THE UNIVERSITY OF IOWA

Scientific Editing and Research Communication Core

Let's Chat about ChatGPT

By now, you've probably heard about ChatGPT, Google Bard or other large language models (LLMs). These are designed to emulate natural human conversation to produce all manner of written texts. ChatGPT in particular, created by OpenAI, has recently inspired hot debate about the potential value and dangers of LLMs for science and science writing. Here we provide a brief introduction to how ChatGPT works, its limitations, and how useful it might be for various types of writing projects.

What is ChatGPT and how does it work?

How ChatGPT emulates human language is aptly described in a blog by the mathematician Stephen Wolfram: "… what ChatGPT is always fundamentally trying to do is to produce a 'reasonable continuation' of whatever text it's got so far, where, by 'reasonable,' we mean 'what one might expect someone to write after seeing what people have written on billions of webpages.'" Given incomplete text, ChatGPT calculates statistically what the next likely word should be. ChatGPT was trained to do this using a massive database of text uploaded to the Internet. Thus, when ChatGPT is writing what reads to us as an intelligent, coherent essay, it creates the whole body of text literally by repeating, over and over, the same operation: "given the text so far, what should the next word be?"

One problem with the strategy of using "the next likely word" is that the resulting text typically sounds flat. To avoid this, ChatGPT incorporates an element of randomness, so that it does not always use the highest ranked "next word" to continue a given phrase or sentence. One way that ChatGPT incorporates randomness is through changing the setting of something called a temperature parameter; setting this to a higher value flattens the probability distribution that guides what the next word should be, creating more diverse outputs. Because of this purposeful introduction of randomness, ChatGPT generally produces a different output every time it responds to the same prompt.

By using certain principles to craft your prompts for ChatGPT, you can enhance your chances of receiving useful output.

What are ChatGPT's limitations?

- According to OpenAI, GPT-4, the architecture underlying ChatGPT, "generally lacks knowledge of events that have occurred after the vast majority of its data cuts off (September 2021), and does not learn from its experience."
- OpenAI is not transparent about what specific text sources ChatGPT is trained on, making it impossible to know if/how ChatGPT is biased.
- ChatGPT could echo untruths from the Internet, and worse, can hallucinate, i.e., it can make up facts about real people and places and provide incorrect or made-up supporting references.
- ChatGPT was designed to model natural human language, but not rigorous scientific or logical thinking. Although it has some ethical training, ChatGPT has not been trained on scientific or clinical best practices.
- AI experts have raised concerns that it may not be possible to adequately protect personal or private information inputted as prompts into ChatGPT.

What writing tasks does ChatGPT do well (or not)?

- **For manuscript writing:** ChatGPT and other LLMs can be helpful in brainstorming while writing a paper. For example, given an abstract or summary of your manuscript, ChatGPT can suggest possible titles. Likewise, to avoid self-plagiarism, an author can ask ChatGPT to rewrite their own (and ethically, only their own) prior published passage, or to substitute synonyms for verbs, etc. The output could serve as a useful *rough first draft.* However, unless active steps are taken to prevent sharing, all input (i.e., prompts) could potentially become part of the ChatGPT training set. Instructions are available for how to prevent your ChatGPT history from being used for training, but how effective these strategies are remains to be determined. Check the journal you are planning to submit to for their policy on using LLMs to help write your manuscript. For example, journals like *Science* have banned the use of ChatGPT; others, like *Nature* or *JAMA*, require an acknowledgement of the role of the AI tool
- **For literature searches:** Use of ChatGPT is problematic because of the limitations listed earlier, especially the propensity for hallucination.
- **For grant writing:** Use of ChatGPT as a tool is problematic given its aforementioned limitations. For example, the use of ChatGPT to briefly summarize the key prior experiments of a field could be marred by inaccuracies and fabrications. Other ChatGPT output, such as critiques of rigor and reproducibility or drafts of Specific Aims pages, could be too generic to be useful.
- **For protocol searches:** ChatGPT might seem like a useful tool for finding lab protocols, but it is not. It can provide inappropriate protocols and bad or nonsensical advice on best practices. It might also inadequately reference its sources, which would make it impossible to determine whether content was illegally scraped from copyrighted material, and thus it could violate transparency

Upcoming Opportunities

Have a question about writing grants or research articles? Email us your question and we'll answer it in a future newsletter.

NSF Virtual Grants Conference
June 5–8, 2023
Join the National Science Foundation for the Spring 2023 NSF Virtual Grants Conference. Just like the in-person grants conferences, the NSF Virtual Grants Conference is a must, especially for new faculty, researchers and administrators. Highlights include: new programs and initiatives, proposal preparation, NSF's merit review process, NSF directorate sessions, award management topics, conflict of interest policies, and NSF systems updates. This conference is designed to give new faculty, researchers, and administrators key insights into a wide range of current issues at NSF. NSF staff will provide up-to-date information about policies and procedures, specific funding opportunities and answer attendee questions. Register for this conference.

BIO-wide Virtual Office Hours on Broader Impacts
June 7, 2023, from 2:00pm–3pm ET
Join NSF's Directorate for Biological Sciences (BIO) for a virtual office hour on broader impacts. BIO Program Directors and staff will be joined by special guest Susan Renoe, PhD, Associate Vice Chancellor at the University of Missouri and Executive Director of the NSF-funded Center for Advancing Research Impact in Society (OIA-1810732). Dr. Renoe will discuss how to make your Broader Impacts plans effective and provide some helpful resources to use when thinking about the broader impacts of your research. Register for this session.

Maximizing Pivot to Find Funding and Collaborators
Do you want to maximize your time spent searching for funding opportunities or potential project collaborators? Join us to learn how Pivot can save you time and effort in identifying the right funding opportunities for your research lines as well as identifying collaborators with the relevant expertise. June 27 from 10am-11am. Register here. July 20 from 2pm-3pm. Register here.

Write Winning Grant Proposals - Phase I Seminar
October 26, 8:30 am
The Research Development Office in the Office of the Vice President for Research is pleased to partner with Dr. John Robertson from Grant Writer's Seminars & Workshops (GWSW) to conduct the Write Winning Grant Proposals seminar. Find more information and register.

standards of publishers and funders.

- **For basic proofreading:** AI tools like ChatGPT may be useful for correcting basic errors and thus could improve equity in science by eliminating disadvantages related to language skills. Again, you should first ensure the information used as input will remain private.
- **For assistance writing medical records:** Currently, feeding protected health information for a patient into ChatGPT would not be HIPAA compliant. Also, some practitioners worry that in their current forms, ChatGPT and its ilk could lead to a lower standard of care by generating medical records lacking all the necessary specific details of patient history and presentation needed for optimal care.

A note about copying and pasting the text output from ChatGPT: When asked about this, ChatGPT assured us "There is no unseen or hidden information included in the copied text.…It does not include any underlying code, metadata, or hidden information." Nevertheless, it would probably be safer to paste ChatGPT output using the Word option, "Keep text only," and then reformat it.

A note about copyright: The U.S Copyright Office issued a guidance on AI that does not allow AI-generated material to be included in applications for copyright protection, except in cases where "sufficient human authorship" can be demonstrated. Thus, images directly generated by AI programs like Midjourney or Open-AI's DALL-E are not protected by copyright.

– Mike Rebagliati and the SERCC Team

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