) or invalidated (retractions), then it risks collapsing the scientific basis of that entire field of research.

While the temporal framework in which the collapse of science's integrity – as measured by its citation integrity – might differ, as a result of multiple factors (e.g., community receptivity to correcting the literature, speed of investigations, editorial biases, etc.), the structural framework's degradation becomes exponential because of the physical link of a paper with any volume of papers

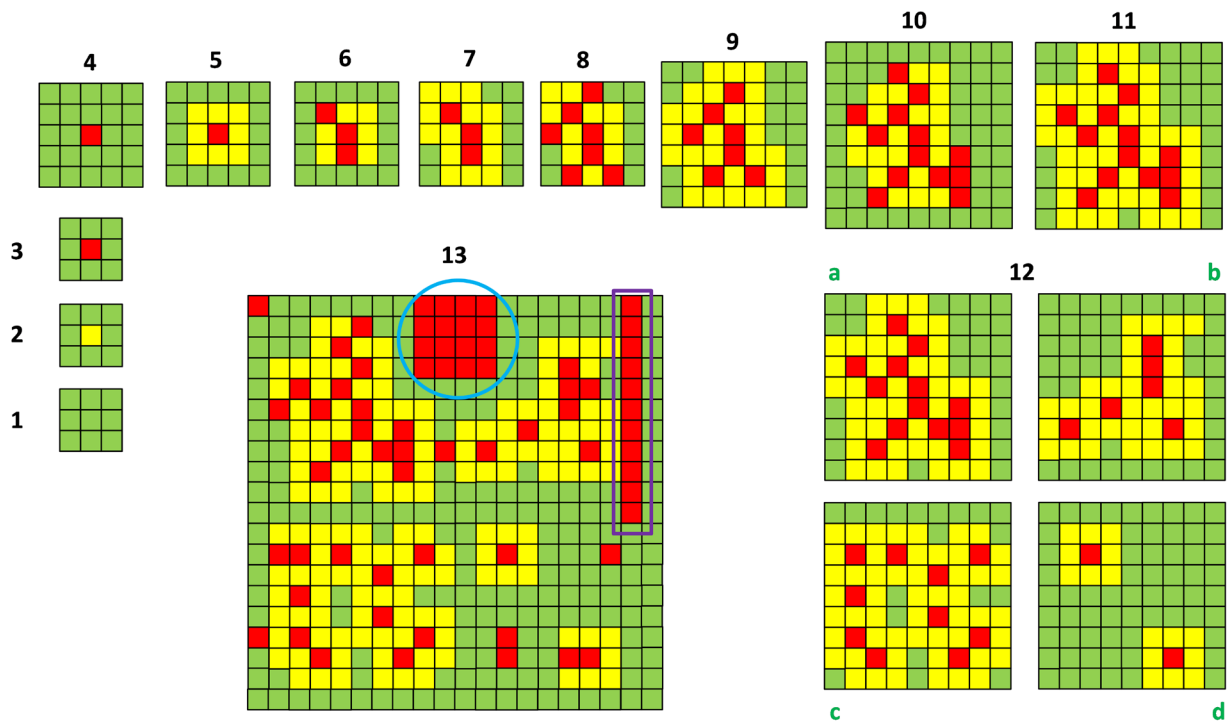


Figure 1 – Simplistic diagram to demonstrate the citation-based fallibility of the scientific literature

(Fig. 1). Science might very well be in steps 5 and 6 (Fig. 1), but in just a few years, it is not impossible to envision a situation where the scientific integrity of entire fields of study might face collapse and thus invalidation (step 12, a and c in Fig. 1).

A detailed explanation of Fig. 1 is warranted. A paper becomes a citation the minute that it is relied upon for whatever reason, and is cited for that purpose. The most prevalent form of citation would be of one paper (peer-reviewed or not) by another, represented in this figure as a square. Thus, in this square, the limit is set that any one paper (i.e., square) can influence – via citation – another four papers (on horizontal and vertical axes), or eight papers (when diagonal directions are also considered), each of which has the ability to then influence other papers – again, via citation. Ultimately, a network of citations forms as a natural (or manipulated) link between papers. A paper (and its citable intellect) is considered to be intact and thus “safe” unless proved otherwise (step 1). However, when a doubt is raised, and an EoC is issued, a doubt is cast on that paper, and this initially places focus on that paper alone (step 2). However, should that paper be retracted, thereby invalidating that citation (via the invalidation of the paper), then the papers (or other media, such as social or news media) that have cited it – or otherwise relied upon it, become negatively impacted by their reliance or dependence on, or association with, that invalidated paper (retracted citation). In this figure, impact is the line that is in contact with the EoC-associated paper (yellow squares) or with retracted papers (red squares), and that contact can be vertical, horizontal, or diagonal. In a micro-field of research in which the retracted paper might only impact 1/8 papers (step 3), the impact is tangibly larger than a slightly larger field of research, such as 1/24 papers (step 4). Evidently, in real science, a field of research is not made up of just 8 or 24 papers, so in this figure, due to size restrictions, a square is merely a theoretical construct, so one square could actually represent dozens, hundreds or even thousands of papers. However, a paper invalidated by retraction – exceptions to that rule are not debated here – might invalidate statements, claims or facts in papers that have cited it, and doubts might then be raised about those papers “in contact with” the retracted paper, leading to a “ring” of potentially “tainted”

papers around an invalidated paper (step 5). Each of those “tainted” papers might then be scrutinized, and be – to some degree or another – invalidated, leading to EoCs being issued for neighboring citing papers, or even retractions (step 6). Over an undefined period of time, challenged (yellow) and invalidated (red) papers begin to form a widening mass that then becomes, in the same theoretical cluster of 25 papers, the majority (steps 7 and 8). And, as the field of research – or the field of influence – widen, impacting a wider network of papers and citations (49 in step 9, or 81 in step 10), the intellectual impact of the flaw that was originally restricted to just one paper (step 1), now could – again, theoretically – impact a minority (33/91 in step 10) or a majority (64/91 in step 11) of the associated literature. If this situation is taking place in four fields of study (a, b, c, d) (step 12), each of which – when observed singly – appear to exist independent of each other, then it can be argued that they might be weakly (d), mildly (b) or strongly (a, c) negatively impacted by a network of papers that have been subjected to EoCs or retractions. Given the interdisciplinary nature of science, the negative impact in one field of research might not necessarily be restricted to that field of research, and may eventually begin to encroach on the literature of other fields of research (step 13, where the four fields of study in step 12 become linked, or amalgamated). Entire chunks of literature (e.g., of a scientist, or of a very specific micro-segment of a field of study) might be entirely invalidated when all literature is retracted (blue circle or purple rectangle in step 13).

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