ChatGPT and other artificial intelligence applications speed up scientific writing

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The launch of ChatGPT (Chat Generative Pre-trained Transformer, OpenAI Limited Partnership, San Francisco, USA) on November 30, 2022, has sparked a wave of enthusiasm.[1,2] People from all walks of life are eager to experiment with this novel application and discussions are lively, especially in the education sector.[3–5] In contrast, discussion of this topic in medical journals has lagged behind,[6–9] and much of the discussion has focused on ghostwriting by ChatGPT, involving academic ethics, originality, and authorship.[10–12] In fact, the use of artificial intelligence (AI) technology in texts has become increasingly mature in recent years,[13] dramatically changing the way scientific writing works (Table 1).

English has been the dominant scientific language (*lingua franca*) for decades.[14] It is undeniable that the vast majority of scientists who do not speak English as their mother tongue still have difficulty or are much less proficient in writing in English. Machine translation, especially natural language processing using neural networks and deep learning, can almost help overcome language barriers. The following demonstrates three AI-powered approaches to writing in English for native Chinese speakers (Fig. 1).

The tools available now for writing assistance, particularly in English, go well beyond simple grammar, punctuation, and spelling checks. They can provide immediate synonym searches to suggest word choices, as well as paraphrasing to alter the tone and style of the text. Take as an example DeepL Write (DeepL GmbH, Cologne, Germany), the public beta version of which has been launched on January 17, 2023. The moment the user types a word, the software automatically suggests various synonyms or related terms. Once the user has written a few words, the software offers a number of additional word choices that can be used to complete the sentence. For an entire sentence, dozens of different ways to write that sentence will be available. AI provides contextualized examples for reference through the sentence search engine and natural language processing.

In translation, AI has dramatically improved the accuracy of machine translation in recent years, with DeepL Translator (DeepL GmbH) being probably the leader.[15] DeepL Translator uses an algorithm called a convolutional neural network in deep learning. In August 2017, DeepL Translator launched the free online translation service. By the end of 2022, it has supported 29 languages, with Chinese in March 2020. A variety of comparable products are available on the internet. Users can paste the Chinese text into various translation tools, compare the results, and choose the right one. More importantly, try to rewrite the original Chinese text repeatedly so that the translation software can understand it and then provide appropriate results.

The use of AI to write scientific papers is clearly unethical, and its accuracy is currently in doubt. Generally speaking, writing is only a small part of the overall research. The core of the research should be the idea together with its results. In addition, science is based on previous research and citation is very important. Currently, AI content generation tools are not yet able to

Table 1

Examples of artificial intelligence applications in scientific writing

Tool	Web address (accessed on February 5, 2023)
Writing assistance	
DeepL Write	https://www.deepl.com/write
Ludwig	https://ludwig.guru/
Grammarly	https://app.grammarly.com/
QuillBot	https://quillbot.com/
Trinka	https://www.trinka.ai/
Microsoft Editor	https://www.microsoft.com/zh-tw/microsoft-365/microsoft-editor
Translation	
DeepL Translator	https://www.deepl.com/translator
Google Translate	https://translate.google.com/
Bing Translator	https://www.bing.com/translator
Reverso Translation	https://www.reverso.net/text-translation
Youdao Translate	https://fanyi.youdao.com/
Baidu Translate	https://fanyi.baidu.com/
Content generation	
ChatGPT	https://chat.openai.com/
Copy.ai	https://www.copy.ai/
Texta	https://www.texta.ai/
ChatSonic	https://writesonic.com/chat
Writier	https://writier.io/
Writerly	https://writerly.ai/

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Conflicts of interest: Dr. Tzeng-Ji Chen, an editorial board member at Journal of the Chinese Medical Association, had no role in the peer review process of or decision to publish this article. The author declares that he has no conflicts of interest related to the subject matter or materials discussed in this article.

Journal of Chinese Medical Association. (2023) 86: 351-353.

Received February 6, 2023; accepted February, 7. 2023.

doi: 10.1097/JCMA.0000000000000900.

<zdoi: 10.1097/JCMA.0000000000000900>

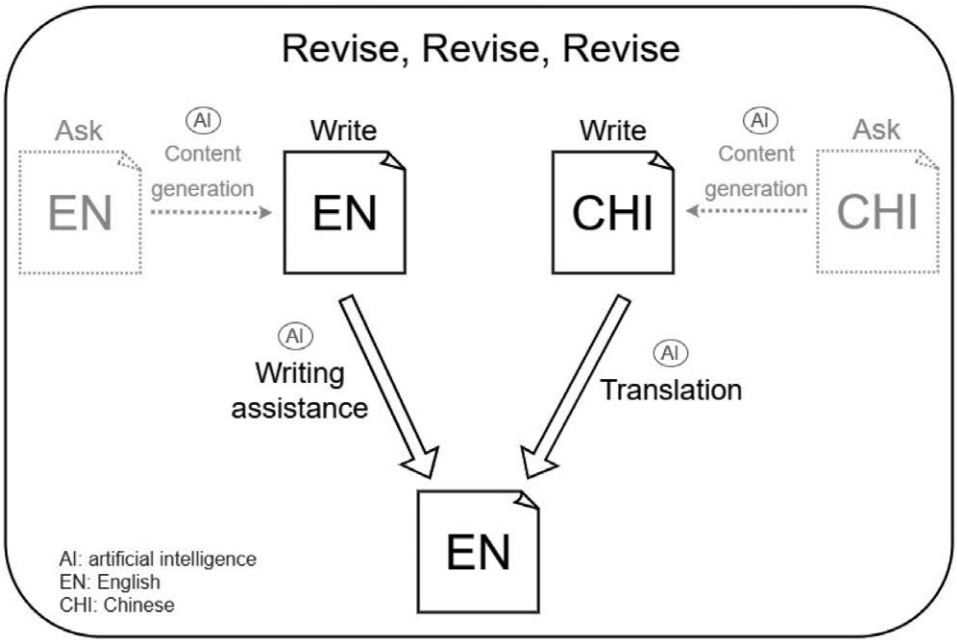

Fig. 1 Use of artificial intelligence applications in scientific writing.

automatically provide correct citing sources. There is no denying that for many people, writing is not easy. ChatGPT and other AI-powered content generation tools can write various versions of text in a few seconds, perhaps inspiring the authors to overcome the writer's block.

Regarding the role of AI in scientific writing, we should bravely embrace the new world with an open mind. Physicians do not need to understand the physics of computed tomography and magnetic resonance imaging in detail, but only how to interpret the images. Researchers do not need to understand the mathematical principles underlying statistical models; instead, they must understand how to apply statistical formulae. Similarly, scientists do not need to be embarrassed about not knowing AI algorithms; rather, they should know how to exploit AI tools.

Dear readers, if you have read the previous paragraphs and found them comprehensible, you are entering the world of AI. The current manuscript was originally written in Chinese without any assistance and then translated into English by means of AI-powered tools. After manual revision, the manuscript was edited again by AI-powered tools.

Experimentally, the original Chinese version of the above text was first summarized into six sentences by ChatGPT and then translated into English using DeepL Translator as follows:

> The launch of OpenAI's ChatGPT has generated a lot of buzz and is being used across a wide range of industries, particularly in the education sector. Advances in AI technology have changed the way science is written. Many scientists who are not native English speakers still have difficulty writing in English. Three ways of using AI technology to help Chinese speakers write English are presented. AI technology has dramatically improved the accuracy of machine translation, with DeepL Translator being the best.

In addition, a six-sentence summary of the English version of the above text is provided by ChatGPT as follows:

> The launch of OpenAI's ChatGPT has received enthusiasm from various sectors, but discussions about its use in medical journals have lagged behind. There have been concerns about the ethical implications of using AI for scientific writing. However, AI technology has greatly advanced in recent years and has changed the way scientific writing works. AI-powered tools such as DeepL Write can provide immediate synonym searches, paraphrasing and even writing suggestions, while AI translation has greatly improved machine translation accuracy. AI-generated writing is still considered unethical and its accuracy is questionable. But, scientists should embrace AI tools and use them to overcome writer's block, without having to understand the underlying algorithms.

Obviously, ChatGPT's handling of the Chinese language still has room for improvement.

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