AI did not write this manuscript, or did it? Can we trick the AI text detector into generated texts? The potential future of ChatGPT and AI in Sports & Exercise Medicine manuscript generation


INTRODUCTION

Researching a topic and generating an academic paper is a nuanced skill. It can take months or years to produce and publish one, if it is ever published at all. What if there were a way to make this happen instantly? Artificial intelligence (AI) may hold a flame to quickly analyse a research topic and generate an academic paper. There are many forms of AI; this editorial discusses natural language model-based AI, such as ChatGPT, and their potential ability to generate academic papers.

Natural language model-based AI, in particular ChatGPT, is generating new content and a lot of controversies. This AI software is innovative. It generates, de novo, content that has a natural conversational flow. It can quickly answer questions and write poems, fan fiction and children’s books.1 ChatGPT has even passed the United States Medical Licensing Examination theory section with no additional training and/or years of studying medicine.2

Language-based AI has already entered the scientific community. Nature reported that four manuscripts in preprint credit ChatGPT as an author.3 Also, an article reported that AI had been used to generate an academic paper.4

In this editorial, we discuss the pros and cons of AI for manuscript generation in sports and exercise medicine (SEM), generate an academic paper using AI and bypass AI-generation detection, and discuss potential concerns regarding natural language model-based AI. We aim to get insights on how AI, in particular ChatGPT and similar language model-based AI, will impact the future of manuscript generation in SEM. To achieve such purpose, we ought to consider what is an academic paper, whether AI should write academic papers, what the issues are, what our stance should be on AI-generated texts and how we deal with them.

WHAT IS AN ACADEMIC PAPER, AND IS AI CAPABLE OF WRITING ONE?

An academic paper has a thesis and aims to persuade readers of its viewpoint using the best available evidence. Before this paper can be created, extensive research must have an advanced and balanced understanding of the topic. Research is not merely collecting and presenting data, but applying investigative and critical thinking to generate quality, interesting and original work that improves the field.5 Professionals generally write papers, and all concepts introduced are referenced accurately.

We decided to test AI’s ability to generate two academic papers, essay 1 (online supplemental appendix 1) and essay 2 (online supplemental appendix 5). For essay 1, the request ‘Can you please write a paper about the pros and cons of using AI to write scientific manuscripts? Include Harvard referencing’ was entered into ChatGPT to generate essay 1. For essay 2, the request was: ‘Can you please write a short essay on the pros and cons of using AI in sports medicine? Include Harvard referencing’ (online supplemental appendix 5).

Essay 1 took a mere 47s to be generated on 24 December 2022. Essay 2 was requested on 24 January 2023, and it was generated in 1 min and 36s. In comparison, the current editorial was started on 24 December 2022, 001568).
and our final proof was submitted on 7 February 2023. This was a total of 45 days with a team of experienced authors.

From this experiment of seeing whether AI is capable of writing a quality academic paper, there are issues regarding whether the produced content is originally interesting, whether the paper shows an advanced and balanced understanding of the topic, and whether it has used critical thinking to generate original thought or if it is simply a summary of knowledge on a topic. The bibliography generated for the two generated essays (online supplemental appendix 1 and 5) was inaccurate. As such, there were no matching authors and publication titles. Due to the falsification of references, such manuscripts would likely be desk rejected or rejected by diligent peer-reviewers, although errata in many journals correcting references suggests diligence is not universal. Regardless of whether or not it is capable of generating a quality manuscript, natural language-based AI models such as ChatGPT are nowadays considered tools worth watching closely.

**WHAT ARE THE ISSUES?**

**Ethics and integrity concerns**

An obvious and significant concern is plagiarism of original content. Although not ChatGPT, AI journalism has been known to commit extensive plagiarism. Other ethical concerns are also raised. For instance, should there be a threshold for how much AI-generated content is acceptable? Nevertheless, the personification of AI-based tools such as ChatGPT may be an objectionable and debatable topic for a wider audience.

Also, is it ethical to have AI generate scientific papers? Multiple companies advertise that they will build an academic paper using AI. These companies can be found online via a quick Google Search. It is important to consider and question whether it is in the interest of our SEM researchers to have novel and interesting theses in mind to advance SEM and improve human health outcomes rather than using AI to generate such ideas.

**Equity concerns**

Currently, ChatGPT is free of cost by using ChatGPT Research Preview. One major problem that one might foresee is that ChatGPT and other similar AI might turn into ‘prohibitively’ expensive subscription-based tools based on their publicity. This might cause an imbalance in equitable resource distribution to researchers in SEM and other fields.

**Accuracy concerns**

In addition to extensive plagiarism, writing errors were significant among the AI journalism mentioned above, and in the references of our AI-generated academic papers (online supplemental appendix 1 and 5).

Furthermore, there are concerns with the completeness of the information. Someone asked ChatGPT to instruct them on how to build a personal computer (PC).

![Figure 1](image)

**Figure 1** ChatGPT generated essay 1 and 2. Scored on ‘GPT-2 Output Detector’ AI detection, paraphrasing and post-paraphrasing AI. AI, artificial intelligence.

The information generated by ChatGPT missed critical steps that may have rendered this PC useless.7

**Potentially flawed AI detection**

It has been found that it can be difficult to discern the difference between AI-generated and original abstracts. There are currently a few tools, including GPTZero, GPT-2 Output Detector and AI Detector, to detect whether a current AI language model generated a text. The tools represent whether it believes the paper is ‘Real’ (human-generated) or ‘Fake’ (AI generated), with its confidence, reported as a percentage. It is outside the scope of this editorial to explain the intricacies of this Real/Fake language model calculation.

One concerning point for AI detection is that the authors have discovered that by using additional paraphrasing AI in essay 1 (online supplemental appendix 1) and essay 2 (online supplemental appendix 5) (and producing rewritten manuscripts (online supplemental appendix 3, 7)), the ‘Real’ percentage using the GPT-2 Output Detector on essay 1 (online supplemental appendix 1) went from 0.02% (online supplemental appendix 2) to 99.52% (online supplemental appendix 4), and from 61.96% (online supplemental appendix 6) to 99.98% (online supplemental appendix 8) on essay 2 (figure 1).

New novel protection methods may need to be created and implemented for AI detection. No other detectors for AI language models were tested; however, we have discovered that the GPT-2 Output Detector alone cannot seem to be relied on solely for AI detection.

These ethical, equity and detection concerns are potential threats to the integrity of scientific literature if AI-generated manuscripts were to be accepted without being thoroughly scrutinised.

**WHAT TOOLS DO WE HAVE TO PREVENT THIS IN THE FUTURE? WHAT CAN EDITORIAL BOARDS AND PUBLISHERS DO?**

As academics and those on the editorial boards, we are aware of several tools to flag potential plagiarism, such as
CONCLUSIONS

Natural language model-based AIs, such as ChatGPT, are tools to watch for generating natural conversational text for various manuscript contents in SEM. However, ethical, equity, accuracy and detection concerns associated with their use are potential threats to scientific integrity. Although these papers would be rejected at BMJ Open Sport & Exercise Medicine (BOSEM) and any BMJ journal due to the falsified references alone, we still need to be aware of this threat to scientific integrity and protect our intellectual property in the field of SEM. BOSEM, scientific publishing companies and academic organisations need to be aware of this threat and may need to implement novel protection methods in the future.

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REFERENCES

1 Nolan B. This man used AI to write and illustrate a children’s book in one weekend. he wasn’t prepared for the backlash. [Internet]. business insider. 2023. Available: https://www.businessinsider.com/chatgpt-midjourney-ai-write-illustrate-childrens-book-one-weekend-alice-2023-1utm_campaign=sf-insider-main&utm_medium=social&utm_source=facebook.com&fbclid=IwAR2kBmWWv0c5fBij16l61kVA2FhXUrPSCTQCiQrFjB2itmNU4j4lI4uRmG4&mbid=txt-zxc2z
3 Stokel-Walker C. ChatGPT listed as author on research papers: many scientists disapprove. Nature 2023;613:620–1. 10.1038/d41586-023-00107-z Available: https://www.nature.com/articles/d41586-023-00107-z; text="18%20January%202023", ChatGPT%20listed%20as%20author%20on%20research%20papers%20in%20one%20weekend-alice-2023-1utm_campaign=sf-insider-main&utm_medium=social&utm_source=facebook.com&fbclid=IwAR2kBmWWv0c5fBij16l61kVA2FhXUrPSCTQCiQrFjB2itmNU4j4lI4uRmG4&mbid=txt-zxc2z
4 Getahun H. After an AI bot wrote a scientific paper on itself, the researcher behind the experiment says she hopes she didn’t open a “pandora’s box” [Internet], insider. insider. 2022. Available: https://www.insider.com/artificial-intelligence-bot-wrote-scientific-paper-on-itself-2-hours-2022-7utm_source=facebook.com&fbclid=IwAR2kBmWWv0c5fBij16l61kVA2FhXUrPSCTQCiQrFjB2itmNU4j4lI4uRmG4&mbid=txt-zxc2z


6 Christian J. CNET’s AI journalist appears to have committed extensive plagiarism [Internet]. Futurism. 2023. Available: https://futurism.com/cnet-ai-plagiarism


12 Tools such as ChatGPT threaten transparent science; here are our ground rules for their use [Internet]. Nature News. Nature Publishing Group. 2023. Available: https://www.nature.com/articles/d41586-023-00191-1

Can you please write a paper about the pros and cons of using AI to write scientific manuscripts? Include Harvard referencing.

Response

AI has the potential to revolutionise many aspects of our lives, including the way we write scientific manuscripts. There are both pros and cons to using AI to write these manuscripts, and it is important to consider both sides of the argument before making a decision.

One of the main pros of using AI to write scientific manuscripts is that it can save time and effort. AI algorithms can analyse and process large amounts of data quickly and accurately, allowing authors to focus on other aspects of their research (Bohannon, 2016). This can be particularly useful for scientific manuscripts, which often require extensive data analysis and interpretation.

Another pro of using AI to write scientific manuscripts is that it can improve the quality of the manuscript. AI algorithms can identify errors and inconsistencies in the data, as well as suggest alternative ways of presenting the information (Bohannon, 2016). This can help authors produce more accurate and comprehensive manuscripts.

However, there are also several cons to consider when using AI to write scientific manuscripts. One concern is that AI algorithms may not fully understand the nuances and complexities of the research, leading to errors or oversimplifications in the manuscript (Bohannon, 2016). This can be particularly problematic for scientific manuscripts, which often require a deep understanding of the subject matter.

Another concern is that using AI to write scientific manuscripts may lead to the loss of human creativity and insight. While AI algorithms can analyse data and suggest alternative ways of presenting it, they may not be able to come up with new and innovative ideas (Bohannon, 2016). This can limit the potential of the research and the impact of the manuscript.

To address these concerns, it may be helpful to consider using AI in combination with human expertise. For example, AI algorithms could be used to perform initial data analysis and suggest areas of focus, while humans could provide the final interpretation and analysis (Rose & Levinson, 2012). This approach could help to balance the strengths of both AI and human intelligence, and may be more effective in producing high-quality scientific manuscripts.
Overall, the pros and cons of using AI to write scientific manuscripts depend on the specific context and goals of the research. While AI algorithms can save time and improve the quality of the manuscript, it is important to consider the potential limitations of these tools.

References


Rose, D. S., & Levinson, W. (2012). Natural language processing for electronic health records. Yearbook of Medical Informatics, 97, 97-
APPENDIX 2 ESSAY 1 - GPT-2 OUTPUT DETECTOR DEMO 24/12/2022 (PC Website)

GPT-2 Output Detector Demo

This is an online demo of the GPT-2 output detector model based on the HuggingFace transformers implementation of RoBERTa. Enter some text in the text box; the predicted probabilities will be displayed below. The results start to get reliable after around 50 tokens.


- Rose, D. S., & Levinson, W. (2012). Natural language processing for electronic health records. Yearbook of Medical Informatics, 97, 97-
APPENDIX 3 ESSAY 1 REWRITTEN USING ADDITIONAL AI TO REDUCE DETECTION (SOFTWARE DELIBERATELY NOT NAMED TO MINIMISE REPRODUCTION)


Request

Can you please write a paper about the pros and cons of using AI to write scientific manuscripts? Include Harvard referencing.

Response

The way we write scientific articles could be one of the many facets of our life that AI has the power to revolutionise. Using AI to produce these texts has both benefits and drawbacks, so it’s crucial to weigh your options before making a choice.

Saving time and effort is one of the key benefits of employing AI to write scientific publications. AI algorithms can swiftly and accurately analyse and handle vast amounts of data, freeing authors to concentrate on other areas of their research (Bohannon, 2016). For scientific articles, which frequently involve considerable data analysis and interpretation, this can be especially helpful.

The ability to enhance the quality of the manuscript is yet another benefit of employing AI to produce scientific articles. Inconsistencies and inaccuracies in the data can be found using AI algorithms, and they can also suggest different ways to present the data (Bohannon, 2016). Authors may be able to generate more thorough and accurate manuscripts as a result.

Nevertheless, there are a number of drawbacks to take into account while utilising AI to produce scientific publications. One worry is that AI algorithms might not completely comprehend the complexities and nuances of the research, which could result in mistakes or oversimplifications in the manuscript (Bohannon, 2016). This can be particularly challenging for scientific publications, which frequently call for a thorough knowledge of the subject.

Another issue is the possibility of losing human originality and insight if AI is used to produce scientific articles. While AI algorithms are capable of analysing data and suggesting different ways to convey it, they might not be able to generate fresh, original ideas (Bohannon, 2016). This may reduce the research’s and the manuscript's impact’s potential.

It could be beneficial to think about utilising AI in conjunction with human experience to allay these worries. For instance, initial data analysis and emphasis areas could be suggested by AI algorithms, while the final interpretation and analysis could be done by people (Rose & Levinson, 2012). This strategy might make it easier to balance the benefits of both AI and human
intellect, and it might also make it more efficient at creating superior scientific papers.

The advantages and disadvantages of utilising AI to produce scientific articles mostly rely on the particular setting and objectives of the study. While using AI algorithms can speed up the writing process and boost the quality of the final product, it’s crucial to be aware of their potential drawbacks.

References


Rose, D. S., & Levinson, W. (2012). Natural language processing for electronic health records. Yearbook of Medical Informatics, 97, 97-
APPENDIX 4 ESSAY 1 REWRITTEN - GPT-2 OUTPUT DETECTOR DEMO
24/12/2022 (PC Website)

GPT-2 Output Detector Demo

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APPENDIX 5 ESSAY 2


Request

Can you please write a short essay on the pros and cons of using AI in sports medicine? Include Harvard referencing.

Response

Artificial intelligence (AI) has the potential to revolutionize the field of sports medicine. From improved diagnoses and treatment planning to real-time monitoring and analysis of athletes’ performance, the use of AI in sports medicine has many potential benefits. However, there are also potential downsides to consider.

One of the main benefits of using AI in sports medicine is increased accuracy and objectivity in diagnoses and treatment planning. AI algorithms can be trained to recognize patterns and make predictions based on large amounts of data, which can lead to more accurate diagnoses and treatment plans. This can lead to improved patient outcomes and a reduction in the number of misdiagnoses or inappropriate treatments (Bjørndal, 2019).

Another benefit of AI in sports medicine is the automation of repetitive tasks, allowing medical professionals to focus on more complex cases. For example, AI can be used to analyze large amounts of imaging data, such as X-rays or MRI scans, freeing up medical professionals to concentrate on more complex cases (Li, 2019). Additionally, predictive analytics can be used to identify athletes at risk of injury, allowing preventative measures to be taken before an injury occurs (Gao, 2018).

However, there are also potential downsides to using AI in sports medicine. One concern is the cost of implementation and maintenance. Developing and maintaining AI algorithms and systems can be expensive, and this cost may be passed on to patients (Bjørndal, 2019). Additionally, there is potential for errors in the data used to train AI algorithms, which can lead to inaccurate predictions or diagnoses (Li, 2019).

There are also ethical concerns to consider when using AI in sports medicine. Privacy is a major concern, as large amounts of personal and medical data will be collected and analyzed. Additionally, there is potential for bias in the algorithms used, particularly if the data used to train the algorithms is not representative of the population being treated (Gao, 2018).

In conclusion, the use of AI in sports medicine has the potential to revolutionize the field, leading to improved patient outcomes and more efficient care. However, there are also potential downsides to consider, such as the cost of...
implementation and maintenance, the potential for errors and bias in the data and algorithms used, and the ethical concerns related to the collection and analysis of personal and medical data. Therefore, it's important for medical professionals and researchers to weigh the pros and cons carefully before implementing AI in sports medicine.

References


APPENDIX 6 ESSAY 2 - GPT-2 OUTPUT DETECTOR 24/01/2023 (Mobile Website)

GPT-2 Output Detector Demo

This is an online demo of the GPT-2 output detector model, based on the 🤖/Transformers implementation of RoBERTa. Enter some text in the text box; the predicted probabilities will be displayed below. The results start to get reliable after around 50 tokens.

Artificial intelligence (AI) has the potential to revolutionize the field of sports medicine. From improved diagnoses and treatment planning to real-time monitoring and analysis of athletes' performance, the use of AI in sports medicine has many potential benefits. However, there are also potential downsides to consider.
APPENDIX 7 ESSAY 2 REWRITTEN USING ADDITIONAL AI TO REDUCE DETECTION (SOFTWARE DELIBERATELY NOT NAMED TO MINIMISE REPRODUCTION)


Request

Can you please write a short essay on the pros and cons of using AI in sports medicine? Include Harvard referencing.

Response

The discipline of sports medicine may undergo a transformation thanks to artificial intelligence (AI). The application of AI in sports medicine offers several potential advantages, from enhanced diagnosis and treatment planning to real-time monitoring and analysis of players' performance. However, there may be drawbacks to take into account.

Accuracy and objectivity in diagnosis and treatment planning are improved by employing AI in sports medicine, which is one of its key advantages. Large volumes of data can be used to teach AI systems to see trends and forecast outcomes, which might result in diagnoses and treatment plans that are more precise. This may result in better patient outcomes and a decrease in the amount of incorrect diagnosis or treatments (Bjørndal, 2019).

The automation of monotonous duties, which frees up medical personnel to work on more difficult patients, is another advantage of AI in sports medicine. Medical personnel may focus on more difficult situations by using AI, for instance, to evaluate vast volumes of imaging data from X-rays or MRI scans (Li, 2019). Additionally, injury-prone players may be identified using predictive analytics, allowing for the implementation of preventative measures before an injury develops (Gao, 2018).

Nevertheless, there may be drawbacks to adopting AI in sports medicine. The price of installation and upkeep is one issue. The expense of creating and maintaining AI algorithms and systems can be passed on to patients (Bjørndal, 2019). Additionally, there is a chance that the data used to train AI systems contains mistakes, which might result in wrong predictions or diagnoses (Li, 2019).

The use of AI in sports medicine raises ethical issues as well. As a result of the extensive collection and analysis of personal and medical data, privacy is a key concern. Furthermore, the algorithms might be biased, especially if the data used to train them is not representative of the community being served (Gao, 2018).
In conclusion, applying AI to sports medicine has the potential to completely transform the discipline and result in better patient outcomes and more effective treatment. The expense of installation and upkeep, the possibility of bias and inaccuracies in the data and algorithms employed, and the ethical issues surrounding the gathering and analysis of personal and medical data are all possible drawbacks to take into account. Before applying AI in sports medicine, medical practitioners and researchers should carefully consider the advantages and disadvantages.

References


APPENDIX 8 ESSAY 2 REWRITTEN - GPT-2 OUTPUT DETECTOR DEMO
24/01/2023(PC Website)

GPT-2 Output Detector Demo

This is an online demo of the GPT-2 output detector model, based on the transformer implementation of RoBERTa. Enter some text in the text box; the predicted probabilities will be displayed below. The results start to get reliable after around 50 tokens.

The discipline of sports medicine may undergo a transformation thanks to artificial intelligence (AI). The application of AI in sports medicine offers several potential advantages, from enhanced diagnosis and treatment planning to real-time monitoring and analysis of players' performance. However, there may be drawbacks to take into account.

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The automation of monotonous duties, which frees up medical personnel to work on more difficult patients, is another advantage of AI in sports medicine. Medical personnel may focus on more difficult tasks, leaving repetitive tasks to AI, which can process large amounts of data efficiently. This can lead to improved patient care and outcomes.