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The Contribution of the Rejection Mechanism to Scientific Knowledge Production: A View from Granular Interaction Thinking and Information Theories

Quan Hoang Vuong[1], Minh Hoang Nguyen[1]

1 Phenikaa University

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Abstract

> Rejection is an essential part of the scholarly publishing process, acting as a filter to distinguish between robust and less credible scientific works. This study examines the advantages and limitations of the rejection mechanism through the lens of Shannon's information theory and the theory of granular interactions thinking. We argue that while rejection helps reduce entropy and increase the likelihood of disseminating useful knowledge, the process is not devoid of subjectivity. We propose two recommendations to improve the rejection mechanism: providing more informative rejection letters to guide authors and encouraging humility among editors and reviewers to minimize bias against novel ideas. These steps could enhance the efficiency of knowledge production by ensuring that valuable scientific contributions are not overlooked.

Quan-Hoang Vuong, and **Minh-Hoang Nguyen***

Centre for Interdisciplinary Social Research, Phenikaa University, Hanoi, Vietnam

*Correspondence: hoang.nguyenminh@phenikaa-uni.edu.vn

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> *"When night falls, he smiles with the utmost pride and satisfaction at the perfect plan to catch fish.*
> *Well, the problem is that he cannot fall asleep on an empty stomach."*
> *In "The Perfect Plan"; The Kingfisher Story Collection*[1]

Rejection is an inevitable challenge that all scholars face when they enter academia. The rejection encountered during editorial evaluations and peer-review processes is typically seen as a filtering mechanism that helps distinguish between perceived qualified and perceived ineligible scientific works. The scientific works perceived as useful and robust will proceed to publication, and those deemed ineligible will be excluded. Here, “perceived useful scientific works” and “perceived ineligible works” highlight the subjectivity inherent in evaluation processes driven by editors and reviewers. In this essay, we aim to elaborate the advantages and limitations of the rejection mechanism through the lens of Shannon’s information theory [2] and the theory of granular interactions thinking[3], which is based on the worldviews of quantum mechanics and the mindsponge theory [4][5][6][7].

The theory of granular interactions thinking suggests that humans’ psychological products are generated through the interactions of quanta at fundamental levels, making their features analogous to quantum mechanics [3]:

- Granularity: Information in a system, including human psychological systems, is finite.
- Relationality: All events occur through interactions with other systems, meaning psychological processes involve the interaction between existing information within the mind and newly absorbed information from the environment.
- Indeterminacy: The future is probabilistically, rather than unequivocally, determined by the past, making psychological products, including knowledge creation, inherently probabilistic.

Given the finite information each person can process, knowledge production appears to be a dynamic, multi-state process requiring contributions from many individuals. Knowledge generated in former states (demonstrated by State 1) can be used as resources for knowledge production in subsequent states (demonstrated by State 2). In other words, knowledge is produced through the interactions between new observations, theoretical formulations, and useful knowledge accumulated in previous states of knowledge production. For instance, reaching the current stage of utilizing solar energy (which accounts for only 4.5% of total global electricity generation) has involved contributions of knowledge from myriad societies (e.g., Ancient Egypt, Ancient Greece, Ancient Rome) and great individuals (e.g., Archimedes, Mikhail Vasilyevich Lomonosov, Edmond Becquerel, Heinrich Hertz, Albert Einstein) over the course of 28 centuries [8].

As the future is probabilistically determined by the past but not unequivocally, maximizing the probability that useful knowledge (or scientific works) can be transmitted from State 1 to State 2 is crucial for upholding the effectiveness of the knowledge production process. Journal and book publishing aim to store and disseminate perceived useful scientific works in State 1 for potential reuse in State 2, thereby facilitating new knowledge generation. Although the rejection mechanism imposes a mental burden on scholars, it is essential for achieving this goal.

Such a knowledge transmission process can be reflected through Shannon’s information theory. According to Shannon[2], the entropy (missing information or uncertainty) $H(X)$ of a random variable X with possible outcomes $x_1, x_2, \ldots, x_n$ and corresponding probabilities $\left\{P\left(x_1\right), P\left(x_2\right), \ldots, P\left(x_n\right)\right\}$ is calculated as:

$$H(X) = -\sum_{i=1}^{n} P\left(x_i\right)\log_2 P\left(x_i\right)$$

$P(x_i)$is the probability of the outcome x_i. Each probability $P(x_i)$ represents how likely each outcome x_i is to occur.

In the context of knowledge production, the variable X can be interpreted as knowledge in State 1, with i number of scientific works. Each scientific work has its $P(x_i)$ probability to be stored and disseminated for subsequent knowledge production process in State 2.

Scenario 1: Assuming that there was no rejection mechanism, all the scientific works would be published regardless of their usefulness and robustness. In this case, all the scientific works might have the same probability of being stored and disseminated, $P(x_i) = 1/n$. Then, the probability of being reused of all scientific works would be equivalent to $1/n$. In this scenario, the entropy would also be maximized as the entropy (missing information or uncertainty) of the knowledge system might also rise monotonously with the increase in the number of scientific works i. In other words, the chance of identifying useful and robust scientific works for subsequent knowledge generation processes would be highly uncertain.

Scenario 2: When the rejection mechanism is applied, editors and reviewers invest their energy in evaluating the usefulness and robustness of scientific works, accepting those qualified for publication, and rejecting those deemed unqualified. By being published in journals or books, these scientific works have a higher probability of being stored and disseminated in State 1 and eventually reused in State 2. Scientific works that are not published are likely to be discarded or stored in online preprint repositories, which generally have less visibility and credibility than peer-reviewed journals and books. Thus, their probability of being stored, disseminated, and reused is lower.

This process reduces entropy during the knowledge transmission from State 1 to State 2, increasing the chance of reusing useful and robust scientific works. However, due to the finite energy of physical systems, scientific works that are less likely to be reused will be eliminated over time. Despite its advantages, the evaluation process is not free from subjectivity as editors and reviewers conduct it. This subjectivity may result in the rejection of scientific works that are useful and robust but do not align with the editors' and reviewers' pool of knowledge or worldviews.

Based on the scenarios discussed, we derive two recommendations. First, rejection letters should be more informative to reduce the entropy (or uncertainty) created by the rejection. This will enable authors to understand their studies' weaknesses and find more suitable places for publication, increasing the probability that useful scientific works can be transmitted to later knowledge production states. Second, editors and reviewers should maintain humility during the evaluation process, making them less likely to reject useful and robust scientific works that are novel and not aligned with their worldviews. Without the humility and openness to new ideas shown by some physicists, the 1905 paper on special relativity by the 25-year-old Albert Einstein would have been completely rejected and forgotten due to its direct challenge to the notion of ether [9].

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