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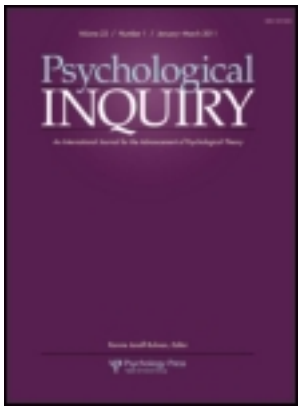

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TARGET ARTICLE

Social Cognition in the Internet Age: Same As It Ever Was?

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The World Wide Web has inarguably become an integral part of the daily lives of the majority of the world's population. Many people spend more time online than with any given person on any particular day, yet the cognitive impact of being online remains understudied in psychology. We examine the research that has been done, and relate other related research findings, in an effort to attract more research to this area. We analyze some of the key factors that may have an impact on what and how we learn online, whether we are interacting with the cloud mind interpreted by Google or with other people via text based communication. We investigate how this development changes our perception of reality and how we may evaluate online information in ways that differ from face-to-face encounters. Living our lives in cyberspace changes what kinds of information we most frequently process and how we habitually deploy our cognitive resources, for better and for worse. When people interact with the Internet they may adopt particular mind-sets, modulating basic psychological processes. We integrate disparate lines of research in an effort to provide avenues for future investigation.

> "It's true, I read it on the Internet!" —said by at least five people in a 1-mile radius while you read this sentence.

At some point today you have "googled" to find the answer to some momentarily burning question and probably discussed with someone an issue that one of you saw posted on a friend's Facebook post or Twitter feed. Often, this is how we become aware of important world events. One author of this article learned of the death of Osama bin Laden, the Boston Marathon Bombing, and the pregnancy of the Duchess of Cambridge on Facebook. It is an understatement that the World Wide Web has become a ubiquitous presence in daily life. People are online whenever they can be, in restaurants, waiting rooms, while watching television, or even walking down the street. We have to be told to turn off our smartphones in public gatherings, and almost every lecturer has unhappily been made aware that not everyone obeys this explicit social stricture.

The Internet has been available to the public at large for less than 20 years, not even a blip on the timescale of human evolution. From that perspective, being online could not change our cognitive anatomy in such a time span. However, our experience of being online feels to us like a game changer, and there are sensational stories (in online news sources of course) that describe the Internet as either a cognitive blessing or a curse. Like most anything else, the truth probably lies somewhere in between, with both context and the area of cognition one focuses on turning the Internet into either friend or foe. In this review we focus on empirical evidence that examines the intersection of the Internet with our memory processes, with persuasion and belief, and with social interactions. We find that sometimes the Internet's influence on cognitive processes is similar to what has previously been found to be true, if writ large. And in other cases, the Internet does appear to be altering what are thought of as typical psychological patterns. It is a complex story, and one that we argue deserves much ongoing research.

The State of Psychological Research on the Internet

The way we know the world has changed quickly, by any measure. In ancient history, narratives and the oral tradition were the only way of finding out about what the world was like. The advent of writing dramatically expanded the human scope of knowledge. And

the advent of the printing press made knowing more democratic still. Most recently the World Wide Web has changed how we know, such that we now have easy access to the knowledge that could be contained in approximately 40 million 500 page books (Ward, 2013). The amount of information shared on the Internet has increased nine times over the past 5 years (Carlson & Shontell, 2013). We examine how the most recent changes in our informational environment, namely, the accessibility of vast amounts of information, changes the ways in which social cognition happens as we interact with the Internet as a source of information.

The pressing question we examine is in what ways the availability of so much knowledge may change the way that we habitually process information, for better or for worse, changing the way our minds work in our effort to adapt to a new information environment and leading us to evolve (in a non-Darwinian sense) into a kind of hybrid robo-sapien. Traditionally, we would learn much of what we know from communication with other people, either through formal education or everyday communication. Some of these communications are now computer mediated, and we therefore analyze the psychological processes that may lead to different outcomes when interaction happens online.

The ever-increasing presence of computers in our lives has been the subject of many utopian as well as dystopian fantasies (Mazlish, 1993; Weizenbaum, 1976) and equally dramatic opinion pieces in recent years (Carr, 2008). However, what is more rare than sensationalist hyperbole is a systematic scientific analysis of the ways in which the presence of a new informational and social environment online is actually changing the way that we use our cognitive resources to learn about the world.

The question of whether the prevalent use of Internet has a positive or negative effect on the way the human minds work is unlikely to have an impassioned unitary answer. As the prevalence of the use of Internet enabled digital devices increases, it's pivotal to ask specific and psychologically informed questions about the benefits and trade-offs of this practice, so that we can make the most of our digital lives, while avoiding potential drawbacks.

Social cognition and social psychology in general has been the pioneer in understanding the importance of situational cues for our behavior; therefore it makes perfect sense that we should also study what occurs when these cues occur in highly controlled computer mediated environments. In a sense, experimental psychologists already have plenty of experience in doing so, as the majority of experiments in psychology occur using a computer and recently online as well, making our traditional approach more ecologically valid compared to generalizations to offline or face-to-face communication. Indeed, the majority of social psychology research in recent decades has been conducted in a computer-mediated environment, and this applies to a much greater extent to cognitive psychology and almost entirely to any study utilizing fMRI techniques (Zaki & Ochsner, 2012).

However, there's been a surprising dearth of studies examining possible ways in which our cognition may actually change as we adapt to a new informational environment. Many applied fields of psychology and computer science have been studying human–computer interaction using concepts and jargon parallel to psychological research, but no integrated psychological approaches exist that systematically include the Internet as a new presence in our informational environment.

How Do People Use the Internet?

The environments and kinds of cues that we encounter on a daily basis are changing as more and more of people's time is spent using a digital device for either work or pleasure. Our social lives are increasingly occurring online, in computer-mediated environments.

According to a national survey, 88% of adults in the United States ("Trend Data [Adults]," 2012) and approximately one third of the world's population (Bennett, 2012) use the Internet daily, with those numbers projected to increase. The most popular uses of the Internet are for finding information using search engines (91% of U.S. adult Internet users) and e-mail communications (88% of U.S. adult Internet users). These activities also take up the most time spent online; that is, 21% of our time is spent searching for information, 20% reading content on the web, and 22% of time is devoted to social networking (Bennett, 2012).

What Are Key Distinguishing Features of the Internet That May Impact Social and Cognitive Processing?

The question of how the digital age and the increasing prevalence of the use of computers impacts human cognition only becomes answerable once we make some key distinctions regarding the kind of networked computer use we are referring to. Different kinds of Internet use may have different consequences for the way cognitive processes unfold.

In accordance with this relatively recent development in human history and the ubiquity of human-networked computer interactions in our everyday lives, social psychological research should include this influential actor in our social environment. Importantly, it seems impossible to study the Internet as a unitary construct, as there are a variety of ways in which it is used that differ in ways that may impact human cognition. One of the key differences for human cognition is the

degree and quality of the implied or actual presence of other intentional agents in the environment, and research has previously demonstrated consequences of human presence on a wide variety of cognitive processes and behavior (Allport, 1920b). The study of social phenomena typically investigated in social psychology differs from strict cognitive accounts in that social processes recruit meaningfully distinct neural substrates (Mitchell, 2009), and unless one is raised in the complete absence of stimuli, in a strict sense all behavior occurs in a social environment.

Although social and cognitive processes occur concurrently, we use these categories in a simplistic way to organize this review into cognitive processes that are individually impacted by being online and social interactions that are occurring in cyberspace. People use computers as a tool to access information on the Internet, thus using it in a relatively impersonal way (although the information itself is provided by other humans) or they use computers to communicate with other people, implying a more explicit social interaction.

The Internet itself as it is interpreted through its mediators—computers and search engines—is likely perceived as an actor in our social environment. Along the two key dimensions of mind perception, experience and agency, people perceive robots to have a significant degree of agency, the ability to cause effects in the world, but very little experience (H. M. Gray, Gray, & Wegner, 2007). The Internet as interpreted by Google, the most frequently used and highly associated search engine, is likely to be perceived with even more agency but equally little experience (although see Ward, 2013, for work that suggests people are mistaking Google's knowledge for their own, which might imply a very different agentic perception). To the extent that actions observed on a computer screen are proportionate to the reward they entail, while also using a probabilistic schedule of responding, these actions will be estimated to be "voluntary," implying agentic (Neuringer, Jensen, & Piff, 2007) qualities to our smartphones, computers, and other devices the actions of which are perceived as having goal directed properties.

When we are using networked computers it is possible to interact with the computer as a networked device that allows us access to the Internet. The Internet in turn is perceived as the hive mind, a vast compendium of continuously updated information, most often interpreted by Google (Ward, 2013). We use this device to find out things about our currently relevant interests, finding and learning various kinds of information. When it is perceived in this relatively nonpersonal way, we are partnering with (or at war with, if we get poor results) the collective, digital mind. The multitude of knowledge that it contains is then curated and represented by search engines, as the metaphorical eyes of this vast digital mind.

Alternatively, computers are also able to channel the presence of other people who we interact with or, at least in theory, could interact with offline. This avatar (the computer proxy for the individual sitting behind their screen) characteristic could produce meaningfully different psychological processes compared to the use of Internet as knowledge search tool. The World Wide Web allows us to connect with or maintain connections with hundreds of people in a way that significantly differs from face-to-face interactions. Although there are many fascinating ways in which this development may actually change our relationships to each other (please see Wilson, Gosling, & Graham, 2012, for a broad review including this topic), we focus on how the communicated information between people changes what we remember and believe to be true. We review some of the research on memory in the context of communicating with other people and present hypotheses about how they may be different in an online social network environment.

In this review, we look at the existing research applying psychological concepts to these meaningfully distinct ways of using the Internet: as a tool for storing and retrieving knowledge and a tool for interacting with other people. In addition, we propose what areas of research that have not been applied to this area may tell us about how the Internet changes what we know and how we process information. In doing so, we aim to open new avenues of research that will illuminate in what ways the dramatic change in lifestyles that has moved many of our interactions online may change the way that we process information, what we remember, and how we evaluate this information. Although this research may help us understand how the presence of the Internet in our lives is changing the way that our minds/brains work, we don't intend to make recommendations about how it should be used but rather point out what the implications may be for specific kinds of Internet use.

Partnering Up With the Hive Mind

The ubiquitous and seamless access to information on the Internet, provided by Google and other search engines, has transformed computers into a significant part of the transactive memory system. The transactive memory system was first conceptualized as a model that expands the cognitive psychology metaphor (Wegner, 1986, 1995) of a single computer processor into a network of processors and has since expanded to accommodate the incorporation of actual computers into the system, which allows us to access the collective knowledge stored on the Internet (Sparrow, Liu, & Wegner, 2011). Instead of conceptualizing the human mind as a single entity metaphorically represented as a computer, we can imagine the human

mind as embedded in an interconnected system of transactive memory partners where knowledge is stored and accessed. The system functions based on the principles of accessibility, relative expertise, and negotiated responsibility (Wegner, 1995). To use the knowledge of our transactive memory partners we have to be able to access it: We can ask friends, search through the dusty shelves of a library, or google some information on the Internet. We also need to know where to find what kinds of knowledge, and this distribution of relative expertise is normally achieved with human partners through negotiating responsibility for remembering different kinds of information.

In long-term relationships, people normally know what kinds of information their partners are good at storing and can rely on accessing this information easily. Thus, initial empirical support for this model comes from research in couples: Compared to impromptu dyads, couples who have known each other well enough to negotiate memory responsibilities remember more information when they are able to choose their area of expertise but actually fare worse than impromptu couples when to-be-remembered categories of information have been randomly assigned (Wegner, Erber, & Raymond, 1991). These results suggest that the transactive memory system becomes stressed when the "where to find it" changes (at least randomly), just as we are stressed when we start a job in a new place and find that previously mindless aspects of getting work done become giant obstacles.

Online Transactive Memory

We have always used transactive memory systems, but only recently has our dependence become transparent and troubling to us. We wonder if our brain is atrophying because we no longer memorize phone numbers and constantly have information available to us online, to look up at a moment's notice. Are we, with our reliance on gadgets that constantly provide us with most of what we want to know, becoming less intelligent as a species? Some people such as Nicholas Carr, who in 2007 wrote the (in)famous essay "Is Google Making Us Stupid?," have concluded that we are in fact cognitively incapacitated. What we wanted to do was look at what was going on with memory and the Internet empirically. We wanted data, not anecdote (Sparrow, Liu, & Wegner, 2011).

First, we had to answer the question to which the answer seems obvious. Do people think about gaining access to their computers when they don't know the answer to things? We had the people who participated in our study answer a block of easy and a block of difficult questions. After each block we gave them a test to see if search engines (such as Google and Yahoo!) as well as other computer terms were highly activated compared to noncomputer terms (such as Nike and Target). We found that after the difficult questions people were indeed thinking about being online more so than with easy questions (although computer terms were activated here too, suggesting computers are associated with knowledge in general).

Second, we were interested in seeing whether people remembered information later if they expected it to be accessible for them to look up, such as information that is online. Half of our participants expected trivia statements to be typed into the computer to be accessible and half did not. In addition, half of each group was asked to explicitly try to remember the information. In turned out that only the accessibility had an impact. If people thought the trivia would be accessible, they didn't memorize the information the way the other participants did, regardless of our explicit instruction to try to remember. This suggests this is not a conscious decision people are making. If information can be found again and again, it would make a kind of sense to keep it stored externally in a transactive memory system that exists online. Our third major finding was that when we gave people highly memorable trivia ("An ostrich's eye is bigger than its brain") and very unmemorable places the information they were typing would be stored (things), they tended to remember one or the other. If they remembered the trivia itself, they did not remember where to find it and vice versa. And aside from remembering neither, they were most likely to remember where to find the information. Just like we know who to go to for certain types of information, we seem to be prioritizing remembering where to look online in our increasingly complex transactive memory system.

Although people do remember less information when they know it is accessible online (Sparrow et al., 2011), this does not necessarily mean that they will learn less information in the long run, particularly when we consider the vast amount of information we consume every day (often called information overload). In addition, it is possible that if people have the need to access information repeatedly, that is if that information is personally relevant, in their area of expertise, and/or generally useful to them, this will result in increased internal memory. In effect, repeated exposure to the same or meaningfully similar information over time has been studied in cognitive psychology as the phenomenon of distributed practice (e.g., Bjork, 1979). Repeated exposure to information improves the memory for that information (Ebbinghaus, 1964). Repeated learning of information is retained longer when it is spaced apart in time compared to spending the same amount of time learning in one go (for a review, see Cepeda, Pashler, Vul, Wixted, & Rohrer, 2006). In a transactive memory system where we repeatedly access information via search engines because we don't remember it internally, spaced repetition is quite likely

to the extent that any given information is important and repeatedly requested of the learner. When we repeatedly visit several similar sources of information that arise from online searches, this may result in the information being better learned in the long run, even if we don't put a lot of effort into remembering information right away. In fact, the advantage of this kind of learning is that we will selectively learn the information that is relevant in that informational context.

However, this kind of learning is not equally advantageous when it is imposed on us (Son, 2010). The judgments that students make about how well they know some material inform their study decisions and are therefore consequential for learning outcomes (Metcalfe, 2009; Metcalfe & Finn, 2008). Given that in a transactive memory setting of learning online students are engaged in independent study, we suspect that they would likely use the same metacognitive judgment to inform their self-guided study as they would offline. In both cases, the element of choice, or agency, would impact performance (e.g., Iyengar & Lepper, 1999, who found that children both performed better and persisted in their performance when they felt agentic, agency that could come from the mother in the East Asian population studied). The questions to address in future research would examine the degree of metacognitive accuracy both on and offline and the decisions that students make based on this metacognitive awareness.

A long tradition of research in metacognition shows that people are for the most part overly optimistic about what they may know, although this tendency is decreased when those judgments are made about specific material rather than general assessments of one's knowledge (Metcalfe, 1998). Recently, Ward (2013) has shown that when people successfully access information online to answer questions that they did not know the answer to, their cognitive self-esteem is greater than that of those who did not access answers. Even though the number of questions they could answer correctly is equivalent, and even after controlling for the actual increased performance that search results bring (with false feedback), those who look up the answers using Google feel more confident about their cognitive ability. When they have access to all the knowledge the Internet offers, people feel more confident about their future performance and their cognitive ability in general.

If they did have access to Google at all times, they would in fact perform very well. However, existing research on overconfidence in metacognitive judgments of learning suggests that overconfidence discourages people from considering alternate studying strategies (Dunlosky & Rawson, 2012; Metcalfe, 1998). They do not have accurate knowledge of how much they have learned, so when they believe a study technique has helped them retain, they keep using it and are overconfident about their performance, and their performance does not meet their expectations. However, research thus far has mainly addressed overconfidence about specific material and in the context of a single user's memory and not in the transactive memory context, so this issue is ripe for future research to address.

Another interesting line of research would be the effect of interacting with a transactive memory partner such as the Internet on retrieval practice (Karpicke & Roediger, 2008; for a review see Karpicke, 2012; Karpicke & Grimaldi, 2012). As the research on the Google effect has shown (Sparrow et al., 2011), people seem to prioritize where to find this information, more than the information itself. It follows that every time some information is requested and individuals want to recall it, they will attempt to query the directory of the Internet in order to retrieve this information. Repeated retrieval attempts from one's own memory, as one would do on a test, have been shown to result in improved memory for material compared to even twice the amount of time spent restudying material (Roediger & Karpicke, 2006a, 2006b). It is important to note that this effect has been shown to generalize to classroom environments (e.g., McDaniel, Agarwal, Hustler, McDermott, & Roediger, 2011; Roediger, Agarwal, McDaniel, McDermott, 2011), and low-stakes tests are now the most empirically based recommended practice for learning environments (Pashler et al., 2007).

Possible Benefits of an Online Transactive Memory

Following this line of research, what are the potential learning gains from repeated queries of the "memory directory" of the Internet? We use the transactive memory system of the Internet when we don't know an answer to a question (Sparrow et al., 2011). This implies that we must have queried our own memories and come up with little to no information to answer the given question, and some recent research shows that even retrieving the wrong information may help learning by potentiating a search set (e.g., Huelser & Metcalfe, 2012; Kornell, Hays, & Bjork, 2009; for a review, see Grimaldi & Karpicke, 2012).

An obvious benefit of a query of the external directory of the Internet is that it helps us learn how to find the answer to a question we may not have been able to answer otherwise, therefore expanding the information we have access to and our ability to successfully search. Future research should address the question of whether the learning that occurs when information is retrieved from the Internet's directory produces learning gains that are more similar to retrieval attempts or relatively passive restudy of information. When looking for answers to questions on the Internet, creating the kind of feedback and test format that most closely resembles

the experience of an agentic retrieval attempt will bolster the testing effect that retrieval practice results in (Kang, McDermott, & Roediger, 2007). Perhaps the retrieval of information from the Internet that one doesn't yet know is most similar to open book tests in which students look up answers in the book when they don't know an answer. These kinds of tests have been shown to have equivalent benefits for learning as closed book tests, and result in better retention compared to restudying at a subsequent criterion test (Agarwal, Karpicke, Kang, & Roediger, 2008). Retrieval practice effects produce learning gains compared to passive restudy, both with word lists typically used in cognitive psychology experiments as well as more ecologically valid materials where restructuring information is required (Karpicke & Grimaldi, 2012).

Online Transactive Memory and Creativity

Recent research on transactive memory in the context of problem solving manipulated the accessibility of information that was not directly relevant to the solution of insight problems that were presented (Sparrow, 2013a). People can settle into a groove when they have strong associations, which are difficult to break. However, it has been shown that simply changing the language used to describe objects (e.g., a box and tacks, instead of the chronic association of a box of tacks) will allow people to solve the creative Dunker Candle problem (Higgins & Chaires, 1980). Solving problems creatively seems to involve not utilizing the most accessible or dominant solution. Breaking free from a highly accessible thought can be difficult. One usually has to have the patience to take a completely new approach. Attentional control, or keeping oneself on task, has been found to predict success in analytic but not creative problem solving (Gilhooly & Fioritou, 2009). When solutions lie outside the range of one's own expertise, creative problem solving declines (Ricks, Turley-Ames & Wiley, 2007; Wiley, 1998). To solve insight problems successfully, this evidence suggests people should overcome the most accessible and obvious solutions in order to solve the problem correctly. In other words, divergent and holistic processing is required to solve these problems.

In our preliminary experiments (Sparrow, 2013b) we gave people insight problems to which we had added extraneous details (a problem involving one stranger at a party talking to another stranger would be described as wearing black jeans and a red shirt, for example). Some of the participants believed they would later solve the series of problems without seeing the problems again in their entirety (in fact, they saw the original problem again without the black jeans and red shirt). Other participants believed the entire problem would be shown to them again (they saw the same version as the other group). In other words, two groups of people saw insight problems and were asked to solve them. One group believed the problem in its entirety would be accessible to them later and the other group did not. The inaccessible group may have, understandably, believed they needed to remember the details themselves in order to successfully solve the problems. The "accessible" participants used the computer as a transactive memory partner, and did in fact recall fewer pieces of information about the problem itself but were in contrast more successful at solving the problems. Participants who memorized the details, who believed the problem would be inaccessible to them later, did in fact recall more details. But they solved fewer problems. In addition, across conditions, the number of details remembered negatively predicted the number of insight problems successfully solved. This evidence suggests that offloading the remembering of details onto the Internet as a transactive memory partner will in fact aid creative problem solving.

Of interest, a survey of college students shows that they use the "look up information" strategy when material has many details and when they need additional information. They report most frequent use of the strategy of offloading information when the topic is accessible; they have no interest in the subject, and somewhat less often when there is a lot of related information; and they have time to spend (Yacci & Rozanski, 2012). These strategies may in fact prove adaptive for learning, as long as information is accessible and the details that they don't wish to remember themselves are not crucial for problem solving. However, one could see this becoming a problem for people who are in fact a transactive memory source themselves. It is hard to think of a situation where one would consult an outside source for information one already knows. Perhaps use of GPS is a good example of possible negative consequences. For people who have a good internal sense of direction, does GPS navigation have the effect of verbal overshadowing of faces (Schooler & Engstler-Schooler, 1990)? Obviously, moving away from pre-Internet ways of knowing isn't going to be beneficial in all cases. But from an education and innovation standpoint it seems that moving away from a memorization model of learning can be beneficial in many ways. At the very least, increasing creative thinking can create a loop in which students become better at finding information online, because they will approach the problem of search from multiple angles (Russell, 2011).

In summary, the evidence shows that when interacting with the Internet as a transactive memory partner, we do not remember as much information, instead relegating that responsibility to the computer or the Internet via search engines (Sparrow et al., 2011), much as we have always done with others, just more so. When we retrieve the information using Google, we feel a greater sense of cognitive

self-esteem and confidence in future performance (Ward, 2013). Finally, offloading memory for details to the Internet aids insight problem solving (Sparrow, 2013a). Future research should address memory processing that occurs as one repeatedly utilizes the memory of a transactive memory partner such as the Internet, as this is likely to occur multiple times for the most relevant information. If people are not remembering information themselves, how does repeated access to important information actually affect their memory for this information in the long term? Moreover, given the confidence that access to an external memory storage inspires, does this change the study choices that learners make based on this metacognitive estimate?

How Do the Characteristics of the Informational Environment on the Internet Influence Cognitive Processing?

The key feature of material that can be found on the Internet is that it is not subject to stringent publishing standards and verification, and yet even medical doctors google answers to their diagnostic or treatment dilemmas (Wolters Kluwer Health, 2011). People are increasingly using information found online to make consequential choices even though a large portion of information is not vetted according to standards of science, medicine, or other practices.

Searches have been tailored to the individual's existing preferences: Computer algorithms used to arrive at one's search results include general ratings of "popularity" relative to the keyword but also the information collected from one's own computer, such as search history (Jansen, Zhang, & Shultz, 2009). Given that typically the design of websites is entrusted to professional graphic designers, the content found on the Internet often contains more graphics and illustrations than in other formats. Both of these characteristics result in an increased sense of processing fluency, which has significant consequences for memory and metacognitive evaluation of material remembered (Alter & Oppenheimer, 2009).

Is Disbelief Difficult?

The content found on the Internet is largely uncensored and is certainly not always subject to comparably more stringent publishing rules that curate and define tastes of readers of some print or e-books. Although this development has made the expression of views more democratic as it is accessible to many more people, it has also produced a need for individuals to more carefully search, navigate, and select material they want to read and accept as true. Search and critical evaluation skills have become more important than ever. People rely on a small set of search patterns, and their lack of specificity in resource selection results in their having difficulty in narrowing down topics, finding relevant resources, or evaluating the sources' credibility (Head & Eisenberg, 2010). Most students rate themselves highly in Internet use skills, even if, objectively, that is not the case. The disparity in actual and self-perceived level of skill is greater in students who perform less well academically (Kuhlemeier & Hemker, 2007). Students tend to choose a search alternative based on the convenience of searching it, and while searching tend not to think of why the results are ordered as they are, if it is given any acknowledgment at all (Julien & Barker, 2009). Students believe that those search engines they use most often are most objective (Jansen et al., 2009), when in fact the opposite is true. Therefore, poorly performing students are most at risk for faulty assessments and an inability to search out the informative online content, making future research into online learning particularly crucial for students.

The emergence of the Internet as a widely used and globally shared network of knowledge—as a kind of collective external hive mind—requires people to adapt to this new feature of our environment with new skills. The skills necessary to compete in the 21st century, termed "new literacies," are defined as the competency to "locate information, critically evaluate the usefulness of that information, synthesize information to answer those questions, and then communicate the answers to others" (Leu, Kinzer, Coiro, & Cammack, 2004).

In addition to a preponderance of lowbrow, user-generated content containing an unusually high proportion of photos of cute animals, the information contained on the Internet can be of very high quality and potentially used for facilitating access to and improving the quality of education. Online education has shown much promise and there are some indicators of success, and the content is increasing in quality and scope with the opening of such institutions as MIT Open Courseware (http://ocw.mit.edu/index.htm), Khan Academy (http://www.khanacademy.org), Rice University's Connexions (http://cnx.org), and most recently Harvard and MIT's joint project EdX ("HarvardX," 2012). These opportunities make it worthwhile to use and learn from the vast opportunities for gaining quality knowledge on the Internet.

Although the amount of information available has grown exponentially, human attention is a scarce resource, and the amount and, more important, the quality of information people actually consume has not followed the same pattern (Johnson, 2012). Hence, it becomes more important than ever to be able to select the right (useful) information, weeding out the unreliable and the false.

As part of critical skills development, proponents of new literacy skills train students using spoof websites, finding that students will believe in the existence of "a tree octopus" facetiously pictured on the spoof website holding a dollar bill. However, this example cannot be taken as real empirical evidence that the Internet makes students more gullible, as there was no control condition to compare it to and the initial impetus to look for this information came from a credible source: the teacher. Instead we need a more fine-grained, experimental, evidence-based analysis of the cognitive processes that may lead to the "It's true, I saw it on the Internet" response.

In fact, assuming information to be true before proven otherwise has been shown to be the preponderant, default response (Gilbert, Krull, & Malone, 1990), and disbelief in presented information relies on effort and recruitment of cognitive resources (Gilbert, Tafarodi, & Malone, 1993). In the experiments in these studies, materials that people have little to no prior knowledge about were used. Presumably, people search for information online that they don't yet have, so these experiments may be a particularly appropriate hypothesis for what may happen during people's interactions with the Internet. As they access their transactive memory directory via information search, they are looking for information they don't have, and their tendency will be to assume it is true, just like they would in the case of asking another individual or looking it up in a book. In that sense, information found online may not be different from offline formats. In the case of face-to-face communication, the appropriate comparison is one of communication with a familiar person online, and we discuss that in the latter section of this article.

Of course, in addition to all the great things one could learn on the Internet, there's a multitude of persuasion attempts to buy this or that product that nearly always accompany any content that gets enough attention, measured in clicks and views. As human attention and memory is a finite and scarce resource and advertisements are indeed processed and require attention, the evaluation process of online information will be slowed and often interrupted. For the purposes of learning new information, the distracting and unwanted content of advertising is detrimental to the extent that it draws attention away from the task at hand. For the purpose of evaluating that information critically, competing attentional demands are precisely the kinds of manipulations that experiments use to induce cognitive load, which then prevents unbelieving the untrue (Gilbert et al., 1990; Gilbert et al., 1993).

Although it is the default tendency to accept the information as true, this does not preclude disbelief and critical epistemic evaluation. When the falsity of some information is informative, such as when we learn that the Supreme Court did not actually render "Obamacare" unconstitutional as originally reported on CNN and FOX news before the judgment was done being read, encoding the falsity of this information would not be easily interrupted with cognitive load (Hasson, Simmons, & Todorov, 2005) as it was in Gilbert's original experiment. This implies that when learning new information, if pronouncing it as false carries great informational value, disbelief will not be interrupted by competing attentional demands. In contrast, when prior knowledge on a topic exists, the rejection of false information is part of the process of comprehension and occurs effortlessly (Richter, Schroeder, & Wohrmann, 2009). This implies that when people need additional information on topics they already know about, prior knowledge is recruited in the process of verification. However, Sparrow and colleagues (2011) have shown that most of the search for information is most likely to occur in contexts where information is not known.

Search Engines Create Illusions of Control

Finding the answer to a question via successful search induces an increase in one's cognitive self-esteem, increasing one's sense of effectiveness (Ward, 2013). To the extent that an increased but illusory sense of cognitive self-esteem (Ward, 2013) also results in an illusory sense of control in the situation, the effects of this inflated confidence may be similar to the effects of power on belief. In particular, research in the area of power has shown the effects it has on cognition are mediated by an illusory, inflated sense of control (Fast, Gruenfeld, Sivanathan, & Galinsky, 2009). To the extent that individuals feel a greater sense of control—compared to an experience of lack of control—they will be inclined to set higher standards for perceiving patterns or meaning where none exist (Whitson & Galinsky, 2008). In addition, decreased sense of control leads to decreased executive functioning that is required in order to critically evaluate and un-believe entirely novel material (Gilbert et al., 1990). This evidence suggests that to the extent that people may feel a greater sense of control in the context of retrieving information online, they may in fact be more inclined to be critical. This is pretty much the opposite of what most people believe, which is that we, especially if we are children, believe everything we read online without question.

We have tested the idea that exercising choice while retrieving information, as one does when using search engines to find new information on the Internet, causes a greater sense of control and agency compared to when the information received is from an outside agent or random. In a pilot experiment we found that people felt most agentic when they chose, and that the random and assigned conditions didn't differ significantly

(Chatman & Sparrow, 2013). We also found that students tended to be more critical of information when they chose, regardless of the content. However, repeatedly making many choices may also result in a decreased sense of control, as is described in the phenomenon of information overload (Toffler, 1984).

In using the Internet as part of one's transactive memory system, people seek out information and risk finding unverified information more than in traditional formats, making critical evaluation of the information a key component of new literacy skills. The psychological factors that would promote the critical evaluation of information are a lack of distractions, high information value of false information, prior knowledge of a topic, and likely a sense of efficacy with an eye toward assessment and deeper, elaborated processing.

Most search engines are biased in how they sort the search results, most notably Google as the most frequently used. Essentially, before search results hit the user, they are first globally ranked and then personally ranked. Global rankings are based on a combination of interlinking and popularity, meaning the most popular—and by extension relevant—links will rise to the top. However, popularity doesn't always mean that the site is credible, and attempts by algorithms to control for credibility have led to every search engine having its own slant. This is especially troublesome when a search engine becomes a user's primary means of discovering new content. Search engines are actually rewarded by the user for the bias in their algorithms, as users will rate search engines that return the results that they are expecting much more highly than search engines that return more diverse results. This effect also works in the opposite way, in that search engines that the user often uses are automatically believed to have a higher degree of objectivity (Jansen et al., 2009) than is actually the case (with our search histories and other personal information, not to mention other people's search results biasing the order in which results are presented to us). Because it feels like we are in charge of our web searches, even if we are not as agentic as we believe, the lack of transparency, paradoxically according to our preliminary research on agency and evaluation, results in web users being more critical in the evaluation of what they read online.

According to a national survey report of adults, people are now more satisfied with search engine results than they've ever been, but they feel unease at the recognition that their online activities are being monitored (Purcell, Brenner, & Rainie, 2012). More than half of search engine users report that they perceive the engines to be fair and unbiased and that the results of search engine use have gotten more useful and relevant. However, experts in the information industry have been discussing the drawbacks of personalization known as the filter bubble (Pariser, 2011). This bubble is created by the inherent bias in the structure of search engines. For the sake of achieving relevance, these algorithms decrease the likelihood of encountering information that does not accord with our own preferences, homogenizing the kind of information we are exposed to and limiting our chances of encountering new information discordant with our existing views and preferences.

The psychological implications of this phenomenon result from the increased frequency of instances that users are exposed to information that is semantically similar or even identical verbatim. The "truth effect" meta-analysis demonstrates that repeating the same information will make the same information more subjectively believable than it was the previous time that it was encountered, and the information that is repeated will seem more believable compared to less frequently encountered but otherwise similar unknown information (Dechene, Stahl, Hansen, & Wanke, 2010). Increased repetition of material results in increased certainty that it is true (e.g., Arkes, Boehm, & Xu, 1999; Hasher, Goldstein, & Toppino, 1977).

Search Fluency

The subjective sense of ease (i.e., the fluency of processing information), produces changes in many metacognitive judgments about the information itself. The sources of the experience of fluency are many: the perceptual qualities of the information, memory-based fluency cues, embodied cues, or higher order processing fluency (Alter & Oppenheimer, 2009). To the extent that repetition causes greater perceptual and recall ease, the aforementioned effects of repetition can also be explained by processing fluency.

The fluency heuristic is a distinct cue for our judgment of how accessible in our memory information is overall (Schwarz, 1998). In addition, the ways in which people use this heuristic to make judgments varies based on the naïve theories they have adopted (for a review, see N. Schwartz, 2004). However, Alter and Oppenheimer showed that regardless of the source of fluency, this heuristic cue biases many kinds of metacognitive judgments. Here we summarize how fluency impacts confidence in one's knowledge and perceived truthfulness of information, as they are most relevant for how we learn new information using the Internet (for other judgments such as liking, frequency, fame, intelligence, valuation, and category typicality, see Alter & Oppenheimer, 2009).

The confidence in the answers we give to a variety of general knowledge questions is enhanced when those questions seem more familiar. When this cue is familiar and thus more fluently processed, people are more confident in the accuracy of their knowledge on the topic, and they feel that they know the answer,

even if they can't retrieve it (Metcalfe, Schwartz, & Joaquim, 1993; Reder & Ritter, 1992; B. L. Schwartz & Metcalfe, 1992). It follows that to the extent that people repeatedly see material on the Internet, they are likely to feel that they may know the answers to these questions more.

Much of the content found on the Internet is presented in a way that typically contains more illustrations than traditional text formats. To the extent that any content on the web contains a greater amount of graphic material, this has consequences for how believable the content seems: Researchers have found that presenting photos along with information makes the information more believable compared to identical information presented by itself (Newman, Garry, Bernstein, Kantner, & Lindsay, 2012), even if the photos are unrelated to the information. Images of the brain seem to make psychological articles particularly believable, as they provide visual, concrete, easy representations for abstract concepts (McCabe & Castel, 2008).

In summary, to the extent that the same or similar information is seen often, it will be well remembered and seem more believable. This may be quite useful, because the information found is actually more relevant to what Internet users are looking for (Purcell, 2012). The implications of this research are that the increasingly relevant but also increasingly homogeneous novel or ambiguous information will be better remembered and more believable.

The trade-off of this practice is that stumbling upon information that one was not expecting and broadening one's view of the world via disconfirming information will become increasingly unlikely due to the customization of searches and the "filter bubble" it produces. In addition, irrelevant illustrations and other cues that result in the sense of ease of processing might seem more believable, due to the heuristic value of fluency for belief judgments.

Personalization Is Shaping Our Preferences

People also look at information in order to make choices between options online: 71% of Internet users buy products as part of their online activity (Bennett, 2012). Between targeted advertising and personalized searches, the array of options that a user chooses from are based on their browsing history, which reflects their prior choices. The literature on how preferences are shaped bears on this issue, pointing to the hypothesis that in this way people's choices may become more and more stereotypic and similar to what the underlying algorithms of the advertisers and search engines believe our preferences to be.

More than half a century of research on the free choice paradigm shows us that once we have chosen one option over another, the chosen option is perceived more favorably than before, whereas the unchosen option is perceived less favorably than before the choice was made (Brehm, 1956). This phenomenon occurs when the options are similar to each other and neither least nor most favorite. Furthermore, this phenomenon even occurs among amnesiacs, suggesting that memory for what was selected has little impact on this phenomenon (Lieberman, Ochsner, Gilbert, & Schacter, 2001). Young children as well as our primate relatives show the same phenomenon (Egan, Santos, & Bloom, 2007). Finally, our prior choices shape our future choices, actually determining and not merely expressing our preferences (Ariely & Norton, 2008).

Furthermore, upon addressing methodological issues (Chen & Risen, 2010; Izuma & Murayama, 2013), Sharot and colleagues showed that even blind choice can change future preferences (Sharot, Velasquez, & Dolan, 2010). This paradigm involves providing participants with an illusion of choice that is not based on their actual preferences and shows that choice-induced preference change occurs even when the people only perceive that they are making a free choice. Blind choice effects were subsequently shown in children and capuchin moneys as well (Egan, Bloom, & Santos, 2010). Of importance, the effects of the free choice paradigm seem to last even 3 years after the original choice was made (Sharot, Fleming, Yu, Koster, & Dolan, 2012)

People make many choices, expressing their preferences online after searching for an item. Searches are now "personalized" based on one's search and purchasing history. These parameters constrain the set of items that one can choose from, and the parameters often include demographic information collected about a user. This personalization of search results based on Google's, or any search engine's algorithm creates a loop in which we are shown what we want to see, and we in turn prefer what we are shown, the mere exposure effect (Zajonc, 1968) based on familiarity with our own pasts. To the extent that these algorithms are based on one's demographic information, over time, via prior choices shaping future choices, this may lead people to have more stereotypic preferences that are based on their demographics.

One caveat of this hypothesis is that the shaping of future choices occurs only when people perceive that they are making choices of their own free will and the options being compared are not dramatically different from each other. As people have some awareness of the fact that their preferences shape their searches (Purcell, 2012), there is a possibility that they will not feel that the choices they make are entirely free and therefore may preclude the choice induced changes in preferences.

Internet as a Device for Channeling Other People

The most popular ways of using the Internet are searching for information and e-mailing other people. In addition, U.S. adults spend just shy of half of their time online socializing through social networks and reading material found online. Some of that material people arrive at through sharing information on social networks, recommended by individuals we know online and most often offline as well. In the early days of Internet use people were often anonymous and interacted with individuals they would likely never meet, engendering a new aphorism—"On the Internet, no one knows you are a dog." Although this kind of Internet use does still occur, it has become the exception rather than the rule. Patterns of Internet use for communication have changed such that individuals are increasingly known, and in fact willingly share a lot of their personal information online (Carlson & Shontell, 2013).

One of the key distinctions in human–computer interaction literature is "presence"—the sense that there is another individual or agent behind the workings of a networked computer, where under high conditions of presence the person is more salient than the technology they are utilizing to interact (Lombard & Ditton, 1997). Although presence of other individuals should be most obviously salient in virtual reality settings, in this review we focus on interactions where the sense of presence is derived from familiarity with the person that one is communicating with rather than the salience of the technological medium. In this review we focus on "general purpose" social networks, which are generally a fairly accurate representation of one's social network offline (Crosier, Zolfaghari, & Webster, 2013).

These online social environments, with Facebook being the most popular, are used primarily for social interaction, and the content presented is presumed to be true information about facts or people's views on particular issues. We focus on social network settings with these characteristics because of their prevalent and thus influential use. In addition, we look at the research on email-based communication as one of the most popular ways of communicating with other individuals.

We are not including social networking sites that people join for particular purposes such as finding a mate (dating websites) or a job (professional networking websites), because communications and information exchanged on those websites may be biased by these explicitly expressed motivations as well as social norms in those particular settings. Specifically, the consequences for one's memory for information differ when the motivation of a communication is not intended to establish what is real, but what is desired, and self-presentation concerns and norms of communication are likely to be very different in these settings.

We first turn to how people are perceived through their social network profiles and then propose an analysis of how the perceived presence of others, as they appear online, may impact our communications and subsequently bias what we remember. Using a social constructivist approach and its experimental incarnations, we then point to possible consequences for what we remember or forget and how much credibility we assign to that information.

How Do We Perceive Others Online?

We use computers to channel the presence of other people in our lives. We communicate with them about a variety of topics, fine-tuning our own views and understanding theirs, as well as explicitly seeking new information. The degree to which the presence of another intentional agent is salient has import for the cognitive processes that unfold in the mind of a networked computer user.

A most useful review of one of the most frequently used social-networking sites, Facebook, summarizes the findings across the social sciences and shows that people's profiles on social networks convey impressions of their personalities fairly accurately, at least as much as in their daily lives (Back et al., 2010; Gosling, Augustine, Vazire, Holtzman, & Gaddis, 2011). The cues used to do so are different and in addition to what people post about themselves, people are perceived based on the information that their friends' responses to their posts convey. Numbers of connections people make in the network provide relatively accurate expressions of extraversion. One's online network is a fairly accurate reflection of a person's actual social network (Crosier et al., 2013). In essence, people rarely misrepresent themselves or at least not more than they would do so offline.

However, the reduced cues theory arising in the computer science field of human–computer interaction claims that the differences between online and face-to-face behavior arise primarily because of the relative paucity of social cues present in the online environment (Kiesler, Siegel, & McGuire, 1984). Online communication, where cues of high status (e.g., clothing, grooming) are less salient, can produce greater equality of influence among co-actors (Dubrovsky, Kiesler, & Sethna, 1991). One can follow the instructions on a Mac forum for fixing a problem with PowerPoint, for example, and not know these instructions were provided by a 14-year-old girl and not a Mac software professional. One can agree and be delighted by a political argument made in a comment on Facebook and never know it came from someone without a high school education. The heuristics we use for persuasion

can often lead us astray in the real world. But even online, this increased democratization of ideas does not exist everywhere. Equalizing is not found in anonymous and stereotype congruent environments (Postmes & Spears, 2002).

The Benefits and Costs of Being Behind a Screen

Compared to voiceless communications, hearing an individual's voice communicate a message results in a perception that the person has greater agency, experience, and humanness compared to when the same message is delivered via text based format (Epley & Schroeder, 2012). Given that most communication on social networks and all of e-mail communication occurs without the presence of voice features, the same people are likely to be perceived as actors with less of a mind. Of course, this is likely to be true for perceptions of those people we don't also communicate with via phone or face-to-face. This has further downstream consequences in that decreased mind perception is associated with less empathy and sense of moral responsibility toward the person (K. Gray, Young, & Waytz, 2012). One need only need look at *any* comments section on any type of online communication, whether it be a news article, opinion piece, or cooking recipe. Worse than any third reviewer is the comments section on CNN or MSBNC (we'll wait; go take a look if you never have). Anonymous commenters seem to completely lose sight that they are discussing real people and that what they say may very likely be read by these people and have consequences for their lives. For example, at the beginning of the pregnancy of the Duchess of Cambridge, she was admitted to a hospital for severe morning sickness. A radio program in Australia called up the hospital pretending (apparently very badly) to be the Queen looking for information on her daughter-in-law. The nurse who put the call through, and who was then mercilessly mocked for incredible stupidity almost everywhere you looked online, committed suicide a few days later. And she *then* was vilified in the comments sections of news articles detailing her suicide.

The amount of information that people share is growing exponentially (Carlson & Shontell, 2013) and is the fastest growing section of data on the Internet. People share in order to connect with other people, satisfying one of the most basic human needs: to affiliate and belong (Baumeister & Leary, 1995). Disclosing information about oneself can be intrinsically rewarding, so much so that people are willing to suffer significant trade-offs to do this (Tamir & Mitchell, 2012), and this can even be therapeutic in some cases (Niederhoffer & Pennebaker, 2009). Self-disclosure generally improves relationships (Collins & Miller, 1994), but it is not just communications about the self that are motivated by relational needs. Rather, both relational and epistemic motives are important when people attempt to establish a shared understanding of reality through communication (Echterhoff, Higgins, & Levine, 2009).

Despite the benefits offered by online communication in increasing the number of opportunities people have to communicate with each other, not all communication channels have the same effect. The rewards offered by communication with a friend after a stressful event are not equally rewarding when they are presented in the form of text only (Seltzer, Zeigler, & Pollack, 2013). Although both forms of communication elicit a physiological response that is associated with social bonding and support, the response is lessened in intensity when the meaning of communication is carried in text only.

However, when communication proceeds through the asynchronous medium of e-mail and text exchanges, the messages that one shares tend to be more controlled, and people tend to choose to share and discuss more interesting content (Berger & Iyengar, 2013). In this way the content of what we share becomes more relevant for the actors involved. Instead of obeying social norms of when one should reply when spoken to, we can take our time online and think about how we want to respond. We may be more thoughful and empathic because we have had the time to perhaps put on the other person's shoes, or maybe we aren't as worried about saying the wrong thing because we can more easily remove ourselves from the situation. The relational characteristics of communication online may also have implications for perceptions of social support, loneliness, and depression, research areas that are important and interesting but beyond the scope of this review.

How Is the Social Construction of Reality Processed Online?

The implied or actual presence of other people has consequences for human performance on mental and physical tasks, enhancing effectiveness when the task is well practiced or simple, and impairing performance when the task is complex, presumably because the presence of others increases drive and arousal (Aiello & Douthitt, 2001; Allport, 1920a; Triplett, 1898; Zajonc, 1965). This phenomenon has been tested in the context of electronic monitoring, where employees are made aware that their computer activity is being monitored. Electronic monitoring has the effect of impairing performance on complex tasks (Aiello & Svec, 1993) and slightly improving performance on simple tasks (Griffith, 1993).

This research implies that inasmuch as online social networking sites create a sense of presence of others in one's environment, particularly if that other has an evaluative role for the user, it may impair performance on complex tasks compared to when the computer is used in a more impersonal context, as we described in the first section, and the user feels he or she is not being observed. In addition, research also suggests that providing individuals with a sense of control over when they are monitored helps to alleviate the detrimental effects on complex task performance (Aiello & Svec, 1993; Douthitt & Aiello, 2001; Stanton & BarnesFarrell, 1996).

In the following section we present current research and implications of communicating information on how it is processed, remembered, and later evaluated. We then suggest that differences in person-perception in online social environments may affect these processes. Although a thorough review of memory effects that arise from social interactions is beyond the scope of this article, we draw on this research and discuss implications for online behavior (for excellent reviews and history of research on social influences on memory, see Coman, Brown, Koppel, & Hirst, 2009; Hirst & Echterhoff, 2012; Hirst & Manier, 2008).

As described earlier, self-disclosure is very rewarding. The consequences of self-disclosure are not merely sharing knowledge with other people but also changing the way that information is stored in our own memory. Preparing to communicate a message itself exerts powerful effects on the way that information is organized and encoded in one's own memory (Zajonc, 1960). In that sense the blogosphere is useful not merely for finding new information, but it is useful to us in that information about the world is more structured, organized, and remembered when it is to be communicated to an audience. Therefore, to the extent that we have more opportunities to communicate to others this will change the level of detail and organization of our own memories. Future research should address to what degree this happens with e-mail communications, blogs, and other asynchronous media that are devoid of direct interpersonal cues. Recent research points to the fact that in these media we already select and choose to share more interesting topics (Berger, 2013).

A related phenomenon occurs when we are communicating with others whose attitudes are familiar to us. When the information is ambiguous and we communicate a message to an audience, that message is tuned toward what we think the audience believes about a topic (e.g., Higgins, 1978; Todorov, 2002; for a review see Higgins, 1999). Furthermore, after successfully communicating a message (which was biased toward the perceived audience attitude), this changes our memory of the original information, resulting in a sense of shared realty between communication partners. In other words, assuming that the communication is successful and relational and epistemic, communication changes what the communicator believes to be true about the topic (for reviews, see Ecterhoff, Higgins, et al., 2009; Hardin & Higgins, 1996). These motives and mechanisms then form the ideological and belief systems that powerfully influence our lives and cause people to adhere to these ideologies in the face of disconfirming evidence (Jost, Ledgerwood, & Hardin, 2007).

Of importance, these memory biases occur when people are communicating with individuals whom they perceive to be part of their ingroup but not outgroup members (e.g., Echterhoff, Higgins, & Groll, 2005; Echterhoff, Kopietz, Higgins, & Groll, 2008). They occur only when the motivation for communication is to establish what is in fact true (Echterhoff et al., 2008), and epistemic trust is a key mediator of the biasing effects of communication on memory for the original event (Echterhoff, Higgins, et al., 2009). In addition, relational motives are crucial for establishing shared reality through communication, as the phenomenon of shared reality is absent when communicating with a high-status member (Echterhoff, Lang, Krämer, & Higgins, 2009) or when the relationship with the audience has been interrupted (Echterhoff, Kopietz, & Higgins, 2013).

A related phenomenon that arises through communication with others is that of false memories. Given that memory is continually reconstructed and not a static and direct representation of an event, decades of research have shown that exposing people to misinformation can cause them to remember the original information differently (for a review, see Loftus, 2005). It is important to note that the plausibility of the misinformation, the credibility of the source, and the degree to which the information can be vividly imagined are all key factors, which increase the possibility of creating false memories that either bias the existing memories (Loftus, Miller, & Burns, 1978) or create entirely new ones (Braun, Ellis, & Loftus, 2002). Future research should address the question of how these effects occur in the absence of linguistic cues provided by voice and dynamic facial cues, what cues people use to perceive the credibility of a source online, and how images provided with a lot of online content may bias the way that it is remembered.

However, vivid imagery and leading questions are not necessary to increase the incidence of false memories: Research on social contagion of (sometimes false) memories shows that when people engage in joint remembering, as people typically do through conversation, this increases the incidence of false memories spreading from one communication partner to another (Roediger, Meade, & Bergman, 2001; Wright, Self, & Justice, 2000).

Conversations that we have with others shape not only what we remember, but what we forget as well.

In a phenomenon termed retrieval induced forgetting (for review, see Anderson & Levy 2002), research shows that the information that is not practiced but is related to practiced material is selectively forgotten compared to material that was not practiced but is also unrelated to the practiced material. The extension of this cognitive phenomenon into a social setting shows that this phenomenon occurs both for the "speaker" and the "listener" during a conversation. What is not talked about in a conversation is forgotten faster than the comparable material that was simply not eligible to be talked about (e.g., Cuc, Koppel, & Hirst, 2007; for a review see Stone, Coman, Brown, Koppel, & Hirst, 2012). Conversations induce people to selectively forget parts of their memories surrounding public, shared and highly emotionally charged events such as 9/11, where the initial information is not the same for all participants (Coman, Manier, & Hirst, 2009). Furthermore, there is initial evidence that retrieval induced forgetting propagates through a social network via sequences of conversations in which people selectively remember a subset of all available information on a topic (Coman & Hirst, 2012).

When people communicate in an online environment, does what they share actually make what is not shared harder to remember? We've seen that in asynchronous communications online people tend to communicate more interesting topics because they have the time to do so (conversation rarely pauses for a minute or two between two face-to-face speakers; Berger, 2013), which implies that the less interesting parts of the same topic of conversation will be forgotten faster than comparable unrelated information.

Bias and Persuasion Online

In applying these findings to an online environment, the important questions for future research refer to what the relevant in-groups are online and how they are perceived in the "thin cues" environment. Furthermore, many social networks have filters that selectively present information to us that the algorithm has calculated we'd be interested in seeing. Although these algorithms are proprietary, you can download a program that can show you whose activity Facebook estimates you want to see (Keeshin, 2011).

To the extent that these algorithms indeed correctly estimate similarity between people, it is likely that people will be exposed to content that is more similar to what we already know, whereas these individuals may be more likely to be perceived as ingroup members who are trusted and liked. The psychological consequences that follow from the shared reality literature (Echterhoff, Higgins, et al., 2009; Hardin & Higgins, 1996) are that these communications biased toward our already-existing attitudes will become what we remember of the original events.

In addition, in everyday conversations the more influential interaction partner is more likely to introduce into conversations content that isn't already shared (Hirst & Manier, 1996), and perceived expertise plays an important role in the propagation of memories through communication (Brown, Coman, & Hirst, 2009). Future research should address perceptions and distribution of expertise among online communication partners and how it influences memory outcomes.

Shared reality also occurs in the context of communicating to a group audience in which case the actual communication of a message does not need to occur, as the group acts as an epistemic authority to the degree that there is perceived group consensus on the attitude on a topic (Higgins, Echterhoff, Crespillo, & Kopietz, 2007). Future research should address how an individual's memory of a topic could be shaped by perceived attitude of the "cloud mind" about that topic. For example, if Buzzfeed or the "blogosphere" has a negative or positive attitude toward some news item, does that change the way that the original news item is actually remembered?

It is important to note that the way that many shared reality studies to date have been conducted has been computer-based communication where the audience is in fact fictitious and the message produced is typed and ostensibly delivered by the experimenter to the ostensible audience member sitting in the next room. This suggests that text-based format is sufficient for these memory biases to occur.

Although memories are shaped through communications themselves, these memories are also processed differently based on the trustworthiness of the source of information when people know about the un/trustworthiness of the source both before (social prewarning; e.g., Boon & Baxter, 2000) and after (social postwarning) the message has been received (e.g., Bodner, Musch, & Azad, 2009; Echterhoff, Hirst, & Hussy, 2005). Overall, warnings about untrustworthy sources are more effective when presented before any to-be-remembered material, but explicit post warnings also decrease the chances of the misinformation effect by causing people to engage in greater source monitoring (Echterhoff et al., 2005; Hirst & Echterhoff, 2012).

However, these strategies reduce but don't eliminate the misinformation effects, and in the context of belief-changing narratives, misinformation persists in the face of discredited sources (Green & Donahue, 2011). Moreover, both strategies have trade-offs: Prewarnings can backfire and de facto decrease accuracy when the task is difficult (Muller & Hirst, 2010), whereas postwarnings can cause incorrect rejection of old material (Echterhoff, Groll, & Hirst, 2007), throwing out the baby with the bathwater.

In the context of communications online, messages often appear with an image of the face of a communication partner. Even in a split second, people make inferences of trustworthiness from people's faces (Todorov, Pakrashi, & Oosterhof, 2009) and the images we see online may interact with our knowledge about the communication partner offline to produce estimates of trustworthiness and alter the perceptions and effects of information shared.

In the realm of persuasion, video and audiotape formats of messages result in more attitude change compared to text only (Chaiken & Eagly, 1983). In addition, in this research text (e-mail) compared to face-to-face communication was less impactful for attitude change for female participants only (Guadagno & Cialdini, 2005, 2007). The analysis of the content of answers pointed to greater systematic/critical processing of the message when only text was present. This suggests that communications that are more devoid of strong interpersonal cues may be analyzed in a more analytical/systematic way. Consistent with the idea of greater amounts of social cues producing more influence, the salience of the presence of other individuals in e-mail communication produces greater compliance with requests. Specifically, the addition of a photograph of the ostensible person making the request induces greater compliance (Gueguen & Jacob, 2002).

Political Polarization

We have long known that we see and create what we expect to see in the world, more formally known as expectancy confirmation. People who are for or against the death penalty will be even more for or against the death penalty after reading an opposing argument (Lord, Ross, & Lepper, 1979). This comes about because people more systematically evaluate opposing information than they do information that confirms their beliefs. Thus people with opposing attitudes are described as becoming more polarized and entrenched in their views.

These days most of us get our political news online. In 2008, and one can only assume an increase in the last few years, 44% of American adults read political news online on a daily basis (Purcell, Brenner, & Rainie, 2012). People tend to go onto sites that have like-minded individuals who have the same political beliefs as they do, and these sites link to like-minded sites (Adamic & Glance, 2005), ensuring that we stay in a bubble far away from opposing beliefs.

When we do come across remarks we consider egregious, it is usually in a network we use for other reasons (Facebook, Twitter), and flame wars, unfollowings, and unfriendings result. Twitter is the social platform of brevity, where what one writes and reads can be no longer than 140 characters. One can retweet what one has read, basically increasing its visibility, or one can mention, which involves contacting the person who wrote a tweet directly. Of interest, these two forms of interaction differ depending on whether the content confirms or violates your beliefs (Conover et al., 2011). Instead of hiding people in the newsfeed on Facebook (presumably so you can remain friends with them) and thus further limiting your exposure to other beliefs, Twitter with its brief format seems to encourage direct dialogue through mentions (people retweet what they agree with). It may be that brevity is the key, or perhaps lack of prior personal connection with the tweeter. It could be that dehumanization that occurs online (K. Gray et al., 2012) may be a mechanism for our allowing ourselves to be exposed to opposing political beliefs.

In summary, to the extent that the computer can convey the presence of other individuals in our lives, this will likely produce negative effects on complex task performance, but facilitation in simple, relatively automatic tasks. The information that we receive through communication may be even more similar to people's current knowledge than would be expected based on ingroup bias to the extent that information from people who are more similar to ourselves is filtered. Communicating information to similar others perceived to be in one's ingroup will likely lead to attitude congruent memory biases. The information communicated by another person may cause us to preferentially forget the uncommunicated information on the same topic, which in this case would more likely be the information that is discrepant with our existing views and preferences. When the source of the information turns out to be untrustworthy either before or after a message has been conveyed, people will still be likely to incorporate this information into their memories about an event, although this effect may be decreased. However, the decreased salience of other individuals in the informational environment may also increase systematic processing, leaving individuals less vulnerable to direct persuasion and attitude change.

Conclusion

We are now able to learn so much more valuable information and even get a very good education from the convenience of our networked computing devices. Here we explore how this may change what we know and how we process information. This information can be derived from this relatively amorphous but nearly omniscient entity: the Internet seen through the lens of Google. Alternately, we still communicate with other people to find out about the world, but we often do so mediated by a computer in a relative deprivation of the usual set of nonverbal cues included in face-to-face interactions. The knowledge that we have access

to is distributed across a network of people and institutions, and now that network includes all the content that Google can find on the Internet.

Unbeknownst to most people, communicating with others alters our memories and beliefs about what is real. In the digital age, it's important to extend that research into how these communications work in a computer-mediated informational environment. As humans adapt to living with technology, social psychology should follow this trend and understand how these adaptations are driving the way our cognitions may change the process and the resulting content of our socially negotiated reality.

In short, we don't see the Internet going away anytime soon, so instead of throwing up our hands and concluding that "Google is making us stupid" without evidence (Carr, 2007), we need to understand the variables that will make the most of our use of the incredible amount of information at our disposal. Indeed, outside of the effects on cognition, we have seen the Internet have a positive impact in several realms. Information has become more democratically available. Someone who has an aptitude for physics, for example, but not the resources to attend university can read journal articles online (this would be even more true if more scientific journals became open access) and join groups of like-minded individuals. Disciplines such as theoretical mathematics may benefit the most from this increased crowd sourcing of information. There have been crimes solved by amateur sleuths who gather such web groups. Social networks have brought about revolutions, such as the current unrest in Turkey, and last year's insurgency in Egypt. On the other hand, we have become collectively unnerved by the secret surveillance of our online activities by our government, as recently brought to light by Edward Snowden. Even outside the domain of social cognition, living our lives online is a double-edged sword.

Note

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