



Editorial

Good Practices for Scientific Article Writing with ChatGPT and Other Artificial Intelligence Language Models

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The release of ChatGPT by OpenAI in late November 2022 has shaken the foundations of many industries based in content generation and writing. In the last months, the scientific community has raised concerns regarding the possible misuse of artificial intelligence (AI) language models, such as ChatGPT. While ChatGPT and similar tools can be used to enhance scientific article writing and facilitate communication within the scientific community, they can also be used to create fake or low-quality papers that may be used to manipulate the publishing process. In particular, one potential threat is the use of AI-powered “paper mills” or “paper forges” that generate fake or low-quality scientific papers using language models, such as ChatGPT. These papers may be used to manipulate metrics, such as citation counts or impact factors, or to deceive readers into believing that the research is of a higher quality than it actually is.

Nonetheless, I think that it is also important to highlight the positive opportunities that AI language models offers to reduce the language barrier for non-native English speakers. In fact, native English speakers often overlook the disadvantage that non-native speakers carry during their whole professional career, as an effective communication of the scientific ideas usually results in a higher visibility and impact of the results in the community. AI language models can be used to reduce this barrier in the following ways:

1. Language and grammar checks: language and grammar are crucial components of any scientific article. With AI language models, researchers can easily check their writing for grammatical errors and ensure that their language is clear and concise. This can help to improve the overall quality of the article and make it more readable and accessible to a wider audience.
2. Drafting paragraphs: language models can be used to help with drafting and outlining scientific articles. By inputting a rough paragraph text, without paying attention to grammar or punctuation, but providing all the critical information that the paragraph should contain, AI language models can generate a more effective paragraph. This can save researchers a significant amount of time and effort, allowing them to focus more on the research itself.
3. Peer-review and feedback: By inputting a draft of their article, researchers can receive feedback and suggestions for improvement from ChatGPT. This can be particularly helpful for researchers who are working independently and may not have access to a peer review process.

Box 1 is an example of use of ChatGPT to help drafting a paragraph.

Box 2 is an example of use of ChatGPT to help providing feedback.



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Box 1. Example of use of ChatGPT to help drafting a paragraph.

AC-G: Could you help me to draft a paragraph for a scientific article? It would be a paragraph to be included in the introduction of the manuscript and it should explain how the development of nanomaterials is a big revolution in the material science but that there is an open challenge to scale up and mass produce these nanomaterials to use them in real-life applications. I would like to start with nanomaterials in general but then to include graphene as an example. While graphene isolation by mechanical exfoliation is very simple and it allowed to observe intriguing physical phenomena, without a proper scaled up synthesis its industrial application will be negligible.

ChatGPT: The development of nanomaterials has transformed the field of materials science, offering new opportunities for the creation of materials with unique properties and applications. One of the most promising nanomaterials is graphene, with its exceptional mechanical, electrical, and thermal properties. Despite the fascinating properties of graphene, its industrial application remains limited due to the challenge of scaling up its synthesis. The isolation of graphene by mechanical exfoliation is relatively simple and has allowed the observation of intriguing physical phenomena. However, without a practical and efficient method for mass-producing graphene, its use in many real-life applications will be negligible. Therefore, there is a pressing need to develop new methods and technologies for scaling up the production of graphene and other nanomaterials, to fully realize their potential for use in a variety of applications.

Box 2. Example of use of ChatGPT to help providing feedback.

AC-G: I've written this paragraph (see below) for a scientific article. Could you provide some feedback about it? Would you recommend some changes in the writing style? Or do you see some flaws in the reasoning?

The release of ChatGPT by OpenAI in December 2022 has shaken the foundations of many industries based in content generation and writing. In the last months the scientific community has raised concerns regarding the possible misuse of AI language models like ChatGPT. While ChatGPT and similar tools can be used to enhance scientific article writing and facilitate communication within the scientific community, they can also be used to create fake or low-quality papers that may be used to manipulate the publishing process. In particular, one potential threat is the use of AI-powered "paper mills" or "paper forges" that generate fake or low-quality scientific papers using language models like ChatGPT. These papers may be used to manipulate metrics such as citation counts or impact factors, or to deceive readers into believing that the research is of a higher quality than it actually is.

ChatGPT: Overall, the paragraph reads well and addresses an important issue in the scientific community. Here are a few suggestions to improve the writing style:

1. Consider breaking up the paragraph into smaller chunks. This can help with readability and make it easier for readers to follow your ideas.
2. Try to vary the sentence structure to avoid repetition. For example, you could rephrase the sentence "While ChatGPT and similar tools can be used to enhance scientific article writing and facilitate communication within the scientific community" to something like "ChatGPT and similar tools have the potential to enhance scientific article writing and improve communication among researchers".
3. When introducing a new term, such as "paper mills" or "paper forges," it's helpful to define the term or provide some context to ensure that readers understand what you mean.
4. Consider providing more specific examples or evidence to support your argument. For instance, you could cite a study or news article that highlights the potential misuse of AI language models in scientific publishing.

Overall, the paragraph is well-written and effectively communicates the potential risks associated with the use of AI language models in scientific publishing. With a few minor tweaks, it could be even stronger.

Another aspect that has been debated in the last months is whether AI language models should be listed as co-authors of papers or not or if there is some kind of copyright conflicts. According to the OpenAI sharing publication policy (<https://openai.com/policies/sharing-publication-policy> (accessed on 7 of April of 2023)), the content is attributed to the user's

name. That is, the generated text is owned by the researcher and can be used in their article without any restrictions. Nonetheless, OpenAI points that some text disclosing the use of an AI language model should be used. OpenAI provides an example of acknowledgement that could be included to describe the use of ChatGPT to generate content:

Box 3 is an example of text to be included in the acknowledgement.

Box 3. Example of text to be included in the acknowledgement.

The author generated this text in part with GPT-3, OpenAI's large-scale language-generation model. Upon generating draft language, the author reviewed, edited, and revised the language to their own liking and takes ultimate responsibility for the content of this publication.

Figure 1 shows an artistic impression of an AI writing a scientific manuscript. The figure generated with Bing Image Creator text2image model based on Dall-E 2 of OpenAI.

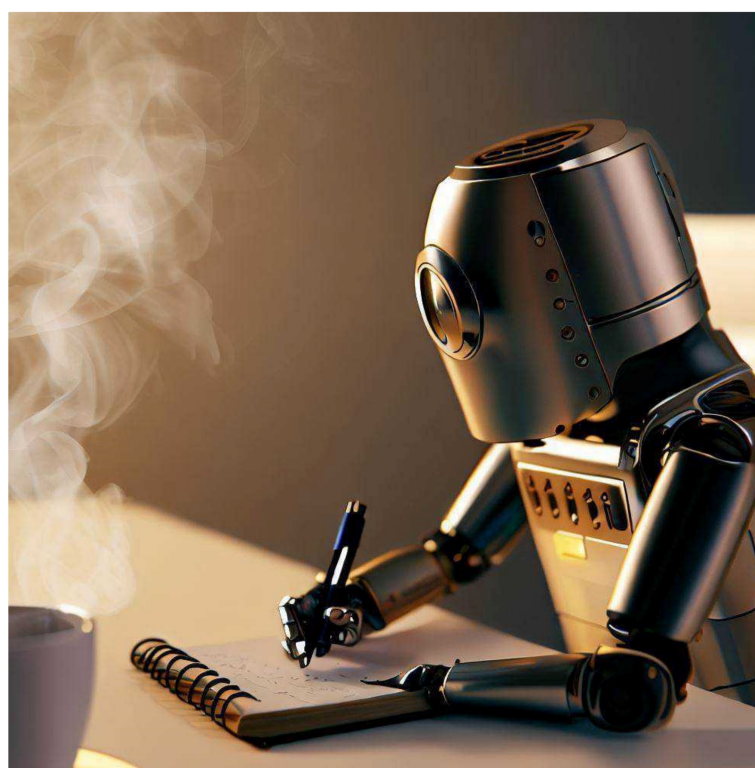


Figure 1. An artistic impression of an AI writing a scientific manuscript.

In summary, despite the potential threat of misuse to strengthen up “paper mills” and to deceive readership to make research look higher quality than it actually is, AI language models can help to reduce the language barrier burden carried by a huge community of non-native English speaker scholars, improving their visibility and impact. To address the concerns on the potential threats, it is important for the scientific community to establish ethical guidelines and best practices for the use of AI language models in scientific publishing. I thus strongly support including a text describing the specific use of AI language models. Acknowledging the use of ChatGPT or other models in scientific articles is a matter of transparency and scientific integrity. While these models are tools that can assist with various aspects of scientific article writing, it is still important to give credit where credit is due.

Acknowledgment

ChatGPT (GPT-3, OpenAI's large-scale language-generation model) has been used to generate some of the examples and to improve the writing style of this Editorial Article. AC-G reviewed, edited, and revised the ChatGPT generated texts to his own liking and takes ultimate responsibility for the content of this publication.

Conflicts of Interest: The authors declare no conflict of interest.

Short Biography of Author



Andres Castellanos-Gomez is a Tenured Scientist in the Spanish National Research Council (Consejo Superior de Investigaciones Científicas, CSIC). He explores novel two-dimensional materials and studies their mechanical, electrical, and optical properties with special interest on the application of these materials in nanomechanical and optoelectronic devices. He is the principal investigator of a prestigious ERC Starting Grant. Among other recognitions, he has been awarded with the highest National and Regional scientific recognitions to young scientists: the Premio Nacional de Investigación “Felisa Martín-Bravo” 2022 and the “Miguel Catalan” Award 2022. He was appointed Fellow of the International Association of Advanced Materials (IAAM) in 2020, and he has been included in the Highly Cited Researchers 2018–2022 lists of Clarivate/WOS and has been also recognized with the Young Researcher Award (experimental physics) of the Royal Physical Society of Spain (2016).

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