

## **The rise of AI chatbots in hearing health care**

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### ***Acknowledgements***

We would like to acknowledge the contribution of ChatGPT, an AI chatbot trained by OpenAI using a large language model (LLM), in providing valuable insights and guidance for this article. We experimented with prompt engineering and had conversations with ChatGPT playing the role of patient and clinician to get a first impression of what AI chatbots, such as ChatGPT, could offer and not offer.

### **Introduction**

One of the most exciting recent technological innovations has been the deployment of artificial intelligence (AI) chatbots based on large language models (LLM). AI chatbots are a type of generative AI that can generate text. Other examples of generative AI create pictures (e.g., DALL-E or Stable Diffusion; See figure 1 and 2 for examples) or music (e.g., Jukebox). In November 2022, OpenAI launched ChatGPT publicly, an AI chatbot that can engage in conversations in response to questions from the user, so-called prompts, generating responses to users' questions (i.e., prompts) that are almost indistinguishable from those of humans. The launch of ChatGPT represents a technological revolution, one that could change the face of healthcare as we know it, including hearing healthcare. ChatGPT is not an isolated example but part of a global race of who can develop the most compelling AI chatbot. Besides OpenAI, which is financed by Microsoft, other large corporations such as Meta, Google, and Tencent have launched similar proprietary products based on LLM (e.g., LaMDA).

### **AI chatbots and health care**

AI chatbots are computer programs that use natural language processing (NLP) to communicate with humans. They are trained on large collections of language (e.g., all written books and most of the internet) to predict what response is most likely to a wide range of queries. For a human user, it may appear as if the system understands the question and can provide personalized advice, recommendations, and support. In reality, chatbots have no understanding of the world around them nor of the human body and its health status. Still, the potential applications for AI chatbots in healthcare are broad, with use cases for patients, clinicians, researchers, and training students.<sup>1</sup>

The broad trend for the use of AI chatbots in healthcare is to increase accessibility (to medical knowledge) and affordability of care. Chatbots can provide 24/7 access to healthcare advice and support, reducing the need for in-person consultations, and potentially improving patient outcomes. Additionally, AI chatbots could potentially provide valuable insights and data to healthcare professionals, allowing them to make more informed decisions about patient care. More transparency on the data these chatbots have access to and use to produce their output is important and has been raised as a concern with regards to existing systems.<sup>2</sup>

In hearing health care, chatbots could be used to support patients, clinicians, and researchers (table 1).

### **Patients and AI chatbots**

Patients can benefit from AI chatbots in hearing healthcare in various ways. One potential application is for initial screening and the recommendation of interventions. For example, a patient could interact with a chatbot that asks about their symptoms and hearing history and provides recommendations for self-management of symptoms, further evaluation, or treatment based on the patient's responses.<sup>3</sup> This could be particularly useful in cases where patients are unsure whether or not they are experiencing hearing loss, or are hesitant to seek medical attention, or where a profound hearing loss inhibits a conversation with a clinician. Chatbots can also serve as educational resources, self-management tools and screening tools for comorbidities, including social needs.<sup>4</sup> Patients can receive information about hearing health, prevention tips, and advice on how to manage hearing conditions. Chatbots can provide information on the use of management options such as hearing aids, how to change batteries, and troubleshooting common issues. However, a potential risk is that chatbots may not provide accurate recommendations, leading to delayed diagnosis or inappropriate treatment.

### **Clinicians and AI chatbots**

Clinicians can benefit from AI chatbots in hearing healthcare in various ways. Chatbots can assist with data collection and analysis by collecting data on patients' hearing health, such as self-reported symptoms or hearing aid usage. Chatbots can provide summary reports or visualizations to help clinicians make treatment decisions, such as providing a summary report of a patient's hearing test results, highlighting areas of concern, and providing recommendations for further evaluation or treatment. Another potential application is to assist with decision-making and treatment planning. For medical applications, Google and Deep Mind developed Med-Palm, a LLM that incorporated clinical knowledge that has been evaluated using newly developed benchmarks.<sup>5</sup> Chatbots that unlock clinical knowledge could suggest treatment options based on a patient's hearing health history and symptoms and provide information on the benefits and risks of each option. For instance, chatbots could suggest a specific type of treatment based on a patient's hearing test results and preferences. Chatbots can also support clinicians in their communication of information in more accessible and person-centered ways.

A potential risk is that chatbots may not provide the same level of clinical judgment and decision-making as a human healthcare professional. Additionally, there is a risk that the data collected by chatbots may be inaccurate, incomplete, biased, or dated, which could lead to misdiagnosis or inappropriate treatment.

### **Hearing researchers and AI chatbots**

Researchers can benefit from AI chatbots in hearing healthcare in various ways. Chatbots can collect large amounts of data from diverse populations, providing researchers with valuable insights into the prevalence and impact of hearing loss. For instance, chatbots can potentially collect data on the prevalence of tinnitus in different countries or regions. Another potential application is to facilitate clinical trials and research studies. Chatbots can screen potential participants for eligibility, collect informed consent, and administer study protocols.<sup>4</sup>

For example, chatbots can collect self-reported data on hearing aid usage and satisfaction in large-scale clinical trials.

However, a potential risk is that the data collected by chatbots may be incomplete or biased, particularly if the chatbots are only accessible to certain populations or if the questions asked by the chatbots are not culturally sensitive or appropriate for all participants.<sup>2</sup> Additionally, chatbots may inadvertently exclude certain populations from research studies, such as individuals who do not have access to technology or who are not comfortable using it.

### **Current priorities**

There is an urgent priority to investigate the (clinical) application of AI chatbots in hearing health care. General guidelines for the appropriate use of AI chatbots by researchers are being developed in this rapidly changing landscape. Academic journals have broadly agreed that chatbots may not be co-author on research papers since they cannot take responsibility for their work.<sup>2,6</sup> In terms of hearing research applications, priority should be given to evaluate the validity and reliability of chatbots in collecting and analyzing hearing health data. Researchers and clinicians need to ensure that chatbots can provide accurate recommendations and treatment options and that the data collected by chatbots is reliable.

Usability is another important research priority to ensure that chatbots are user-friendly and accessible to as many patients as possible, regardless of their age or technological literacy. Cultural sensitivity is also important to ensure that chatbots are culturally sensitive and appropriate for all populations. There are also important ethical considerations for using chatbots in hearing healthcare, including issues related to informed consent, data privacy, and data security. Researchers will also need to assess long-term outcomes of using chatbots in hearing healthcare. This includes evaluating the impact of chatbots on patient outcomes such as quality of life, satisfaction, and adherence to treatment. Overall, the research priorities for AI chatbots in hearing research should focus on ensuring that chatbots are accurate, reliable, accessible, and culturally sensitive.

Guidelines for appropriate use of AI chatbots by clinicians or patients are not yet available. As the language models have been trained largely by using text from the internet, they are likely to have the same general opinions, stereotypes and biases that are present on the internet.

### **Conclusion**

The rise of AI chatbots (based on LLMs) represents a significant technological advancement that has the potential to revolutionize hearing health care. AI chatbots have the potential to provide personalized advice and support to patients while also providing valuable insights and data to healthcare professionals. However, it is important to consider the potential risks and benefits of AI chatbots and to prioritize further research to ensure that these technologies are used ethically, effectively, and safely in hearing health care.

**Table 1. AI chatbots in hearing health care - applications, risks and research priorities for patients, clinicians and researchers**

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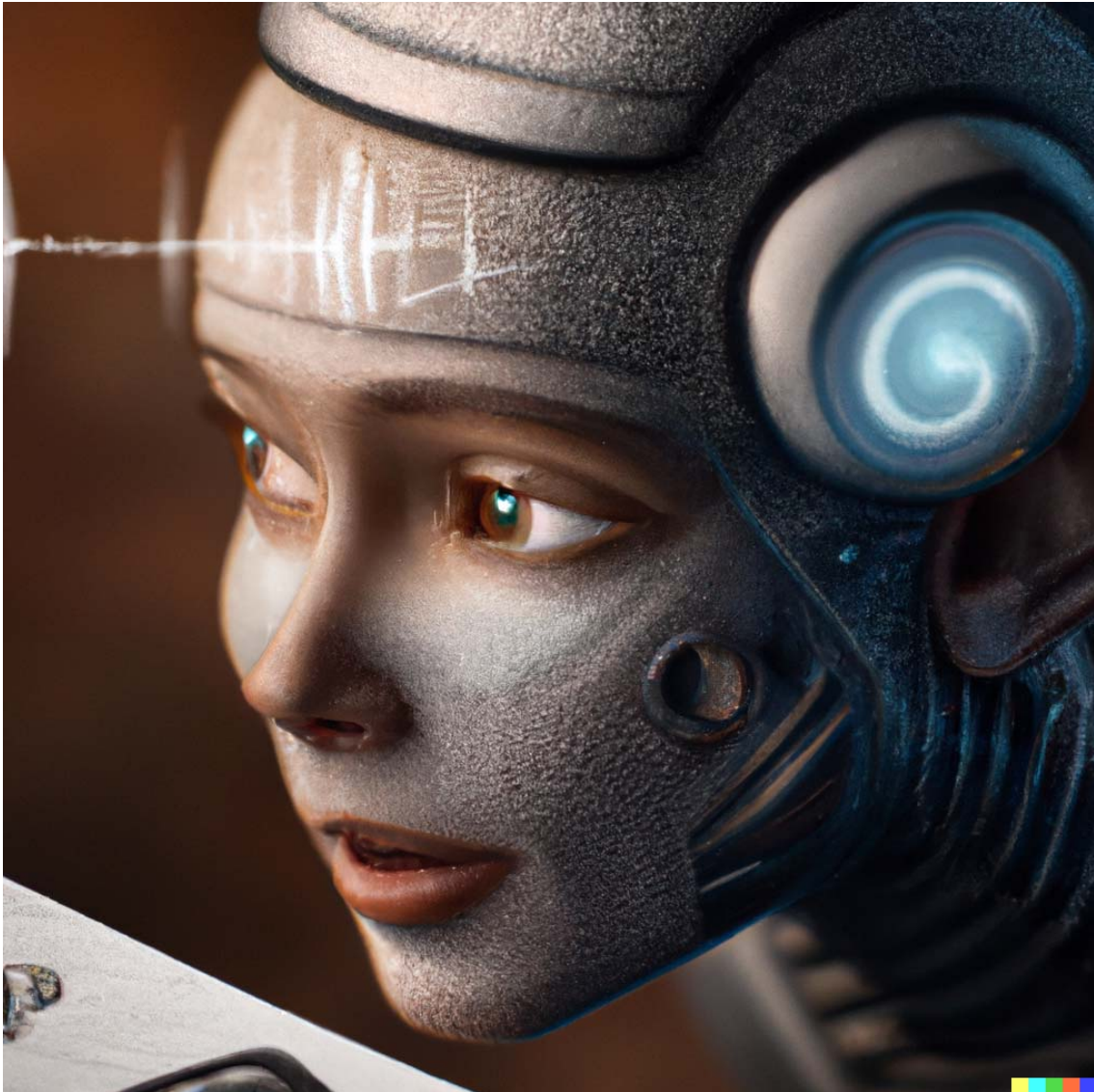


Figure 1. Caption: DALL·E created artwork. Prompt “The rise of AI chatbots in hearing healthcare, digital art”.



Figure 2. Caption: DALL·E created artwork. Prompt “A futuristic illustration of the “Planet of the AI chatbots in hearing health care”, a movie about invading an ear that is also an hospital”.

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