



## Commentary

## The Digital Expansion of the Mind: Implications of Internet Usage for Memory and Cognition



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In their article *The Digital Expansion of the Mind: Implications of Internet Usage for Memory and Cognition*, (Marsh and Rajaram, 2019) highlight ten properties of the Internet and discuss the seven very different possible implications for how we think, process, and use information. Beyond merely listing fascinating behaviors, the authors implicitly identify a set of important effects on humans—for both good and ill—and in the process, illuminate several directions for research on the ways in which the internet is influencing all of us.

The key idea of the paper is that properties of the technology that we call “the internet” has potentially profound implications for cognition. In many ways, this is the inevitable consequence of any information technology, with the internet simply being the technology of the moment. The effects of almost every information technology have heavily influenced cognition. The technology of writing, with its ability to store information that transcends time, giving the written word the ability to instruct and inform future generations, was the first big cognitive amplification technology. In the same way, the ability to organize information according to a predefined sort order (such as alphabetizing by title, or in taxonomies as with the Dewey Decimal System or the Library of Congress Subject Headings) gives humans entirely new powers to organize content into searchable collections.

With each information technology came a host of problems along with worries about whether or not the effects of the technology would be permanent and/or damaging to human thought. Most famously, Plato wrote of his concerns in *Phaedrus*, (Plato, 370 BCE) where he commented on worries about writing (as a technology), saying that writing is an inhuman way to capture knowledge. By attempting to turn living thoughts, with all their richness and detail, into mere scratchings on paper, people will damage their abilities to reason and remember. Plato, on writing:

[What] you have discovered is an aid not to memory, but to reminiscence, and you give your disciples not truth, but only the semblance of truth; they will be hearers of many things and will have learned nothing; they will appear to be omniscient and will generally know nothing; they will be tiresome company, having the show of wisdom without the reality. . . Once [facts are] written down, they are tumbled about anywhere among those who may or may not understand them (p 278).

Of course, the advantages of writing are obvious now. But concerns about technology are everpresent, especially as the tech grows faster, deeper, richer, and cheaper. As Blair points out in her book *Too Much to Know* (Blair, 2010), scholars complained about the crush of too many books after the introduction of inexpensive printing, which led not only to having too much to read, but also information that was cheap enough to dissect with scissors, leading to the creation of slips of text (from cheap books) and the invention of cut-and-pasting into other volumes.

The speed of information-sharing becomes important with the introduction of the telegraph. This electrical series of carefully timed clicks radically changed the speed with which information could be shared from place to place, profoundly changing what we thought of as “news,” as well as our expectations for knowing something at the right time, be it personal information, business, or knowledge about distant events. The telegraph forever shifted what humans thought of as timely knowing (Standage, 2009). Just as with the invention of writing, printing, sort algorithms, and telegraphy, the internet is changing what we consider knowledge, properties of knowing, and ways of thinking.

While the ten properties of this paper are a useful start, they don’t cover all of the effects of the internet on cognition. (The authors acknowledge this.) But it’s a great start, and these

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properties highlight some of the most salient effects of the current crop of technologies. I want to touch on a few of the properties covered in this article, starting with the first: *unlimited scope*.

While the content of the internet is wide and deep, there is a common misconception (particularly among students) that “everything is on the internet,” and its corollary, “if it’s not on the internet, it’s not worth knowing.” Librarians and professional researchers realize that this isn’t true, but it is a common misconception among students and the less technically skilled, those who may often use search engines to do their research but who will rarely go beyond the internet as a resource (Purcell et al., 2012).

Does this change cognition, or does the fast and easy access simply encourage laziness? Or, is there a larger concern at work here? As rapid, facile search becomes well-known, it’s possible that expectations shift: *Of course* you should be able to do that report in 20 minutes! It’s just a few searches, right? It is unclear to what extent this is a change in transactive memory processing, or just a realization that the time horizons are shortening and the work needs to be done rapidly.

There is a body of work in both sensemaking (Russell, Stefik, Pirolli, & Card, 1993) and information foraging theory (Pirolli, 2007) that makes predictions about human information seeking behavior taking into account the cost of search, decisions made during the search, and processing the information found, along with the rate of return based on the quality of the content. When modeled as a economic foraging question, it seems clear that exogenous factors (such as time pressures to complete the task) can have an important influence on information search strategies. There is no doubt that shifting one’s beliefs about resources will change the analysis plan and subsequent behaviors, but is that really a persistent cognitive change? Is this a cognitive shift, or the just rational economic behavior of an already existing system?

Of course, people are adaptable to a wide variety of circumstances. Providing an information seeker with a (much) larger suite of information resources should change their behaviors. But as Marsh and Rajaram point out, the information resources of today’s internet differ substantially from traditional sources such as books and journals. And with the rise of the technologies that allow for ultra-low cost authorship (Property 8) comes another key question: How accurate is all that new information (Property 2)?

Cognitive effects come into play here, as searchers now find themselves in a sea of information that is larger, more questionable, and subject to overt design. It’s not all just plain information anymore: Some information sources actively attempt to convince the reader that their point-of-view is correct. It’s not just that “the internet is not a passive presenter of information” requiring an active need to search (as the authors point out; Marsh & Rajaram, 2019, p. 4), but it is also full of striking advocacy on the part of many information providers, some of whom employ every cognitive trick in the book to make their information attractive and especially memorable. As a consequence, internet users need to not only have the skills to search for the information they seek, but they increasingly need to be

aware of the way in which that information is presented—both in a straightforward evaluative sense, and in a deeper sense of understanding the psychology at play (Russell, 2015).

In (Wineburg’s, 2018) book *Why Learn History*, the author points out that 80% of students in his sample (across a broad range of universities and schools) are not able to correctly assess the quality of a questionable information source or to pursue an effective strategy to determine the correct information. Property 9 (source information is obscured) is relevant here, as not all information available on the internet comes with clear and correct attribution. So, not only are there clear effects on cognition as readers swim through a surfeit of information, much of it created by champions and advocates of a particular position, but understanding and learning how to counteract those effects becomes an important challenge.

It is imperative that we (academics, scholars, and teachers) understand how to instruct our students (and ourselves) about the cognitive effects of the tools the internet provides, and about what it means to work in an infinite soup of information. Can we modify our own cognition to compensate for the offloading-of-memories effect (as the authors discuss)? Can we understand our own habitual behaviors vis-à-vis the internet? I suspect so, as we manage to teach students certain metacognitive strategies (such as the use of checklists and calendars to overcome forgetting effects). In principle, this is just another kind of metacognition that we need to understand and teach.

Overall, the authors bring up a great set of issues here: How many of these behaviors (Properties 1–10) are attributable to intrinsic cognitive effects as opposed to resource and training effects? How many of these properties can be dealt with appropriate measures, tools, or training?

For instance, Property 3 (content changes rapidly) is difficult for all internet users, although it is clear that many users don’t grasp the depth of the issue (Purcell et al., 2012). Not only does content change constantly, but content availability is also problematic for online research. While internet users are upbeat about the range, breadth, and availability of content, a common understanding about availability seems to be wildly off the mark. Link rot happens all the time, much more often than people estimate (Klein et al., 2014). (It happened three times while searching for articles to complete this commentary.) Marsh and Rajaram (2019) are right to wonder what these properties mean for estimates of content authoritativeness if the actual content is believed to be available, but actually is not.

However we think about the effects of the internet on memory and cognition, one property (any distractions and choices) is perhaps the most salient. The authors are right to point out that the problems of overchoice, visual distraction, and interruptions clearly influence the way people go about their daily lives (and in particular, how they get work done); but I wonder if this is a property of the internet *per se*, as much as it is the manifestation of the net in user interfaces and the overall ecosystem that we inhabit.

Certainly the internet makes more information and distractions available, but pinning the effect on the internet itself is a bit like blaming the interstate highway system for the traffic jam outside your door. The highway certainly enabled it, but

the effects are a systems-in-use property, rather than an effect of the substrate. The internet moves bits, providing flow and directional services, much as the highway system moves cars.

Instead, I would frame this property as a product of the internet ecology: that is, the information providers, the tools, the advertisements, and the networking all together create a kind of welter of goods, service, entertainments, and distractors. It is clear that not only do distractors (in all their forms) affect cognition, but they also create expectations about interruptions. You know your cognition is different when you've been trained by experience to expect a distraction or interruption at a specific rate (Mark, Gonzalez, & Harris, 2005).

### Summary

Overall this article highlights a number of cognitive effects of internet use, but not all of them are due to the internet *per se*. Some (like distraction) are driven by user-interface design and marketing forces that stand outside of the normal cognitive research paradigm, while others (like editability or content persistence) are products of system design, while still others are part of the larger social network in which we are all embedded. That network shifts constantly, while providing an increasing number of *types* of information that connect with our memories, potentially transforming the nature of our memory.

Marsh and Rajaram do us a great service by elevating the conversation about the cognitive effects of the tools, content, and systems we use. This is a complex milieu, and effects on thinking and remembering are clearly taking place through a multiplicity of factors, which will doubtlessly continue into the future.

This paper gives our field a general direction in which to move, especially as the substrate of the internet ecosystem will not remain constant for long. As we continue to design new tools, create new repositories, and invent new types of media, research needs to proceed in sync with these developments. Indeed, with some foresight, research can actually guide these developments toward more productive systems while avoiding the more egregious mistakes that can diminish our cognitive abilities.

### Author Contributions

This commentary is my own work, commenting on the article *The Digital Expansion of the Mind: Implications of Internet Usage for Memory and Cognition* by E. Marsh and S. Rajaram for JARMAC.

### Conflicts of interest

The authors declared no conflicts of interest.

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