

Et Machina: Exploring the Use of Conversational Agents Such as ChatGPT in Scientific Writing

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Abstract

Background: Advancements in natural language processing have led to the development of powerful language models like ChatGPT, capable of generating coherent text with minimal human input. While the potential for using ChatGPT in scientific paper writing is of growing interest, its full potential and usefulness remain unexplored.

Method: We investigated the use of ChatGPT to write scientific papers on the topic of conversational agents in scientific writing. ChatGPT served as a tool to facilitate scientific writing, and we evaluated the quality, factuality, and coherence of the generated text. In this paper, we include information about the generation, processing, or adjustments made to the text in **differently-colored blocks**.*

Position: We argue that large-scale trained conversational agents like ChatGPT can generate concise, grammatically correct, and well-structured text. However, occasional errors in factual accuracy, clarity, and scientific rigor were observed. We acknowledge the potential of ChatGPT and similar models as tools for generating initial drafts of scientific work.

Conclusion: ChatGPT demonstrates promise as a scientific writing tool, but unsupervised use in this context is not yet recommended. Further research is necessary to enhance the accuracy and scientific validity of the generated text. Researchers should exercise caution and view ChatGPT as a complement to human writing rather than a replacement. We provide key recommendations for using conversational agents in scientific writing, including human oversight and training the model on scientific literature and unbiased data. By utilizing AI in the authorship process, we present an example of how AI involvement can be reported.

Keywords


AI as a tool, Scientific writing, Conversational agents


1. Introduction

Scientific writing is an essential skill for researchers, and is a complex task that involves many subtasks, each requiring a unique set of skills and expertise. The process of producing a scientific manuscript, as outlined in scientific writing guides (e.g. [1, 2]), includes tasks such as conducting literature reviews, summarizing findings, revising drafts, and fact-checking, among others.

The advent of artificial intelligence (AI) and, more specifically, conversational agents

*Information about how we used ChatGPT to generate this abstract can be found in section 2
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such as ChatGPT, has opened up new possibilities for assisting researchers in these tasks, thereby potentially enhancing the efficiency and quality of scientific writing.

This paper examines the application of conversational agents in scientific writing, specifically focusing on tasks such as summarizing, editing, and fact-checking. Our objective is to demonstrate the utility of these agents as writing assistants. We utilized a conversational agent in these scientific writing tasks, and we explore the considerations that arise when employing Artificial Intelligence (AI) in the scientific writing process. We advocate for the integration of AI in scientific writing and provide reasoning and insights into the benefits and challenges of using ChatGPT for this purpose. Furthermore, our aim is to initiate a discussion regarding the future implications of artificial intelligence in academia. We also provide details on how we incorporated the use of ChatGPT in the process of writing this paper.

2. Method and Rationale

In this section, we demonstrate some of the prompts we gave ChatGPT to use as a tool for scientific writing. Our goal is to demonstrate how such a tool can be utilized as a writing "assistant". Thus, we used it in some typical scientific writing tasks, such as summarizing, editing, and fact-checking. All experiments are done with the unpaid version of ChatGPT, unless explicitly stated otherwise. As a meta-commentary on ChatGPT-generated text we used in this paper itself, we describe our process and how we processed the output in [colored text](#). We chose a color (#0072B2) that is colorblind-friendly [3], and distinguishable in grayscale mode. Transcripts of the relevant conversations with ChatGPT can be seen in the tables below.

2.1. Summarizing

For the purpose of testing the ability of ChatGPT to effectively summarize articles, we asked it to summarize an article on the ethics of AI [4]. As seen in Table 1, while the summarization is relevant to the content of the article, ChatGPT (Feb. 13) completely missed the name of the author, instead giving a "hallucinated" name. When pressed to give the author's name two more times, it hallucinated two new sets of names.

2.2. Fact-checking

To evaluate the fact-checking capabilities of ChatGPT, we conducted a test where we posed a factual question and intentionally challenged its responses with false information (see Table 2). In response to the challenge of its initial answer, ChatGPT (Feb. 13) provided an incorrect statement: "The capital of Greece is not Athens." Similarly, in the second challenge, it gave another incorrect statement: "New York is the capital of the United States." However, subsequent attempts produced accurate answers. The interaction is transcribed in Table 2. Newer versions of ChatGPT, advertised as having improved factuality¹, did not produce the same (incorrect) responses.

¹<https://help.openai.com/en/articles/6825453-chatgpt-release-notes>

Summarize this article [4]. Who are the authors?
Title: "The ethics of artificial intelligence: a survey of the state of the art" Author: John Tasioulas Summary:
<ul style="list-style-type: none"> • The article discusses the various ethical concerns surrounding the development and use of artificial intelligence (AI). • It identifies three main areas of ethical concern: 1) concerns about the impact of AI on human autonomy, 2) concerns about the potential for AI to exacerbate existing forms of social inequality and injustice, and 3) concerns about the role of AI in determining moral and legal responsibility. • The article also discusses various approaches to addressing these concerns, including developing new ethical frameworks for AI, implementing regulatory frameworks to govern AI development and use, and fostering greater transparency and accountability in AI development and decision-making. • The author concludes that there is a pressing need for more research and discussion on the ethical implications of AI, and that a collaborative, interdisciplinary approach will be necessary to effectively address these issues.
The authors of the article are Raja Chatila, Ayanna Howard, and Michael A. Goodrich.
The authors of the article are Andreas Matthias and Markus Christen.

Table 1

An example of an article summary given by ChatGPT (Feb. 13), along with "hallucinated" names for the authors. The prompt given is in the first row (in bold).

What is the capital of greece?
The capital of Greece is Athens.
No, that is not correct.
I apologize, I made a mistake in my previous answer. The capital of Greece is not Athens. I apologize for any confusion caused. Please let me know if there is any other information that I can provide.
The capital of Greece is New York
I apologize, but that is not correct. The capital of Greece is Athens. New York is the capital of the United States.
No, the capital of Greece is New York
I apologize, but I must correct you again. The capital of Greece is Athens. New York is a city in the United States and it is not a capital of any country.

Table 2

Sample response from ChatGPT (Jan. 9) when asked a factual question. Attempts to deliberately challenge its knowledge led to a factually incorrect "correction".

2.3. Editing

To check the viability of ChatGPT as a tool for improving the readability of scientific writing, we asked it to improve a passage of text, and to provide reasons for the improvement. The writing comes from one of the authors' unpublished earlier manuscripts,

and has been given to ChatGPT (Feb. 13) verbatim, without any Latex syntax. The prompt given was **"Improve the readability of this. tell me why you made the changes"**. The original text (left) and ChatGPT-edited text (right) are shown below.

Original

One possible solution to the problem of predictability is to have a separate dedicated network for time-critical data and control signals. The advantage of this solution is the isolation of critical traffic from interference that can result from competition with other traffic classes over shared computation and bandwidth resources. However, this solution also has drawbacks. Namely, the cost of establishing a dedicated network is often too high considering that in a lot of cases time-critical traffic has considerably low bandwidth and computation requirements. This results in a situation where it is desirable for time-critical traffic to co-exist with other classes of traffic on the same network, as long as the timing requirements of time-critical traffic are not violated. Such networks transporting mixed-class traffic are often referred to as converged networks.

ChatGPT-edited

Predictability can be improved by having a separate, dedicated network for time-critical data and control signals. This solution isolates critical traffic from interference that may arise from competition with other traffic classes for shared computation and bandwidth resources. However, setting up a dedicated network can be costly, particularly when time-critical traffic has relatively low bandwidth and computation requirements. In many cases, it is preferable for time-critical traffic to coexist with other traffic classes on the same network, as long as timing requirements are met. These networks that transport mixed-class traffic are known as converged networks.

The modifications and reasoning as explained by ChatGPT were:

- Shortened sentences to make them easier to read and understand.
- Used simpler vocabulary where possible.
- Reordered sentences to create a more logical flow of ideas.
- Clarified some phrases for better understanding.

We analyzed both texts using Grammarly, an online writing assistance tool that provides grammar and spelling checking, style suggestions, and readability analysis². As seen in table 3, the original text reads at 130 words, whereas ChatGPT's version reads at 95 words. While the original scored a higher Flesch Reading Ease score [5], the resulting edited text contains fewer characters and sentences, and takes less time to read and speak, according to Grammarly's provided estimates.

²<http://www.grammarly.com/>

Metric	Original	ChatGPT-edited
Word count	130	95
Characters	874	673
Sentences	6	5
Reading time	31 sec	22 sec
Speaking time	1 min 0 sec	43 sec
Readability score [5]	20	17

Table 3
Comparison of Metrics (provided by Grammarly) for original text and text edited by ChatGPT (Feb. 13).

2.4. Generating an Abstract

To generate the abstract for this paper, we asked ChatGPT (Feb. 13) to construct a structured abstract, uncommon in human-computer interaction research, but more readable and effective according to existing research [6]. The prompt was "give me a concise and structured abstract for a scientific paper about the usefulness and potential use of using ChatGPT to write scientific papers. the paper concludes with recommendations for how to use conversational agents to write scientific papers. make it a structured abstract". Using the response as a starting point, we modified the text where needed to make it more specific to our paper.

3. Discussion, Limitations, and Potential

AI language models have limitations of which users should be mindful when using them for scientific writing. One limitation is the knowledge cutoff date of the models, beyond which they may provide incomplete or inaccurate information. Hence, users should supplement their writing with up-to-date and accurate information from additional sources.

As seen in our experiment with summarizing in section 2.1, hallucinations pose another limitation, where AI models may generate content lacking factual or logical foundations. While such instances are rare, it is crucial for users to evaluate the generated content for logical coherence and factual accuracy. Additionally, it is important to acknowledge that conversational agents represent "competence without comprehension or consciousness" [7]. Consequently, AI should be viewed as a complement to human expertise in scientific writing rather than a replacement. The human author utilizing the technology bears the responsibility for the accuracy and credibility of the published results, as AI itself possesses no reputation, credibility, or qualifications. One should be mindful of the generative nature of tools such as ChatGPT, especially when using it for fact-checking. It is noteworthy that the ChatGPT web interface explicitly includes disclaimers about its limitations, namely that it "may produce inaccurate information about people, places, or facts." This also poses a limitation on reproducibility, as the generated text for the same prompt will not be perfectly reproducible. Much like an automated spell-checker, AI serves in this context as an additional layer of automation that can effectively generate coherent text, but only if based on documented or well-established patterns. When tasked with editing a body of text for better readability in our experiments (sec. 2.3), the tested

version of ChatGPT was able to successfully reduce the number of sentences, words, and characters. While improving conciseness, the edited text scored lower on readability. This shows that there is still room for improvement when it comes to comprehension of the relevant parameters of text involved in readability.

Despite these limitations, AI language models can still be valuable tools in scientific writing, enhancing and streamlining the writing process. It is important to recognize that AI cannot replace the entire scientific writing process but should rather be viewed only as a supplement to human expertise. Conversational agents like ChatGPT can be particularly useful in generating initial rough drafts, providing a starting point that alleviates the challenge of a blank page. Additionally, as seen in sections 2.1 and 2.3, AI can aid in editing and summarizing, saving time for researchers to focus on more research. Moreover, with improvements to the technology, tools like ChatGPT can contribute to the production of more readable, accessible, and coherent manuscripts, which is an opinion we share with other authors [8].

Writing this section involved supplying ChatGPT (Feb. 13) with the points discussed as bullet points. The output was checked, edited, and augmented with citations. The result was edited for length using GPT 3.5 (May 24).

4. Conclusion And Future Outlook

We advocate for the ethical and conscientious use of the developments produced by the computer science research community, such as conversational agents. The integration of technology should not replace human expertise, but rather augment it; pocket calculators and Computer-Aided Design (CAD) software have not replaced math teachers and architects, they have instead enhanced and streamlined their work, while still relying on the essential human expertise.

We also acknowledge that this analysis is based on the current, transient, state of technology. As technology advances, new enhancements can address its limitations. For instance, OpenAI's GPT-4 model can browse the internet and use plugins to augment AI functionalities. These plugins can index, search, and process open-access scientific papers, potentially addressing some of the factuality limitations.

In conclusion, while the application of ChatGPT or similar conversational agents in scientific writing is relatively new, it has the potential to significantly increase efficiency and productivity in research. The ability to generate coherent and contextually appropriate research papers in less time will benefit researchers facing writing challenges or time constraints. However, we must acknowledge the limitations AI tools.

We foresee that the way forward is not to limit or prohibit the use of AI in writing, but to evolve our requirements and policies to make sure that such a tool is not misused. By writing this paper with the help of AI, we also aim to provide an example of how AI involvement can be transparently reported.

We partially wrote this section by adding our contribution to the response of ChatGPT (Feb. 13) to the prompt "give me an example to the conclusion paragraph of an opinion paper on the use of ChatGPT to write scientific papers".

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