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Commentary

Thoughts on the Digital Expansion of the Mind and the Effects of Using the Internet on Memory and Cognition

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Marsh and Rajaram's (2019) thought-provoking analysis of the various implications of internet usage for memory and cognition will undoubtedly serve as a timely stepping-stone for advancing the area of research. The mingling of mind and machine is still in an incipient stage of development, and it is precisely for this reason that research on the topic is so important. The internet is affecting the way we think and remember, and as psychological scientists it is imperative that we are forward thinking in our efforts to study and understand these effects, focusing not only on the consequences of how we use the internet today but how we are likely to use it in the future. In the current commentary, I discuss the importance of thinking about what it means to remember and forget in a system that encompasses both internal and external memory, and I outline a few additional potential limitations that I think will be important to consider when thinking about how the internet is affecting memory.

Marsh and Rajaram (2019) repeatedly refer to the blurring of the line between what we know and what we can access online. Certainly, internal and external memories differ in many important ways, but both ultimately reflect information that informs behavior. Externally represented information can affect judgments and decisions, determine whether and how people seek out additional information, and influence how people think about themselves and others (Fisher, Goddu, & Keil, 2015; Hertel, 1993; Hamilton, McIntyre, & Hertel, 2016; Ward, 2013). In the everyday use of memory, therefore, as online information becomes increasingly available and easy to access, and as more of what we know involves a confluence of information stored internally and externally, perhaps the line between what is in the head versus not in the head becomes a little less consequential. Indeed, it may be useful to reconsider how we characterize whether something is in memory. If someone can use a search engine to retrieve information, and they can do so quickly and easily, and for a goal-directed purpose, perhaps it makes sense to say that such information is in the person's extended memory system—a system that encompasses not only information in the brain but information potentially accessible online and via other transactive memory partners (e.g., Wegner, Erber, & Raymond, 1991; Wegner, Guiliano, & Hertel, 1985).

The concepts and terminology we use to characterize memory should be broad enough to capture the expanding scope of memory. Consider the distinction between retrieval strength (i.e., the momentary accessibility of information in memory) and storage strength (i.e., how well learned or entrenched information is in memory) (Bjork & Bjork, 1992; Tulving & Pearlstone, 1966). This distinction is important for many reasons, not least because it provides a more nuanced way of representing what it means for an item to be forgotten. Indeed, much of what people think of as forgetting reflects a loss of retrieval strength, not storage strength. An item can become highly inaccessible at one point in time even though it remains stored in memory and can be easily recovered following a reminder or the encountering of the right set of retrieval cues.

To characterize retrieval strength in an extended memory system, we might expand the concept to include not only information retrieved from internal memory, but information retrieved from the internet and other external memory stores. Determining the factors that limit retrieval strength in this context would require a more nuanced understanding of the combined influence of internal and external retrieval processes, something that would not be as simple as taking the probability

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of retrieving an item from internal memory and adding it to the probability of retrieving it when relying on external memory. The use of the internet, for example, is likely to affect the accessibility of information in internal memory, and the accessibility of information in internal memory is likely to affect whether, how, and to what consequence one relies on the internet. Indeed, people often choose not to rely on the internet even when it would likely be in their interest to do so (Storm, Stone, & Benjamin, 2017). Thus, to understand the factors contributing to this extended form of retrieval strength, one needs to factor in the multi-directional interactions between internal and external memory and how they play out in the context of addressing the everyday demands of memory.

The concept of storage strength poses an even greater challenge. If we know more than simply what is in the head, then perhaps we need to broaden the scope of storage strength to represent the overall availability of information not only in the structures of internal memory but in the array of external stores that might be available to that person. Using this definition, because it is potentially retrievable, online or offloaded information could be said to have a degree of storage strength even if it is wholly forgotten (i.e., no longer available in the brain) or not learned in the first place. To be sure, the nature and impact of such information would be different fundamentally if it was held internally. We learn and remember most effectively, for example, by integrating new information with information already embedded in long-term memory. The more we know about a topic, the easier it is to learn and remember new information about that topic. Because online information is not stored within the structures of internal memory, it is not expected to potentiate or support new learning in this way. Thus, even if we say that online or offloaded information has storage strength, it will still be important to identify the internal and external components and how they blend or interact to create what might be referred to as total or extended storage strength.

Along these lines, using the internet as an external memory source may have the potential to alter the nature of expertise. What are the consequences of distributing knowledge and information across internal and external memory systems? Given the properties of the internet discussed by Marsh and Rajaram (2019)—that it has unlimited scope, that it provides fast and easy access to information, and that it is constantly updated—such a distribution is likely to be quite powerful, providing access to far more information than would otherwise be possible. On the other hand, it could reduce our ability to take advantage of the remarkably flexible and generative systems intrinsic to internal memory, systems designed not only to store bits of data but to work together to produce something akin to wisdom or insight. Of course, the internet is advancing every day, and with the development of technologies like artificial intelligence, it may be possible to integrate internal and external memory processes in a way that maximizes the potential benefits while mitigating the potential costs.

As discussed by Marsh and Rajaram (2019), using the internet can also lead to a metacognitive illusion where people think they know something internally when they do not. The effect likely occurs for various reasons, but primarily, perhaps, because of the heightened sense of subjective fluency or feeling of knowing that results from having such ready access to information. Research has shown, for example, that it can be difficult to tell the difference between information highly accessible because it is well learned and information highly accessible because it is primed or accessible for some other superficial reason (Bjork, 1999; Koriat, 2000). The confluence of internal and external memory processes may lead to a heightened sense of accessibility or fluency that is misinterpreted as an indication of how strongly embedded the information is within the internal structures of long-term memory. The potential consequences of this metacognitive illusion are not insignificant. If people think they know something internally, for example, they may fail to engage in the types of learning conditions and practices critical for promoting long-term retention and transfer (Bjork, Dunlosky, & Kornell, 2013). In this way (and many others), the memory costs associated with relying on the internet are likely to extend far beyond the costs associated with cognitive offloading (Sparrow, Liu, & Wegner, 2011; Storm & Stone, 2015).

Someone who relies on the internet to retrieve information will certainly have access to more information than someone who does not. Moreover, the internet provides a tool that can allow people to overcome some of the most powerful barriers to retrieving information from internal memory, such as the cue-dependent nature of retrieval and the competition caused by other items in memory (McGeoch, 1932; Watkins & Watkins, 1975). A quick Google search, for example, is often all one needs to resolve a stubborn case of tip-of-the-tongue. The remarkable potential of the internet to provide access to such an overabundance of information, however, may belie its actual ability to provide access to information. Indeed, many factors (beyond those discussed by Marsh & Rajaram, 2019) have the potential to limit the breadth and depth of the information we come across online.

First, online search engines do not always provide easy access to the particular information we seek, and it can be difficult and time-consuming to find information that does not appear on the first page of a search result. Indeed, digital assistants like Alexa typically provide only a single response to a given query with no additional pathways to explore other potentially related information. Second, it is not always obvious what terms to use in a given search, and people can be quite bad at finding information online and in the files they save (Bergman & Whittaker, 2016). Moreover, people are likely to repeatedly rely on the same websites and search terms, leading them to suffer from a sort of Einstellung effect (Luchins, 1942) that limits the scope of the information to which they are exposed. As a consequence, users are likely to remain oblivious to the vast information to which they never encounter, opting instead to stay (consciously or unconsciously) in familiar and less challenging waters less likely to give them either new information or a new point of view. Third, external retrieval does not involve flexible gist-based mechanisms like those involved in retrieving information from internal memory. Thus, subtle differences in spelling or word choice can cause an otherwise reasonable search to fail to bring about relevant and sought-after information. Fourth, to

conduct a successful search, one must first think to search. This limitation is particularly serious in that it suggests our ability to take advantage of online information is limited by what we know internally and whether we know there is something online that we want to know. It is difficult to know what we do not know, however, and as we know less internally and become more reliant on the internet to tell us what we need to know, perhaps it will become even more difficult. Finally, as demonstrated by research on part-set cuing and collaborative inhibition, exposure to external information can limit our ability to retrieve internal information that we would have been able to retrieve otherwise (Nickerson, 1984; Weldon & Bellinger, 1997). The upshot of these and many other factors is that although the internet may provide access to a functionally limitless amount of information, and although it may be far more powerful (in some respects) than our internal memory, coming across the particular information we seek or that we would find most useful is far less likely than we might think.

Another potential consequence of using the internet is that it may disrupt the natural functioning of memory by interfering with mechanisms responsible for adaptive forms forgetting, misremembering, and reconsolidation (Anderson & Milson, 1989; Bartlett, 1932; Bjork & Bjork, 1992; Conway & Pleydell-Pearce, 2000; Ditta & Storm, 2018; Hardt, Einarsson, & Nader, 2010; Newman & Lindsay, 2009; Schacter, 2001). In the practical use of memory, for example, it is useful to lose access to information no longer frequently or recently retrieved, thus giving precedence to the learning of new information and maximizing the accessibility of information that is more recently and frequently retrieved. It is also adaptive for old and outdated information to maintain some degree of storage strength even if it is no longer needed, as doing so may allow such information to continue to potentiate new learning and be quickly relearned should it regain its relevance. There are also good functional reasons for retrieval to modify memory and for new learning to update the information stored in memory as our goals and contexts change. A critical question, therefore, is how an increased reliance on the internet and other digital technologies might affect or disrupt these adaptive processes, especially since information on the internet is constantly changing and not in a way necessarily tied to an individual's goals and needs.

To conclude, it is worth noting that although this commentary has focused on the potential limitations, I am generally quite optimistic about the future of memory and cognition in the context of the internet. Fears about new technologies are nothing new, of course, and across the millennia humans have shown a remarkable capacity to use new technologies in a way that builds and expands upon their cognitive abilities. Perhaps it is different this time, and features of the internet do differ in profound ways from prior technologies, but ultimately I think the advantages of the internet will outweigh the disadvantages. By investigating the potential costs or limitations of the internet, moreover, we place ourselves in a stronger position to develop and refine the technology in a way that makes it potentially more productive, less disruptive, and more aligned with the everyday goals and functions of human cognition.

Conflict of Interest Statement

The author declares no conflict of interest.

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