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The Extended Mind and the Influence of Cognitive Artifacts on Human Cognition

La mente estesa e l'influenza degli artefatti cognitivi sulla cognizione umana

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Abstract
The extended theory of mind is based on the idea that cognition does not occur only within the brain, but is distributed through the brain, body and environment. The resources in the environment and the operations performed on them are considered constituent parts of the cognitive process. In this sense, external tools are also relevant, as they help to reduce the cognitive load of the agent, who is thus taken over by external objects that can effectively facilitate and guide the cognitive process.
This article explores the cognitive implications of the increasingly pervasive use of LLMs, focusing on the potential of this tool to decrease or improve human cognitive abilities. Through a review of recent literature, the article briefly examines the benefits of balanced use of this tool, assessing concerns about the risks of the technology that could undermine critical thinking and problem-solving skills. In line with the theory of the extended mind, it seems that these tools can act as extensions of the human cognitive process, enhancing thinking and learning. By advocating responsible use, educators can integrate technology in ways that support, rather than replace, the human aspects of education

Keywords: Extended Mind, ChatGPT, Human Cognition, Learning.

Riassunto
La teoria della mente estesa si basa sull'idea che la cognizione non si svolga unicamente all'interno del cervello, ma sia distribuita tra cervello, corpo e ambiente. Le risorse presenti nell'ambiente e le operazioni compiute su di esse sono considerate parti costitutive del processo cognitivo. In questo senso, anche gli strumenti esterni rivestono un ruolo rilevante, poiché contribuiscono a ridurre il carico cognitivo dell'agente, il quale viene così supportato da oggetti esterni capaci di facilitare e guidare efficacemente il processo cognitivo.
Questo articolo esplora le implicazioni cognitive dell'uso sempre più pervasivo dei Large Language Models (LLM), concentrandosi sul potenziale di questi strumenti nel ridurre o potenziare le capacità cognitive umane. Attraverso una rassegna della letteratura più recente, il contributo analizza brevemente i benefici derivanti da un utilizzo equilibrato di tali tecnologie, valutando al contempo le preoccupazioni legate ai rischi che potrebbero compromettere il pensiero critico e le competenze di problem-solving. In linea con la teoria della mente estesa, sembra che questi strumenti possano agire come estensioni del processo cognitivo umano, favorendo il pensiero e l'apprendimento. Promuovendo un uso responsabile, gli educatori possono integrare la tecnologia in modi che supportino — anziché sostituire — le dimensioni umane dell'educazione.

Parole chiave: Mente Estesa, ChatGPT, Cognizione Umana, Apprendimento.

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1.Introduzione

Cognitive artifacts have become deeply integrated into human cognition, serving as external supports that significantly reduce the cognitive load associated with various complex tasks. By automating some operations and facilitating information processing, these tools have redefined the cognitive landscape, offering an efficient approach that would traditionally demand substantial mental effort.

As suggested by Clark and Chalmers (1998) in their theory of the extended mind, cognition is not confined within the brain, but can be extended to the tools and resources that shape and influence human cognitive processes. An example is the use of a calculator in which the device effectively becomes an extension of our cognitive system, handling calculations that the brain might find complex.

This perspective has become particularly relevant in the age of advanced digital technologies in which cognitive artifacts not only store information but also dynamically process and adapt it, enabling users to offload demanding tasks to these external systems (Floridi, 2014). For example, large language models (LLMs) like ChatGPT, are artificial neural networks designed to perform sophisticated language processing tasks that would require considerable mental effort. By automating some processes, tools like ChatGPT exemplify how cognitive artifacts enable users to focus their mental resources on more abstract and creative tasks. This dynamic reflects the concept of distributed cognition (Hollan et al., 2000) where cognitive processes are shared across individuals, artifacts, and environments. These systems go beyond traditional tools, actively collaborating with users by analyzing inputs, suggesting novel perspectives, and refining outputs through interactive interactions.

Moreover, the interaction between users and advanced tools like ChatGPT not only enhances individual cognitive efficiency but also transforms the nature of problem-solving and knowledge creation (Floridi & Chiriatti, 2020). Obviously, the implications of these advancements are profound. As cognitive artifacts become more integrated and interactive, they reshape the boundaries of cognition, extending mental processes into networks of both biological and artificial components. This shift positions humans within an interconnected "infosphere," where cognitive tasks are shared and optimized through interactions with digital systems (Chiriatti et al., 2020).

Such tools not only enhance individual capabilities but also facilitate the production of collective knowledge by aggregating vast amounts of information. Recognizing tools such as ChatGPT as active participants in cognitive processes requires adopting a broader definition of cognition that recognizes its distributed and collaborative nature. This perspective emphasizes the transformative potential of technological artifacts in enhancing human thinking, emphasizing the interaction between mind and technology in various domains, with particular attention to the educational context.

The objective of this article is to examine the cognitive implications of the use of ChatGPTs to understand whether the way they are employed may lead to the establishment of a "system 0," characterized by a lack of cognitive effort (Chiriatti et al., 2024) with performance entirely dependent on LLMs. This raises concerns about the potential reduction in critical thinking and problem solving skills due to dependence on these technologies.

Through analysis of recent studies, the article also considers how balanced and informed use of these tools can effectively support and extend human cognitive capabilities, in line with the concept of the "extended mind" proposed by Clark and Chalmers (1998). When properly integrated, these tools can act as extensions of the human cognitive process, facilitating thinking and learning.

The article also briefly explores how interaction with LLMs can affect system 1, which handles rapid and intuitive perception, and system 2, which is responsible for analytical and deliberative reasoning systema (Kahneman, 2011). It is proposed that LLMs, if used appropriately, can enhance the capabilities of system 2. The discussion lies at the intersection of psychological and educational issues, highlighting the importance of an approach that avoids uncritical dependence and promotes a use that enhances and amplifies human capacities.

2. Cognitive artifacts

Cognitive artifacts are external tools that actively interact with human cognitive processes to enhance our cognitive abilities (Norman, 1991). Given the rapid advances in technology and their expansive role in our daily lives, these artifacts have profound implications. They are particularly intertwined with Artificial Intelligence (AI), as both are designed to enhance human cognitive capabilities through various means. AI acts as an extension of human cognitive capabilities, automating complex tasks and minimizing errors. AI can be viewed as a sophisticated cognitive artifact that not only emulates but also enhances fundamental mental functions such as reasoning, learning, and problem-solving. For example, AI systems in fields like medical diagnosis or predictive analytics automate complex tasks and significantly reduce the occurrence of human error, thereby extending our cognitive capacities (Rajkomar et al., 2019). These technologies do more than just support human activity; they fundamentally transform the interaction between our internal cognitive processes and the external world (Morley et al., 2020).

The traditional view that cognition is confined to the brain and body is increasingly challenged by the capabilities of these tools. Under the extended mind theory, cognitive processes can be delegated to external artifacts, which then become integral components of our cognitive systems. This interaction does not merely supplement the mind's capabilities but becomes an active participant in the cognitive process, influencing how information is processed, decisions are made, and tasks are performed. This redistribution of cognitive tasks enhances efficiency, as individuals can offload certain tasks to these artifacts, allowing them to focus on other aspects of problem-solving or decision-making. Thus, cognitive artifacts are not passive tools but are essential elements that actively shape and participate in the cognitive processes (Hutchins, 1995).

In environments that demand continuous learning and quick adaptation, cognitive artifacts are crucial. They help individuals manage complex and rapidly changing streams of information, making them indispensable in these contexts (Jones & Nemeth, 2005).

However, the implications go beyond practical benefits, as they challenge deeply held assumptions about where the mind "ends" and the world "begins." In this sense, if cognitive processes can be entrusted to external tools, the traditional view of cognition as an activity bounded by the brain and body must be revised. In the extended mind framework, when individuals rely on an external artifact to perform cognitive tasks, they enter a system in which mind and artifact actively interact. In this system, the tool does not merely supplement mental processes, but becomes part of the cognitive mechanism itself, shaping the way information is processed, decisions are made, and tasks are completed. The increasing dependency on such tools also blurs the boundaries between what is inherently human and what is facilitated by technology. This dependency, while beneficial in many ways, can also pose risks. Over-reliance on cognitive artifacts might lead to a diminished capacity for independent thought, potentially making users overly dependent on external aids (Vallor, 2020).

This reconfiguration of cognitive resources can lead to greater cognitive efficiency, as users can rely on artifacts to handle specialized tasks. In this framework, the theory of extended cognition could explain how technology, by integrating into the cognitive system, has the potential to transform the way individuals think, learn, and interact with information.

According to the extended theory of mind, these external devices should not be viewed as mere supports but as fundamental building blocks for mental functioning in certain contexts. This perspective is particularly relevant in domains that require continuous learning and adaptation, where cognitive artifacts play an essential role in helping individuals manage complex and rapidly changing information flows. However, all of this raises relevant issues. Indeed, as dependence on external tools increases, the boundaries between what is produced internally by the mind and what is facilitated by external elements become increasingly blurred. Despite the cognitive advantages, excessive reliance on these tools can carry certain risks, which must be carefully identified.

3. Critical thinking and ChatGPT: educational insights

The rapid development of AI technologies has affected various fields, including education. One AI tool increasingly used in this area is ChatGPT, which is capable of generating texts in response to specific questions and requests. The pervasive interaction between individuals and technology has highlighted how the use of technology can impact cognitive processes, particularly a skill known as critical thinking (Ku et al., 2019). In fact, students may often use ChatGPT as a tool to access a vast amount of information, but how this information is evaluated remains unclear. The reasons that makes the use of ChatGPT controversial is the excessive dependence that students might develop, with still unclear consequences on their critical thinking skills (Kasneci et al., 2023). The tendency to delegate assigned tasks to this tool could have important consequences on cognitive abilities and the way knowledge is acquired. While artificial intelligence can offer important opportunities, non-critical or excessive use of such tools risks turning into passive dependence, reducing students' direct involvement in the fundamental cognitive processes of analyzing and evaluating information. The cognitive processes involved in using ChatGPT are often compared to dual-process theory (System 1 and System 2), which refers to two distinct reasoning systems [16]. Daniel Kahneman's (2011) dual process theory identifies two different cognitive systems: *System 1,* characterized by rapid, automatic and often subconscious responses, and *System 2*, which is slower, deliberate and analytical. A potential disadvantage of overuse of these tools is dependence on System 1, which could compromise analytical abilities that are typically governed by System 2. When individuals consistently delegate complex cognitive tasks to tools such as ChatGPT, they may run the risk of becoming overly dependent on quick, automatic responses, avoiding the need for reflective analysis. When individuals consistently delegate complex cognitive tasks to tools such as ChatGPT, they may run the risk of becoming overly dependent on automatic responses, avoiding the need for reflective analysis.

Automatic and controlled processes, in fact, are critical to understanding how we perform tasks that require different levels of attention and mental effort. The following table (**Table 1**) provides the main differences between the two systems and their implications for cognitive performance.

Aspect	**System 1**	**System 2**
Awareness	Low (minimal conscious awareness)	High (requires conscious attention)
Mental Effort	Minimal	High
Speed	Fast	Slower
Practice Needed	Develops through extensive practice	Often used for new or complex tasks
Adaptability	Less flexible to new information or tasks	Flexible and adaptable to novel tasks

Tab. 1: Main differences between the two systems

Automatic processes are fast, require minimal mental resources and are often performed simultaneously with other tasks (Schneider and Shiffrin, 1977). Controlled processes, on the other hand, require conscious attention and mental effort. They are deliberate, slow and require an individual's concentration and active engagement. Controlled processing is typically used in unfamiliar or complex tasks, where multitasking is more challenging due to high cognitive demands.

The impact of ChatGPT on reasoning processes depends largely on how it is used. According to cognitive load theory (Sweller & Chandler, 1994), frequent use of ChatGPT may ease the burden on working memory by reducing cognitive overload. However, habitual and passive reliance on the tool could foster heuristic thinking, thereby undermining critical reasoning skills.

In this debate, the recently introduced notion of *System 0* (Chiriatti et al., 2024) provides a valuable theoretical lens. It describes a state of minimal cognitive engagement and maximal reliance on artificial intelligence—a form of outsourced cognition where the decision-making process is external to the human mind. Although not yet extensively explored in cognitive science literature, *System 0* raises concerns about

the erosion of sustained attention and cognitive autonomy (Chiriatti et al., 2024). The central question, then, is whether excessive delegation to AI risks a decline in critical and creative thinking. Avoiding AI altogether is not the answer. Rather, students should be encouraged to approach such tools as cognitive aids that still require independent thought and reflective judgment. In this light, AI becomes both a challenge and an opportunity—capable of extending human cognition when used deliberately, instead of replacing it through passive repetition.

Indeed, language models like ChatGPT are increasingly deployed across domains as cognitive extensions that help users manage information overload, sustain productivity, and generate original insights (Boži et al., 2023). When a student engages with ChatGPT, the interaction involves a dynamic flow of information between human and machine, contributing uniquely to the cognitive task. These tools are not passive supports but active participants in shaping thought, learning strategies, and decision-making processes. As cognitive load is distributed between the individual and the artifact, the overall cognitive system becomes more adaptive, efficient, and responsive (Floridi & Chiriatti, 2020). This underscores the importance of a thoughtful and balanced use of AI that amplifies human capabilities while preserving autonomy and depth of thought.

4. Implications for education

The current literature on Artificial Intelligence using ChatGPT seems to support the hypothesis that its use in education improves students' critical thinking skills (Kosar et al., 2024). Despite the encouraging results, the interaction of students with ChatGPT and its potential impact on their critical thinking ability must consider various variables that play a decisive role in this relationship. Several factors, in fact, may influence the relationship between ChatGPT and critical thinking, such as frequency of use, type of engagement (active or passive), and attitude and confidence in AI. Artificial intelligence systems, such as ChatGPT, are designed to assist users by alleviating the mental effort associated with routine or complex tasks. For example, students can use these tools to structure arguments, synthesize large amounts of data, or quickly clarify concepts. This efficiency allows them to focus their cognitive resources on higher-order thinking. Therefore, while moderate and strategic use of AI can supplement human cognition and reduce cognitive load (Shin, 2020), excessive dependence could lead to habitual externalization of mental effort. This dependence is likely to reduce the user's ability to critically analyze and solve problems. Regular use, in fact, if unbalanced, could foster dependence on heuristic shortcuts rather than on analytical and deliberate thought processes. The type of engagement (*active or passive*) further complicates this relationship. Active use, characterized by questions and verification of AI responses, can stimulate thinking by encouraging users to evaluate information critically (Fabio et al., 2024). Conversely, passive engagement, in which users accept AI results uncritically, can erode the user's ability to evaluate the validity and reliability of information. Over time, passive use may normalize superficial cognitive processing, leaving users more vulnerable to errors or misinformation. The user's skill level significantly influences the impact of AI on critical thinking. Novices may benefit from reduced cognitive load by using AI to support their understanding. However, they might lack the metacognitive awareness needed to critique AI results, increasing the risk of over-reliance. In contrast, experts could use AI more effectively as a complementary tool, leveraging it to enhance their well-developed reasoning skills. The relationship between students' trust in technology and its perceived usefulness is a central theme in studies of human-technology interaction. Trust acts as a psychological mechanism that influences how people perceive and adopt a technology, particularly in contexts of advanced automation such as artificial intelligence. A high degree of trust can amplify the perception of usefulness, as users are more likely to recognize the benefits of the technology and minimize concerns related to its complexity or potential risks (Silva et al., 2023).

A student's level of familiarity with a technology influences usage intention at several levels. First, the domain of knowledge increases perceived competence, that is, the feeling of being able to use the technology effectively. This perceived competence, in turn, reduces perceived risk, as users who feel competent tend to evaluate technologies as less uncertain. Reducing perceived risk contributes to increased confidence in AI, as in the case of ChatGPT.

Trust is a crucial element because it raises a more positive perception of technology, alleviating fears related to errors, privacy violations, or lack of control. Finally, trust fuels perceived usefulness, as users who trust technology are more likely to recognize its functional benefits and integrate it into daily life or work. These considerations suggest that the intention to use a technology such as ChatGPT does not depend solely on its technical features, but also on psychological and cognitive factors. The context of AI use (Chang et al., 2022) significantly influences attitudes toward it and consequently the intention to use it. Another interesting aspect concerns the propensity to rely on technology primarily for objective tasks (Mahmud et al., 2022). rather than subjective tasks, suggesting that its use is generally perceived as useful in objective knowledge domains. Artificial intelligence, by providing quick and personalized responses tailored to individual needs, can foster a more participatory approach, sparking greater interest and encouraging active student engagement. Additionally, AI-based chatbots can offer students a safe space where they can seek help and obtain answers without the fear of being judged (Ait Baha et al., 2023). The integration of AI chatbots into teaching and learning environments also offers significant potential to transform educational practices, particularly in enhancing student learning outcomes. The efficacy of AI chatbots as a tool for improving educational performance is effective when employed as short-term interventions, rather than over prolonged periods (Wu and Yu, 2023). This is likely due to the ability of short-term implementations to maintain novelty, engagement, and focus without diminishing their pedagogical impact over time.

In this sense, current scholarship has initiated an empirical investigation into the ways in which the application of ChatGPT in educational settings can influence critical thinking skills of students. Suh, Bang, and Han (2025) have investigated this correlation in the scenario of second language learning and discovered that the methodical application of ChatGPT for argumentative writing activities under the guidance of critical thinking models can augment learners' reasoning ability. Similarly, Guo and Lee (2023), writing on chemical education, have illustrated how – through the critical analysis of ChatGPT content rather than its passive acceptance – this tool can be transformed into a useful prompt for reflection and conceptual clarification. In support of these findings, Wang and Fan's (2025) meta-analysis revealed that the use of ChatGPT, when pedagogically guided, not only optimizes learning outcomes, but also students' higher-order thinking and conceptions of learning. Overall, the results of these studies indicate that ChatGPT can be a useful tool as long as it supports active, evaluative and reflective interaction.

To support balanced engagement, it must be recognized that artificial intelligence systems are most effective when used as a supplement to and not a replacement for human cognition. Despite these advantages, the impact of ChatGPT on critical thinking has not been thoroughly studied, and many educators often lack the knowledge needed to effectively incorporate these technologies into their teaching practices. Teachers and students need to be trained in the effective use of these technologies (Morley et al., 2020) allowing them to address and identify potential biases in AI algorithms. For this reason, it is crucial to analyze the potential of ChatGPT as an educational tool to improve critical thinking skills and train teachers to explore different perspectives in the use of such tools. Indeed, despite their transformative potential to improve human cognition, the use of these tools must be balanced by an awareness of the risks associated with over-reliance.

5. Conclusions

Generative AI tools have proven to be transformative in extending human cognitive capabilities. By enabling individuals to externalize specific cognitive tasks, these tools enable them to handle complex tasks with reduced mental effort. According to Clark and Chalmers' theory of the extended mind (1998) which highlights the interdependence of human cognition and external tools in creating an enhanced cognitive system, this externalization effectively expands the functional boundaries of the human mind.

Obviously, the implications are profound, suggesting that cognitive artifacts not only expand individual capabilities, but also reshape the way we approach processes such as problem solving, critical thinking, learning, and decision making. These tools enable greater efficiency, creativity, and accessibility in a wide range of information, playing a critical role in reducing cognitive load and allowing users to focus on higher-order thinking. However, the growing reliance on cognitive artifacts brings with it significant con-

cerns. The primary risk is a reduction in critical and analytical thinking skills as users increasingly rely on automated processes. Additionally, the opacity of some technologies can foster a lack of understanding of their inner workings, potentially leading to misuse, overconfidence, or ethical lapses.

Future research should explore the long-term effects of generative AI tools on student learning outcomes and provide a more comprehensive understanding of how these technologies influence various dimensions of education. By thoroughly analyzing the cognitive effects of these technologies, we can optimize their benefits, ensuring they serve as powerful allies in knowledge acquisition. Despite growing interest, empirical evidence on the long-term cognitive effects of generative AI tools remains limited. Further research is needed to assess their real impact, especially in educational settings, in order to develop informed strategies for their responsible integration.

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