

Exploration III of Uncited Chinese Research Papers: Postprint of the Competition-Selection Mechanism in the Context of Scientific Communication Relevance

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Abstract

[Purpose/Significance] Unlike numerous statistical analyses based on the uncited phenomenon, this paper employs deductive analysis methods to explore the underlying mechanism of why papers remain uncited. [Method/Process] By situating the uncited phenomenon within the broader context of scientific communication, this paper proposes a competition-selection mechanism for paper uncitedness, noting that this mechanism is a process of relevance judgment and decision-making based on literature content, while being profoundly influenced by the extrinsic features of documents. On this basis, a specific analytical process is developed from both temporal and spatial dimensions. [Results/Conclusions] From the perspective of temporal evolution, competition between new and old relevant literature is the primary reason triggering the uncited phenomenon. From a cross-sectional temporal viewpoint, competition among homogeneous literature in literature search, literature referencing, and the expression of new potentially relevant information during the cyclical problem-solving process constitutes an important cause of the uncited phenomenon, while citation selection is a self-organizing process set against the backdrop of competition.

Full Text

Preamble

Exploring Uncited Chinese Research Papers III: The Competition-Selection Mechanism in the Context of Scientific Communication Relevance

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Abstract

[Purpose/Significance] Unlike numerous statistical analyses based on uncited phenomena, this paper employs deductive analysis to explore the underlying mechanisms of paper uncitedness. **[Method/Process]** By situating the uncited phenomenon within the broader context of scientific communication, we propose a competition-selection mechanism for paper uncitedness, arguing that this mechanism represents a relevance-based judgment and selection process grounded in document content while being profoundly influenced by external document characteristics. Based on this framework, we conduct specific analyses from both temporal and spatial dimensions. **[Result/Conclusion]** From the perspective of temporal evolution, competition between old and new relevant literature constitutes the primary cause of paper uncitedness. From a cross-sectional view, competition among homogeneous literature during iterative problem-solving cycles—including literature searching, referencing, and expression of new potentially relevant information—emerges as a significant factor, while citation selection itself represents a spontaneous, self-organizing process set against this competitive backdrop.

Keywords: uncited papers; zero-cited papers; scientific communication; relevance; competition-selection mechanism

Introduction

Research papers serve as markers and symbols of scientific knowledge exchange, expressing the value and function of specific knowledge within scientific heritage. Papers that receive citations within a statistical time window are called cited papers, while those without citations are uncited papers. For various reasons, some research outputs may never be cited throughout their existence. Although specific circumstances vary across disciplines, uncitedness has proven to be a universal phenomenon [1]. E. Garfield once estimated that among 25 top international journals, 3.9% of research and review papers published in 1978 remained uncited five years after publication [2]. In China, 62.18% of 450,000 papers published in 2012 or earlier had not been cited by the end of 2013 [3]. Even among scientific elites with high h-indexes, such as Nobel laureates and Fields Medalists, over 10% of their papers have never been cited [4].

Why do some papers remain uncited? Although citation studies can provide some explanatory insights, citation and uncitedness are not reciprocal problems. A paper is typically considered uncited when it receives no citations within a measurement window; once cited, it becomes a cited paper regardless of citation count. Much citation research focuses on citation frequency and distribution. Therefore, exploring the causes of uncitedness must fundamentally address the phenomenon itself, rather than other factors. Numerous studies have examined uncited phenomena by analyzing paper characteristics (e.g., number of authors,

keywords, references) and derivative features (e.g., journal characteristics, international collaboration, interdisciplinary features) to identify influencing factors. However, these studies suffer from a major limitation: they represent post-hoc summaries and extrapolations based on observed phenomena, failing to reveal the root causes of uncitedness from their origins. Using Chinese uncited papers as the research object, this paper adopts a deductive approach to analyze the generative mechanisms of research paper uncitedness. We explore uncited phenomena from alternative perspectives, examining the underlying mechanisms from the viewpoint of scientific communication relevance.

Related Work

E. Garfield has noted that being an uncited scientist should not be a source of shame, as numerous factors contribute to paper uncitedness, not necessarily indicating low quality [5]. Many scholars have investigated whether papers get cited by examining factors such as reference count, author count, paper length, discipline, international collaboration, interdisciplinary span, publishing institution, and journal. These studies explore the correlation between these factors and citation likelihood [6].

Some scholars have attempted to explore uncitedness causes by examining relationships between uncited rates and other metrics within specific collections. Numerous studies have found negative correlations between uncited rates and citation indicators. For instance, A. R. Weale et al. discovered that the percentage of uncited papers in a journal negatively correlates with the journal's impact factor [7]. T. N. Van Leeuwen et al. found a declining functional relationship between journal impact factor and uncited rate, with a Pearson correlation coefficient of -0.63 [8]. Liu Xueli et al. observed that positive journal evaluation metrics (e.g., impact factor, 5-year impact factor, h-index) negatively correlate with uncited rates, with correlation coefficients exceeding -0.7 [9]. L. Egghe identified a mathematical relationship resembling a horizontal S-curve between journal impact factor and uncitedness factor [10-11].

Other scholars have explored uncitedness from a temporal perspective, seeking evolutionary patterns. Dong Jianjun found that National Natural Science Foundation papers published in China between 2001-2010 showed a clear upward trend in uncited rates within a two-year window after publication [12]. Liu Tao's statistics indicated that SCI papers published by 15 Chinese universities between 1997-2002 exhibited an overall declining trend in uncited rates within four years after publication [13]. Tang Xiaoli et al. demonstrated that the relationship between paper uncited rates and journal comprehensive influence weakened over time [14]. Q. L. Burrell constructed a theoretical model for the temporal variation pattern of paper uncited rates [15].

However, these studies predominantly rely on post-hoc fitting or calculation of collected data, attempting to reveal causes through induction without examining the essential factors behind the phenomenon from a broader scientific

communication perspective. This paper examines Chinese research papers from a scientific communication viewpoint, employing deductive methods to explore the generative mechanisms of paper uncitedness based on the principle of relevance.

The Competition-Selection Mechanism for Paper Uncitedness from the Perspective of Scientific Communication Relevance

3.1 The Relevance Principle in Scientific Communication

Scientific communication serves as a crucial pathway for scientists to publish results and exchange ideas during knowledge production. The functioning of the scientific communication system directly reflects the vitality of research activities and, to some extent, regulates the relationship between the scientific system and broader society [16]. Scientific communication systems are divided into formal and informal channels based on their communication pathways, though the boundary between these channels is becoming increasingly blurred with the strong resurgence of informal communication.

Generally, researchers publish their results in scientific communication systems only when they anticipate potential relevant users. Similarly, information retrieval systems organize these results when they expect relevant users, and scholars use these systems only when they believe relevant content exists. Researchers cite relevant literature to demonstrate their work's position within existing knowledge systems and highlight its innovativeness. Thus, scientific communication is fundamentally a knowledge production, exchange, and utilization process based on relevance. Relevance connects all stages of knowledge production, demonstrating the inheritance and development relationship of knowledge creation across time, with citation relationships serving as the central manifestation linking these stages.

Examining the scientific communication system within the broader social context reveals that citation relationships among research papers represent knowledge exchange between temporally related documents. First, this relationship manifests as content relevance—documents with minimal content relevance are typically excluded from citation (except for abnormal citations). Second, it manifests as reference value for problem-solving—documents with low reference value are also typically excluded. Third, this relevance judgment is profoundly influenced by external evaluation systems (e.g., citation requirements for journal publications). Documents failing to meet these external evaluation system requirements are likewise typically excluded from citation. Therefore, knowledge exchange among researchers on a specific topic or field manifests as conscious citation of earlier literature by later documents. With numerous similar documents of varying quality in the scientific communication system, this conscious citation results in a substantial portion of relevant documents being excluded from citation. For a given document, if it continuously loses citation oppor-

tunities during its peak citation years, its likelihood of becoming an uncited document increases significantly.

Thus, exploring conscious citation behavior from a relevance perspective offers a viable approach to revealing uncited phenomena. This exploration can proceed in two directions: first, scanning the overall citation process mechanism of a discipline from the temporal dimension; second, examining detailed citation process mechanisms at specific temporal cross-sections.

3.2 The Temporal Dimension Competition-Selection Mechanism for Literature Uncitedness

For researchers in any field, the primary motivation and fundamental requirement of scientific work is to achieve breakthrough innovations through exploration of unknown territories. Based on this, they seek peer attention and social recognition as a form of academic honor. To achieve this honor, researchers must address several issues: first, understanding what problems the scientific community is focusing on within existing knowledge structures (scientific frontiers and hotspots), which research results are relevant to their interests or expertise, and where breakthrough points might be found to generate new innovations; second, identifying what theoretical problems of objective cognition their discipline needs to solve and what research outputs society needs to transform the objective world. Only when their research outputs meet these needs can they gain attention from the scientific community and society. Disciplines maintain enduring vitality only by continuously addressing core contradictions and responding to societal demands. As individual researchers, they must constantly comprehend and organize the state of disciplinary knowledge structures, keenly perceive societal needs, and provide new knowledge and skills that withstand historical scrutiny based on careful examination of predecessors' research in specific fields.

Therefore, the production process of any scientific document involves using existing knowledge structures as background, making relevance judgments based on content, and being profoundly influenced by external characteristics. This forms the basis for analyzing uncited phenomena from temporal and spatial dimensions. We can construct a temporal evolution model of scientific literature citation as shown in Figure 1 [Figure 1: see original paper].

For all researchers, scientific research is both a goal and a means—addressing both the internal contradictions of disciplinary development and the external theoretical and technical needs of societal development. To achieve individual, group, and societal needs, researchers must understand which aspects of current knowledge structures attract the most scientific community attention and which emerging fields might trigger research revolutions when selecting research scopes, determining projects, and implementing specific plans. Referencing predecessors' research achievements helps overcome knowledge barriers when exploring the same or similar unknown areas, enabling researchers to stand on

others' shoulders to create new knowledge, accelerate scientific progress, and effectively avoid infinite repetition. Citation, as a form of recognizing predecessors' work, represents a spontaneously formed, effective research culture norm and institutional design, while being cited serves as a manifestation of recognition for successful researchers from academia and society.

The temporal dimension demonstrates scientific research's self-renewal and self-correction capabilities, objectively promoting continuous knowledge innovation and development. The rapid emergence of new literature carrying similar or updated content accelerates the likelihood of uncitedness for older literature carrying similar content. This is a temporal competition-selection mechanism between old and new literature with similar content, fundamentally based on content competition and representing macro-level selective citation behavior based on relevant content. As a result, some documents quickly fade into the historical torrent, objectively becoming uncited documents. These represent the self-organized selection results of researchers based on existing knowledge structures and utilization demands—a mechanism of natural selection. While the “sleeping beauty” phenomenon may occasionally occur due to special reasons, these cases are extremely rare.

3.3 The Temporal Cross-Section Competition-Selection Mechanism for Literature Uncitedness

The origin of scientific research lies in the problem-solving needs of understanding and transforming the objective world. Such needs have existed since humanity's birth, but awareness of these needs depends on humanity's overall knowledge structure system. Specific implementation occurs through researchers and their teams, based on individual researchers' knowledge structures (denoted as $K[S]$). If the knowledge and skill requirements for problem-solving fall within the subject's knowledge structure, the subject directly applies existing knowledge. Once beyond this scope, possibilities emerge for applying human knowledge systems and creating new knowledge. This process involves both querying and referencing existing knowledge to solve problems and a selective citation process where homogeneous literature competes—a competition-selection mechanism at temporal cross-sections we term the homogeneous literature competition-selection mechanism, with its process structure shown in Figure 2 [Figure 2: see original paper].

3.3.1 The Competition-Selection Mechanism in Literature Searching

When problem-solving knowledge and skill requirements exceed the subject's knowledge structure, the typical behavior is seeking help from existing knowledge systems, primarily manifested as querying relevant knowledge from objective and subjective knowledge systems.

Objective knowledge systems are organized knowledge systems created by social knowledge workers according to certain norms, such as various retrieval systems and bibliographic systems. Subjects search these information systems for needed

information based on perceived information needs. Due to subjects' information literacy, perceived needs may deviate from real needs, causing some relevant information to be overlooked. Additionally, differences in information expression, understanding, and language symbol usage among authors, knowledge workers, and searchers cause some relevant information to be missed, especially when using non-standardized terms. Even among retrieved relevant information, subjects select only a portion based on actual needs, potentially discarding a large portion.

Subjective knowledge systems typically exist in subjects' minds as know-how and experience—the main focus of knowledge management research. In practice, subjects acquire relevant knowledge from subjective knowledge systems through inquiry when needed for problem-solving. Compared to objective knowledge systems, subjective knowledge systems have higher ambiguity and more difficult formal confirmation, but sometimes higher problem-solving value.

Regardless of acquisition method, the process is fundamentally a competition-selection process based on content relevance. With currently rich and well-developed objective information systems, subjects' choices regarding which system to use, which terms to express perceived needs, how to input search identifiers, and how to select from retrieved information represent competition among information systems, terms, search identifiers, and substitutable literature, as well as intentional or unintentional selection based on subjects' knowledge structures. Similarly, the selection process for problem-solving-related potential information is also a competition-selection process. From a research perspective, this is the process of researchers acquiring information on research topics. Since scientific research is fundamentally an innovative exploratory activity, the primary criterion is avoiding duplication. Therefore, researchers should first exhaust the relevant information set, especially core content; otherwise, it may constitute duplicate research. The peer review mechanism can eliminate studies without innovative content to some extent. The selection process of potentially relevant information is simultaneously the generation process of uncited literature. If a paper repeatedly loses in numerous competition-selection rounds during its active citation period (typically 2-4 years after publication), its likelihood of becoming an uncited document increases significantly. Thus, the direct cause of paper uncitedness is elimination in the competition-selection process—a complex socio-cognitive psychological process directly related to both document content and external characteristics.

Exclusion from the potentially relevant literature set represents both researchers' active selection process and competition among documents and their stakeholders. With the professionalization of scientific research, numerous researchers work on related topics, potentially producing massive outputs. Given limited information processing capacity, subjects can only select the most valuable and citable papers from numerous candidates, eliminating outdated, obviously useless, or non-competitive papers. Therefore, beyond ensuring content relevance, document producers must compete for priority in exploring

unknown fields and publishing priority to win attention among numerous research outputs.

From previous analyses of uncited papers in Chinese library and information science, cited papers consistently show higher similarity to overall disciplinary research content than uncited papers, while highly cited papers representing core research content show very low content similarity with uncited papers, indicating that research content significantly influences paper uncitedness. From an information querying perspective, only content-relevant documents can become potentially relevant information. Furthermore, external characteristics such as authors, author count, keyword count, paper length, reference count, and paper type not only increase document visibility in retrieval systems but also affect subjects' quality judgments. Content and external characteristics jointly determine the likelihood of documents becoming potentially relevant information, with excluded documents having significantly increased probability of becoming uncited.

3.3.2 The Competition-Selection Mechanism in Literature Referencing For problem-solving needs, subjects further assimilate or absorb relevant information from the potentially relevant information set obtained through searching, based on their understanding of the problem, thereby forming new subject knowledge structures. Subjects' selection and absorption of information primarily depend on two factors: problem-solving needs and existing knowledge structures.

Any document may contain substantial knowledge content, but only a small portion may directly contribute to solving a specific problem (denoted as ΔI). Documents that can provide this problem-solving knowledge and technology (especially those already selected in the potentially relevant information set) form competitive relationships. Subjects reasonably select relevant documents based on problem attributes (theoretical, technical, engineering, etc.) and extract specific knowledge content to incorporate into their knowledge structure systems.

Knowledge structure becomes a key factor affecting absorption effectiveness. If the knowledge content provided by relevant information aligns well with the subject's knowledge structure, the subject can easily integrate this knowledge with low knowledge energy barriers, forming a new knowledge structure (denoted as $K[S+\Delta S]$). If the knowledge is disharmonious or incompatible, the subject must modify their knowledge structure to accommodate the external system, requiring higher knowledge energy barriers and more time and effort. However, when relevant knowledge far exceeds the subject's knowledge scope—especially beyond the knowledge scope of everyone in the same era—the subject may reject the relevant knowledge content, potentially creating “sleeping beauty” documents. Choosing more easily absorbable knowledge becomes the default alternative.

The subject's knowledge structure change and improvement aim at problem-solving. If problems posed by the objective environment are well-solved, the literature referencing selection process ends, making significant citation generation unlikely. However, in practice, even after absorbing all relevant information into the subject's knowledge structure, problems may remain unsolved or incompletely solved, necessitating further research.

To effectively ensure smooth research progress, researchers must first conduct detailed research design. In research design, problem formulation, research objective setting, and selection of research content and methods all require reference support from relevant literature. Problems must be previously unsolved, objectives should exceed completed work, research content must be novel, and research methods should ideally be innovative—all gradually achieved through reviewing current relevant literature. Therefore, researchers carefully select referenceable literature, naturally eliminating low-value, non-substantive, outdated, or non-cutting-edge documents.

Both the knowledge absorption process for problem-solving and the research process for developing new problem-solving knowledge are competition-selection processes based on relevant content. This process not only promotes knowledge dissemination and utilization in social systems but also gradually eliminates literature with low utilization value from the historical stage, including those repeatedly eliminated in selection. This secondary selection significantly increases the likelihood of some documents becoming uncited, while simultaneously forming a new potentially relevant information base for future citations.

3.3.3 The Competition-Selection Mechanism in New Potentially Relevant Information Expression Both the formation of new knowledge structures centered on problem-solving and research processes aimed at creating new problem-solving knowledge generate new potentially relevant information. When subjects realize that new potentially relevant information has potential users or serves other objectives (e.g., completing work tasks), they select appropriate forms to express this information, creating citation possibilities.

Both knowledge structure formation and research processes produce substantial new knowledge content. Subjects' selection of which new information to express or disclose is constrained by factors beyond the importance and value of the knowledge content itself. For instance, contractually restricted or organization-internal documents, even if cited as references, cannot be accessed in ordinary information systems. Alternatively, subjects may choose not to disclose content they believe could weaken their competitiveness. These citations, being unverifiable, objectively increase the likelihood of literature uncitedness and render uncited rate calculations based on literature systems inaccurate—essentially still a competition-selection outcome. Therefore, we only discuss publicly released citations in objective knowledge forms below.

First, publicly released information content determines reference citation cir-

cumstances. Although problem-solving knowledge integration or new knowledge development for problem-solving may reference many documents, publicly released information typically contains only a portion of innovative knowledge or what the subject considers most valuable. Consequently, corresponding references can only be a partial set. Other relevant documents, even if influential in problem-solving or knowledge production, may be hidden in the competition-selection process. Additionally, if referenced literature's role in the subject's work is implicit or indirect, it typically won't appear in reference lists.

Second, selective citation expression and abnormal citation motivations can distort citation results. For example, if cited literature is highly relevant to released content and might significantly affect its innovativeness, subjects may selectively omit it from references. Some journals' citation preferences or disciplinary citation customs may also cause deviations from actual referencing situations. Abnormal citation motivations (e.g., ingratiating citations, mutual flattery citations, self-citations, factional interest citations) can seriously deviate from genuine literature referencing. Although these abnormal citation practices are not mainstream, their unfair treatment may profoundly affect low-quality, low-value, or non-mainstream language documents, representing an important cause of uncitedness during their existence, with uncitedness being one result.

After multiple competition-selection rounds, whether existing as subjective knowledge or presented as objective knowledge, cited literature constitutes only a tiny portion of potentially relevant information. Many relevant documents won't appear in reference lists during new potentially relevant information expression. For documents repeatedly losing in literature selection, becoming uncited becomes their destiny. As R. Rousseau noted, many documents may be relevant to an author's research, but only an extremely small portion will be cited in their research outputs [17]. Thus, most relevant documents may become uncited due to subjects' intentional or unintentional selection.

The competition-selection mechanism permeates the entire problem-solving process, with competition within the cited set occurring throughout. In practice, competition-selection in information querying, literature referencing, and new potential information expression doesn't proceed sequentially but may involve multiple cycles and repetitions. Regardless, these competition-selection processes represent intentional or unintentional choices among homogeneous literature under the combined influence of subjects' knowledge structures and external evaluation systems, resulting in a small number of documents appearing in reference lists while a large portion of relevant literature fades into historical obscurity.

Conclusion

Relative to numerous post-hoc inductive summaries of uncited phenomena, this paper uses Chinese research papers as its object and deductive analysis to parse the possible generative mechanisms of literature uncitedness. Against the grand

backdrop of scientific communication and based on the relevance principle of scientific knowledge inheritance and development, we analyze the generation process of uncited phenomena from the perspective of practical problem-solving demands, identifying literature uncitedness as a normal phenomenon in scientific communication and proposing a competition-selection mechanism for its generation. From the temporal evolution dimension, we analyze the generation mechanism of paper uncitedness, finding that competition between old and new literature with similar or identical content constitutes the main cause. At specific temporal cross-sections, competition among homogeneous literature during subjects' iterative problem-solving processes—including literature searching, referencing, and expression of new potentially relevant information—emerges as an important cause. Subjects' literature citation represents a selection process against a competitive backdrop, a relevance-based judgment and decision-making process grounded in document content while profoundly influenced by external characteristics—a spontaneous, self-organizing process.

This paper provides a theoretical summary based on previous empirical research, aiming to explore the mechanisms of literature uncitedness from the perspective of subject behavioral mechanisms and scientific development dynamics. Scientific communication relevance represents only one analytical perspective, and the generalizability of its conclusions requires further empirical supplementation and refinement in future research.

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Note: Figure translations are in progress. See original paper for figures.

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