Journal of Applied Research in Memory and Cognition 8 (2019) 36–39

Contents lists available at ScienceDirect

Journal of Applied Research in Memory and Cognition

journal homepage: www.elsevier.com/locate/jarmac

Commentary

Examining the Implications of Internet Usage for Memory and Cognition: Prospects and Promise

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The advent of the Internet fundamentally altered the informational landscape in which many go about their day-to-day cognitive lives. Marsh and Rajaram (2019) provide a cogent description of the relevance of particular properties of this landscape for human cognition. They also provide useful advice for pursuing a project aimed at providing a deeper understanding of the cognitive consequences of this shifting landscape, encouraging the field to build on previous work at the intersection of cognition, technology, and cognitive science more broadly in order to suggest productive ways forward. In other words, we need to be sure to "stand on the shoulders of giants." This advice contains in it a caution against the seductive tendency to approach emerging areas of research as a kind of blank slate. We already know a great deal about the human cognitive system and this knowledge can and should be leveraged to guide research examining the intersection of Internet usage and cognition. This seems like important advice and Marsh and Rajaram's paper takes long strides in that direction.

Marsh and Rajaram's (2019) paper also raises important questions about the nature of the broader project they outline. In particular, they begin by stating,

> The question discussed here is, does our reliance on the internet change cognition, given that our cognitive system developed in a very different world, for different goals and in response to different pressures Nairne and Pandeirada (2008)—and if so, how does relying on the internet change cognition? (p. 3)

As Marsh and Rajaram note, many have weighed in on this question. That said, I could not help but wonder what the authors meant by "change cognition." While this might seem overly pedantic, it is (in my view, at least) a central issue in this emerging area of research and, as such, one worth reflecting on. What does it mean for Internet usage to change cognition? How would we know if it did or did not? I am not asking these questions because I know what it means for Internet usage to "change cognition." Instead, what I am suggesting is that in the context of attempting to articulate the broader project and guide its future direction, as Marsh and Rajaram work to do, it is worth examining the idea closely. Below is a modest attempt to take a step in that direction in the context of the Marsh and Rajaram article.

The reference to the evolutionary pressures that shaped cognition suggests that Marsh and Rajaram (2019) might have a conception of change at a rather "deep" level. That is, the changes wrought by the evolutionary pressures they refer to shaped the basic processes responsible for human cognition. Could Internet usage bring about change at this level? While it might be tempting to answer in the affirmative for those engaged in this effort, there is good reason to be skeptical of such far-reaching impacts. In a collection of essays where authors (including prominent cognitive scientists) were asked, "Is the Internet changing the way you think?" (Brockman, 2011), Steven Pinker responded simply in the title of his essay "Not At All" (p. 86; Pinker, 2011). Roger Schank responded no less clearly: "The Internet has not changed the way I think nor has it changed the way anyone else thinks" (p. 355; Schank, 2011). This skepticism appears rooted in a view of cognition that considers basic processes as relatively immune to the type of change that Internet usage might bring to the proverbial table (see, e.g., Pinker, 2010). From this perspective, such skepticism does not appear unreasonable. For example, recent discussions of the limits of cognitive training (Sala & Gobet, 2019; Simons et al., 2016) seem consistent with the idea that changing cognition, in at least

Author Note

This work was supported by a Discovery Grant from the Natural Sciences and Engineering Research Council of Canada (NSERC), an Early Researcher Award from the Province of Ontario and funding from the Canada Research Chairs program to E.F.R.

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one sense of the term, would be a tall order indeed. But I suspect there is room for dissent, and Marsh and Rajaram might view it differently.

A different sense of the phrase "change cognition" may be found in Marsh and Rajaram's (2019) concluding paragraph where they state, "Our key aim has been to identify the ways in which specific properties of the internet and the specific characteristics of human information processing meld to shape human cognition" (p. 33). This statement appears to treat as separate the "properties of the internet" and the "characteristics of human information processing," and identifies the project with understanding how they interact to determine cognitive performance. It seems important to note first that the sense of change here (as I am interpreting it) is notably different than above in that Internet usage is not changing the characteristics of human information processing per se (though the use of "shape human cognition" might return us to that deeper sense of change). Instead, "change cognition" here might mean change relative to a kind of pre-Internet (how would one complete this cognitive task prior to having experienced the Internet?) or disconnected (how would one complete this cognitive task if they did not have access to the Internet?) baseline. For example, Marsh and Rajaram discuss offloading memory to an external store (e.g., the Internet). The unlimited storage and ease of access afforded by the Internet makes storing to-be-remembered information "in-the-cloud" a desirable option. Recent research investigating cognitive offloading has provided at least some evidence that doing so impairs our internal, biological memory for the stored information (Eskritt & Ma, 2014; Sparrow, Liu, & Wegner, 2011). Thus, it appears that how we encode information into our internal memory might change when we can store that information on the Internet (or some other external store) relative to a situation where we need to rely solely on our internal memory (though the authors note that this claim might be more complex than hitherto imagined; see also Hertel, 1993). Thus, the "change" here is relative to a "disconnected" state rather than a change in the basic processes responsible for encoding information into memory. For example, when we can offload memory demands, we might be less likely (relative to when we cannot offload) to engage in mnemonic activities known to increase the likelihood of future retrieval from our internal memory (e.g., rehearsal). From this perspective, "change cognition" is more a change in which specific component processes are brought to bear to achieve some cognitive goal rather than a change in those component processes themselves: more rearranging the furniture, less getting different furniture.

If this is the sense of "change cognition" meant by Marsh and Rajaram (2019), then we are seemingly tilling much less controversial (though no less interesting) soil. The idea that Internet usage might "change cognition" in this sense of the term would fit comfortably within the general notion that how we go about performing a given cognitive task can vary considerably with changes in context (e.g., O'Malley & Besner, 2008). And, as Marsh and Rajaram aptly describe, the Internet represents a considerable shift in the context in which much of our day-to-day cognitive acts occur. This view arguably closes the door on "does our reliance on the internet change cognition?" (or, at least, it would be surprising if it did not) but leaves "how does relying on the internet change cognition?" or, a less provocative frame, "how does internet usage change how we perform cognitive tasks?" wide open. If we allow that there are different assemblies of cognitive operations that we can bring to ostensibly similar cognitive tasks (i.e., storing information for recall in the future), then the Internet or Internet usage could bias us toward or away from certain assemblies, which could have both positive and negative consequences (e.g., biasing us toward an assembly that does not include deep processing, or that discourages reflection because we view it as an expert). Many of Marsh and Rajaram's examples seem to fit comfortably in this frame. Nevertheless, Marsh and Rajaram might view it differently.

In considering the nature of the project laid out by Marsh and Rajaram (2019), it might be worth thinking about what such a project has to offer beyond the (admittedly wide) confines of understanding cognition in the context of Internet usage. One interesting avenue to pursue might be to view this effort in the context of trying to understand the principles governing distributed (or extended) cognitive systems (e.g., Clark, 2008; Clark & Chalmers, 1998; Hollan, Hutchins, & Kirsh, 2000; Hutchins, 1995). This would require a shift in the traditional unit of analysis from the individual cognitive agent to wider brain-body-world systems. The human-Internet system would represent one instance of this general class of distributed cognitive systems and one could search for principles that cut across the different instantiations. Marsh and Rajaram, for example, discuss the idea that searching the Internet might lead us to appropriate the knowledge-out-there as our own (Fisher, Goddu, & Keil, 2015; Hamilton, McIntyre, & Hertel, 2016; Ward, 2013). Interestingly, Sloman and Rabb (2016) demonstrated a similar phenomenon wherein individuals would report that they themselves had a greater understanding of a given natural phenomenon when they were told that experts understood it (relative to being told that experts did not understand it). Interestingly, this only seemed to be true when the individual could, in principle, access that information (i.e., it was not being kept a secret; Sloman & Rabb, 2016). Thus, being an active part of a distributed cognitive system seems to lead individuals to take on properties that belong to the broader system (or parts of that broader system). Research investigating different forms of transactive memory systems (Ferguson, McLean, & Risko, 2015; Fisher et al., 2015; Hollingshead, 1998; Sparrow et al., 2011; Wegner, 1986, 1995) and different external stores (see Hamilton et al., 2016; Hertel, 1988) also embody this general approach.

Another potential avenue might be to use the human-Internet context as a tool to better understand individual human cognition. One of the properties of the Internet that Marsh and Rajaram (2019) describe is that its results are fast. This is important because previous research has demonstrated that speed of retrieval is related to confidence (e.g., in an answer to a general knowledge question; Ackerman & Zalmanov, 2012; Kelley & Lindsay, 1993; Thompson et al., 2013). Thus, individuals appear to interpret the speed of retrieval as related to its quality or likelihood of being true (Marsh & Rajaram, 2019). Marsh and Rajaram suggest that the same might be true when we are retrieving information from the Internet (or other external knowledge

stores). That is, answers to questions that are retrieved more quickly might be believed more strongly (though it would be important to manipulate speed of retrieval independently). While this is an empirical question (and an interesting one), if true, then this might provide an opportunity to better understand speed of retrieval as a metacognitive cue. For example, it might be the case that individuals hold this belief (e.g., "the faster I retrieve an answer from memory the more likely it is correct") about their own minds (retrieval from an internal store) and be generalizing it to other forms of retrieval (retrieval from an external store). Alternatively, individuals might hold a belief about the relation between speed of retrieval and answer quality (or system performance) in general and, when asked, be applying it to the particular case of retrieval from their own memory or to retrieval from the Internet. Lastly, the beliefs that individuals hold might be independent, despite taking the same form (e.g., "the faster I retrieve an answer from memory, the more likely it is correct"; "the faster I retrieve an answer from the Internet, the more likely it is correct"). Contrasting these alternatives experimentally might provide novel insight into how individuals think about their own minds. From this perspective, examining the human-Internet context provides a tool to better understand individual human (meta)cognition (Risko & Gilbert, 2016).

Conclusion

The cognitive consequences of Internet usage are increasingly drawing the attention of cognitive scientists (Barr, Pennycook, Stolz, & Fugelsang, 2015; Ferguson et al., 2015; Fisher et al., 2015; Hamilton & Yao, 2018; Risko, Ferguson, & McLean, 2016; Storm, Stone, & Benjamin, 2017; Ward, 2013). Marsh and Rajaram (2019) have provided a roadmap of sorts to help navigate this effort. From this, it seems clear that there is much to be learned about the interaction between human cognition and the Internet and the potential insights promise an expanded understanding of the human mind.

Conflicts of interest

The authors declared no conflicts of interest.

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Received 20 December 2018;
accepted 24 December 2018