



Cognitive Science 48 (2024) e13487
© 2024 Cognitive Science Society LLC.
ISSN: 1551-6709 online
DOI: 10.1111/cogs.13487

This article is part of the “Progress & Puzzles of Cognitive Science” letter series.

Can Large Language Models Counter the Recent Decline in Literacy Levels? An Important Role for Cognitive Science

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Received 5 May 2024; received in revised form 20 June 2024; accepted 2 August 2024

Abstract

Literacy is in decline in many parts of the world, accompanied by drops in associated cognitive skills (including IQ) and an increasing susceptibility to fake news. It is possible that the recent explosive growth and widespread deployment of Large Language Models (LLMs) might exacerbate this trend, but there is also a chance that LLMs can help turn things around. We argue that cognitive science is ideally suited to help steer future literacy development in the right direction by challenging and informing current educational practices and policy. Cognitive scientists have the right interdisciplinary skills to study, analyze, evaluate, and change LLMs to facilitate their critical use, to encourage turn-taking that promotes rather than hinders literacy, to support literacy acquisition in diverse and equitable ways, and to scaffold potential future changes in what it means to be literate. We urge cognitive scientists to take up this mantle—the future impact of LLMs on human literacy skills is too important to be left to the large, predominately U.S.-based tech companies.

Keywords: Literacy; Large Language Models; Writing; Reading; Literacy acquisition; Cognitive science

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In this letter, we propose that cognitive science has an important opportunity to scaffold the development and use of Large Language Models (LLMs) toward improving the fundamental human skill of literacy. We focus on the “traditional” notion of literacy as the “ability to identify, understand, interpret, create, communicate, and compute, using printed and written materials associated with varying contexts” (UNESCO Institute for Statistics, 2024). Recent research has revealed that literacy not only results in secondary effects in terms of the *knowledge* gained but also has extensive direct effects on perception and cognition. These primary effects reflect the enhancement of cognitive and perceptual *skills* of literate individuals as a function of learning to read and write (Huettig & Hulstijn, 2024). These effects include *language-related* skills such as phonological awareness (Morais, Cary, Alegria, & Bertelson, 1979), robust enhancement of language prediction skills when reading and even during speech (Huettig & Pickering, 2019), and increases in verbal memory (Demoulin & Kolinsky, 2016). Literacy, moreover, leads to enhancements of *nonlanguage skills* such as increases in object recognition abilities including the recognition of human faces (Van Parijs, Ostarek, Arunkumar, & Huettig, 2021), faster detection of targets during visual search (Bramao et al., 2007), and faster naming of visual objects and color patches (Araujo et al., 2023).

Given these enhancements, it is a worrying trend that many countries across the world have reported declining literacy levels in recent years. Moreover, only a tiny number of individuals currently develop the necessary critical literacy skills to competently evaluate written text, and which may serve as an inoculation against fake news (Picton & Teravainen, 2017) in addition to the mechanisms and regulations that society should put in place to protect readers. According to PISA level 6, for example, readers must be able to reflect deeply on the text’s source in relation to its content, use criteria external to the text, compare and contrast information across texts, identify and resolve intertextual discrepancies and conflicts through inferences about the sources of information, their explicit or vested interests, and other cues as to the validity of the information. In Finland (a representative case), only 3.6% of girls and 1.1% of boys reached PISA reading level 6 in 2018 (Ahonen, 2021). As a further (typical) warning sign, 63% of Finnish 15-year-old boys agreed with the statement “I read only if I have to.” Educators may ignore these declining literacy levels at their own peril.

The success of LLMs has brought the prospect of artificial intelligence back into the foreground of both public and academic discourse. The downward literacy trend is likely to continue (perhaps at an increasingly faster pace) if people engage less in literacy activities in this future world of generative AI. A reduction in literacy levels is likely to amplify the recent declines in the Flynn effect (that IQ levels increase across generations) that have been reported in some Western countries (Bratsberg & Rogeberg, 2018; Teasdale & Owen, 2008). The intersection of LLMs and literacy, in short, has potentially massive ramifications for individuals and society alike. Yet, given the recency of their development, little attention has been paid to how LLMs might be used to *improve* human literacy skills—and this is where cognitive science has an opportunity to play a key role.

Cognitive scientists should systematically explore what LLMs might mean for the future of literate minds and societies. The field must steer the development and use of LLMs in such a way that it maximizes the potential to increase literacy skills. New approaches and

tools will be needed to carefully examine the complex interplay between LLMs and literacy-related knowledge and skills, and cognitive scientists are especially well-suited to develop such tools. Here, we highlight four key areas for such work:

- *Facilitating the critical use of LLMs.* Considering the language production side, it is noteworthy that for many people writing is an arduous process that stands in the way of expressing ideas, thoughts, and feelings (Levy & Ransdell, 1995). Many individuals have trouble with writing and LLMs may be used to facilitate this process (e.g., Berdejo-Espinola & Amano, 2023; Tregoning, 2023), which may, in turn, feed back into improved reading (Graham & Harris, 2017). Cognitive science could investigate how LLMs can be used critically, to not only overcome writer’s block but also to suggest various continuations for any type of writing that encourages (rather than hinders) users to think for themselves.
- *Using turn-taking to promote literacy.* Given the reluctance by many to read long texts, including books, perhaps chatbots may be used to facilitate literacy skills by taking advantage of the natural human ability for turn-taking (the rapid and regular switching in a conversation between comprehending an utterance and producing an appropriate response). Investigations of turn-taking in both cognitive science (Levinson & Torreira, 2015) and machine learning (Skantze, 2017) could provide a foundation for the development of LLMs that would hone different kinds of reading and literacy skills through interactional engagement in ways that are adapted to the individual learner.
- *Promoting educational equity.* Cognitive scientists could determine how individuals with low socioeconomic status (SES), non-native speakers, and other disadvantaged groups might benefit from LLMs, both at the knowledge and the skill level (Berdejo-Espinola & Amano, 2023). In France, Germany, and Israel, for instance, there is a gap of more than 170 PISA reading score points (the equivalent of more than 4 years of schooling) between the 10% most SES disadvantaged and 10% SES most advantaged pupils (Schleicher, 2019). Using multilingual pretraining, LLMs may also be able to generate new reading materials for heritage and other under-resourced languages in culturally aligned ways (AlKhamissi, ElNokrashy, AlKhamissi, & Diab, 2024). Cognitive science can help educators figure out how LLMs can be used to level the playing field and make literacy-related activities more equitable and more diverse (e.g., Bala et al., 2023; Kasneci et al., 2023).
- *Scaffolding potential future changes in what it means to be literate.* Reading and writing will remain crucial technological tools for many years to come but “literacy continues to evolve as the definition of what it means to be literate changes in an increasingly digitalized world” (UNESCO, 2024). It cannot be ruled out that written language will turn out to be a transitional technology in human history. We may well be at the beginning of a dramatic shift away from “traditional” (reading and writing) literacy toward new types of literacy. LLMs may help individuals keep some of the cognitive advantages of “book language” (e.g., due to its more complex syntax compared to speech; Favier & Huettig, 2021) even if the medium is spoken (as, for example, in

audio books). Cognitive science may be able to cushion the impact of such technological changes, for instance, by modeling various ramifications of generative (nontext) AI on individual minds and societies and suggesting potential solutions to mitigate adverse consequences.

Cognitive science can help steer the upcoming changes so that they are more likely to encompass the promises of LLMs for literacy rather than the pitfalls. But the need for action is urgent—literacy is too important to be left to chance and in the hands of large technology companies (Maslej et al., 2024).

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