# Impact of AI on the Peer Review Processes

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## 1 Introduction/Background of Peer Review Processes

Peer review serves as the foundation of scholarly publishing, acting as a critical mechanism to ensure the quality and integrity of scientific research [3]. This traditional process has long relied on human expertise to evaluate academic submissions before publication. However, the scholarly landscape is undergoing significant transformation due to the exponential growth in research output. Quantitative analysis suggests that the volume of scientific manuscript submissions to journals doubles approximately every 15 years [3] [17]. This growth trend has been persistent, with no indications of a decrease in the rate over the past half-century [17].

The substantial increase in submissions has placed considerable strain on the traditional peer review system, creating significant challenges in terms of efficiency and scalability [3]. Journal editors have observed a steady rise in submitted research articles over the past decade, bringing both benefits and shortcomings to the academic publishing ecosystem [31]. The traditional process, while valuable for its human expertise, presents several inherent challenges including inconsistencies in reviewer judgments, potential human biases, conflicts of interest, and the extensive time commitment required for thorough evaluations [7].

As the scientific community grapples with these mounting pressures, artificial intelligence (AI) technologies have emerged as potential solutions to augment and enhance the traditional review process [3]. The advent of AI promises to revolutionize peer review by providing a more standardized, impartial, and efficient evaluation process, potentially improving the overall quality, efficiency, and fairness of scientific assessments [7]. Among these technologies, advanced language models like ChatGPT show promise as AI reviewers for academic journals [3].

> Peer review is the cornerstone of scientific publishing that ensures research quality and integrity, but faces challenges due to exponential growth in

submissions. The traditional system struggles with efficiency and scalability issues, creating an opportunity for artificial intelligence to revolutionize the process.

## 2 Current Challenges in Traditional Peer Review

The traditional peer review process is increasingly strained by the exponential growth in academic submissions across disciplines. A key challenge is the widening "review imbalance" in scholarly publishing, where approximately 20% of researchers handle over 90% of review tasks [16]. This imbalance creates a substantial workload disparity, with 5% of reviewers contributing 13% or more of their research time to peer review while 70% dedicate merely 1% or less [22].

The limited reviewer pool is further stretched by the significant time investment required for thorough evaluations. An estimated 15 million hours are spent annually just on reviewing manuscripts that were previously rejected and resubmitted to other journals [6]. Overall, researchers devoted approximately 63.4 million hours to peer review in 2015 alone, with nearly 19 million hours provided by the top 5% of contributing reviewers [16].

This reviewer shortage has led to concerning trends in review acceptance rates. Data spanning 2003-2015 shows a steady decline in the proportion of review invitations that result in completed reviews, dropping from 56% to just 37% [11]. This decline strongly correlates with the number of invitations researchers receive annually, indicating growing reviewer fatigue [24] [4].

The issue is particularly acute in rapidly growing fields like artificial intelligence, where conferences have resorted to soliciting reviewers through social media to fill the reviewer gap [21]. At top conferences like NeurIPS, reviewers may be asked to evaluate 6-7 papers each, with some AAAI reviewers handling as many as 10 papers [21].

This pressure has led to concerning quality issues in the review process. Inexperienced reviewers often provide inadequate assessments, with some reviews as brief as 17 words [21]. The problem extends to review consistency, with studies showing significant discrepancies when papers are evaluated by multiple reviewer groups - a quarter of papers received differing recommendations from separate pools of reviewers [21].

These challenges collectively contribute to longer publication cycles [20], potential amplification of existing biases [13], and questions about the overall reliability, fairness, and efficiency of the traditional peer review model [2]. The growing concern within the academic community is that these issues may compromise the integrity of scientific evaluation [26], particularly as the volume of submissions continues to double approximately every 15 years [3] [17].

These systemic inefficiencies and quality concerns create an urgent need for more scalable peer review processes [15], opening the door for technological interventions to support and enhance the traditional system.

The traditional peer review system faces significant challenges including reviewer shortages, uneven workload distribution, and decreasing acceptance rates of review invitations. These inefficiencies contribute to long review times, inconsistent quality, and potential biases, creating an urgent need for more scalable solutions.

# 3 AI Applications in Peer Review

The integration of artificial intelligence into the peer review ecosystem spans multiple applications, each addressing different challenges in the traditional system:

- *Automated Manuscript Screening*: AI tools can assess manuscripts for technical quality, grammatical issues, and content completeness before human review. Systems like AIRA from Frontiers evaluate grammar, style, figures, legends, and detect plagiarism [22]. Similarly, PubSURE Report examines "reporting hygiene" related to readability and comprehensiveness [22].

- *Reviewer Selection and Matching*: AI algorithms can match manuscripts with appropriate reviewers based on expertise and research interests, improving the reviewer allocation process and addressing workload imbalances [14]. These systems perform feature and profile-based matching while potentially reducing selection bias [22].

- *Automated Review Generation*: Large language models (LLMs) like ChatGPT can assist in generating review comments on manuscripts. Studies have shown that AI-generated comments demonstrated a 31%-39% overlap with human reviewers, while inter-human overlap was 29%-35% [1]. Research has found that 70% of scholars observed at least partial alignment between AI and human reviews [1].

- *Decision Support Systems*: AI can augment editorial decision-making by analyzing reviewer sentiment and feedback. Ghosal et al. proposed a system that predicts acceptance or rejection by analyzing reviewer sentiment embedded in review texts, potentially serving as an "additional AI reviewer" for providing perspective in borderline cases [12].

- *Consistency and Bias Detection*: AI tools evaluate manuscripts objectively, potentially reducing human biases and ensuring consistent assessment standards [14]. This approach enables manuscripts to be evaluated solely on content merit, fostering a more equitable review process [14].

- *Plagiarism and Academic Misconduct Detection*: AI enhances the identification of plagiarism and other forms of academic misconduct, strengthening publication integrity [14].

- *Workflow Optimization*: Algorithmic approaches can streamline the overall review process. Mrowinski et al. used Cartesian genetic programming to develop an artificially evolving method that reduced peer review time by approximately 30% without increasing the reviewer base [22] [19].

- *Specialized Review Tools*: Systems like ReviewRobot assign review scores and generate comments on aspects such as soundness and novelty, showing ac-

curacy ranges from 71.4% to 100% in NLP and ML domains [9]. Similarly, ReviewAdvisor produces reports across seven distinct evaluation criteria [9].

- *Scaffolding for Novice Reviewers*: AI systems can provide guidance and structure for less experienced reviewers who face challenges with creating well-structured reviews and making quality judgments [28].

These applications highlight how AI is being developed to complement rather than replace human reviewers, addressing efficiency concerns while maintaining the integrity of scientific evaluation [5]. Evidence suggests that reviewers themselves may already be employing ChatGPT in their review processes, as detected in peer-review texts from top AI conferences such as ICLR 2024, NeurIPS 2023, and others [30].

> AI technologies are being integrated into various aspects of the peer review process to address efficiency, quality, and bias concerns. From manuscript screening to reviewer selection and automated feedback generation, these tools aim to complement rather than replace human reviewers.

# 4 Benefits of AI in Peer Review

The integration of artificial intelligence into peer review processes presents numerous benefits that address many of the challenges plaguing traditional review systems. Perhaps the most immediate advantage is the substantial improvement in efficiency. AI tools can automate preliminary screenings and evaluation tasks, potentially saving millions of working hours annually [6]. This efficiency gain is particularly significant considering that an estimated 15 million hours are spent each year reviewing manuscripts that were previously rejected and resubmitted to other journals [6].

The time-saving aspect of AI-assisted peer review directly translates to faster publication cycles. By streamlining various review stages from manuscript screening to reviewer selection, AI technologies can significantly reduce the time from submission to publication, which is "crucial in advancing scientific discovery" [14]. This acceleration of the publication process enables research findings to reach the scientific community more rapidly, potentially accelerating the pace of innovation and discovery [8].

AI tools also address the growing concern of reviewer fatigue by redistributing workload more effectively. By automating preliminary evaluations and filtering submissions, these systems allow human reviewers to focus on more nuanced aspects of manuscript assessment [14]. Studies have demonstrated that AI-generated reviews can significantly complement human evaluation, with one large-scale study finding that AI-generated comments had a 31%-39% overlap with human reviewers, similar to the 29%-35% overlap observed between different human reviewers [1]. This alignment suggests that AI can effectively shoulder some of the review burden while maintaining quality standards.

The quality of peer review itself may be enhanced through AI assistance. These technologies can identify patterns and inconsistencies that human review-

ers might miss, potentially leading to more thorough and accurate assessments [8]. AI tools can assist reviewers in "providing more detailed and accurate feedback to authors, improving the quality of the final paper" [29]. Additionally, a prospective study revealed that 70% of scholars found AI-generated comments to have at least partial alignment with human reviews, and notably, 20% actually found AI feedback more helpful than human comments [1].

Another significant benefit is the potential for AI to enhance objectivity and reduce bias in the review process. AI systems evaluate manuscripts based solely on content merit, fostering a more equitable review process [14]. This objective assessment may help reduce various forms of bias that can influence human reviewers, leading to fairer evaluation of research contributions [8].

The integration of AI into peer review also improves the matching of manuscripts with appropriate reviewers based on expertise and research interests [14]. Tools like ScholarOne and Editorial Manager employ machine learning algorithms to recommend reviewers and detect potential conflicts of interest, enabling a more efficient and unbiased review process [20].

Furthermore, AI can enhance research integrity through improved detection of academic misconduct. Advanced AI systems can identify plagiarism, image tampering, and other forms of scientific misconduct more effectively than traditional methods [20] [14].

As the scholarly landscape continues to evolve, the collaboration between humans and AI in peer review represents not a distant possibility but an unfolding reality [25]. This partnership has the potential to revolutionize traditional academic evaluation by closing gaps among diverse scholars and competing scholarly traditions [25]. Some researchers even suggest that "AI-assisted peer review will surpass the median conference reviewer with further prompt and fine tuning approaches, possibly within a couple of years" [23].

The growing body of evidence supporting AI's effectiveness in peer review makes its integration "inevitable" according to some experts, who argue that "AI should and will be increasingly used to assist in peer review" to address longstanding challenges of effectiveness, fairness, and efficiency [2]. While AI implementation continues to evolve, its potential to enhance efficiency, quality, and fairness positions it as a transformative force in the future of scientific evaluation [5].

> AI implementation in peer review offers significant advantages including efficiency gains, workload reduction, and improved quality assessment. These technologies enable faster publication timelines, more consistent and objective evaluations, and better matching of manuscripts with appropriate reviewers.

# 5 Limitations and Concerns

The integration of artificial intelligence into peer review processes, while promising, brings substantial limitations and concerns that warrant careful con-

sideration. One of the most significant issues is algorithmic bias. AI systems trained on existing peer review datasets may perpetuate and potentially amplify biases already present in academic evaluation [18]. These biases include "first impression bias, cultural and organizational biases including language skills, and biases towards highly reputable research institutes or wealthy countries with high research and development expenditure" [18] [6]. Such biased evaluations could significantly impact researchers' careers and team reputations, underscoring the necessity of human oversight in the process [18].

AI systems also fundamentally lack the depth of subject-matter expertise required for truly evaluating complex scientific content. While these tools excel at language processing and general tasks, they struggle with detecting "subtle methodological flaws or theoretical inconsistencies because cannot 'reason' through content like an expert" [10]. This limitation becomes particularly critical in disciplines where deep domain understanding is essential for assessing research validity and implications.

A growing concern in the academic community involves the potential misuse of AI in peer review. Evidence suggests that reviewers may already be employing tools like ChatGPT in their evaluations at top AI conferences including ICLR 2024, NeurIPS 2023, and others [30]. A recent analysis revealed that "at least 15% of reviews were fully or partially AI-assisted, thereby leading to roughly half of the submissions receiving at least 1 AI-assisted review" [27]. This trend raises concerns about the authenticity and thoroughness of peer evaluations, with some fearing that AI tools could enable "fake peer reviewers to create more unique and well-written reviews" [18] [13].

The risk of over-reliance on AI technologies presents another significant challenge. As editors and reviewers increasingly depend on AI-generated suggestions, the quality of peer review could deteriorate [10]. This dependency might lead reviewers to "overlook their own experience, scientific and expert judgment," potentially compromising their autonomy in the evaluation process [18]. When combined with algorithmic biases, this over-reliance could undermine authors' trust in the peer review process due to reduced transparency in decision-making rationales [18].

Perhaps most critically, AI tools struggle with evaluating the novelty and significance of research—a cornerstone of effective peer review. While these systems "can analyze existing patterns in the literature and detect similarities with previous work," they "may not fully acknowledge the importance of groundbreaking findings or the value of new theoretical approaches" [10]. Human reviewers, with their deep knowledge and insight into field development, remain better equipped to evaluate the potential long-term impact of research [10].

The deployment of AI in peer review also raises questions about academic mentorship and the social functions of peer review. The automation of certain aspects of this process "might lead to concerns about the devaluation of human mentorship or the loss of personalized guidance and support" [23]. This social dimension extends to concerns about accountability—"ensuring accountability in cases where an AI-generated review leads to a wrongful rejection or

acceptance of a paper" remains a significant challenge [23].

The fundamental opacity of AI systems' inner workings presents additional complications. The "opacity of LLMs' training data, inner workings, data handling, and development processes raise concerns about potential biases, confidentiality and the reproducibility of review reports" [30] [13]. This lack of transparency affects both the evaluation process and the ability to reproduce or validate AI-generated assessments.

While AI promises to address efficiency issues in peer review, the problems it introduces must be weighed carefully against potential benefits. As noted by researchers, "AI brings ethical and social concerns that could compromise the integrity of the peer review process and outcomes" [26]. This complex balance suggests that AI technology should enhance rather than replace human expertise, with researchers emphasizing that "AI-assisted reviews could lead to the scientific merit of submissions being incorrectly judged," potentially decreasing the peer review system's reliability [24].

Despite the potential benefits, AI integration in peer review raises significant concerns about algorithmic bias, reduced human oversight, and possible misuse. These technologies face limitations in evaluating novelty and significance of research, lacking the deep domain expertise and critical judgment that experienced human reviewers provide.

# 6 Future Directions and Recommendations

As artificial intelligence continues to evolve, the future of peer review will likely center on effective human-AI collaboration rather than complete automation. This collaborative approach appears "inevitable" as the academic community seeks solutions to longstanding challenges of effectiveness, fairness, and efficiency in manuscript evaluation [2]. The integration of AI into peer review processes represents not a distant possibility but "an unfolding reality" that could facilitate the closing of gaps among diverse scholars and competing scholarly traditions [25].

Research suggests that AI-assisted peer review could potentially surpass the capabilities of median conference reviewers "within a couple of years" with further refinement of prompting and fine-tuning approaches [23]. This rapid advancement necessitates proactive development of guidelines and frameworks to ensure responsible implementation. Key recommendations include establishing comprehensive ethical guidelines for AI use in review processes, coupled with robust bias mitigation measures and accountability mechanisms to maintain research integrity [5].

A promising direction involves the development of AI systems that serve as supplementary reviewers rather than replacements for human expertise. These systems could provide "an additional perspective to the editor in cases of contrasting/borderline reviews," helping resolve conflicts among human reviewers and potentially offering more balanced evaluations [12]. This approach aligns

with research showing that AI reviews can achieve similar overlap with human reviews as humans achieve with each other, suggesting AI could effectively complement existing evaluation processes [2].

To address concerns about bias amplification, future AI systems should incorporate transparent algorithms with explainable decision-making processes. These systems should clearly articulate the basis for their evaluations, allowing human editors and reviewers to understand and potentially override AI recommendations when necessary [5]. Additionally, ongoing training and education for editors, reviewers, and authors about AI capabilities and limitations will be essential for establishing appropriate expectations about technology's role in the evaluation process .

The academic community must also consider how AI integration might affect traditional mentorship roles within academia. As review processes become increasingly automated, institutions should develop strategies to preserve the valuable human elements of academic mentorship, including empathy, experience-based guidance, and personalized support [23]. This balanced approach recognizes that while AI can enhance efficiency, human judgment remains essential for evaluating creativity, originality, and the broader implications of research.

Finally, ongoing research should focus on improving AI's ability to detect sophisticated forms of academic misconduct and evaluate the novelty and significance of research contributions. These advancements, coupled with continuous monitoring and assessment of AI performance in real-world peer review contexts, will be crucial for refining systems that truly enhance rather than undermine the integrity of scientific evaluation [5]. The ultimate goal should be developing AI tools that address the efficiency challenges of traditional peer review while maintaining or improving the quality, fairness, and reliability of academic assessment.

> The future of peer review will likely involve collaborative human-AI systems that enhance efficiency while preserving scientific integrity. Key recommendations include developing ethical guidelines, implementing bias detection mechanisms, and creating transparent AI systems that complement rather than replace human expertise.


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# Author Biography

Rachel So is an AI scientist. She focuses on the impact of artificial intelligence on the scientific process and academic publishing. Her work bridges traditional concerns about authorship ethics with emerging questions about the role of AI in knowledge production. Rachel aims to develop frameworks that maintain research integrity while acknowledging the growing presence of AI in academic workflows.