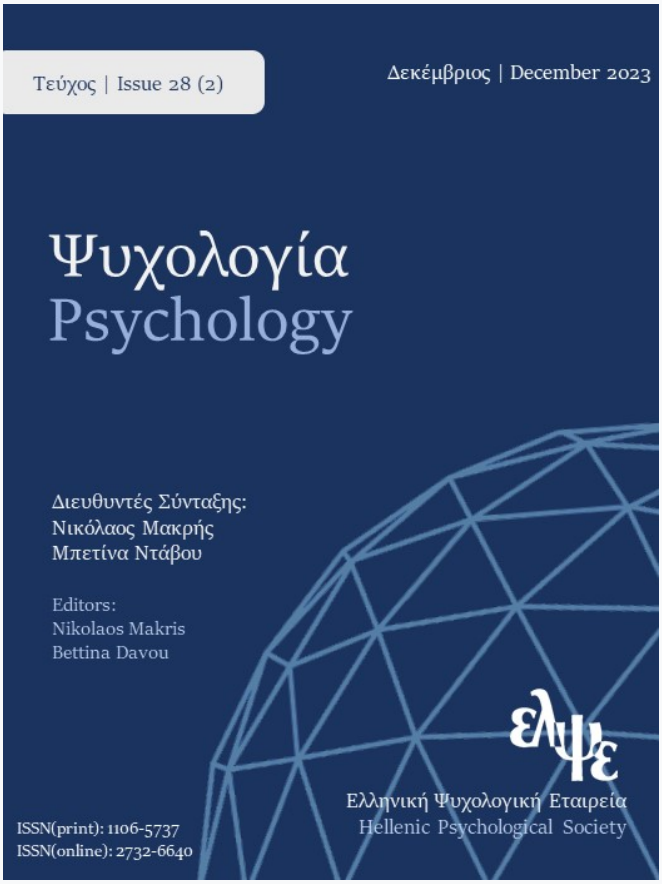
Psychology: the Journal of the Hellenic Psychological Society

Vol 28, No 2 (2023)

Special Section: Nous: A powerful machine



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doi: 10.12681/psy_hps.36228

To cite this article:

Sidiropoulou, E., & Metallidou, P. (2023). Metacognitive phenomena during human–Internet interactions. *Psychology: The Journal of the Hellenic Psychological Society*, *28*(2), 69–82. https://doi.org/10.12681/psy_hps.36228

ΨΥΧΟΛΟΓΙΑ | PSYCHOLOGY, 28(2), 69-82

Ελληνική Ψυχολογική Εταιρεία
Hellenic Psychological Society

ΒΙΒΛΙΟΓΡΑΦΙΚΗ ΑΝΑΣΚΟΠΗΣΗ | REVIEW PAPER

Metacognitive phenomena during human–Internet interactions

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KEYWORDS

Internet,
Metacognition,
Metacognitive judgments,
Memory,
Transactive memory systems,
Cognitive offloading

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ABSTRACT

External information systems often serve as an extended cognitive system and are usually conceived as expansions of the capacity of human cognition. However, the boundaries between our own mind and a powerful cloud mind, like the Internet, are increasingly blurry. This paper discusses recent empirical evidence of various metacognitive phenomena taking place while searching for information on the Internet**,** against the backdrop of the theory of transactive memory systems and the theory of cognitive offloading. The discussion focuses on the ways our cognitive systems maneuver and adapt their responses to the medium of the Internet by examining its effects on the metacognitive evaluations of oneself as a knower, the novel metacognitive experience of the feeling of findability, and how our metamemory judgments are affected. The conclusion proposes directions for future research and a better understanding of our interaction with the Internet.

Introduction

Humans have always used external aids or tools to accomplish tasks that are difficult or impossible for their cognitive systems to handle on their own. These aids are regarded as distributed or extended (designations derived from cognitive science and philosophy of mind, respectively) and imply a broader conception of cognition, namely that cognition is not a quality of the mind but "a product of the relationships between mental structures and the tools of intellect provided by the culture" (Pea, 1985, as cited in Salomon, 1988, p. 5) and that cognitive processes occurring in the mind can be extended beyond the boundaries of the individual to include the individual's physical and sociocultural environment (Kiverstein et al., 2013). Today, these types of aids have evolved to an unprecedented degree in terms of variety of uses, efficiency, seamless accessibility, and mass availability. Anyone can access a plethora of tools through digital devices, such as the Global Positioning System (GPS), language translators, identification tools (from plants and birds to constellations), trackers of all types (from daily mood trackers to activity trackers), and, of course, the Internet, the world's most extensive data source and storage. This updated interest in cognitive tools has led to a remarkable boom in research focusing on the interactions between them and the human cognitive system. This paper discusses how the above relationship is expressed at the cognitive and metacognitive levels by using the Internet as a sample cognitive tool, constituting an information source and, at the same time, an information storage device (Ward, 2013b). In the context of our discussion, the term "Internet" is conceptualized specifically to refer to the activity accessing and retrieving digital information via search engines. The perspective adopted for online search is that of a problem-solving process (Brand-Gruwel et al., 2009).

We begin our exploration by describing how humans enter into this special relationship with the Internet based on the theory of transactive memory systems (Wegner, 1987), which states that the Internet is more of a partner than a tool. Thus, an intriguing question arises: how does delegating the responsibility for completing a cognitive task to such a partner affect the cognitive system? In order to theoretically frame our question, we

introduce the theory of cognitive offloading, which assigns a pivotal role to metacognition and argues that "opportunities to offload cognition can affect both lower-level cognitive systems (e.g., memory) and higher-level metacognitive evaluations of these systems (e.g., confidence)" (Risko & Gilbert, 2016, p. 683). We then present evidence on the factors affecting the decision to use the Internet, the bias of the inflated feeling of confidence in oneself as a knower (which is induced by searching the Internet), the feeling of findability, and how it can be seen as an example of a functional adaptation to the specificities of the medium, and how knowledge of the future availability of information in an electronic medium influences the way people remember information. Suggestions for future research are presented at the end of the discussion.

The human Internet relationship

In the study of human–cognitive tool interaction, a very challenging idea is that human and cognitive tools enter into a relationship. This relationship is often portrayed in various terms. For example, it can be viewed as an *intellectual partnership.* Specifically, Salomon (1988) discusses that similar to the role of social interaction in a child's zone of proximal development, auxiliary tools and symbols are also internalized, serving as cognitive signs for self-guidance. Thus, tools could also serve as "more capable peers" (Vygotsky, 1978, as cited in Salomon, 1988, p. 3), the functions of which are internalized. This partnership involves a complementary division of labor and interdependence between internal processes, external processes, and intermediate products (outputs contributing to the final goal). Despite this interconnection, the individual may not necessarily be aware of the strategies employed by the tool. Attempting these activities individually, without the partnership, would exceed a person's mental capacity (Pea, 1985, as cited in Salomon, 1988).

The human-cognitive tool relationship has also been described as a *coupled system*, which can be viewed as an independent cognitive system, each part of which plays an active role in its functioning, guiding behavior as cognition typically does. Removing the external component would lead to a decline in performance, similar to the decline that would occur if a part of the brain was removed. This kind of coupled process counts just as well as a cognitive process, regardless of whether it is entirely in the head or not (Clark & Chalmers, 1998).

Another way to describe the relationship is as a cognitive dyad, a rudimentary *transactive memory system* in which the tool becomes a site of external storage for the individual (Wegner, 1987). The latter type of relationship is analyzed in the next section since it is the one most frequently used in contemporary research on the Internet.

The Internet as a transactive memory partner

In the last decade, the theory of transactive memory systems (Wegner, 1987) has been revisited to explore the relationship between humans and the Internet. This theory posits that people typically use other people as external information storage based on areas of expertise. Recent studies have extended this concept of socially distributed memory to encompass human-technology interactions (Risko & Gilbert, 2016). Specifically, in Wegner's (1987) division of memory into internal and external, transactive memory is part of the latter. Internal memory contains memory and processes that occur in the individual's mind, while external memory includes all kinds of external storage media. A distinctive property of external memory is that the same processes applied internally (that is encoding, storage, retrieval, and semantic networks) can also be applied externally. Transactive memory systems are formed when other people (or as currently proposed, the Internet) become external storage sites for an individual. Empirical evidence supporting this idea resulted from experiments (Giuliano & Wegner, 1985, as cited in Wegner, 1987; Wegner et al., 1991) that used the smallest possible transactive memory system, such as pairs of either randomly selected participants or participants who were involved in a romantic relationship. These pairs worked together in tasks to recall a list of words. In the absence of experimental instructions, couples divided the memory load based on perceived expertise or situational factors. If one person was seen as knowledgeable in a specific area (e.g., food), they took on the related tasks (e.g., food names) and provided the other person with words in their own field of expertise (e.g., history information). Just as humans form transactive partnerships in which they delegate the responsibility of storing (i.e., memorizing) information to other individuals with expertise (Flanagin & Lew, 2022), they can likewise delegate this responsibility to the Internet, thus making it a "transactive memory partner" (Ward, 2013b, p 11). Of course, the Internet is very different from an ordinary transactive partner, since it can be conceived as a "supernormal stimulus" (Ward, 2013a). Supernormal stimuli are exaggerated or magnified versions of the stimuli that have shaped humans'

neural structures and cognitive tendencies during evolution (Tamir & Ward, 2015). Thus, the Internet almost always has a higher degree of expertise than any individual person, as well as an information storage capacity that far exceeds human measures (Ward, 2013a). Considering this, are there any cognitive and metacognitive consequences of being in a relationship with such a transactive memory partner?

Cognitive offloading

This question can be best answered within the theoretical framework of cognitive offloading (Risko & Gilbert, 2016). This theory assigns a pivotal role to metacognition whenever an individual decides to delegate the responsibility of handling cognitive tasks to an external medium. Cognitive offloading is defined as "the use of physical actions to alter the information processing demands of a task in order to reduce cognitive demands" (Risko & Gilbert, 2016, p. 676). Examples of such physical actions include turning one's head to view a rotated image, counting with one's fingers, or using a smartphone to schedule an appointment (Risko & Gilbert, 2016). When faced with a problem, metacognitive experiences, and metacognitive beliefs initially shape the decision as to whether an individual turns to external cognitive tools for assistance or relies solely on their own strengths. Then, the reliance on the former can affect both lower-level cognitive systems (e.g., memory) and higher-level metacognitive evaluations of those systems (e.g., confidence) (Risko & Gilbert, 2016). For example, if an individual needs to recall some information, their knowledge about the past successes of internal or external storage, their beliefs about their reliability, and/or a feeling of fluency can contribute to their decision to store that information internally or externally. However, the use of internal or external strategies per se may modify metacognitive evaluations (e.g., after successfully using GPS, one may conclude that it is a more reliable method of navigation than relying solely on memory). Thus, the use of strategies may directly affect cognitive functions (e.g., continuous use of GPS may have an impact on visuospatial memory) (Risko & Gilbert, 2016). The cognitive offloading theory predicts a type of self-reinforcing pattern that produces a tendency to disengage from internal resources in an environment with highly effective cognitive technologies (Risko & Gilbert, 2016).

In the following sections, we present empirical evidence for the cognitive and metacognitive consequences of the above transactive relationship. Specifically, in the first part, we present studies concerning the decision to use the Internet, the confidence inflation phenomenon, and the feeling of findability. In these studies, the Internet is seen mostly as an information source, so the transactive partner becomes a transactive all-knower (Ward, 2013b). In the second part, we present studies on memory storage in which the Internet is seen mostly as a storage device, so the transactive partner is transformed into a transactive super memorizer (Ward, 2013b).

The transactive all-knower: Effects of the Internet as an information source

In most of these studies, the typical experimental design required the participants to answer general knowledge questions. They were assigned to two conditions: either the Internet condition in which they were allowed to search for answers or information on the Internet or the control condition in which they were instructed to answer without external help. In both conditions, they were asked to report their metacognitive experiences on a Likert scale (e.g., feeling of knowing and feeling of familiarity) before and after submitting their answers. The studies mentioned in the following subsection, *The decision to use the Internet*, explored whether the participants in the Internet condition were more likely to offload the task of answering questions compared with those in the control group, while the studies in the *Inflated feeling of confidence* subsection investigated whether the participants in the Internet condition tended to report higher feelings of confidence in terms of their current and future performance relative to those in the control condition.

The decision to use the Internet

The theory of cognitive offloading predicts that the decision to use an external medium is informed by offline metacognitive beliefs and online metacognitive experiences. With respect to Internet use, to our knowledge, there are no studies that explicitly examine this idea. We report the research evidence from studies that are relevant to this topic instead. Specifically, in a study conducted by Storm et al. (2017), the participants in the Internet group and those in the control group were asked to answer a series of difficult general knowledge questions. The participants in the Internet group were instructed to answer after searching the Internet, and they were compelled to do so, even if they knew the answers. In the next phase of the experiment, the participants in both groups were asked to answer easy questions and were given the choice of either conducting an online search or answering on their own. It was found that the Internet group preferred to search the Internet significantly more

often (Experiment 1a) and decided to do so in considerably less time than the control group (Experiment 2). This difference remained significant even when participants had to get up from their seats and cross the room in order to use a computer or tablet (Experiment 1b).

In Ferguson et al.'s (2015) research, all participants were presented with general knowledge questions and instructed to indicate whether they knew the answer. If they did, they were asked to type it. Only those in the Internet group who did not know the answer were permitted to look it up and then type it. It was found that these participants were less willing to respond to questions without using the Internet, and, as a result, they provided fewer replies compared with the participants in the no-Internet-access group. Nevertheless, the answers in the Internet condition were more likely to be correct, and the participants were quicker to decide whether they knew an answer (Experiment 1). It appeared that people recognized the expertise of the transactive memory partner (the Internet) and chose to offload the responsibility of answering questions to it. Indeed, the way the participants in the experimental condition of these two studies addressed the task was successful, since they gave more correct answers when seeking help from the Internet compared with the participants in the control condition.

Furthermore, research evidence from studies using functional magnetic resonance imaging (fMRI) showed that people may develop impulsivity to search the Internet. In particular, Dong and Potenza (2015) compared their study's participants' brain activation while answering general knowledge questions in an online search condition versus an encyclopedia search condition. A positive correlation was found significant only in the online search condition between brain activation in orbitofrontal cortex- a region associated with executive control, emotional regulation, and impulse inhibition- and the participants' reports of their impulsivity to search the Internet to answer new questions. However, this correlation was significant only in the Internet condition and not in the encyclopedia search condition. It is noteworthy that the same brain regions seem to play a role in drug cravings, potentially implying a similar mechanism behind the impulsivity associated with internet use. In a similar vein, a study by Wang et al. (2017) showed that after six days of training in online searching, participants reported higher rates of impulsivity to search the Internet for answers to unusual questions compared with their reports before training. In addition, a positive correlation was found between the participants' impulsivity reports and activation of the dorsolateral prefrontal cortex and anterior cingulate cortex, regions connected to impulsivity and distraction control respectively.

Thus, at the stage where people must decide whether to use external aid, they are quick to turn to the Internet. The same pattern is observed in the research on cognitive offloading of future intentions, where people tend to set external reminders even in very easy experimental conditions (Gilbert et al., 2023). These results are in accordance with the main hypothesis of the cognitive offloading theory that we tend to disengage from our internal resources when we are in an environment with highly effective cognitive technologies (Risko & Gilbert, 2016), presumably in order to avoid cognitive effort (Gilbert et al., 2023). Also, the Internet, as a transactive all-knower, may create a change in the internal benchmark against which personal competence is assessed, which results in a reduction in the feeling of knowing (Ferguson et al., 2015). Since offloading on the Internet is simultaneously less mentally taxing, even though Internet search does create cognitive load (Gwizdka, 2010), and provides the highest likelihood of obtaining accurate information, people might naturally opt for this strategic approach to the task. Lastly, the factor of impulsivity might also suggest that the quick turn to the Internet could be driven either by an imperative cognitive need to fill a knowledge gap (Loewenstein, 1994) or by the search engine/websites' user interface, which might be designed to encourage compulsive use (e.g. Mathur et al., 2021).

To summarize, taking into consideration the scarcity of data so far, it appears that when the option of searching the Internet for answers is available, people quickly turn to the transactive memory partner even for easy-to-answer questions (Ferguson et al., 2015; Storm et al., 2017). It seems that the use of the medium also leads to impulsivity to continue using it, a finding that seems to have a neuropsychological basis (Dong & Potenza, 2015; Wang et al., 2017). Next, we examine the impacts of using the Internet on our feeling of confidence.

The phenomenon of the inflated feeling of confidence

The studies we examine below reveal that using the Internet to answer questions creates a bias that inflates the feeling of confidence. Is this an indication that the boundaries between the individual and the all- powerful transactive partner are becoming blurred and that the individual is taking credit for the partner's remarkable ability? (Ward, 2013b). Ward (2013b) examined the idea that the boundaries between the two members of the cognitive dyad become blurred and that people attribute properties of the Internet to themselves. He based this

on his finding that when people offload the responsibility of answering general knowledge questions to the Internet, there is a tendency to overestimate their personal ability to answer such questions even without the use of an external medium. Specifically, in a series of experiments originally conducted for his dissertation (Ward, 2013b) and recently enriched (Ward, 2021), the participants who used Google to answer general knowledge questions, compared with those who were instructed to answer on their own, rated themselves significantly higher both in the ability to search external media (access) and the ability to remember (memory). However, they did not rate themselves as high in other types of abilities, such as physical, social, or mathematical (Ward, 2021, Experiment 1). In addition, they predicted significantly higher performance on a similar future test of answering general knowledge questions without the use of external means (Ward 2021, Experiment 2), but when they were actually exposed to these tests, their performance did not match their predictions (Ward, 2021, Experiment 3). Overestimation was maintained for the Internet on the variables of future performance estimation, memory and ability to think, when they had to answer questions of moderate difficulty (Ward, 2021, Experiment 7).

Research by Fisher et al. (2015) followed a similar line of reasoning. In their basic experimental design, in the induction phase, the participants in the Internet group were instructed to search online for explanatory answers to general knowledge questions in a particular domain (e.g., meteorology), while the participants in the control group simply viewed the same questions. Both groups then rated their ability to explain the answers (but without answering them). In the target phase, they were exposed to an entirely new set of questions in different domains (e.g., anatomy and physiology) and were asked to assess how well they could answer similar questions without the use of an external medium. It was found that in the target phase, the participants in the Internet group rated their ability to answer this entirely different set of questions significantly higher relative to the control group (Experiment 1a). In a subsequent experiment, they were provided with an artificial brain activation scale with the misleading information that the scale showed brain activation and that the more qualitative explanations one gave, the more the brain was activated. When they were asked to choose the level of their brain activation during the processing of the previous task, the participants in the Internet group chose the highest brain activation for themselves compared with the participants in the control group (Experiment 2a).

However, this finding regarding the transfer of confidence overestimation from the induction phase (an initial set of questions) to the target phase (an entirely different set of questions) was not confirmed in a replication study conducted by Pieschl (2019). The latter also asked the participants to submit their answers to the questions along with their predictive and postdictive judgments about their ability to answer such questions and about their performance. It was found that the judgment of those who used the Internet was inflated and that their actual performance did not correspond to their judgment compared with the control condition. Finally, in Dunn et al.'s (2021) study, the participants in the Internet condition reported marginally significantly higher confidence in their predictive judgment about the accuracy of their responses to general knowledge questions and significantly higher confidence in their postdictive judgment. They were also less able to distinguish between correct and incorrect answers relative to the participants in the control condition. Several factors have been suggested to explain the phenomenon of inflated confidence, such as fluency in processing, the act of searching the Internet, the lack of external evaluation criteria, and the ambiguity of performance. In the following paragraphs, we briefly discuss these factors.

Fluency in processing. One important factor that seems to contribute to overconfidence is fluency in searching, which is possibly perceived as a cue for the feeling of confidence to emerge. Pieschl (2019) interpreted the phenomenon within the context of Koriat and Levy-Sardot's (1999) dual-process theory, which distinguishes metacognitive judgments into experience-based judgments and information-based judgments. The former emerge automatically as a by-product of information processing and are based on various mnemonic cues, such as accessibility, fluency, familiarity, ease of retrieval, and memorization effort, while the latter draw on people's domain-specific knowledge and beliefs and emerge from goal-directed inferential processes, which can lead to informed self-evaluation (see also Koriat et al., 2008). Thus, if a user experiences the process of searching for information on the Internet as positive (i.e., they experience ease, fluency in processing, and immediate availability of information), they may feel that they can answer a knowledge question (experience-based judgment). Yet, these signals may reflect the speed offered by the web service or search engine's algorithm rather than the individual's understanding. Metacognitive experiences arising from the act of searching may bias users toward overestimating their ability to solve information problems (Pieschl, 2019). Indeed, the phenomenon of overestimation was eliminated when Ward (2021) introduced the parameter of analytical thinking or time delay.

When the participants were asked to write down their answers before conducting an online search (Experiment 5) or when a delay of 25 seconds in retrieving Google results was introduced, there was no difference in the scores between the experimental and control conditions (Experiment 6).

Dunn et al. (2021) on the other hand, argued that when individuals engage in an online search, they are more likely to be prone to errors, possibly not due to misinterpretation of the signals but due to the lack of signals. This is because the emergent metacognitive experience is irrelevant (e.g., one may feel fluency during a search, but it does not mean anything). Therefore, a person may rely more on metacognitive knowledge—in this case, the perception that the Internet is a reliable source of information. In their research, they found that individuals in the Internet condition were less able to distinguish between correct and incorrect answers compared with the participants in the control group. This may have been due to the interference of the metacognitive belief that the Internet is trustworthy combined with the fact that, when searching the Internet, individuals are highly prone to make mistakes (e.g., judging sources and the reliability of a website) and they may not be aware of this (Dunn et al., 2021).

The act of Internet searching. The contribution of Internet searching to the emergence of the inflated confidence bias can be found in the research experiment of Fisher et al. (2022). In their study, the participants were administered learning tasks on various topics, asked to make predictive judgments of performance, and answered a multiple-choice quiz. The Internet group had access to study materials via prompts to search the Internet for specific articles located on specific websites (e.g., Topic: Autism Treatment Options in apa.org). The no-Internet group was exposed to the same materials, but they had to read the text without engaging in an online search. The participants in the Internet group had significantly lower performance on the quiz and spent significantly less time studying the material but evaluated their future performance higher compared with the control group (Experiment 1). The pattern of overconfidence and worse performance in the Internet group remained intact despite variations in the experiment; for instance, when the no-Internet group was exposed to potentially disruptive factors mimicking those encountered during an online search (e.g., They were asked to solve a CAPTCHA by identifying and typing letters and numbers in a noisy image into a box) (Experiment 2) when both groups were required to devote the same amount of time to studying (Experiment 3a), when both groups were asked to reflect on their knowledge before each trial (Experiment 3b), and when a novel link condition was created to be compared with the Internet condition in which the participants accessed the study materials by clicking a ready-made hyperlink (Experiment 4).

The implications are quite alarming, since the act of searching online leads to metacognitive biases concerning performance by masking Internet-induced learning deficits (Fisher et al., 2022) The inflated feeling of confidence might be accompanied by inadequate performance and lead to a more superficial processing of information (Fisher et al., 2022). This poor calibration seems to be a result of the misinterpretation of various external cues emerging during an Internet search. It has been shown that inferences or feelings-of-knowing generated from various cues increase confidence but reduce overall calibration and that confidence often is related to cue familiarity (Juslin, 1994, as cited in Stone, 2000). In a web search, such cues constantly occupy the working memory. The process of finding the right keywords, viewing, assessing the results page, etc., may create numerous associations. Along with the fluency felt by the rapid retrieval of results, all these cues together could evoke a false feeling of familiarity, leading individuals to exhibit a 'knew it all along' bias, believing they had known the answer all along when they, in fact, did not (Ward, 2013b).

The lack of external evaluation criteria. Another factor that may contribute to overconfidence and might provide insight into why the act of searching makes people prone to biases, is the lack of external evaluation criteria. Mattes and Pieschl's (2022) research was based on the idea that when individuals make metacognitive judgments, they are in essence comparing their knowledge to an idiosyncratic internal standard (see Winne and Hadwine's COPES model of self-regulated learning, 1998), and it is the lack of external objective knowledge evaluation criteria that makes them susceptible to the overconfidence bias. Indeed, when the participants in the Internet condition were given a rubric schema clarifying how answers would be scored to guide their responses, their predictive and postdictive confidence biases about performance were reduced compared with the participants who searched the Internet without external guidance. In higher education, the use of rubrics, including criteria and performance standards with specific examples of the final product, resulted in higher use of self-regulatory learning strategies, performance, and accuracy (Panadero & Strijbos, 2016). Also, feedback, and especially process feedback (e.g. concerning learning strategies) seems to have a significant impact on calibration

levels (Stone, 2000). It seems the mis-calibrated confidence may be due to the discrepancy between people's everyday online experience and the experimental task demands. People don't typically perceive online searches as performance tasks; instead, they see them as a way to satisfy their personal information needs. The satisfaction of these needs, combined with a lack of feedback about the accuracy of their comprehension of the information obtained, may lead to inflated confidence. As initial metacognitive judgments are based on past experiences (Zhao & Linderholm, 2008), this subjectively effective engagement with the Internet could serve as an anchor for future metacognitive evaluations. However, these consequences seem to be reversible; when an external performance criterion is introduced, people are quick to adjust and perform adequately.

Performance ambiguity. Fisher and Oppenheimer's (2021) research provides another interesting perspective on the phenomenon of overconfidence. In their basic experiment with a task of answering general knowledge questions, participants were divided into two conditions: the individual condition in which the participants were alone and the group condition in which the participants collaborated with two algorithms. In the latter condition, each participant answered five out of fifteen geography questions, and the algorithms answered the rest. The participants did not see the algorithms' answers but directly received feedback on the correctness of both their own answers and those of the other group members. Next, the participant was asked whether they could satisfactorily answer an upcoming set of questions in either geography or other knowledge areas without aid from the teammate algorithms. The group condition showed overconfidence in their performance on future quizzes in the same knowledge domain (geography) but not in other knowledge domains. Their actual performance did not differ from that of the participants in the individual condition (Study 1). In various experimental variations, the effect of overconfidence was eliminated only when the participants simply observed the algorithms providing responses without their personal involvement compared to those involved in the group condition (Study 3) and when they were informed about their own contribution to the group's performance by replying to the questions assigned to the algorithms compared to those who did not (Study 5). Thus, it appears that people in a transactive system have increased confidence in their performance on a future task not because they confuse their own performance with the group's performance but because each member's contribution to the final performance is not made clear. Assessing, thus, one's ability becomes more challenging when one has only experienced a task in the context of a transactive memory system (Fisher & Oppenheimer, 2021).

To summarize, it seems that offloading the responsibility for answering questions to the Internet has a profound effect on the metacognitive level of functioning, as it leads to an overconfidence bias concerning (a) one's ability to process, remember, and access information (Ward, 2013b; 2021); (b) judgments of future performance in similar tasks (Fisher et al., 2022; Pieschl, 2019; Ward, 2013b, 2021); and (c) judgments of the correctness of answers (Dunn et al., 2021). This bias, in turn, affects cognitive processing by decreasing the time spent learning and the level of performance (Fisher et al., 2022). The factors that contribute to this bias seem to be either a misinterpretation of cognitive processing cues or a lack of these cues (Dunn et al., 2021; Pieschl, 2019; Ward, 2021), the lack of an objective external criterion for performance standards (Mattes & Pieschl, 2022), the act of online searching (Fisher et al., 2022), and ambiguity with respect to an individual's contribution to task performance (Fisher & Oppenheimer, 2021). We have seen how the individual–Internet transactive relationship may lead to metacognitive biases, followed by adverse consequences at the cognitive level of functioning but we cannot state conclusively that the boundaries between humans and the Internet have become indistinct. Notably, when the factors contributing to the inflated feeling of confidence are controlled for, the phenomenon appears to be diminished. Beyond making us susceptible to fallacies, could this transactive relationship also foster our metacognitive sensitivity regarding information retrieval? The feeling of findability has been studied as an example of a metacognitive experience emerging in the context of retrieving information from such a transactive system.

The feeling of findability

Based on Wegner's (1987) theoretical premise that in a transactive memory system it is necessary for individuals to know how to access information, Risko et al. (2016) examined whether individuals develop such knowledge in the context of their interactions with the Internet. They studied the development of the feeling of findability, which is an estimate of the time it takes to retrieve information from the Internet. In their experiments, the participants were shown general knowledge questions and asked to indicate whether they knew

the answers and rate how quickly they could retrieve the answers using the Internet on a Likert scale (Studies 1a and 1b). The results revealed that the feeling of findability negatively correlated with search time was not affected by the perceived difficulty of the questions and did not strongly correlate with the individuals' familiarity with the Internet. In their Study 2, they investigated whether the feeling of findability was distinct from the feeling of knowing. A new condition was introduced, in which participants were asked to rate the likelihood of recognizing the answer, immediately after indicating whether they knew the answer to the presented question. Although the results showed a negative correlation between the feeling of knowing and search time, no significant correlation was found between the feeling of findability and the feeling of knowing, nor was there a correlation between the feeling of findability and the probability that a question would receive an "I know" response; however, there was a strong significant correlation between such a response and the feeling of knowing. Finally, two factors were found to correlate with the feeling of findability, namely the difficulty in generating a search query and a belief in the popularity of a search item; that is, an estimation of how often other people search for that specific question (Study 3).

The above evidence shows that people seem to develop the ability to accurately estimate how quickly they can find information on the Internet. Given that in transactive memory systems internal cognitive processes can also have external applications (Wegner, 1987), the feeling of findability appears to be an external manifestation of the internal feeling of knowing and the experience of ease of access (Risko et al., 2016), adapted specifically for the medium of the Internet. This remarkable metacognitive sensitivity contradicts the bias discussed earlier and the proposed ambiguity of human–Internet boundaries (Ward, 2021). Why are we sometimes able to make such distinctions and other times not? A possible explanation is that these judgments are influenced by a different set of cues. For instance, the feeling of findability correlates with the difficulty of formulating search terms and the popularity of those terms. In contrast, the feeling of confidence seems to be dependent on the misinterpretation of the search engine's fluency cues.

The transactive super memorizer: Effects of the Internet as a storage device

Not only is the Internet a source of information, as presented up to this point, but it is also a huge storage device. We now move on to examine the effects of the Internet as a storage device on human memory by presenting evidence for the so-called Google effect and discussing how our metacognitive beliefs can regulate our memorization strategies.

The Google effect: A case of directed forgetting?

The Google effect refers to the phenomenon of people having better memory for the location where information is stored but worse memory for the content of this information. In a study conducted by Sparrow et al. (2011), the primary experimental design consisted of two conditions in which the participants were instructed to memorize general knowledge statements that would be either saved on a computer or deleted. They found that the participants had significantly worse memory for the material they believed would be saved (Experiments 2 & 3). Moreover, when the name of the storage folder was provided alongside the statements without explicit instructions, it was highly likely that neither the statements nor the folder would be remembered but equally likely that only the folder would be recalled (Experiment 4). This study has been criticized for its methodological drawbacks (e.g., assessing the comparison between recall and recognition test outcomes) (Marsh & Rajaram, 2019) and lack of ecological validity, as it did not involve Google or the Internet but folders on computers in a psychology laboratory (Heersmink, 2016). However, it seemed to highlight a phenomenon confirmed by other studies (see below), and as Sparrow et al. (2011) argued, the type of experiment resembled directed forgetting experiments in which participants are instructed to either remember or forget sentences. It has been shown that individuals have better memory for sentences to be remembered (Sahakyan & Foster, 2016). In this context, considering that the participants had worse memory for the to-be-saved statements, it was as if they were instructed to forget the information to be saved. Nevertheless, since there was no explicit instruction to forget the information, what caused the to-be-saved information to be perceived as a cue to forget it? We will address the question by analyzing studies that explore the impact of saved versus unsaved information on memory and a smaller subset of studies with ecological validity due to their connection with Internet search.

Metacognitive beliefs and strategy adjustment. A possible explanation consistent with the cognitive offloading theory (Risko & Gilbert, 2016) is that the to-be-saved prompt is perceived as a cue for offloading and that metacognitive processes are activated to help us adjust our task-related strategies. Domain-specific metacognitive knowledge is potentially triggered, drawing on our experiences of storing information in external media, so that we give high priority to to-be-deleted information. This is in accordance with directed forgetting in which the role of metacognitive beliefs in the memorability of objects is highlighted, as they can lead to different recall patterns depending on whether individuals are trying to achieve the goal of memorizing or forgetting information (Sahakyan & Foster, 2016). Offloading between people in transactive memory systems is activated when trust exists among those involved. If people distrust a particular medium, they are less likely to offload information onto it (Schooler & Storm, 2021). As demonstrated by Schooler & Storm (2021), people exhibit inferior memory performance for information they expect to be stored externally, but this phenomenon is observed only when the external storage medium is perceived as unreliable. Storm and Stone (2015) examined how the knowledge that a piece of information will be saved affects other pieces of information. They found that saving a file before studying a new file significantly improved memory for the contents of the new file. This effect was eliminated, though, when the participants were informed that the storage process may be unreliable or when the contents of the file to be stored did not create a significant mnemonic load to interfere with memory for the new file.

Another factor that may affect worse memory for saved information is the value that individuals assign to information. According to the theory of value-directed memory (Castel, 2007), memory is influenced by the value that people assign to information, and this value can be impacted by several factors, such as the relevance of the information to the current goals, its consistency with prior knowledge, its expected future use, and the individual's motivation. In Park et al.'s (2022) study, participants were given words assigned with arithmetic values and were instructed to memorize them so that, when tested, they could achieve the highest score by summing those values. Participants who were falsely informed that words from the last two trials would be stored showed significantly poorer performance in the subsequent memory test compared to the control group, which shows that the Google effect can persist even for high-value information. However, it would be intriguing to see whether this is replicated in an experimental design more aligned with everyday contexts, including information with emotional value, or that is more closely related to participants' interests.

Moving forward, we will focus on studies that offer greater ecological validity and incorporate elements of the Internet. Macias et al. (2015) found that people implicitly distinguish between searchable and non-searchable information, remembering non-searchable information better. Interestingly, this distinction wasn't mentioned in the experiment instructions. In the experiment, sentences were categorized either as searchable on the Internet (e.g., a mathematical constant's value) or as non-searchable on the Internet (e.g., a lock's number). Participants, unaware of this categorization, were only asked to memorize the sentences. In the subsequent recall test, their memory for non-searchable information was significantly better compared to searchable information, which shows that people not only monitor storage reliability hints but material searchability as well.

In the study conducted by Kang (2023), participants were shown a credit card advertisement highlighting its benefits in bullet points. One group (the easy access condition) was told they could use a specific keyword to search for the credit card later. The other group (the difficult access condition) was told they'd have to make a request via email to view the advertisement in the future. After reviewing the advertisement for as long as they wanted, both groups were asked to recall the keyword or email address and the credit card benefits they saw earlier. The results suggest that when information is readily accessible (e.g., by searching the Internet), people tend to remember the retrieval method (e.g., the keyword) rather than the content itself. This pattern was more pronounced in people with better working memory. Similar to the inflated confidence phenomenon, the misinterpretation of cues of fluency and ease of access emerging during a web search creates a fallacy leading people to falsely perceive easily retrieved words as more memorable. Storm and Stone (2021) found that answers retrieved more quickly from the Internet were judged to be more memorable than answers that took more time to retrieve, even though recall was better for those slower-retrieved answers compared to the quickly retrieved ones. Thus, we both observe a strategic adjustment to the storage process of digital media and a misinterpretation of web search fluency cues leading to mis-calibrated judgments of memorability. The "Google effect" seems to suggest that the default strategy people use is to allocate resources in a way that prioritizes the retention of non-saved information, while continuously monitoring explicit or implicit hints about storage reliability and material searchability. When storage is deemed unreliable or material unsearchable, people promptly adjust their strategy

and allocate their resources equally. The finding that people with better working memory are more likely to remember the retrieval method rather than the content of information shows that the prioritization of not-to-be-saved-information may be adopted not as compensation for poorer working memory, but as an optimization of the allocation process.

In the end, the finding that faster retrieved answers are perceived as more memorable is rather interesting. The swift and seamless interface between internal thought and external information that characterizes online search (Ward, 2021) might lead people to perceive an online search as an internal process and apply the same internal metacognitive processes. Thus, participants misinterpreted the ease of information retrieval with the ease of future retrieval of this information (Storm & Stone, 2021), just as retrieval fluency from the long-term memory affects metamemory judgments (Benjamin et al., 1998). Further, answers that require more time to retrieve could signal a feeling of difficulty, potentially initiating a data-driven, bottom-up process (Efklides, 2011). This would possibly result in deeper information processing and better actual memory performance.

To summarize, the Google Effect suggests that people have worse memory for information that they know will be saved and better memory for the location of information. Regarding worse memory for saved information, studies confirm that people have worse memory for saved information when they perceive the storage process as reliable (Pereira et al., 2022; Schooler & Storm, 2021; Sparrow et al., 2011; Storm & Stone, 2015). The pattern of worse memory for saved information persists even for high-value information (Park et al., 2022). Furthermore, people distinguish between searchable and non-searchable information and exhibit worse memory for the former (Macias et al., 2015). Also, when information is readily accessible, people tend to remember the retrieval method rather than the content itself (Kang, 2023) Finally, people seem to be prone to incorrectly assessing the memorability of a piece of information based on how quickly it can be retrieved (Storm & Stone, 2021).

Conclusion

The empirical evidence presented in the above sections suggests that, in transactive memory systems, the same cognitive processes that are applied internally can also be applied externally, although they may manifest in different ways (Wegner, 1987). A pattern observed in the previous studies is that external fluency cues, inferred from the act of searching and possibly inherent to the search engine's design, are misinterpreted as internal inferential cues, which in turn leads to inflated metacognitive judgments. These judgments enhance beliefs about the effectiveness of the cognitive tool and, as the theory of cognitive offloading suggests, a self-reinforcing pattern emerges, leading to a tendency to rely less on internal resources while working in an environment with highly efficient cognitive technologies (Risko & Gilbert, 2016). It is noteworthy that, although the engagement with the web search makes people prone to fallacies, this is not always the case. It seems that, while using the cognitive tool, people are constantly monitoring the current conditions and adjusting their strategies accordingly (e.g., prefer to encode the information internally, when the storage is perceived as unreliable). This strategic adjustment and the need for effective access to the transactive system can also give rise to novel metacognitive experiences, such as the feeling of findability. It can be described as a manifestation of the internal feeling of knowing, which is tailored to the external medium.

Future steps

In the digital era, people have constant access to the Internet, which serves both as an information retrieval tool and a storage device. As we have seen in the previous sections, its unprecedented efficacy makes it more of a partner than a mere tool, a relationship that is reflected at the metacognitive level. This interaction with the Internet profoundly shapes the way we process information and influences the formation of opinions and behaviors in social and educational contexts. Therefore, understanding the exact mechanisms that affect our engagement with this cognitive tool is crucial.

Future research should focus on understanding exactly which components of the web search produce cues that could potentially influence metacognitive judgments. For example, the generation of search keywords might produce a feeling of familiarity, or the perceived mental effort may trigger a false judgment of learning (Koriat et. al, 2014). Affective states induced either by the searching process (Kuhlthau, 1993, 2004) or by the content of information could also play a role. Another focus should be identifying the conditions under which people

distinguish between external and internal inferential cues. For instance, an internal feeling of difficulty during search, as opposed to the search engine's fluency might prompt a more accurate interpretation of the external cues. A more ecologically valid approach is needed for exploring the "Google effect" further. A good start would be to examine how high value information is handled, based on aspects such as the emotionality of information or expected future use. Also, the worse memory for saved information warrants further breakdown to identify exactly which part of the memory process fails. For example, if any information is retained, is it random, or does it include specific elements used for formulating keywords? Since people are quick to turn to the Internet when encountering problems, it should be examined whether there's a strong underlying belief that the Internet is an all-knower, thus it's the right strategic choice to use it under any circumstance. An example of a research question could be how people act when having to choose between answering simple questions by themselves or using a readily accessible, yet more error-prone tool. Does medium reliability matter in information retrieval as we saw it matters in "Google effect" studies? Lastly, use of external strategies may directly affect cognitive functions (Risko & Gilbert, 2016). Could continuous reliance on the Internet permanently alter our metacognitive judgment accuracy and memory? We offload our hopes for answers to future studies of metacognitive phenomena in the context of external media.

References

Benjamin, A. S., Bjork, R. A., & Schwartz, B. L. (1998). The mismeasure of memory: when retrieval fluency is misleading as a metamnemonic index. *Journal of Experimental Psychology: General*, *127*(1), 55-68. https://doi.org/10.1037/0096-3445.127.1.55

Brand-Gruwel, S., Wopereis, I., & Walraven, A. (2009). A descriptive model of information problem solving while using internet. *Computers & Education*, *53*(4), 1207–1217. https://doi.org/10.1016/j.compedu.2009.06.004

Castel, A. D. (2007). The adaptive and strategic use of memory by older adults: Evaluative processing and value-directed remembering. *Psychology of learning and motivation*, *48*, 225-270. https://doi.org/10.1016/S0079-7421(07)48006-9

Clark, A., & Chalmers, D. (1998). The extended mind. *Analysis*, *58*(1), 7–19. https://doi.org/10.1093/analys/58.1.7

Dong, G., & Potenza, M. N. (2015). Behavioural and brain responses related to Internet search and memory. *European Journal of Neuroscience*, *42*(8), 2546–2554. https://doi.org/10.1111/ejn.13039

Dunn, T. L., Gaspar, C., McLean, D., Koehler, D. J., & Risko, E. F. (2021). Distributed metacognition: Increased bias and deficits in metacognitive sensitivity when retrieving information from the internet. *Technology, Mind, and Behavior*, *2*(3). https://doi.org/10.1037/tmb0000039

Efklides, A. (2011). Interactions of metacognition with motivation and affect in self-regulated learning: The MASRL model. *Educational Psychologist*, *46*(1), 6–25. https://doi.org/10.1080/00461520.2011.538645

Ferguson, A. M., McLean, D., & Risko, E. F. (2015). Answers at your fingertips: Access to the Internet influences willingness to answer questions. *Consciousness and Cognition*, *37,* 91–102. https://doi.org/10.1016/j.concog.2015.08.008

Fisher, M., Goddu, M. K., & Keil, F. C. (2015). Searching for explanations: How the Internet inflates estimates of internal knowledge. *Journal of Experimental Psychology: General*, *144*(3), 674–687. https://doi.org/10.1037/xge0000070

Fisher, M., & Oppenheimer, D. M. (2021). Who knows what? Knowledge misattribution in the division of cognitive labor. *Journal of Experimental Psychology: Applied*, *27*(2), 292–306. https://doi.org/10.1037/xap0000310

Fisher, M., Smiley, A. H., & Grillo, T. L. H. (2022). Information without knowledge: The effects of Internet search on learning. *Memory*, *30*(4), 375–387. https://doi.org/10.1080/09658211.2021.1882501

Flanagin, A. J., & Lew, Z. (2022). Individual inferences in web-based information environments: How cognitive processing fluency, information access, active search behaviors, and task competency affect metacognitive and task judgments. *Media Psychology*, 1–19. https://doi.org/10.1080/15213269.2022.2085116

Gilbert, S. J., Boldt, A., Sachdeva, C., Scarampi, C., & Tsai, P.-C. (2023). Outsourcing memory to external tools: A review of "intention offloading." *Psychonomic Bulletin & Review,* *30*(1), 60-76. https://doi.org/10.3758/s13423-022-02139-4

Gwizdka, J. (2010). Distribution of cognitive load in web search. *Journal of the American Society for Information Science and Technology*, *61*(11), 2167-2187. https://doi.org/10.1002/asi.21385

Heersmink, R. (2016). The Internet, cognitive enhancement, and the values of cognition. *Minds and Machines*, *26*(4), 389–407. https://doi.org/10.1007/s11023-016-9404-3

Hesselmann, G. (2020). No conclusive evidence that difficult general knowledge questions cause a "Google Stroop effect." A replication study. *PeerJ*, *8*, Article e10325. https://doi.org/10.7717/peerj.10325

Kang, E. (2023). Easily accessible but easily forgettable: How ease of access to information online affects cognitive miserliness. *Journal of Experimental Psychology: Applied,* *29*(3), 620-630. https://doi.org/10.1037/xap0000412

Kiverstein, J., Farina, M., & Clark, A. (2013). The extended mind thesis. In *Oxford bibliographies online. Philosophy* (pp. 1–20). Oxford University Press. https://doi.org/10.1093/OBO/9780195396577-0099

Koriat, A., & Levy-Sadot, R. (1999). Processes underlying metacognitive judgments: Information-based and experience-based monitoring of one's own knowledge. In S. Chaiken & Y. Trope (Eds.), *Dual-process theories in social psychology* (pp. 483–502). The Guilford Press.

Koriat, A., Nussinson, R., Bless, H., & Shaked, N. (2008). Information-based and experiencebased metacognitive judgments: Evidence from subjective confidence. In J. Dunlosky & R. A. Bjork (Eds.), *Handbook of metamemory and memory* (pp. 117–135). Psychology Press.

Koriat, A., Nussinson, R., & Ackerman, R. (2014). Judgments of learning depend on how learners interpret study effort. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *40*(6), 1624-1637. https://doi.org/10.1037/xlm0000009

Kuhlthau, C. (1993). *Seeking meaning: A process approach to library and information services*. Ablex.

Kuhlthau, C. C. (2004). *Seeking meaning: A process approach to library and information services* (Vol. 2). Libraries Unlimited.

Loewenstein, G. (1994). The psychology of curiosity: A review and reinterpretation. *Psychological bulletin*, *116*(1), 75-98. https://doi.org/10.1037/0033-2909.116.1.75

Macias, C., Yung, A., Hemmer, P., & Kidd, C. (2015). Memory Strategically Encodes Externally Unavailable Information. In D. C. Noelle, R. Dale, A. Warlaumont, J. Yoshimi, T. Matlock, C. D. Jennings, & P. P. Maglio (Eds.), *Proceedings of the 37th Annual Meeting of the Cognitive Science Society, CogSci 2015* (pp. 1458-1463). The Cognitive Science Society.

Marsh, E. J., & Rajaram, S. (2019). The digital expansion of the mind: Implications of internet usage for memory and cognition. *Journal of Applied Research in Memory and Cognition*, *8*(1), 1–14. https://doi.org/10.1016/j.jarmac.2018.11.001

Mathur, A., Kshirsagar, M., & Mayer, J. (2021). What makes a dark pattern... dark? design attributes, normative considerations, and measurement methods. In *Proceedings of the 2021 CHI conference on human factors in computing systems* (pp. 1-18). https://doi.org/10.1145/3411764.3445610

Mattes, B., & Pieschl, S. (2022). An alignment of standards enhances metacognitive judgment accuracy in explanatory knowledge tasks with internet search. *Proceedings of the Annual Meeting of the Cognitive Science Society*, *44*(44), 2818-2824.

Panadero, E., Brown, G. T., & Strijbos, J. W. (2016). The future of student self-assessment: A review of known unknowns and potential directions. *Educational Psychology Review*, *28*, 803-830. https://doi.org/10.1007/s10648-015-9350-2

Park, J. S., Kelly, M. O., Hargis, M. B., & Risko, E. F. (2022). The effect of external store reliance on actual and predicted value-directed remembering. *Psychonomic Bulletin & Review*, *29*(4), 1367–1376. https://doi.org/10.3758/s13423-022-02064-6

Pereira, A. E., Kelly, M. O., Lu, X., & Risko, E. F. (2022). On our susceptibility to external memory store manipulation: Examining the influence of perceived reliability and expected access to an external store. *Memory*, *30*(4), 412–428. https://doi.org/10.1080/09658211.2021.1990347

Pieschl, S. (2019). Will using the Internet to answer knowledge questions increase users' overestimation of their own ability or performance? *Media Psychology*, *24*(1), 1–27. https://doi.org/10.1080/15213269.2019.1668810

Risko, E. F., Ferguson, A. M., & McLean, D. (2016). On retrieving information from external knowledge stores: Feeling-of-findability, feeling-of-knowing and Internet search. *Computers in Human Behavior*, *65*, 534–543. https://doi.org/10.1016/j.chb.2016.08.046

Risko, E. F., & Gilbert, S. J. (2016). Cognitive offloading. *Trends in Cognitive Sciences*, *20*(9), 676–688. https://doi.org/10.1016/j.tics.2016.07.002

Sahakyan, L., & Foster, N. L. (2016). The need for metaforgetting: Insights from directed forgetting. *The Oxford Handbook of Metamemory*, *1*, 341–355.

Salomon, G. (1988). AI in reverse: Computer tools that turn cognitive. *Journal of Educational Computing Research*, *4*(2), 123–139. https://doi.org/10.2190/4lu7-vw23-egb1-aw5g

Schooler, J. N., & Storm, B. C. (2021). Saved information is remembered less well than deleted information, if the saving process is perceived as reliable. *Memory*, *29*(9), 1101–1110. https://doi.org/10.1080/09658211.2021.1962356

Sparrow, B., Liu, J., & Wegner, D. M. (2011). Google effects on memory: Cognitive consequences of having information at our fingertips. *Science*, *333*(6043), 776–778. https://doi.org/10.1126/science.1207745

Stone, N. J. (2000). Exploring the relationship between calibration and self-regulated learning. *Educational Psychology Review*, *12*, 437-475. https://doi.org/10.1023/a:1009084430926

Stone, S. M., & Storm, B. C. (2021). Search fluency as a misleading measure of memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *47*(1), 53–64. https://doi.org/10.1037/xlm0000806

Storm, B. C., & Stone, S. M. (2015). Saving-enhanced memory: The benefits of saving on the learning and remembering of new information. *Psychological Science*, *26*(2), Art. 2. https://doi.org/10.1177/0956797614559285

Storm, B. C., Stone, S. M., & Benjamin, A. S. (2017). Using the Internet to access information inflates future use of the Internet to access other information. *Memory*, *25*(6), 717–723. https://doi.org/10.1080/09658211.2016.1210171

Tamir, D. I., & Ward, A. F. (2015). Old desires, new media. In W. Hofmann, & L. F. Nordgren (Eds.), *The psychology of desire* (pp. 432–455). Guilford.

Wang, Y., Wu, L., Luo, L., Zhang, Y., & Dong, G. (2017). Short-term Internet search using makes people rely on search engines when facing unknown issues. *PLoS ONE*, *12*(4), Article e0176325. https://doi.org/10.1371/journal.pone.0176325

Ward, A. F. (2013a). Supernormal: How the internet is changing our memories and our minds. *Psychological Inquiry*, *24*(4), 341–348. https://doi.org/10.1080/1047840x.2013.850148

Ward, A. F. (2013b). *One with the cloud: Why people mistake the internet's knowledge for their own* [Doctoral dissertation]. Harvard University. Available at https://dash.harvard.edu/handle/1/11004901

Ward, A. F. (2021). People mistake the internet's knowledge for their own. *Proceedings of the National Academy of Sciences*, *118*(43), Article e2105061118. https://doi.org/10.1073/pnas.2105061118

Wegner, D. M. (1987). Transactive memory: A contemporary analysis of the group mind. In B. Mullen, & G. R. Goethals (Eds.), *Theories of group behavior. Springer series in social psychology (pp.*105-108). Springer. https://doi.org/10.1007/978-1-4612-4634-3_9

Wegner, D. M., Erber, R., & Raymond, P. (1991). Transactive memory in close relationships. *Journal of Personality and Social Psychology*, *61*(6), 923–929. https://doi.org/10.1037/0022-3514.61.6.923

Winne, P. H., & Hadwin, A. F. (1998). Studying as self-regulated learning. In D. J. Hacker, J. Dunlosky, & A. Graesser (Eds.), *Metacognition in educational theory and practice* (pp. 277–304). Lawrence Erlbaum Associates Publishers.

Zhao, Q., & Linderholm, T. (2008). Adult metacomprehension: Judgment processes and accuracy constraints. *Educational Psychology Review*, *20*, 191-206. https://doi.org/10.1007/s10648-008-9073-8

ΒΙΒΛΙΟΓΡΑΦΙΚΗ ΑΝΑΣΚΟΠΗΣΗ | REVIEW PAPER

Μεταγνωστικά φαινόμενα κατά την αλληλεπίδραση ανθρώπου - Διαδικτύου

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Διαδίκτυο,
Μεταγιγνώσκειν,
Μεταγνωστικές κρίσεις,
Μνήμη,
Συναλλακτικά συστήματα μνήμης,
Γνωστική εκφόρτωση

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ΠΕΡΙΛΗΨΗ

Τα εξωτερικά πληροφοριακά συστήματα συχνά λειτουργούν ως ένα διευρυμένο γνωστικό σύστημα και δυνητικά εκλαμβάνονται ως επεκτάσεις της ικανότητας της ανθρώπινης νόησης. Ωστόσο, τα όρια μεταξύ του δικού μας νου και ενός ισχυρού υπολογιστικού νέφους (cloud), όπως το Διαδίκτυο, γίνονται ολοένα και πιο ασαφή. Η παρούσα εργασία εξετάζει πρόσφατα εμπειρικά δεδομένα σε σχέση με μεταγνωστικά φαινόμενα που λαμβάνουν χώρα κατά τη διάρκεια της αναζήτησης πληροφοριών στο Διαδίκτυο, με βάση τη θεωρία συναλλακτικών συστημάτων μνήμης και τη θεωρία της γνωστικής εκφόρτωσης. Η συζήτηση επικεντρώνεται στους τρόπους με τους οποίους το γνωστικό μας σύστημα ελίσσεται και προσαρμόζει τις αντιδράσεις του στο μέσο του Διαδικτύου, εστιάζοντας στις επιπτώσεις της χρήσης στις μεταγνωστικές αξιολογήσεις του εαυτού μας ως γνώστη, την καινοφανή μεταγνωστική εμπειρία του αισθήματος της ευρεσιμότητας καθώς και στον τρόπο με τον οποίο επηρεάζονται οι μεταμνημονικές μας κρίσεις. Στο τέλος, προτείνονται κατευθυντήριες γραμμές για τη μελλοντική έρευνα και για την καλύτερη κατανόηση της αλληλεπίδρασής μας με το Διαδίκτυο.