



Is ChatGPT a “Fire of Prometheus” for Non-Native English-Speaking Researchers in Academic Writing?

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Large language models (LLMs) such as ChatGPT have garnered considerable interest for their potential to aid non-native English-speaking researchers. These models can function as personal, round-the-clock English tutors, akin to how Prometheus in Greek mythology bestowed fire upon humans for their advancement. LLMs can be particularly helpful for non-native researchers in writing the Introduction and Discussion sections of manuscripts, where they often encounter challenges. However, using LLMs to generate text for research manuscripts entails concerns such as hallucination, plagiarism, and privacy issues; to mitigate these risks, authors should verify the accuracy of generated content, employ text similarity detectors, and avoid inputting sensitive information into their prompts. Consequently, it may be more prudent to utilize LLMs for editing and refining text rather than generating large portions of text. Journal policies concerning the use of LLMs vary, but transparency in disclosing artificial intelligence tool usage is emphasized. This paper aims to summarize how LLMs can lower the barrier to academic writing in English, enabling researchers to concentrate on domain-specific research, provided they are used responsibly and cautiously.

Keywords: Large language model; ChatGPT; Generative pretrained transformer; Artificial intelligence; Academic writing; Publication; Editing

INTRODUCTION

English is the global “lingua franca,” particularly in the fields of science and academic writing [1]. In many countries, including Korea, writing articles in English is essential for securing a professional academic position, conducting research, and building a successful career. However, non-native English speakers often face challenges in various aspects of manuscript writing, requiring more

time and effort [2]. Several studies have highlighted that non-native English-speaking researchers experience significant difficulties in writing English papers due to their limited English proficiency [2-4]. These researchers typically struggle with expressing themselves, taking longer to write in English, and having a less proficient vocabulary [3].

These difficulties stem not only from linguistic factors such as grammar, vocabulary, and sentence structure but also from meta-linguistic factors such as logical connections between sentences, paragraph development, and overall organization. Although meta-linguistic factors are considered more important than linguistic factors in determining the value of a clinical study, it does not mean that linguistic factors have less impact on the writing of non-native English-speaking researchers [2,5,6]. With the advancement of the internet and computers, linguistic factors have become easier to correct for non-native English-speaking researchers [7]. However, meta-linguistic factors still pose a

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significant challenge for these researchers.

Large language models (LLMs) have garnered significant attention following the emergence of ChatGPT. ChatGPT, a generative artificial intelligence (AI) developed by OpenAI, is a chatbot version of the generative pre-trained transformer (GPT). It is an LLM capable of generating sentences based on a statistical approach, utilizing a vast database of human-generated text from books, articles, and internet websites covering a wide range of domains [8]. Since its release in November 2022, LLMs, including ChatGPT (OpenAI), Bing (Microsoft), and Bard (Google), have had a profound impact on the academic community and internet users due to their ability to generate coherent and grammatically correct sentences in response to user inquiries or “prompts” [9]. However, concerns have been raised about LLMs generating factually inaccurate or even fraudulent yet authentic-looking articles [10]. As a result, careful and responsible use of LLMs is necessary.

LLMs can serve as personal, round-the-clock English tutors, either for free (Bing, Bard) or at a monthly fee of \$20/month (ChatGPT). This accessibility can lower the barrier to academic writing in English and allow non-native English-speaking researchers to focus more on domain-specific research. Although LLMs can be used for various purposes during academic research, this article focuses on the use of LLMs for the preparation of articles in English.

Use of LLMs for Text Generation

The difficulty of writing an English article varies across academic fields. Non-native English-speaking researchers may be more suited to quantitative studies, as writing in science or engineering is relatively easier than in the arts or humanities [11]. The format in scientific papers is often logical and follows a fixed structure. The results are based on statistics and rarely require persuasion through an individual's linguistic skills. Since LLMs excel at generating contextually relevant content [10,12,13], they can be useful tools for writing English manuscripts [9]. Considering that non-native English-speaking researchers face the most difficulties in writing the introduction and discussion sections [11], LLMs can provide significant assistance in these areas. One recent study showed that the degree of productivity boost obtained by using ChatGPT was larger in weaker writers than more competent ones [14], which sends a hopeful message for researchers who have struggled in manuscript writing.

The authors' recommendations on the use of LLMs for text generation in each section is as follows. For the Introduction section, LLMs may be utilized to summarize the studies into coherent sentences. LLMs can also help overcome the “blank page syndrome” that authors occasionally experience, particularly in the introduction section [13]. Providing detailed prompts and supplying real references can result in high-quality sentences generated by LLMs while avoiding “hallucinations” or false fabrications not based on facts. For the Materials and Methods section and the Results section, these sections are often formulaic in many studies and mostly fixed during and after the study, leaving little room for LLMs to contribute. The Discussion section is primarily for explaining the main observations and interpreting the study in comparison with prior research. For these purposes, LLMs can be of great help when given appropriate prompts.

The applicability of LLMs in manuscript writing (and scientific research as a whole) was demonstrated by a pair of researchers at Technion—Israel Institute of Technology, who developed a software—“Data to Paper”—that automatically prompts ChatGPT to explore a dataset, develop study objectives, create a plan and a code for data analysis, and write a draft that reads rather fluently with a typical structure of a research paper, all within a span of one hour. An interesting strategy that the “Data to Paper” software employed was opening two separate conversations with ChatGPT, of which one instructed ChatGPT to write a draft of the paper and the other instructed ChatGPT to assume the role of peer reviewer that generated feedback on the aforementioned draft.

Caution When Using LLMs for Text Generation

AI Hallucination

Compromise in the accuracy of information is a critical issue in scientific communication. As such, the foremost point of concern when using LLMs is “AI hallucination,” in which LLMs produce misinformation without “realizing” that they are doing so and sound as confident as when they are giving correct information. LLMs such as GPT are prone to hallucinating due to three reasons: 1) limitations in the training data, 2) transformer architecture, and 3) reinforced learning from human feedback (RLHF).

First of all, the dataset used for training LLMs may be incomplete, contradictory, or contain misinformation. While this is the most fundamental cause of AI hallucination, we expect that future LLMs trained using quality data including

medical research papers behind paywalls will continue to reduce this limitation. Second, GPT uses the transformer architecture, which consists of input embedding, self-attention, positional encoding, decoding, and output, to create a string of words that are statistically most appropriate. While the transformer model allows for the generation of naturally sounding text based on its training data, its content can be untrue because it does not answer questions based on facts but uses mathematical techniques to create sentences [15]. Lastly, during its training using RLHF, ChatGPT was instructed not to shy away from answering questions that it does not know the answer to or are far outside the boundaries of its training data; rather, ChatGPT tries its best to provide responses to a vast array of questions and prompts by using its transformer architecture, and receive feedback from humans on the quality and accuracy of its responses to further fine-tune itself.

LLMs often hallucinate when given a task to generate very specific pieces of information, such as the details of a reference paper or the ClinicalTrials.gov identifiers of ongoing clinical trials. While the responses generated by LLMs may sound reasonable and logical in a glance, researchers must ensure that sentences generated by LLMs do not contain false information and that they are in line with the authors' original intentions. Ultimately, the authors are responsible for all contents in the published text. Therefore, authors must understand the AI hallucination phenomenon and always cross-check the validity of the information laid out in the generated text by using traditional information searching tools such as PubMed and Google.

Plagiarism

The second point of caution when using LLMs for text generation involves the potential for plagiarism. The use of LLM-generated text in one's draft may be considered a form of plagiarism in that the author is not the one who truly generated the content, which is termed "ai-generation" [16]. Also, using LLMs for text generation is also vulnerable to the traditional definition of plagiarism in which a certain number of consecutive words (usually ranging from five to seven) from the source text is used in a subsequent manuscript [17]), either with or without citation. This type of plagiarism is more likely to occur in LLMs such as Bing or Bard, which are connected to the internet in real-time and are designed to cite existing sources in their responses. ChatGPT, on the other hand, may also inadvertently generate a string of words that are exactly the same as that found in

a published source while trying to generate the most likely response. Therefore, it is advisable to check LLM-generated texts using text similarity detectors such as iThenticate® or Turnitin™ to ensure that the draft does not contain pieces of copyrighted text.

Privacy and Sensitive Information

The Privacy Policy of ChatGPT states that "the contents of any messages you send" are collected, which can be used for training subsequent models [18]. Therefore, entering sensitive information such as patient data or personal details likely entails serious privacy issues. Hospitals are therefore advising the medical staff to stop entering patient information and data into ChatGPT for the purpose of writing medical notes [19], and the same precaution should be taken when using LLMs for manuscript writing. For ChatGPT, one measure that can be taken to add safety to its use is turning off the "Chat history & training" option, which can be found under "Settings - Data controls". By doing so, one can ensure that the contents of the chats will not be used for training the subsequent models of ChatGPT by OpenAI.

AI Detectors

Alarmed by the sudden influx of AI-written content on the internet, many companies and agencies including OpenAI developed AI-based tools that provide the probability that a block of text is human- or AI-generated. These AI detectors scan texts for characteristics that are often specific to AI-generated contents, including sentence length and low levels of randomness. However, soon after the emergence of these AI detectors, it was evident that these tools have high rates of both false positive and false negative results. Some AI detectors produce false negative results to LLM-generated texts that were generated along with prompts that asked for a higher degree of randomness. On the other hand, one AI detector flagged parts of the US Constitution, written in the 18th century, as being AI-generated [20]. In light of the low rates of accuracy, OpenAI shut down its AI detector [21] and the founders of other AI detectors are also publishing notes of caution [20]. In July 2023, several AI companies including OpenAI, Google and Meta have made voluntary commitments to the White House to implement measures such as watermarking AI-generated content, so that users will know when the technology has been used. However, it is still unclear how the watermark will be technically successful [22].

Journal Policies Regarding LLMs

Considering the possibility of plagiarism and dissemination of false information resulting from AI hallucination, some journals such as *Science* prohibit the use of LLMs to generate written content. Most other journals as well as organizations including Committee on Publication Ethics (COPE), International Committee of Medical Journal Editors (ICMJE), and World Association of Medical Editors (WAME) do not ban the use of LLMs—rather, they emphasize the importance of transparency in disclosing how AI tools were used in the study and manuscript preparation. Specifically, authors are advised to “note the AI tool used, the version number, the date accessed, and the manufacturer/creator name along with a description of how and for which parts of the submission the tools were used” [23].

Similar policies apply to peer reviewers in generating peer review comments, as funding agencies such as the National Institutes of Health forbids the use of LLMs “for analyzing and formulating peer-review critiques” due to concerns regarding the breach of confidentiality of the contents of grant applications and contract proposals [24]. *Science* and *Journal of Clinical Oncology (JCO)* also note that peer reviewers may not use LLMs or other similar AI tools to produce review comments, as parts of the comments may contain errors stemming from AI hallucination [25]. Similarly, *Journal of American Medical Association (JAMA)* specifies that including the contents of the manuscript or abstract being reviewed in the prompts for LLMs violates the confidentiality agreement, while using an AI tool in a manner that does not violate the confidentiality policy is not prohibited, which in the authors’ opinion likely involves either using an LLM for searching information or editing the non-crucial parts of the review comments for grammar and spelling. The policies of several prominent authorities in scientific publishing regarding LLMs or AI-generated content are summarized in Table 1 [23,26-33].

Use of LLMs for Text Editing/Refinement

We believe that LLMs are safer and more efficient for editing and refining content rather than generating it from scratch. When non-native English-speaking researchers prepare an article in English, collaborating with native English coauthors has been considered the best strategy for successful writing [11]. However, these options are not always available to many researchers.

The most common approach for non-native researchers to improve their English writing is to use commercial professional editing and proofreading services. However, this can result in substantial expenses for non-native researchers, placing an additional burden on those from under-resourced countries [34]. Besides the financial burden, there are drawbacks to using these services. Many native speakers working as proofreaders may not be specialized in specific areas of study, risking misinterpretation of the study itself. Sometimes, they may focus solely on linguistic corrections, such as grammar or vocabulary. Furthermore, since many of these services charge on a one-time basis, non-native English authors may face difficulties in obtaining additional corrections or communicating with proofreaders without incurring extra costs, even if the initial proofreading is insufficient or misleading.

LLMs offer several advantages over companies that offer English editing services. Receiving English editing from LLMs is readily available, and the process is highly interactive, allowing users to ask for revisions or further clarification without incurring additional expenses. LLMs can also provide multiple versions of proofreading, enabling authors to choose the best option for their intended message. As sentences generated by LLMs are generally neutral and have few grammatical errors [10], non-native researchers can learn from LLMs and improve their English skills through back-and-forth interaction with LLMs in refining their drafts. Moreover, the chance for AI hallucination is lower when LLMs are prompted to edit an existing block of text than to create one. Aside from LLMs, there are many AI-based tools that provide assistance with text editing and rephrasing such as Grammarly™, QuillBot™, and Rewriter AI™, which provide suggestions at the word/phrase level and therefore are unlikely to add in misinformation. Accordingly, journals such as *JAMA* and *JCO* note that it is not necessary to report the use of AI tools in checking grammar, spelling, formatting, or reference of manuscripts [23,26].

While LLMs may be useful in providing a quick review of a manuscript for grammar, typo, and expression, LLMs are less capable of capturing and following individual writing styles or conveying nuanced details, which is less of a problem for highly experienced English editors. Moreover, experienced English editors may be able to provide editing and constructive comments by considering the context of the study as a whole beyond the simple mechanistic editing of the English language at the word or phrase level as LLMs do. Therefore, non-native researchers would benefit the

Table 1. Comparative summary of policies on the use of large language model and generative artificial intelligence by prominent authorities in scientific publication

Name*	Guidelines for AI authorship [†]	Additional guidelines for authors, reviewers, and editors [†]
Journal		
<i>JAMA</i> and <i>JAMA Network journals</i> [26]	Nonhuman AI, language models, machine learning, or similar technologies do not qualify for authorship. If these models or tools are used to create content or assist with writing or manuscript preparation, authors must take responsibility for the integrity of the content generated by these tools.	<ul style="list-style-type: none"> • The submission and publication of content/images created by AI, language models, machine learning, or similar technologies is discouraged, unless part of formal research design or methods, and is not permitted without clear description of the content that was created and the name of the model or tool, version and extension numbers, and manufacturer. Authors must take responsibility for the integrity of the content generated by these models and tools. • Authors should report the use of AI, language models, machine learning, or similar technologies to create content or assist with writing or editing of manuscripts in the Acknowledgment section or the Methods section if this is part of formal research design or methods. This should include a description of the content that was created or edited and the name of the language model or tool, version and extension numbers, and manufacturer. (Note: this does not include basic tools for checking grammar, spelling, references, etc.)
<i>Journal of Clinical Oncology (JCO)</i> [23]	<i>JCO</i> does not accept manuscripts with nonhuman authors. LLMs and AI tools cannot be listed as an author under any circumstances.	<ul style="list-style-type: none"> • Authors must be aware of the rapidly evolving capabilities and deficiencies of these tools. Authors remain responsible for the accuracy of all content submitted and are liable for any breach of publication ethics. • <i>JCO</i> generally discourages the use of LLMs and AI tools to generate written content in submissions. LLMs and AI tools used to assist in writing Original Reports or Clinical Trial Updates must be noted in the Acknowledgments. If LLMs or AI tools are used in the research itself (eg, data analysis), it must be disclosed in the Methods section. In either place, the authors must note the LLM or AI tool used, the version number, the date accessed, and the manufacturer/creator name along with a description of how and for which parts of the submission the tools were used. AI tools used to assist with grammar, spelling, formatting, and reference clean up do not need to be disclosed. • <i>JCO</i> forbids the use of LLMs or AI tools in the preparation of submissions primarily advancing the authors opinion and perspective. • Reviewers may not use LLMs or AI tools when reviewing work submitted to <i>JCO</i> for peer review.
<i>Korean Journal of Radiology (KJR)</i> [‡] [27]	Authorship assignment to AI is prohibited.	<ul style="list-style-type: none"> • Authors who employ generative AI tools are solely responsible for all content produced and submitted. • <i>KJR</i> discourages the use of generative AI tools for the primary purpose of creating any types of content for scientific manuscripts. If such tools are used, the authors must report their use transparently, including specific details and a comprehensive explanation of the use in the study conduct and manuscript writing. • The use of LLMs or other AI tools to enhance the linguistic quality of a submission is considered acceptable and does not require specific disclosure. • When generative AI itself is the focus of a study, the use of AI should be explicitly detailed in the Materials and Methods section. • Reviewers are forbidden from using LLMs for the primary purpose of generating review comments.
<i>Nature</i> and <i>Springer Nature journals</i> [28,29]	LLMs, such as ChatGPT, do not currently satisfy our authorship criteria.	Use of an LLM should be properly documented in the Methods section (and if a Methods section is not available, in a suitable alternative part) of the manuscript.
<i>Science journals</i> [30]	An AI program cannot be an author of a <i>Science</i> journal paper.	Text generated from AI, machine learning, or similar algorithmic tools cannot be used in papers published in <i>Science</i> journals, nor can the accompanying figures, images, or graphics be the products of such tools, without explicit permission from the editors.

Table 1. Comparative summary of policies on the use of large language model and generative artificial intelligence by prominent authorities in scientific publication (continued)

Name*	Guidelines for AI authorship [†]	Additional guidelines for authors, reviewers, and editors [‡]
Organization		
COPE [31]	COPE joins organisations, such as WAME and the JAMA Network among others, to state that AI tools cannot be listed as an author of a paper.	Authors who use AI tools in the writing of a manuscript, production of images or graphical elements of the paper, or in the collection and analysis of data, must be transparent in disclosing in the Materials and Methods (or similar section) of the paper how the AI tool was used and which tool was used. Authors are fully responsible for the content of their manuscript, even those parts produced by an AI tool, and are thus liable for any breach of publication ethics.
ICMJE [32]	Chatbots (such as ChatGPT) should not be listed as authors because they cannot be responsible for the accuracy, integrity, and originality of the work, and these responsibilities are required for authorship. Authors should not list AI and AI-assisted technologies as an author or co-author, nor cite AI as an author.	<ul style="list-style-type: none"> • At submission, the journal should require authors to disclose whether they used AI-assisted technologies (such as LLMs, chatbots, or image creators) in the production of submitted work. • Authors who use such technology should describe, in both the cover letter and the submitted work, how they used it. • Humans are responsible for any submitted material that included the use of AI-assisted technologies. • Authors should carefully review and edit the result because AI can generate authoritative-sounding output that can be incorrect, incomplete, or biased. • Authors should be able to assert that there is no plagiarism in their paper, including in text and images produced by the AI. • Humans must ensure there is appropriate attribution of all quoted material, including full citations.
WAME [33]	Chatbots cannot be authors.	<ul style="list-style-type: none"> • Authors should be transparent when chatbots are used and provide information about how they were used. • Authors are responsible for material provided by a chatbot in their paper (including the accuracy of what is presented and the absence of plagiarism) and for appropriate attribution of all sources (including original sources for material generated by the chatbot). • Editors and peer reviewers should specify, to authors and each other, any use of chatbots in the evaluation of the manuscript and generation of reviews and correspondence. If they use chatbots in their communications with authors and each other, they should explain how they were used. • Editors need appropriate tools to help them detect content generated or altered by AI. Such tools should be made available to editors regardless of ability to pay for them, for the good of science and the public, and to help ensure the integrity of healthcare information and reducing the risk of adverse health outcomes.

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*Listed in alphabetical order, [†]Direct quotes from the statements of respective authorities, [‡]Summary of the current policy statements. AI = artificial intelligence, LLM = large language model, COPE = Committee on Publication Ethics, WAME = World Association of Medical Editors, ICMJE = International Committee of Medical Journal Editors

most from having their manuscripts reviewed by both LLMs and human editors in terms of receiving a manuscript that is not only free of simple errors but superior in terms of overall logical flow.

CONCLUSION

LLMs have the potential to significantly assist non-native

English-speaking researchers in the preparation of articles in English. However, researchers must exercise caution when using LLMs for text generation. To ensure the responsible use of LLMs in academic writing, authors should always cross-check the validity of the information generated by LLMs using traditional information searching tools such as PubMed and Google. Additionally, it is advisable to check LLM-generated texts using text similarity detectors like

iThenticate® or Turnitin™ to prevent plagiarism.

As LLMs continue to evolve and improve, their potential to support non-native English-speaking researchers will likely grow. By understanding the limitations and potential risks associated with LLMs, researchers can safely harness their power to enhance the quality and efficiency of their manuscript writing process, ultimately contributing to the advancement of scientific knowledge. At the same time, it should be noted that overdependence on LLMs may deprive researchers of the opportunity to improve not only their English writing skills but also their understanding of their domain knowledge. The process of selecting appropriate vocabulary and arranging words in a coherent manner allows for a better understanding of the text as well as the development of ideas. Therefore, non-native researchers are advised to both learn how to efficiently and safely use LLMs in manuscript preparation and, at the same time, practice writing and editing texts on their own in order to ensure their personal growth in the art of scientific writing.

Conflicts of Interest

Sung Il Hwang, the section editor of the *Korean Journal of Radiology*, was not involved in the editorial evaluation or decision to publish this article. All authors have declared no conflicts of interest.

Author Contributions

Conceptualization: Sung Il Hwang, Joon Seo Lim. Project administration: all authors. Resources: Sung Il Hwang, Joon Seo Lim, Ro Woon Lee. Supervision: Sung Il Hwang. Writing—original draft: Sung Il Hwang, Joon Seo Lim. Writing—review & editing: all authors.

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