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AI in Applied Linguistics: Implications, Limitations, and Issues

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ABSTRACT

AI's transition from theory to practice has revolutionized many fields, and scientific research is no different in this sense. AI is immensely influential in linguistics, changing language analysis, corpus development, and language learning. This paper reviews the literature and examines the potential of AI in linguistic research through its applications in corpus linguistics and applied linguistics. Also, the limitations and ethical issues inherent in AI's use are explained. This paper starts with describing traditional AI notions followed by the practical applications of AI in corpus linguistics and the impact of AI on language learning and applied linguistics, specifically its role in creating personalized learning technologies and assisting in language acquisition. Finally, this paper will cover the controversial topics of AI, including its inherent limitations and the ethical challenges it poses, concluding that while AI has potential, utilizing it responsibly is key to advancing linguistic research and education.

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Introduction

Artificial intelligence (AI) is a field of computer science that aims to create computer systems that can perform tasks that normally require human intelligence. These tasks include speech recognition, natural language processing (NLP), text generation and translation, video, sound, image generation, decision-making, and planning. AI systems imitate human behavior and decision-making processes by processing large datasets and identifying patterns to make decisions or take actions. Modern AI has made considerable strides in interpreting and generating human language, which has tremendous implications for linguistics and communication. The confluence of AI and linguistics has been particularly fertile, with each field informing and enriching the other. As linguistic models become increasingly sophisticated, they analyze linguistic data and reveal something about the structure and evolution of human language.

Interestingly, although it has been used widely in linguistic studies, linguists still have no consensus concerning AI and linguistic research. For example, Alaqlobi et al. (2024) analyze 73 articles based on their viewpoint on linguistic research. They report that AI models like ChatGPT are considered promising for linguistic tasks even though responsible implementation is crucial for ethical and quality assurance. Apart from the ethical issues of AI, which will be dealt with in detail later in the paper, the difference between human intelligence and artificial intelligence regarding linguistic competence and performance is also considered a barrier (Dupre, 2021; McShane & Nirenburg, 2021). The current artificial intelligence can be referred to as "weak AI," which is designed to simulate human intellectual processes, while "strong AI" is designed to develop genuine cognition - a form of intelligence that indeed has and knows the mental states (Flowers, 2019; Hockly, 2023). Consequently, whereas current AI inherently possesses some limitations, the eventual deployment of strong AI, as admitted by Dupre (2021), could facilitate AI systems for performing linguistic functions on par with the human species along with clear insight into operationalization that could create new research paradigms in defining human cognitive processes. Indeed, Sindhu et al. (2024) present the potential future trends in AI technologies, including enhancing context handling capabilities, methods of bias mitigation, and increased computational efficiency through emerging trends such as federated learning. Therefore, numerous unanticipated AI improvements are looming on the horizon. Nevertheless, as would be expected, linguistic research is not immune to the impact of AI, which transforms the way linguists study and learn about language.

This paper seeks to demonstrate how AI is reshaping modern linguistic research while focusing on corpus analysis and applied linguistics and why it is essential to consider its limitations. The outline of the paper is as follows: after clarifying often-confused AI concepts, the practical applications of AI in corpus and applied linguistics are examined, and the ethical and technical challenges that hinder AI's full potential are explored.

AI-Related Concepts

Before delving into AI and linguistics, there are some interrelated but different concepts to focus on to understand the relationship between AI and modern linguistic research, which

are Artificial Intelligence (AI), Machine Learning (ML), Generative AI, and Large Language Models (LLMs).

Artificial intelligence (AI) refers to computer systems designed to perform tasks that typically require human intelligence, including learning from experience, recognizing patterns, understanding language, solving problems, making decisions, and adapting to new situations (Prodan et al., 2024). These systems perform such tasks via machine learning: deep learning, computer vision, and reinforcement learning. Machine learning (ML) is a subset of AI where systems learn and improve from experience without explicit programming via algorithms to train AI models on vast datasets to identify patterns and make predictions. In other words, data exposure improves systems using neural networks with multiple layers. Machine learning employs commercial-grade algorithms that enable AI models to extract functional patterns from large datasets. Such algorithms are mechanisms of learning that allows the system to improve its performance over time on specific tasks through exposure to examples in a repetitive manner. For instance, while training an image recognition system, the model is exposed to thousands of labeled images, learning to extract visual features that characterize various objects over time. Neural networks, particularly deep networks with numerous layers, are the architectural backbone of most modern ML systems. The 'deep' in deep learning is the chain of hidden layers that enables the system to build increasingly abstract data representations. Each later layer relies on the earlier one, and the network can pick up hierarchical patterns - from low-level edges and shapes to more abstract objects and concepts. The learning process is adapting the weights connecting neurons according to feedback received about prediction performance. The optimization process, usually under the guidance of methods such as gradient descent, progressively reduces the discrepancy between predicted and actual outcomes. The most potent of machine learning is its ability to generalize from trained data to unseen situations. Trained adequately, an ML system can provide logical predictions on new data, permitting applications from computer vision and natural language. In addition, the more diverse and extensive datasets systems are exposed to, the higher predictive accuracy they are likely to exhibit, leading to improved performance in various fields of application. Consequently, while ML is a method for training those machines, AI is the broader concept of intelligent machines.

In terms of output, a distinction is made between discriminative and generative AI types. Through learning the existing patterns, generative AI models can synthesize new data that mimics the source material (Hagos et al., 2024). In other words, generative AI is a very sophisticated type of machine learning that extends beyond the recognition of patterns to the generation of patterns. These models learn to identify patterns in data and generate entirely new material that maintains the statistical and structural characteristics of the training data. On the other hand, discriminative AI is the opposite of generative AI in machine learning since discriminative AI analyzes and/or acts upon existing data, focusing on boundary determination and classification rather than creation (Corchado et al., 2023). These systems are adept at looking at existing data to predict, classify, or determine something based on patterns in data. It can be said that discriminative AI learns boundaries between data categories for classification tasks while generative AI creates new data similar to its training data, which results in generating images or videos (e.g. DALL-E), computer codes (e.g. Anthropic Claude), music

(e.g. beatoven.ai) or texts (e.g. ChatGPT). Large language models (LLMs) are a specific type of generative AI built upon foundation models and focused on natural language processing. In other words, LLMs are a particular application within generative AI, explicitly focusing on language-based tasks (Corchado et al., 2023).

In the beginning, Large Language Models are based on Language Models (LMs) that aim to predict the next word or a character in a given sequence of text to develop algorithms and models that can understand and generate coherent human language (Hadi et al., 2023). However, as noted by Hadi et al. (2023), the breakthrough for LLMs occurred in 2017 with the advent of a new architecture in which the self-attention feature facilitated parallelization and improved the handling of long-distance relationships within text as well as the effect of the context. Thereafter, the architectural design continued to evolve, but one underlying element of LLMs, e.g., the GPT and BERT families, continued to be the same: their training process. It consists of initial pre-training on general text data and subsequent fine-tuning for targeted tasks (Sindhu et al., 2024). LLMs learn linguistic structures by being trained on massive data, enabling them to produce a fluent, contextually relevant text and understand the relationship between words. Later, the models are cleansed by fine-tuning, whereby the models are trained on specialized data to enable the models to perform exceedingly well in conversation and text generation. As a result, LLMs have been outstanding in performing varied tasks in different fields. For example, Sindhu et al. (2024) believe that generative AI models can be applied in other fields such as medicine, education, science, mathematics, finance, and robotics. Similarly, Hagos et al. (2024) also enumerate the prospective applications of generative AI in drug and material discovery, fraud detection, and content personalization. In terms of the language-specific applications of generative AI, in addition to text generation, translation, summarization, question-answering, and sentiment analysis (McShane & Nirenburg, 2021), language understanding, speech recognition, and chatbots (Hagos et al., 2024) are the most prevalent AI applications in language.

AI and Corpus Linguistics

Corpus linguistics experienced a tremendous revolution in the past decade, with AI catalyzing unparalleled methodological advances that transcend traditional research models to include corpus creation for historically underrepresented languages and pedagogic purposes. AI has revolutionized corpus linguistics by enabling analysis on a scale hitherto unknown. Researchers can now analyze billions of words in multiple languages and varieties to determine nuanced patterns. AI achieves this through facilitating analysis software development, enhancing multimodal corpus development, informing applied language instruction tools, and automatic tagging (see Curry et al., 2024 for a list of studies). As a central component, AI has transformed corpus linguistics' research processes and applications in the real world (Curry et al., 2024). For example, web spiders and text scraping software can now construct hundreds of millions of words in a range of languages and domains, compiling datasets of unprecedented size and diversity. Another advantage that can be seen in utilizing AI in corpus linguistics is annotation and preprocessing enhancements. Previous corpus analysis relied upon rule-based or hand-tagging systems for parts of speech, syntactic phrases, and semantic tags, which are now performed with high accuracy by AI-driven natural language processing tools using

machine learning algorithms. Also, AI assists linguists in pattern detection and discovery. Traditional corpus linguistics relied on concordance analyses and frequency counts in the past, but AI can now identify subtle patterns that might otherwise go unnoticed by humans. In addition, AI has widened corpus linguistics from text into speech, gesture, and visual mode by speech recognition programs that can automatically transcribe spoken corpora. At the same time, computer vision technology can parse communicative gestures or contextual properties out of video material, which results in researchers' investigation of the use of language more comprehensively. These AI-powered corpus linguistics developments not only facilitate large-scale analysis of well-documented languages but also hold great potential for developing a comprehensive corpora of less-documented languages while simultaneously transforming educational uses through customized language learning materials.

Studies present the capabilities of AI use in corpus linguistics, focusing on multimodal analysis, corpus building, data collection, annotation, and pattern recognition. For example, Zappavigna (2023) shows how AI systems can be used to study datasets that include unconventional abbreviations, hashtags, emojis, and various unique linguistic forms. Zappavigna (2023) demonstrates how ChatGPT can facilitate developing and deploying regular expressions and code that enable text searching, matching, and manipulation in corpora. Additionally, ChatGPT completes term extraction tasks in significantly less time than the lengthy, often manual process required with corpus tools. For example, Curry et al. (2024) replicated three studies to investigate ChatGPT's usefulness in supporting automated qualitative analysis within corpus-driven discourse analysis. They reported that ChatGPT performs well to a certain point. In another study, after conducting various tasks such as generating word frequency lists, collocations, and words that fit specific ungrammatical patterns and identifying genres by LLM (ChatGpt), Uchida (2024) compares the results with a large-scale general corpus (COCA). Uchida (2024) reports that although the findings are not favorable, widespread items are seen, which can be utilized to show general trends. These diverse applications and evaluations of modern AI in corpus linguistics, ranging from large-scale pattern identification to specific linguistic analyses, are promising. In one study, Łukaisk (2023) focuses on Kashubian, a regional language spoken in Kashubia, a region in the north-central part of Poland, and investigates the effectiveness of modern corpus tools versus ChatGPT in extracting biology terminology from the Kashubian language. Łukaisk (2023) reports that ChatGPT outperforms corpus linguistics tools (Sketch Engine) in term extraction, offering a higher volume of terms, better data presentation, and faster refinement through prompt engineering. Such research illustrates AI's transformative potential while highlighting crucial considerations for its responsible and effective integration into future research.

AI, Applied Linguistics and Language Learning

AI is already powering many language learning aids, including interactive apps, automated writing feedback, grammar and translation tools, applications that facilitate speech and game-based learning, and computer-assisted testing and corpus analysis. Apart from other uses of AI in language education, its use in language teaching materials cannot be underestimated. For example, Crosthwaite & Baisa (2023) state that data-driven learning (DDL) utilizing corpora has become a well-established method in language education over the

past two decades, and its impact is seen in dictionary creation and material development. Uchida (2024) calls GenAI-generated word frequency lists promising despite falling behind large-scale corpora. In this sense, without being aware, learners take advantage of corpus data created through pattern recognition by GenAI, and the outcomes of research on corpus linguistics can also be seen in applied linguistics and education in many papers. For instance, in one study, Kartal & Yeşilyurt (2024) examined 185 articles on AI applications in L2 teaching and applied linguistics from 1995 to 2022 and reported a multidisciplinary field with four main clusters: AI, NLP, robot-assisted learning, and chatbots along with key themes including intelligent tutoring systems, the role of syntax and vocabulary, and the use of robots and gamification. The study highlights AI's potential for personalized feedback and instruction, indicating a growing interest in AI-assisted language learning and a need for further research. Similarly, Ahmad et al. (2024) reviewed the research trends in AI and education between 2014 and 2022. They showed that applications of AI in education included grading and assessment, student retention and predictions for student drop-out as well as sentiment analysis, intelligent tutoring, classroom monitoring, and recommender systems. There are studies focusing on AI and assessment in terms of assessment and education. For example, Mohammadi (2024) focused on AI-aided Language Assessment Literacy (LAL) among EFL teachers by conducting a study involving 261 teachers with varying experience levels. The results indicate that AI-aided ALE training improves teachers' LAL. However, teaching quality decreased with experience level (most experienced teachers performed the worst, but teachers with moderate experience (3-5 years) showed the greatest improvement in LAL. Bannister (2024) used a mixed-methods approach to explore the impact of AI on language assessment and found low Language Assessment Literacy (LAL) among educators and significant unease regarding GenAI-assisted academic misconduct. Laborda et al. (2024) address the challenges of implementing oral assessments in computer-assisted language learning and conclude that chatbots can effectively aid in language evaluation and offer a tool for both learning processes and certification methodologies. In conclusion, it can be said that AI might be promising in terms of assessment and feedback for not only teachers but also learners.

Apart from institution-based use, AI has already been used in language learning by individuals as it provides valuable tools that can be adapted to the needs of learners. For example, personalized learning platforms like Duolingo, Babbel, and Rosetta Stone utilize AI algorithms to track user progress and modify the difficulty level of material accordingly. Such software spots patterns of error and learning pace to create personalized learning paths targeted at specific vulnerabilities. Also, artificial intelligence-based speech recognition software has transformed pronunciation practice. For instance, software like ELSA, Speechling, and other language learning apps give instant feedback on pronunciation correctness, enabling learners to improve their speaking abilities without needing a human interlocutor. Besides, conversational AI peers, like language-learning chatbots, provide safe, judgment-free environments to hone conversational skills. To match learners' comfort zones, virtual conversation partners can be set by difficulty level, topic interest, and speech rate. Text-to-speech and automated reading functions allow for listening comprehension by allowing learners to control speech rate and repetition. This flexibility helps bridge the gap between classroom listening practice and actual language exposure. Similarly, grammar and writing aids

like Grammarly and ProWritingAid correct mistakes and provide the rationale for corrections, making editing a learning experience. These programs learn to recognize individual writing styles and patterns of frequent mistakes, giving more relevant feedback with time. In addition, artificial intelligence-driven vocabulary learning tools like Memrise and Anki utilize spaced repetition algorithms that adapt dynamically to an individual's retention rhythms. By adapting to retention rhythms, students focus on words they struggle with while conserving time on well-learned words. Translation tools have also shifted from word-for-word translation. DeepL and Google Translate now support context-sensing translations and paraphrasing, allowing learners to understand the subtle use of language in different contexts. What makes such uses of AI so valuable is their accessibility, availability, and potential to provide instant feedback that traditional language learning methods can scarcely offer at scale or outside the classroom.

Many studies are already reviewing the studies focusing on using AI in language learning. For instance, Sharadgah & Sa'di (2022) reviewed 200 articles focusing on using AI in language learning and concluded that the integration of AI within English language teaching yielded favorable outcomes across a spectrum of domains, encompassing the optimization of English language proficiencies, translation accuracy, assessment methodologies, recognition technologies, and the cultivation of positive learner attitudes and satisfaction. Similarly, Hockly (2023) elucidates the contemporary utilization of artificial intelligence within English Language Teaching, explicitly focusing on chatbots to improve speaking (see Hockly, 2023 for a list of studies) and presents how chatbots have been used to enhance speaking skills in ELT. Kostka & Toncelli (2023) present examples and studies focusing on using AI to improve writing skills in language learning. Kwok et al. (2025) investigated the impact of AI as a post-editing tool on translations made by students and reported that, with some minor syntactic complexities, AI improved lexical complexity. It is clear that AI has already established itself as a valuable resource for language learners, and continued research will likely reveal even more practical applications.

Issues surrounding AI

Research on AI and applied linguistics seems promising regarding language learning. However, it is not a bed of roses. Almost every paper reviewing the utilization of AI in applied linguistics mentions challenges and/or limitations, considering either AI or its usage. Apart from more technical problems, including domain adaptation, computational cost, limited context window, long-term memory, measuring capability, and quality (see Hagos et al., 2024 for a comprehensive list of concerns), there are some common concerns in the literature regarding AI and bias, data privacy, security, and ethical issues. For instance, the data upon which AI is trained might cause bias in the output because it might not reflect the real world (Hagos et al., 2024). Since AI models learn patterns and relationships from the data they are fed, if the data is skewed, incomplete, or unrepresentative of the diverse realities of the world, the model will inherit and perpetuate those biases. For example, if a language model is primarily trained on texts written by a specific demographic group, it may struggle to process or generate language used by other groups accurately. This can lead to outputs that reinforce stereotypes, exclude marginalized perspectives, or fail to account for regional and cultural variations in language use. Also, as training AI requires massive amounts of data, the data

might (and will, in most cases) be unsupervised, which might include falsified or incorrect information, resulting in bias in the output produced by AI (Zyda, 2024). When an AI model learns from this flawed data, it may incorporate and amplify these inaccuracies in its outputs. For example, a model trained on a dataset containing conspiracy theories or biased news articles may generate text promoting these false narratives. Similarly, because language is so contextual, the exact words can have very different meanings depending on who uses them and in what context. AI has difficulty understanding context and, therefore, can easily misinterpret information (Dupre, 2021). Hence, even with the best intentions, false or incorrect information can slip through the cracks and result in bias. Also, as the data needed to train AI comes from individuals, data privacy and security are a matter of concern (Hadi et al., 2023). The training data might include sensitive personal information, and leaks in data may cause data security issues (Kaddour et al., 2023). Training datasets often contain name data, home addresses, credit card details, medical data, or other traceable data that can be obtained from various places, such as user behavior, public databases, or purchasing datasets. Organizations might not always be able to access all the sensitive content in large training data sets and anonymize them. In the end, data breaches can potentially reveal sensitive personal data to attackers, leading to identity fraud, privacy violations, and even reputational damage. Finally, the hidden or non-disclosed processes behind large-scale data gathering are also problematic (Hockley, 2023). Individuals are not asked for consent and/or notified of data collection and processing methods. Instead, their data, willingly or unwillingly, is used to train AI. These issues raise important ethical questions about the transparency, fairness, and accountability of AI systems, demanding careful consideration and robust safeguards in their development and deployment.

Another challenge for AI is purely linguistic and involves distinguishing between performance and competence. Linguistic competence is the internalized, unspoken knowledge the speaker has of language structure and rules - what they know automatically about how their language works. In contrast, linguistic performance is the actual use and comprehension of language in everyday life, which can be affected by various considerations such as attention, memory constraints, distractions, and errors. As Dupre (2021) states, while language models and GenAI are trained on linguistic performance-based data, theoretical theories focus on competence-based data. Dupre (2021) continues to explain how performance reflects competence that sets a barrier for AI and concludes that the nature of linguistic competence is beyond the scope of insights provided by AI models. The ‘barrier’ that Dupre speaks about is the view that mere recognition of patterns of linguistic performance (what artificial intelligence does) will not automatically amount to knowledge of linguistic competence (what people possess). AI programs might become progressively more skilled at simulating human language without establishing the higher-order cognitive representations that underlie proper language understanding. Similarly, McShane & Nirenburg (2021) focus on various levels of linguistic ambiguities and the limited processing done by AI. For example, AI falls short in processing linguistic structures, including ambiguities such as whether "reading" is a verb or a noun or the agent in “the chicken is ready to eat." Also, semantic vagueness (e.g., double sense of words like bank) or pragmatic ambiguity (e.g., interpreting sarcasm or inferred meaning) are linguistic areas where AI has trouble processing. While humans tend to resolve such ambiguities automatically using context and linguistic competence internalized, artificial intelligence

programs typically get them wrong because they lack competence-based language knowledge. They can only rely on statistical regularities in the performance data that do not directly correspond to the cognitive structuring that would be required for proper language understanding. These observed shortcomings in AI's linguistic capabilities are central to the ongoing discourse within the field, which is extensively documented in the literature. For example, Curry et al. (2024) report that when keywords are semantically categorized, they are often too generic for specialized contexts. They also report that inaccurate inferences and data alterations are seen, raising concerns about its reliability and integrity. Similarly, as Backus et al. (2023) explain, Large Language Models (LLMs) sometimes create false or fabricated information, so-called 'hallucinations', even though they generate grammatically correct sentences. This is because LLMs learn language patterns from statistical analysis of word co-occurrence without understanding the underlying meaning, which has been, as Dupre (2021) mentions, unique to human intelligence so far.

Building competence in AI concepts can enable students and teachers to use AI technologies to improve their learning process and critical thinking abilities. For example, Roe (2024) speaks of the AI-driven future of applied linguistics and says that although there are some problems with AI technology and education, it can be fruitful to make people aware of its potential and limitations. Similarly, Hockly (2023) and Kwok et al. (2025) note that applying AI in education can be promising if students are taught AI literacy and enhance their linguistic and technical skills. Bannister (2024) reports a lack of confidence in detecting GenAI tool usage and institutional capacity to respond. However, emphasizing the need for continuous professional development programs focused on enhancing language assessment literacy and GenAI competency, Bannister (2024) considers AI as an effective tool. Regarding the natural challenges and ethical issues, these studies collectively point to the inclusion of AI within learning contexts, particularly in corpus-based language acquisition and translation, being of great potential when complemented by critical AI literacy and focus on building students' and teachers' general linguistic and technical skills.

This positive view of AI integration in learning is supported by new studies that show tangible benefits when these tools are properly executed. For instance, Fang et al. (2023) conducted longitudinal studies that found students who developed robust literacy in AI and traditional language skills demonstrated superior comprehension and production results compared to control groups. Their research indicates that applications of AI, when used as supplements to traditional learning methods rather than replacements, can accelerate the learning of complex linguistic forms and offer more naturalistic practice possibilities. Furthermore, Wang et al., (2025) advocate for scaffolded AI integration, where teachers progressively introduce AI ideas and resources to students as students progress in disciplinary literacy. Such progressive introduction allows students to build critical assessment skills to differentiate between AI-generated learning support content and AI-generated content that might reinforce misconceptions or oversimplifications. It is essential in translation studies where subtle cultural and contextual understanding is still paramount regardless of technological improvements. The pedagogical implications are more profound than embracing mere devices. Baidoo-anu & Ansah (2023), for instance, examine the impact of ChatGPT on education since its release in November 2022, when it accumulated over one million

subscribers in its opening week. The writers scour literature to identify the strengths and weaknesses of implementing this generative AI tool in schools. Some of the key benefits that have been noted include how ChatGPT can enable customized, interactive learning and the creation of formative assessment questions that give continuous feedback to enhance teaching and learning. However, the article also refers to some significant drawbacks, including ChatGPT's tendency to give false information, potential bias based on the training data, which could reinforce current prejudices, and privacy concerns associated with its use. By understanding the strengths and limitations of AI systems, students can strategically utilize these tools while maintaining human imagination and reasoning, which are still uniquely valuable assets in academic and professional environments.

Conclusion

This paper examined the broad impact of artificial intelligence (AI) on modern linguistic research, namely its application in corpus analysis and applied linguistics. This paper shows how AI, mainly through large language models (LLMs), is revolutionizing linguists' methodology in analyzing language, building corpora, and designing language learning materials. From making complex analyses more straightforward to making learning materials more specific, AI's potential to enhance linguistic research and teaching cannot be refuted.

However, it has also been argued that this potential is not unproblematic. Ethical problems of bias, data privacy, and the proper usage of AI are still considered problematic. Also, the inherent restrictions of AI, primarily in mimicking human linguistic capacity and understanding nuanced linguistic phenomena, call for a cautious and discerning stance. The difference between linguistic performance, where AI is superior and linguistic competence, which is still a human realm, underscores the necessity of human oversight and critical evaluation. However, in the future, linguists must adopt AI as an immense force while being aware of its boundaries. Building AI literacy, improving ethical practices, and building interdisciplinary cooperation will be essential to unlocking the full potential of AI for linguistic scholarship and education. Maintaining a balance between innovation and strict scrutiny, we can enable AI to advance language knowledge and enhance language learning for all.

The AI in today’s world is considered weak, which is an attempt to imitate the human mind in contrast to strong, which aims to create a true mind, a form of intelligence that genuinely possesses and comprehends mental states (Flowers, 2019; Hockly, 2023). Therefore, although AI today is limited to a certain extent, when strong AI is reached, as Dupre (2021) accepts, the ability of AI to perform linguistic tasks like humans and our ability to see how they do it, can create a new way to study human cognition. In fact, Sindhu et al. (2024) point to future directions of AI which include managing longer contexts, lowering bias, and increasing efficiency through methods like federated learning. As a result, many more unexpected wonders of AI are yet to come.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the author used Grammarly/Gemini/Claude.ai in order to improve language and readability. After using this tool/service, the author reviewed and edited the content as needed and takes full responsibility for the content of the publication.

Publication Ethics

This study complies with Research and Publication Ethics and the current study does not require ethics committee approval.

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