Science in the Era of ChatGPT, Large Language Models and AI: Challenges for Research Ethics Review and How to Respond

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Abstract

Large language models of artificial intelligence (AI) such as ChatGPT find remarkable but controversial applicability in science and research. This paper reviews epistemological challenges, ethical and integrity risks in science conduct. This is with the aim to lay new timely foundations for a high-quality research ethics review in the era of AI. The role of AI language models as a research instrument and subject is scrutinized along with ethical implications for scientists, participants and reviewers. Ten recommendations shape a response for a more responsible research conduct with AI language models.

1 Introduction

Since the release of popular large language models (LLMs) such as ChatGPT, the transformative impact of artificial intelligence (AI) on the broader society is unprecedented. This is particularly alarming for science and its conquest of truth. Conversational AI and its language models set new ethical dilemmas for knowledge, epistemology and research practice. From authorship, to misinformation, biases, fairness and safety of interactions with human subjects, research ethics boards need to adapt in this new era to protect research integrity and set high-quality ethical standards of research conduct. This paper focuses on reviewing these challenges with the aim to lay foundations for a timely and effective response.

ChatGPT is an AI chatbot released in November 2022 by OpenAI. It is a Generative Pre-trained Transformer (GPT), a type of artificial deep neural network with a number of parameters in the order of billions. It is designed to process sequential input data, i.e. natural language, without labeling (self-supervised learning) but with remarkable capabilities for parallelization that

^{1.} Noam Chomsky et al., "The false promise of ChatGPT," New York Times, 2023, https://www.nytimes.com/2023/03/08/opinion/noam-chomsky-chatgpt-ai.html.

^{2.} Eva AM van Dis et al., "ChatGPT: five priorities for research," Nature 614, no. 7947 (2023): 224–226.

significantly reduce training time. The model is further enhanced by a combination of supervised and reinforcement learning based on past conversations as well as human feedback to fine-tune the model and its responses.³ Other corporations follow with similar chatbots such as the one of Bard by Google.

ChatGPT demonstrates powerful and versatile capabilities that are relevant for science and research. From writing and debugging software code to writing, translating and summarizing text, the quality of its output becomes indistinguishable from humans, while generating complex responses to prompts in a few seconds. Despite this success, AI language models suffer from hallucinations, an effect of producing plausible-sounding responses, which are nevertheless incorrect, inaccurate or even nonsensical. Disclaimers of ChatGPT state the following: "May occasionally generate incorrect information", "May occasionally produce harmful instructions or biased content", "Our goal is to get external feedback in order to improve our systems and make them safer", "While we have safeguards in place, the system may occasionally generate incorrect or misleading information and produce offensive or biased content. It is not intended to give advice", "Conversations may be reviewed by our AI trainers to improve our systems.", "Please don't share any sensitive information in your conversations" and "Limited knowledge of world and events after 2021".

Each of these disclaimers reveal alerting implications of using AI language models in science. They oppose core values to support research integrity such as the concordat of the UK Research Integrity Office (UKRIO):⁴ (i) honesty in all aspects of research, (ii) rigor in line with disciplinary standards and norms, (iii) transparency and open communication, (iv) care and respect for all participants, subjects, users and beneficiaries of research and (v) accountability to create positive research environments and take action if standards fall short.

AI language models also set foundational epistemological challenges addressing Karl Popper's seminal work on philosophy of science.⁵ Can AI language models assist us to make scientific statements that are falsifiable or are they rather preventing us from doing so within their opaque nature? Are we addressing reality by relying our scientific inquiry on them and which reality is this? Do over-optimized AI language models subject to Goodhart's law manifest irrefutable truth? And if so do these models constitute the wrong view of science that betrays itself in the craving to be right?

This paper dissects these questions with a focus on the research ethics review, although the discussion finds relevance to other facets of science such as education. To dissect the implications on science, the role of AI language models is distinguished as a research instrument and research subject when addressing a research hypothesis or questions related to AI language models or not related. Moreover, the ethical challenges of digital assistance to scientists, human research subjects and reviewers of research ethics by AI language models is assessed. This scrutiny yields ten recommendations of actions to preserve and set new quality standards for research ethics and integrity as a response to the

^{3.} Nisan Stiennon et al., "Learning to summarize with human feedback," Advances in Neural Information Processing Systems 33 (2020): 3008–3021; Leo Gao, John Schulman, and Jacob Hilton, "Scaling Laws for Reward Model Overoptimization," arXiv preprint arXiv:2210.10760, 2022

^{4. &}quot;The concordat to support research integrity," 2020, https://www.universitiesuk.ac.uk/sites/default/files/field/downloads/2021-08/Updated%20FINAL-the-concordat-to-support-research-integrity.pdf.

^{5.} Karl R Popper, "The logic of scientific discovery.," 1959,

2 The Role of AI Language Models in Research Design

Within a research design serving a research hypothesis or question, AI large language models can be involved as a research instrument or as a research subject, along with human subjects. This section distinguishes and discusses challenges and risks that may arise in research ethics review applications. Figure 1 illustrates where language models can emerge in a research design.

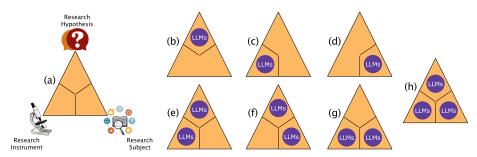


Figure 1: AI large language models (LLMs) can be present in multiple stages of a research design within a research ethics application. Here we depict all combinations: (a) No AI language models are involved. (b) AI language models can be the motivation behind formulating a research hypothesis or question. (c) They can also be used as a research instrument to acquire knowledge. (d) They can also be the research subject itself, when interacting with human research subjects or when acting independently. (e)-(h) AI language models may be involved in multiple stages of the research design. In this case, it becomes imperative to distinguish their role at each phase to dissect research integrity and ethical dilemmas that may not be apparent anymore. Note in (c), (d), and (h) in which AI language models do not motivate a research hypothesis or question but they are involved as a research instrument or subject, research integrity and ethical risks are likely to arise.

2.1 AI language model as a research instrument

ChatGPT is documented as an emerging research instrument capable of writing manuscripts for publication, often controversially featured as a co-author,⁶ writing software code⁷ and collecting data via queries.⁸ Such tools are expected

^{6.} Siobhan O'Connor et al., "Open artificial intelligence platforms in nursing education: Tools for academic progress or abuse?," Nurse Education in Practice 66 (2022): 103537–103537; ChatGPT Generative Pre-trained Transformer and Alex Zhavoronkov, "Rapamycin in the context of Pascal's Wager: generative pre-trained transformer perspective," Oncoscience 9 (2022): 82; H Holden Thorp, ChatGPT is fun, but not an author, 6630, 2023, 313–313; Holly Else, "Abstracts written by ChatGPT fool scientists," Nature 613, no. 7944 (2023): 423–423.

^{7.} Yogesh K Dwivedi et al., ""So what if ChatGPT wrote it?" Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy," *International Journal of Information Management* 71 (2023): 102642.

^{8.} Dwivedi et al.

to come with capabilities for hypotheses generation in the future, including the design of experiments.⁹ Each of these instrumentation comes with different opportunities and challenges, including ethical ones.

During the design stage of research, including research ethics applications, there may be minimal support of AI on writing. However, the motivation of research, including the literature review, ¹⁰ generation of hypotheses, research questions as well as identifying ethical dilemmas may be a result of interactions with conversational AI. Using the large capacity of conversational AI for knowledge summarization, these interactions can be systematized based on the Socratic method to foster intuition, creativity, imagination and potential novelty. 11 However, often creativity cannot be balanced with constraint. 12 At this stage, interactions with conversational AI require caution, running the risk of emulating or reinforcing a synergetic Dunning-Kruger effect: 13 conversational AI may rely on limited (or wrong) knowledge, which while presented as plausible to humans with similar limited knowledge, it may induce confirmation biases and diminish critical thinking. The mutual limitations of knowledge can be significantly underestimated under such condition. While research design choices may emerge from such interactions with conversational AI, a factual justification, a rigorous auditing process and moral judgments of these choices remain entirely under human premises. Finding reliable sources, revealing data sources, accurate contextualization of facts and moral framing are not attainable at this moment as they require both cognitive capabilities, accountability and transparency that current AI language models lack of. Whether existing ethics review processes are able to distinguish the risk level of research designs produced with the support of conversational AI as well as the mitigation actions is an open question.

During research conduct, integrity and ethical dilemmas may arise when using the direct output of conversational AI (knowledge acquisition) to confirm or refute a hypothesis, especially when this hypothesis is not about the AI system itself (see Figure 1c, 1d and 1h). This output is in principle unreliable as it may contain incorrect or inaccurate information. For instance, correct referencing may approach just 6%. Moreover, AI language models tend to produce plausible content rather than content to be assessed as falsifiable, raising

^{9.} Eva AM van Dis et al., "ChatGPT: five priorities for research," *Nature* 614, no. 7947 (2023): 224–226; Yogesh K Dwivedi et al., ""So what if ChatGPT wrote it?" Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy," *International Journal of Information Management* 71 (2023): 102642

^{10.} Bastian Burger, Dominik K Kanbach, and Sascha Kraus, "The role of narcissism in entrepreneurial activity: a systematic literature review," *Journal of Enterprising Communities: People and Places in the Global Economy*, no. ahead-of-print (2023).

^{11.} Edward Y Chang, "Prompting large language models with the socratic method," in 2023 IEEE 13th Annual Computing and Communication Workshop and Conference (CCWC) (IEEE, 2023), 0351–0360.

^{12.} Noam Chomsky et al., "The false promise of ChatGPT," New York Times, 2023, https://www.nytimes.com/2023/03/08/opinion/noam-chomsky-chatgpt-ai.html.

^{13.} Bor Gregorcic and Ann-Marie Pendrill, "ChatGPT and the frustrated Socrates," *Physics Education* 58, no. 3 (2023): 035021.

^{14.} P Davis, "Did ChatGPT just lie to me," *The Scholarly Kitchen*, 2023, https://scholarlykitchen.sspnet.org/2023/01/13/did-chatgpt-just-lie-to-me/.

^{15.} Alexandre Blanco-Gonzalez et al., "The Role of AI in Drug Discovery: Challenges, Opportunities, and Strategies," arXiv preprint arXiv:2212.08104, 2022,

epistemological challenges. ¹⁶ The reliability of AI language models as effective proxies for specific human populations is subject of ongoing research. ¹⁷

Even if the output of AI language models is correct and accurate, it may not explain how such output is generated. For instance, there is often uncertainty to distinguish between lack of relevant data in the training set and failure to distill these data to credible information. These models are usually black boxes with very low capacity to explain or interpret them. So far, this explainability is hard to assess anyhow for systems such as ChatGPT and Bard that are closed and intransparent. This scenario may resemble an instrument collecting data exposed though to an unknown source of noise. Using instruments that have not passed quality assurance criteria may introduce various risks for users and work performed with such instruments and this is not different for AI language models. Standardized quality metrics are likely to arise for reporting to future research ethics applications, for instance, the 'algorithmic fidelity' that measures how well a language model can emulate response distributions from a wide spectrum of human groups. 19

2.2 AI as a research subject

The actual release of ChatGPT can be seen itself as a subject of research conducted by OpenAI with the aim to acquire user feedback that will improve AI language models. The initial interest lies on their actual capabilities to generate text and meaningful responses to user prompts. It also includes a discourse around its capabilities to perform calculations, write working code and jailbreaking via prompts that bypass the filters of its responses.

While these initial investigations are mainly experimental and anecdotal, a rise of empirical research on ChatGPT is ongoing.²⁰ However, this outbreak of empirical research is to a certain extent a byproduct of releasing a closed AI blackbox, with low capacity for explainability let alone when the broader public does not have access to the model itself or the exact data with which it is trained.

OpenAI and other corporations may benefit from such research as a (free) crowd-sourcing feedback to calibrate their products, without though sharing responsibility for doing so. Nonetheless, this may not be the original aims and intentions of scientists conducting such research. Such misalignment comes with ethical considerations on the value of this research and requires a critical stand by researchers and research ethics reviewers. While the methods of research on human subjects are well established (e.g. statistical methods, sociology, psychology, clinical research), the methods on AI subjects remain of different nature, pertinent to engineering and computer science. As human and AI subjects become more interactive, pervasive, integrated and indistinguishable, research

^{16.} Karl R Popper, "The logic of scientific discovery.," 1959,

^{17.} Lisa P. Argyle et al., "Out of One, Many: Using Language Models to Simulate Human Samples," *Political Analysis*, 2023, 1–15, https://doi.org/10.1017/pan.2023.2.

^{18.} Eva AM van Dis et al., "ChatGPT: five priorities for research," Nature 614, no. 7947 (2023): 224–226.

^{19.} Lisa P. Argyle et al., "Out of One, Many: Using Language Models to Simulate Human Samples," *Political Analysis*, 2023, 1–15, https://doi.org/10.1017/pan.2023.2.

^{20.} Yogesh K Dwivedi et al., ""So what if ChatGPT wrote it?" Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy," *International Journal of Information Management* 71 (2023): 102642.

ethics reviews need to account for (and expect) inter-disciplinary mixed-mode research methods.

3 Digital Assistance by AI Language Models

AI language models can provide assistance to scientists, participants in human experimentation as well as to reviewers of research ethics applications. This section assesses ethical challenges pertinent to these beneficiaries.

3.1 AI-assisted scientist

As introduced in Section 2, the support of AI language models to scientists for literature review, writing papers, code, collecting data and performing experiments involves several integrity and ethical challenges. One question that may arise is how AI language models can contribute to the making of future scientists. Can they be part of the education of PhD students or will they result in deskilling, especially when students are not familiar with academic norms?²¹ Will such models be able to provide any level of self-supervision capability? The feasibility of research designs, success prediction of research proposals and reviewing manuscripts at early stages and before submission to journals are some examples in which linguistics, epistemology and theory of knowledge set limits that AI language models are hard to overcome.²²

3.2 AI-assisted participant

Studying human research subjects assisted by AI language models requires a highly interdisciplinary perspective to dissect the ethical challenges and risks that may be involved. Such studies may aim to address the human subjects (i.e. social science), the AI language models when interacting with humans (i.e. computer science, decision-support systems), or both (e.g. human-machine intelligence). Design choices in AI systems for digital assistance to humans have direct ethical implications.

For instance, access to personal data for training AI models, centralized processing of large-scale sensitive information by untrustworthy parties and intransparent algorithms that reinforce biases, discrimination and informational filter bubbles pose significant risks. These include loss of personal freedoms and autonomy by manipulative algorithmic nudging, which participants may experience directly under research conduct, as well as broader implications in society related to environment, health and democracy.²³ The use of emerging open

^{21.} Yogesh K Dwivedi et al., ""So what if ChatGPT wrote it?" Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy," *International Journal of Information Management* 71 (2023): 102642.

^{22.} Noam Chomsky et al., "The false promise of ChatGPT," New York Times, 2023, https://www.nytimes.com/2023/03/08/opinion/noam-chomsky-chatgpt-ai.html.

^{23.} Evangelos Pournaras et al., "Collective Privacy Recovery: Data-sharing Coordination via Decentralized Artificial Intelligence," arXiv preprint arXiv:2301.05995, 2023, Thomas Asikis et al., "How value-sensitive design can empower sustainable consumption," Royal Society open science 8, no. 1 (2021): 201418; Dirk Helbing et al., "Ethics of smart cities: Towards value-sensitive design and co-evolving city life," Sustainability 13, no. 20 (2021): 11162; Dirk Helbing et al., "Democracy by Design: Perspectives for digitally assisted, participatory upgrades of society," Journal of Computational Science, 2023, 102061.

language models provides higher transparency to address some of these challenges.²⁴ Privacy-preserving interactions with AI language models, comparable to browsing with DuckDuckGo, are required.

Participants need to be informed about these risks when participating in such studies. For instance, information consent needs to account for any sensitive information shared during interactions with ChatGPT. Researchers do not have full control of the data collected in the background by OpenAI. As a result, participants need to be informed about the terms of use of AI language models. Moreover, responses by AI language models require moderation by researchers if they are likely to cause any harm to participants or special groups. Research ethics applications need to reflect and mitigate such cases.

3.3 AI-assisted reviewer

The support of AI language models to research ethics reviewers is a highly complex matter that perplexes both ethical matters within research communities as well as moral matters of individual reviewers. People do not share the same judgments between the ethical choices of a human or a machine.²⁵

AI language models show limited capabilities for ethical positioning, let alone moral positioning, possessing an apathy and indifference to implications of ethical choices. ²⁶ They can endorse both ethical and unethical choices based on correct and incorrect information. ²⁷

On the other hand, AI models can be used to effectively detect plagiarism or to perform pattern matching tasks that do not involve complex explanations or analysis of consequences. Moreover, they can assist reviewers, whose research background may be in a different discipline than the one of the proposed research. Summarizing necessary background knowledge and providing summaries in layman's terms can benefit research ethics reviewers as long as they remain critical on the generated output of AI language models.

As a result, AI language models are far from replacing reviewers in distilling ethical and moral implications of a research design, nevertheless, they can still play a role in the reviewing process by automating processes for pattern matching or making necessary background knowledge more accessible to reviewers, who may lack of .

4 Ten Recommendations for Research Ethics Committees

This section introduces ten recommendations for research ethics committees. They distill the challenges and responses to AI language models involved in research ethics applications. They significantly expand on other earlier recommendations such as the one of World Association of Medical Editors (WAME)

^{24.} Dylan Patel and Afzal Ahmad, "We Have No Moat, And Neither Does OpenAI," Semi-analysis, 2023, https://www.semianalysis.com/p/google-we-have-no-moat-and-neither; Teven Le Scao et al., "Bloom: A 176b-parameter open-access multilingual language model," $arXiv\ preprint\ arXiv:2211.05100$, 2022,

^{25.} César A Hidalgo et al., How humans judge machines (MIT Press, 2021).

^{26.} Noam Chomsky et al., "The false promise of ChatGPT," New York Times, 2023, https://www.nytimes.com/2023/03/08/opinion/noam-chomsky-chatgpt-ai.html.

^{27.} Chomsky et al.

that mainly address authorship, transparency and responsibility.²⁸ The ten recommendations are summarized as follows:

- 1. Humans should always remain accountable for every scientific practice.
- 2. An interdisciplinary panel of reviewers should be employed to assess research ethics applications with elements on AI language models.
- 3. The use of AI language models, their version, prompts and responses need to be documented and reported in any phase of the planned research. As a response, ethics review should detect potential inaccuracies, biases and inappropriate referencing. Mitigation by encouraging and promoting open language models can improve accountability and transparency.
- 4. Research ethics applications that aim to address research hypotheses and questions out of the scope of AI language models, which though do involve AI language models as a research instrument or subject, are likely to involve research integrity and ethics risks.
- 5. Ethics review applications require new criteria and practices to distinguish low and high integrity risks in research designs produced with the support of AI language models. Determining appropriate mitigation actions to account for different risk levels is required.
- Researchers who engage with AI in their research should report their countermeasures against inaccuracies, biases and plagiarism. Ethical review applications need to cover these risks.
- The motivation and aim of research on AI language models should come with merit and go beyond testing of prompts lacking a rigorous scientific inquiry.
- 8. Auditing protocols are required for each input to closed proprietary AI models as a way to prevent sharing sensitive personal or proprietary information of researchers or participants.
- 9. Preventing participants from sharing sensitive information with AI language models and information consent to relevant terms of use of such third-party tools is required. Any output of AI language models that may harm participants or is sensitive to special groups requires moderation by researchers.
- 10. Communities on research ethics and regulatory bodies require to maintain an agreement on AI language models that can be used or should not be used in research. For instance, models that are obsolete, inaccurate, highly biased and violate value of science conduct shall be excluded or replaced.

These recommendations should be used as an open and evolving agenda rather than a final list of actions. The current landscape of AI language models and research ethics remains multi-faceted, rapidly changing and complex, and timely adjustments are needed as a response.

^{28.} Chris Zielinski et al., "Chatbots, ChatGPT, and Scholarly Manuscripts-WAME Recommendations on ChatGPT and Chatbots in Relation to Scholarly Publications," *Afro-Egyptian Journal of Infectious and Endemic Diseases* 13, no. 1 (2023): 75–79.

5 Conclusion and Future Work

To conclude, the challenges and risks of AI language models for science conduct are highly multi-faceted and complex. They are not yet fully understood as developments are fast with significant impact and unknown implications. Research ethics boards have a moral duty to follow these developments, co-design necessary safeguards and provide a research ethics review that minimizes ethical risks. For this, a deep interdisciplinary understanding of the role that AI language models can play in all stages of research conduct is imperative. This can dissect ethical challenges involved in the digital assistance of scientists, research participants and reviewers. The ten recommendations introduced in this paper set an agenda for a dialogue and actions for more responsible science in the era of AI.

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