



# One with the Cloud: Why People Mistake the Internet's Knowledge for Their Own

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*One with the Cloud:*  
*Why People Mistake the Internet's Knowledge for Their Own*

A dissertation presented  
by  
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to  
The Department of Psychology  
in partial fulfillment of the requirements  
for the degree of  
Doctor of Philosophy  
in the subject of  
Psychology

Harvard University  
Cambridge, Massachusetts

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One with the Cloud:

Why People Mistake the Internet's Knowledge for Their Own

**Abstract**

The internet is a consistent presence in people's daily lives. As people upload, download, and offload information to and from this cloud mind, the line between people's own minds and the cloud mind of the internet may become increasingly blurry. Building on the theory of transactive memory, the current research uses 2 pilot studies and 6 experiments to explore the possibility that using the internet to access information may cause people to become one with the cloud—to lose sight of where their own minds end and the mind of the internet begins, and to lose track of which memories are stored internally and which are stored online. These experiments explore three key factors that may lead to blurred boundaries between the self and the cloud: accessing the internet through a familiar access point or transactive memory partner (i.e., Google), having the “feeling of knowing” that often accompanies internet search, and experiencing the “knew it all along” effect when this feeling of knowing is falsely confirmed. These factors are often present when accessing information online, and may lead people to misattribute internet-related outcomes and characteristics to the self.

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## One with the Cloud:

### Why People Mistake the Internet's Knowledge for Their Own

“Where is my mind?” (The Pixies, 1988)

We tend to think that our minds—our thoughts, preferences, personalities, and memories, the parts of ourselves that represent who we are and where we've been—reside within the confines of our bodies; even if we are feeling a bit dualistic, we generally maintain the belief that our minds are uniquely *ours*, unshared and self-contained. However, this may not be the case. People seem to readily offload responsibility for memories to external storage devices such as friends, family, books, and—most recently—the internet. In this way, our minds—and our memories—are *not* uniquely ours; they are distributed throughout our social networks, stored in our libraries, and streaming all around us in the form of digitally transmitted bits and bytes. Although the same cognitive tendency may lead people to offload information to a variety of external devices, the outcomes of offloading this information—and accessing it in the future—may differ according to the storage device. Specifically, interacting with particularly unobtrusive storage devices—such as the internet—may cause a blurring of the boundaries between the internal, personal, mind and the external, distributed, mind. As a result, people who use the internet to find information may take ownership of both the outcomes and characteristics of this external mind; they may both attribute internet-enabled positive outcomes to the self and incorporate the internet's characteristics—such as the ability to process, remember, and locate information—into their own self-perceptions.

Any time information is offloaded to an external source, the mind is—in a sense—distributed; it is no longer self-contained, but is spread between both internal sources (the self) and external storage devices (e.g., friends, family, books, computers). However, the division



between the internal and external often remains relatively clear. Asking a friend for information often requires a relatively lengthy process: locating that friend, hoping she knows this information, and waiting through hemming, hawing, and a throat-clearing or two as she searches her own memory for the material. Similarly, finding information in a book may involve driving to a library, fumbling through a card catalog, and wandering through shelves and indices before the desired material is finally located. These involved search processes may make the division between the internal and the external minds almost unmistakable; the mere act of searching for externally-stored information makes it evident that these parts of the extended mind reside primarily in someone or something else.

The internet stands in stark contrast to other forms of external memory, primarily because of its remarkably unobtrusive nature. It is always present, reachable via access points strewn throughout homes and offices, smartphones carried in pockets and pocketbooks, and even wearable computers such as the Sony SmartWatch and Google Glass; it almost always delivers the desired information; and, perhaps most importantly, it is fast—information that may have taken minutes, hours, or even days to track down is now accessible with the simple swipe of a finger. Searching the internet may be even faster than searching one's own mind; whereas attempts to recall information from one's own memory can be immensely time-consuming—and may never be successful—Google returns search results in fractions of a second, often even faster than these questions can be asked (Mayer, 2010).

This speed advantage—over both other external sources and people's own minds—may make people more likely to use the internet than any other information source, both external (e.g., friends) and internal (e.g., one's own memory). Because searching the internet is more efficient than searching one's own memories, in terms of both time spent and cognitive energy

expended, people may be inclined to search for information that they believe they already know, but cannot currently recall. This “feeling of knowing” (e.g., Nelson & Narens, 1990), or belief that one knows something that might not be immediately accessible, is not always a reliable predictor of actual knowledge (or of the ability to recall this knowledge). Once the correct information is retrieved, however, people may experience recognition memory, leading to the “knew it all along” effect (e.g., Fischhoff & Beyth, 1975). In this way, internet use may “confirm” that people know what they never actually knew (or, to be more specific, information that they never could have recalled, but may have been able to recognize). This blurry distinction between what the individual knows and what the internet knows may be related to more general blurred boundaries between the self and the internet. Again, it may be that merging one’s own internal mind with the external cloud mind of the internet creates two effects; perhaps people do not simply take personal credit for performance enabled by the internet, but actually go a step farther and incorporate the attributes of this external cloud mind—replete with processing, storage, and search skills—into the internal mind of the individual.

### **Transactive Memory**

The expansion of the mind through the process of offloading memories to external storage devices is captured by the theory of “transactive memory” (e.g., Wegner, 1986). The basic premise of transactive memory is one of efficiency. People cannot possibly know everything. However, by offloading the responsibility for specific types of information to others, they gain the capacity to both acquire increased depth of knowledge in a few domains of personal expertise and access the information held by a broad range of others, each with similarly advanced knowledge in his or her domains of expertise. When it comes to most topics, people ensconced in a transactive memory structure do not need to know much at all—they

simply need to know who knows it; content knowledge (e.g., “How do I fix this car’s radiator?”) can often be replaced by location knowledge (e.g., “Who do I know that knows about car repairs?”).

These transactive memory structures consist of links between individual members of groups, where each link represents an individual’s location knowledge regarding another member’s content knowledge. The division of content knowledge between group members generally occurs according to three principles: negotiated responsibilities, relative expertise, and knowledge of other members’ access to information (Wegner, Erber, & Raymond, 1991). In a perfectly functioning transactive memory structure, each member is responsible for a unique set of information and all members know who knows what. These structures—and the division of knowledge within them—generally seem to form and operate automatically, particularly in long-term relationships. As people get to know each other, they intuitively divide responsibility amongst themselves, often without explicit discussion; however, any apparent shortcomings of this intuitive process—for example, a particular type of information that to fall through the cracks—can be remedied through explicitly negotiating responsibilities. Once these roles are set, the transactive memory structure serves as both a cognitively efficient system—allowing people access to both depth and breadth of knowledge—and as a form of social cohesion—members are bound together through cognitive interdependence, and losing a group member entails losing all of that member’s accumulated knowledge.

The most basic form of a transactive memory structure appears at the dyadic level. Any time two individuals interact for a relatively extensive period, they form such a structure—a cognitive connection that connects the mind of each person (and the knowledge contained within it) to the mind of the other (e.g., Peltokorpi, 2008; Wegner, Giuliano, & Hertel, 1985; Wegner,

1986). This connection affords both individuals access to a broader set of information than either could have alone; each individual has access to information stored internally (in his or her own mind), as well as externally (in the partner's mind). One early study showed the effectiveness of this information distribution system for memory encoding and recall (Wegner, Giuliano, & Hertel, 1985). Dating participants came into the lab with their partners, whom they had been seeing for at least three months, and were either allowed to remain in their preexisting partnerships or split from their partners and placed into a new dyad. Not only did preexisting partners do better than newly formed dyads at remembering a list of trivial information, but each member of the preexisting partnership also remembered overwhelmingly *unique* information—that is, information not remembered by the other partner. This experiment shows both that transactive memory structures increase the ability to remember new information and that this memory advantage may be due to efficient division of responsibility for incoming information. When part of a transactive memory structure, people remember only the information for which they are responsible, believing that their partners will remember the rest—and these beliefs are generally correct.

This intuitive and automatic division of information binds individuals (both dyads and larger social groups) together into a single working unit. For example, imagine that a couple has been invited to a mutual friend's birthday party. Without explicitly discussing it, one partner may remember the location while the other remembers the dress code. All will go well if the two remain together; if separated, however, one partner may show up to a cocktail party in a bathing suit and flip-flops while the other aimlessly wanders the streets in a full tuxedo. When people form transactive memory structures, they enter into a form of cognitive interdependence in which each mind is incomplete without the other(s). The distributed mind present in a properly

functioning structure is capable of remembering and processing more information than any single human mind; however, the individual remnants of a shattered transactive memory structure may be incapable of performing even simple tasks, as these tasks require information that was distributed among the various members and is now inaccessible.

The ineffectiveness of individual ex-members of transactive memory structures highlights a crucial aspect of transactive memory: the important of accessibility. The formation—and efficient application—of a transactive memory structure is dependent on all minds involved both containing information and having the ability to communicate this information. An entity’s wealth of knowledge is worthless if it is inaccessible, either temporarily (e.g., while a person sleeps or is on vacation) or permanently (e.g., when a person passes away). For much of human history, the necessity of accessibility has forced people to form transactive memory relationships only with other human beings; although humans may often be unavailable, they are the only species consistently capable of engaging in an exchange of information. One’s dog, for example, probably has little interest in remembering the details of one’s birthday party, and little ability to do so—even if Spot was a real party animal, he would have no way of relating these details to Dick, Jane, or any other person. Even animals apparently capable of spectacular mental feats—for example, grey parrots that can classify novel information (e.g., Pepperberg, 1983) or dolphins that appear to understand human intentions (e.g., Lilly, 1967)—cannot be of use within a human transactive memory structure, for the simple fact that an inability to communicate precludes accessibility.

### **The Internet: Storage Device or Transactive Memory Partner?**

Inorganic information storage devices, however, offer high levels of accessibility despite their status as nonhumans. Although the cognitive tendency to form transactive memory

structures probably developed in the absence of such resources, external storage devices such as books, file cabinets, computers, and—most recently—the internet may be integrated into transactive memory structures. For the most part, however, these devices are provisional members of the transactive memory club. Most transactive memory structures form automatically, through the three basic guidelines of negotiated responsibilities, relative expertise, and access to information. However, file cabinets have no privileged access to information, computers—although adept at many computational processes—lack inherent informational expertise, and one cannot negotiate responsibilities with a set of encyclopedias. Moreover, these devices can neither proactively record new information nor spontaneously share such information. Despite their accessibility—which often exceeds the accessibility of human transactive memory partners (a computer is much less likely than a human partner to be angry when awoken from “sleep”)—these devices cannot operate as full members of a transactive memory structure, both absorbing and sharing specialized areas of knowledge. Rather, they seem more like highly useful receptacles—they do not encode memories or develop knowledge on their own, but merely store the expertise of other members of the transactive memory system.

The internet may be the exception to this rule, despite appearing to share the shortcomings of other inorganic memory storage devices. Like these devices, the internet is somewhat passive in its role as a transactive memory partner; it does not actively encode new incoming information. However, the sheer scope of the information contained within the internet may make up for this ostensible shortcoming; it does not need to encode incoming information, simply because this information is probably already present somewhere within the internet’s vast informational network. And while the internet cannot spontaneously share this information, people’s knowledge of the internet’s informational dominance may largely preclude

the necessity for spontaneous sharing. In human transactive memory structures, people often seek out experts rather than waiting for these experts to come to them; if people acknowledge the internet as an “expert” for virtually all types of factual information, the human propensity to seek out this expert may eliminate any need for the internet to proactively engage with the rest of the transactive memory structure.

Most information stored in inorganic memory storage devices was initially created by human minds; the internet is no exception. Some devices, like file cabinets and personal computers, may only store information intentionally placed there by a human member of the transactive memory structure; they may be redundant, allowing greater access to preexisting information but failing to provide access to any unique knowledge. Other devices, like the internet, may often provide access to unique knowledge, or information that is not possessed by any other member of a transactive memory structure; although the information stored online is generally placed there by a human agent, this agent is rarely a member of one’s own human transactive memory structure. Books often share this benefit of containing knowledge from an external source; however, the information contained on the internet exceeds that of over 35 billion 500-page books.<sup>1</sup> Thus, the vast scope of the internet eliminates many problems inherent in printed information—a gap in knowledge does not require a trip to the book store, but simply a quick web search; in a sense, accessing the internet is like having every book ever written at one’s fingertips—plus a multitude of other informational tidbits never recorded in book form.

The internet’s ability to provide access to vast amounts of information otherwise inaccessible to

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<sup>1</sup> The internet contained approximately 50 petabytes of data as of 2009 (Ashton, 2009), and one 500-page book requires approximately 1.5 megabytes of data (Franca, n.d.). 1 Petabyte is equal to 1,024 terabytes, which equals 1,024 gigabytes, which equals 1,024 megabytes. The precise number of 500-page books that could be stored on the internet (at its 2009 size) is 35,791,394,113.

other members of a transactive memory structure seems to put it in a class apart from other inorganic external memory storage devices—one that is a step closer to the status enjoyed by human transactive memory partners.

The prospect of the internet as a transactive memory partner also fares well when evaluated according to the criteria used to divide responsibility within transactive memory structures (relative expertise, access to information, and negotiated responsibilities). First, the internet almost always has relatively higher expertise in a given area than any one individual. The internet, at its best, is a continuously updated, peer-reviewed, compendium of knowledge (Arbesman, 2012). Accessing the internet can be like tapping into a field of *actual* experts, as opposed to simply asking the individual in one's transactive memory structure that has the highest level of *relative* expertise. The information people can access using these smartphones (or other access points) is vaster in scope than the information contained by any human transactive memory partner (by a factor of approximately 341 to 1)<sup>2</sup>, and is not subject to the same problems of memory decay and distortion that afflict human beings. Second, many individuals almost always have access to the internet, and the internet always has access to up-to-date information. 63% of Americans carry smartphones—access portals to the internet—around with them on a daily basis (VisionMobile, 2011), and almost all of them keep these portals to the cloud mind with them at all times—even sleeping with them by their sides (Pew, 2010). Accessing information stored on the internet is as simple as inputting the right search string, and people need not worry that the internet has gone on vacation or misplaced a relevant memory.

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<sup>2</sup> The internet contained approximately 50 petabytes of data as of 2009 (Ashton, 2009), and the human brain has been estimated to contain approximately 3 terabytes of information (Birge, 2006). 1 Petabyte is equal to 1,024 terabytes. Thus, the internet (at its 2009 size) contains as much information as approximately 341.33 human brains.



When it comes to expertise and information access, the internet seems to unequivocally outperform human transactive memory partners.

Like other inorganic memory storage devices, negotiating responsibilities with the internet is difficult, if not impossible. However, the structure of the internet may make this criterion moot. In human transactive memory structures, responsibilities are negotiated when it is unclear who should encode a given type of information. The structure of the internet makes the division of mental labor evident; the internet “remembers” virtually all factual informal, leaving other members of the transactive memory structure to encode those things that the internet cannot remember—primarily personal autobiographical events such as conversations (unless they occurred over email or online chat), details about what someone ate or wore (unless these data were captured by a fitness tracker or camera phone), and interpersonal information that may not be available online, such as friends’ favorite books or activities (unless this friend is an active Facebook user). Although one cannot easily negotiate responsibilities with the internet, this negotiation may be unnecessary; the roles are clear, and the internet is capable of doing the lion’s share of the work. As a potential transactive memory partner, the internet may be uncompromising, but it is not particularly demanding.

Recent research on the “Google Effect” suggests that the internet is being used as a primary external memory storage device, and may even be treated similarly to a human transactive memory partner (albeit one with superhuman memory storage abilities). This study suggests that people’s first impulse may be to outsource responsibility for many types of information not to friends, colleagues, or lovers (i.e., human transactive memory partners)—but to the internet (Sparrow, Liu, & Wegner, 2011). When people believed that trivia facts were being stored (or “remembered”) by a computer, they failed to encode them within their own

memories—even when they were explicitly instructed to do so; this suggests that people may intuitively and automatically offload responsibility for information to the internet, and that this tendency is so strong that even explicit instructions to do otherwise are ineffective. Further results suggest that people do not just expect the internet to store information, but also look first to the internet when they need this information. When researchers asked participants difficult questions, words related to internet search (Google, Yahoo) produced significantly more Stroop interference than general brand-related words (Nike, Target), suggesting that the experience of not knowing something primed people to think of the internet. Taken together, these results suggest that people use the internet like a transactive memory partner—they offload memories to this source, and look to it first when information is needed. Moreover, these studies suggest that the internet’s status in the hierarchy of transactive memory partners is among the elite; people thought of the internet when presented with *any* hard questions, suggesting that the area of expertise attributed to the internet is not a specific topic (e.g., cars, clothing), but the broad topic of “information” (including, but not limited to, information related to difficult questions). These results could suggest that people connect to the internet much like they would to a human transactive memory partner; on the other hand, they could merely suggest that the internet is a highly useful external memory storage device.

### **The Internet as a Transactive Memory Partner**

The crux of the separation between “transactive memory partners” and “external memory storage devices” may be found in the word *partner*. A partner implies a companion, a coworker, an entity with a mind. And it may be that the mindedness—or perceived mindedness—of the internet determines whether it is truly a *partner*, or merely a *device*.

Minds have been defined in many ways: as things that act and feel (e.g., Gray, Gray, & Wegner, 2007), as things that contain information (Kurzweil, 1992), and as things that have the ability to communicate information—even if they don't understand it themselves (e.g., Russell & Norvig, 2003; Searle, 1980). Although the internet may not seem particularly mind-like according to the former definitions—those that allude to what it is like to have or be a mind—it seems to pass with flying colors according to the latter ones—those that allude to what it is like to interact with a mind. These latter definitions may be the most important; because it is impossible for someone to know what it is like to have another mind (Nagel, 1974)—or even that other minds exist (Mill, 1882)—what determines an individual's experience of the world is ultimately the *perception* of other minds (Epley & Waytz, 2009). For purposes of the individual, other minds seem to be defined by the information they communicate—and the internet may be the most proficient communicator of them all. This mind represents a supreme cloud intelligence, engaging in give-and-take relationships with users, both providing and asking for information. It is both knowledgeable—containing information on everything from aardvarks to Zambia—and adept at communicating this knowledge—an internet search provides relevant information in an instant, whereas searching one's own memory may not present the correct information even if given infinite time. Perhaps even more importantly, the internet—as experienced through its access points—often *seems* like a mind. Advanced GPS systems talk to lost travellers, Apple's *Siri* talks *with* users (often for no apparent reason), and Ask.com originated with the idea of a virtual butler (Jeeves) who would carry out a user's every command. Both by definition (the internet is composed of information, meant to be communicated) and by design (the internet's access points often make the communication

process as human-like as possible), the internet seems to fit the criteria of both acting like and feeling like a mind.

“The internet,” though, is a nebulous concept, one too large to fully comprehend. Even if the internet is like a mind—and thus eligible for status as a transactive memory partner rather than simply an external memory storage device—it still seems to be a mind too large to grasp. Like directly connecting to each individual volume in the Library of Congress, individually connecting to and keeping track of each source of information contained within the internet seems to be an impossible task. People need a librarian—a central source that sifts through all of the available knowledge, and produces only that which is relevant to one’s current goal. It may be that search engines serve as these librarians—access points to the mind of the internet.

Google, a popular search engine, seems to be a top candidate for the role of primary electronic librarian, indexing the internet’s vast amounts of information, pointing people in the appropriate direction, and often even providing the desired information itself (Singhal, 2012). Google is both the most used search engine and the most accessed of all websites (Appendix A), and people connect Google to the concept of “internet” more than any other website (Appendix B). Taken together, these data suggest that people go to Google specifically, not the internet in general, for answers; Google is a librarian, but it is also the face of the incomprehensibly vast cloud mind of the internet. Just as people tend to communicate face-to-face, rather than mind-to-mind, it may be that they engage with the cloud mind of the internet through its most common access point, or face: Google. As a result, people may form transactive memory relationships with Google—this simple, relatable, whimsical yet efficient face of the internet—rather than the broader concept of the internet per se.

Although the cognitive tendencies underlying transactive memory structures likely developed in a world where other human beings were the only viable transactive memory partners, the “new” technology of the internet seems to have hijacked this “old” cognitive process. The process remains the same—people expand their minds by distributing memories between themselves and transactive memory partners—but the outcome is different—instead of connecting to a wide range of human partners, each clearly distinct from the self, people may now need little more than the internet (as accessed through Google), a partner so unobtrusive that it is often unclear where the cloud mind ends and the mind of the individual begins. The internet certainly seems to be more than just an external memory storage device, and may even be more than a transactive memory partner—it may represent an external cloud mind ripe for assimilation into the mind of the individual; it may become, in some ways and in some cases, a part of the self.

### **The Internet as an Aspect of Self**

When two minds are connected in a transactive memory system, the boundaries between them may blur, creating confusion over where one mind ends and the other begins (Wegner, 1995). This phenomenon occurs between the minds of two people, despite how fallible, unreliable, and laden with extraneous qualities such as “personalities” they may be. How much more, then, may this effect occur between the minds of people and the cloud mind of the internet, a mind that is seemingly omniscient, omnipresent, and unobtrusive? When two people form a transactive memory structure, it seems clear that each is sharing information with an external entity; the very act of physically asking another person for information draws attention to the fact that this information is coming from outside the self. The internet, however, gives no physical clues to its presence; it is an almost entirely unobtrusive source, providing correct information

both quickly and invisibly. As people form transactive memory systems with this cloud mind, they may lose sight of the internet as an external memory storage device—or as an external entity altogether; instead, people may simply merge the cloud into the self, a neural prosthetic connected not by wires but by incessant and instantly available streams of data.

This merging of the individual human mind and the cloud mind of the internet may produce two primary effects. First, people may misattribute internet-related outcomes to the self; they may be unable to distinguish between what output was produced by their own minds and what output was produced by the mind of the internet. Second, people may incorporate characteristics of the internet into their own self-concepts; they may believe that they themselves are increasingly adept at thinking about, remembering, and locating information. These two effects of merging the self with the internet go hand in hand, but speak to distinct aspects of this phenomenon; the former states, “I *did* this,” whereas the latter states, “I *am* this.” Taken together, they suggest that internet use may cause people to blur the boundaries between the self and the internet in terms of both outcomes and attributes.

### **Owning the Internet’s Outcomes**

Taking personal credit for internet-related outcomes may be lubricated by the correspondence bias (e.g., Gilbert & Malone, 1995; Gilbert, Pelham & Krull, 1988)—that is, the tendency to see dispositions rather than situations. When people use the internet to find information, then perform well on an information-based task, the obvious explanation is a situational one: they performed well because they used a performance-enhancing tool. However, experiments on attribution of outcomes suggest that people tend to overlook situational explanations in favor of dispositional ones. For example, in a study centered around a quiz game in which one participant composed questions and the other answered them (quite poorly, as it

turns out), both questioners and answerers offered dispositional explanations of the answerer's poor performance; they claimed that the questioner simply had higher levels of general knowledge than the answerer. The obvious situational explanation—that the questioner composed the questions him- or herself, and thus knew all the answers, while the answerer enjoyed no such luxury—was ignored (Ross, Amabile, & Steinmetz, 1977). Similarly, cognitively busy participants watching people discuss either anxiety-inducing or relaxing topics failed to attribute the apparent anxiety displayed by those discussing anxiety-inducing topics to this situational factor, instead attributing them relatively high levels of trait anxiety (Gilbert, Pelham, & Krull, 1988). It seems that, in general, people are predisposed to attribute behavior to dispositional rather than situational causes, even when the situational cause is readily apparent. In the case of the internet, this may be reflected in a belief that high levels of performance are due to intrinsic ability (i.e., one's own knowledge and/or memory) rather than situational explanations (i.e., access to the internet)—regardless of how obvious these situational explanations may be.

Although research on the correspondence bias generally deals with dispositional attributions related to *others'* behavior, these principles may also apply to causal explanations of one's *own* behavior. In the case of the internet, accessing this external source tends to have positive effects on performance; these outcomes may predispose people to view outcomes resulting from internet use as products of the self. Using the internet to find information—as people are wont to do when engaged in a transactive relationship—may confirm people's initial positive views of themselves (as intelligent, capable, etc.) by enabling them to perform well on knowledge-based tasks; internet users may in turn attribute this positive information to an internal cause: the self (e.g., Ross, 1977).

Correcting initial trait attributions with information related to situational influences requires identifying these influences and having both the cognitive capacity and willingness to incorporate them into causal judgments (e.g., Gilbert, McNulty, Giuliano, & Benson, 1992; Gilbert, Pelham, & Krull, 1988; Ross, Amabile, & Steinmetz, 1977); each of these processes may be difficult when the internet serves as a situational influence on performance.

Collaborating with a human transactive memory partner generally requires an involved process—tracking down this partner, explicitly explaining the situation at hand, waiting while she (hopefully) produces the desired information, and so on; the internet, on the other hand, is nearly always immediately accessible, requires minimal input, and is quick to provide information. The relatively unobtrusive nature of the internet may prevent people from ever being aware of it as an external, or situational, influence on behavior; when not confronted with the physical cues of another person giving them information, people may fail to realize that this information comes from an external source. Even if people do recognize the internet as an external source, correcting causal judgments to take this subtle source into account may require prohibitively large amounts of cognitive resources. Like people viewing or listening to degraded information (i.e., sources that are obscure or difficult to categorize), the relative difficulty of recognizing the internet as an external source may leave little cognitive resources left for correcting initial dispositional inferences (Gilbert, McNulty, Giuliano, & Benson, 1992).

Finally, even if people have the cognitive capacity to reevaluate the causes of their performance, they may be willing to do so when the true cause of positive performance is the internet. People generally like to see themselves in a positive light (e.g., Alicke, 1985), a tendency that almost certainly works against the willingness to correct misattributions of a self-promoting outcome. Motivated cognition (e.g., Miller & Ross, 1975) may lead people to brush the situational



explanation of the internet under the table or hide it in the corner of their minds, a process which is certainly easier than attempting to do the same with human information sources such as loud Uncle Dave, the resident automobile expert.

The belief that one's performance is due to an internal cause or disposition (i.e., the self) as opposed to situational factors can be assessed by asking people to predict how well they will do on a similarly-designed second task in the absence of the true (situational) cause. This strategy was outlined by a study in which participants took a quiz either with or without access to an answer key, then were asked to predict their performance on a second quiz to be taken without an answer key (Chance, Norton, Gino & Ariely, 2011). In this case, participants who had seen the answer key overweighted the dispositional cause of their performance, as revealed by significantly higher predictions for performance on the second quiz relative to predictions made by participants who had not seen the answer key. Similarly, people who use the internet to perform an initial task may believe that they will continue to do well on a second task when not allowed to use the internet, and their estimates of future performance may exceed those provided by people who did not use the internet on this initial task; this pattern of results would suggest that people who use the internet are misattributing internet-related outcomes to the self—they are so sure that their performance on the first task was due to dispositional abilities that they predict that this performance will persist even when the situational factor of the internet is removed.

### **Acquiring the Internet's Attributes: Cognitive Self-Esteem**

Misattributing the cause of internet-related outcomes suggests that people may blur the boundaries between self-produced output and output produced by the internet. However, it does not directly speak to whether or not people see the internet—accessed through the transactive memory partner of Google—as being a part of the self. If people do merge their own minds with

the cloud mind of the internet in this way, merging with the internet should change self-perceptions; specifically, people should view attributes associated with the internet as being self-descriptive (Galinsky, Ku, & Wang, 2005). These attributes may be related to the internet per se (e.g., information-related abilities), or to the specific transactive memory partner used to access the internet: Google (e.g., information search abilities).

If self/other overlap between the individual mind and the cloud mind of the internet affects self-perceptions, changes in these perceptions should be uniquely related to attributes that are relevant to the internet, such as the ability to process and remember information. Accessing the internet should not affect self-perceptions in unrelated areas. Tapping into a vast source of information may make people believe that they have better memories, but it is unlikely to make them believe that they are excellent swimmers, social butterflies, or even particularly worthwhile individuals—these attributes are simply not related to the internet, and merging with the internet should not have any effect on them.

Self-perceptions are captured by a wide variety of constructs, and one's self-esteem can be captured not simply by a global scale (such as the Rosenberg Self-Esteem Scale; Rosenberg, 1965), but also by series of more specific scales (e.g., Wylie, 1989). For example, there are separate scales assessing one's belief about his or her physical prowess (PASCI-physical; Fleming & Whalen, 1990), academic ability (BASE; Coopersmith & Gilberts, 1982), social skills (PASCI-social; Fleming & Whalen, 1990), and feelings about one's own body (The Body-Esteem Scale; Franzoi & Shields, 1984). The proliferation of targeted self-esteem scales draws into focus the concept that people may have radically different self-perceptions related to different parts of their bodies, minds, personalities, and abilities. Despite the proliferation of potentially related scales, including those assessing the propensity to think (Cacioppo & Petty,

1982), and self-esteem related to academic achievement (e.g., Fleming & Whalen, 1990; Janis & Field, 1959; Marsh, Byrne, & Shavelson, 1988; Marsh & O’Neill, 1984), no scale exists to measure Cognitive Self-Esteem (CSE), or how an individual perceives his or her own ability to think about and remember information. This aspect of self-esteem seems most relevant to the attributes of the internet, and thus may be most likely to be affected by any blurring of the boundaries between the internet and the self.

### **Pilot Study 1: Google Effects on CSE**

A pilot study was conducted in order to (1) develop a scale related to individual differences in CSE and (2) provide a preliminary exploration of the hypothesis that using the internet may lead to increases in this measure, as people incorporate attributes of the internet into their own self-perceptions. In order to test whether this scale would be sensitive to state-level changes, particularly those that may arise from accessing information on the internet, half of the participants were asked to use the internet to search for information and the other half were prevented from using the internet. Participants who used the internet were instructed to search for internet-based information using Google, because previous research (Appendices A, B) suggests that this access point to the internet is more familiar than any other, and may be most likely to be used as a transactive memory partner.

Participants ( $n = 66^3$ , 36 female;  $M_{\text{age}} = 36.7$ ) were recruited through Amazon Mechanical Turk, an online participant recruitment tool that provides a more diverse sample than lab-based populations while maintaining similar levels of reliability (Buhrmester, Kwang & Gosling, 2011), to complete a brief trivia quiz consisting of information they may have heard before, but might not be able to remember at the moment (e.g., “Which ocean is the smallest on

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<sup>3</sup> Original  $n = 70$ ; 4 excluded for failing to complete the entire study

earth?"). Prior to beginning the quiz, they were instructed to either use Google or not use Google to check their answers. Following the trivia quiz, participants indicated their level of agreement with 11 statements related to CSE, including items such as "I am good at thinking" and "I have a better memory than most people." One item ("I enjoy thinking") was later judged to be too conceptually similar to Cacioppo and Petty's Need for Cognition Scale (1982), and was excluded from all subsequent analyses. See Appendix C for a factor-analyzed list of all items.

Responses to the remaining ten CSE-related items were used to make an initial version of the CSE scale. A principal components factor analysis with Varimax rotation revealed two factors explaining 70.9% of the variance. Factor one explained 37.5% of the variance and was related to confidence in the ability to think; factor two explained 33.4% of the variance and was related to confidence in the ability to remember (Appendix C). Reliability analyses revealed high reliability for the scale overall ( $\alpha = .92$ ), as well as for both the thinking ( $\alpha = .89$ ) and memory ( $\alpha = .90$ ) subscales.

A one-way ANOVA (condition: Google, no Google) revealed that people scored higher on the CSE scale after using Google than after not using Google ( $M_{Google} = 3.90$ ,  $M_{NoGoogle} = 3.35$ ;  $F(1,64) = 8.96$ ,  $p = .004$ ). This effect held for both the thinking subscale of the CSE ( $M_{Google} = 4.08$ ,  $M_{NoGoogle} = 3.66$ ;  $F(1,64) = 5.62$ ,  $p = .021$ ) and the memory subscale of the CSE ( $M_{Google} = 3.67$ ,  $M_{NoGoogle} = 2.95$ ;  $F(1,64) = 8.94$ ,  $p = .004$ ).<sup>4</sup>

This pilot study both provided a working model for a two-factor CSE scale (thinking, memory) and offered preliminary evidence that accessing information on the internet (in this case, through Google) affects CSE. Because CSE scale items are worded in trait terms (e.g., "I am smart") rather than state-level analogues (e.g., "I performed well"), this suggests that people

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<sup>4</sup> Participants' responses to the CSE measures for Pilot Study 1 are on a 1-5 scale; responses to CSE measures for all other studies are on a 1-7 scale.

think more highly of their own cognitive abilities after searching the internet for information—perhaps indicating that using the internet leads people to assimilate the internet’s attributes into their own self-concepts.

### **Pilot Study 2: Three-Factor CSE Scale**

Pilot Study 1 validated a two-factor CSE scale, but a third aspect of CSE may also be relevant, particularly when taking into the account the central role Google plays in accessing the internet. It may be that accessing the internet causes people to assimilate attributes not just of the end destination—the internet—but also of the access point—Google. Previous research suggests that self/other overlap tends to happen primarily between transactive memory partners (e.g., Wegner 1995), and Google may be treated as people’s primary virtual transactive memory partner when accessing online information.

This pilot added four additional items to the CSE scale, each related to perceived ability to locate information within a transactive memory system (e.g., “When I don’t know the answer to a question right away, I know where to find it”). The addition of these items served two purposes. First, it allowed for an expansion of the scope of the CSE scale to both internet- and Google-related attributes. Second, it allows for increased conceptual clarity in future studies. It could be that using the internet simply elevates people’s beliefs in their ability to locate information, and that elevated self-perceptions in this area drive self-perceptions related to the domains of thinking and memory; in other words, the apparent effects of internet use on thinking and memory might not be due to an assimilation of the internet into the self, but to a side effect of increased belief in one’s own ability to navigate the internet (a belief which could ostensibly be based on fact, given that people who use the internet to find information are necessarily required to search for the desired information). Including items related to transactive memory, or

information search, will create the ability to test whether or not any effects of internet use in this area are completely responsible for effects on thinking and memory.

In Pilot Study 2, 362 participants<sup>5</sup> (187 female;  $M_{age} = 33.63$ ) were recruited using Amazon mTurk and asked to indicate agreement with 14 statements related to CSE: 10 statements, related to thinking and memory, previously tested in Pilot Study 1 and 4 new statements related to transactive memory. Participants were also asked to complete a brief demographic questionnaire. Unlike in Pilot Study 1, participants were not asked to perform any related tasks (e.g., a trivia quiz) before completing the CSE measure.

A principal components factor analysis with Varimax rotation revealed three factors explaining 71.17% of the variance. Factor one explained 26.03% of the variance and was related to confidence in the ability to think; factor two explained 23.65% of the variance and was related to confidence in the ability to remember; factor three explain 21.49% of the variance and was related to confidence in transactive memory skills. See Appendix D for the full list of factor-analyzed scale items. Reliability analyses revealed high reliability for the scale overall ( $\alpha = .91$ ), as well as for the thinking ( $\alpha = .90$ ), memory ( $\alpha = .92$ ), and transactive memory ( $\alpha = .82$ ) subscales.

Additional analyses yielded insight into the relationship between this three-factor CSE scale and two potentially relevant demographic variables: education level and internet use. Education level was positive correlated with overall CSE score,  $r = .15$ ,  $p = .006$ , indicating that people with higher levels of education have greater confidence in their cognitive abilities. This correlation was significant for the thinking,  $r = .14$ ,  $p = .008$ , and transactive memory,  $r = .13$ ,  $p = .018$ , subscales of the CSE, and marginal for the memory subscale,  $r = .09$ ,  $p = .095$ . Perhaps

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<sup>5</sup> Original n = 365; 3 participants did not fully complete the survey.

most pertinent to the current set of experiments, frequency of internet use was not correlated with either overall CSE or any subscale of the CSE measure, all  $r_s < .09$ , all  $p_s > .11$ . This suggests that the effects of internet use on CSE demonstrated in Pilot Study 1 may be proximal effects, caused by immediate exposure to internet-based information, rather than long-term effects caused by frequent exposure to this information.

The three-factor CSE scale developed in Pilot Study 2 will enable a more nuanced analysis of the effects of internet use on CSE. All three subscales of CSE reflect characteristics associated with the internet and/or Google: in providing access to the thoughts and insights of others, the internet may lead people to believe that they themselves are better at thinking; in recording and delivering vast amounts of information, it may lead people to believe that they themselves are better at remembering information; and the indexing and search capabilities of Google—people’s primary access point for the internet, and perhaps the best candidate for an internet-related transactive memory partner—may lead people to believe that they themselves are good at finding information. Using the internet may lead people to believe that they are especially adept at each of these skills—particularly when the lines between the internet and the self are blurred.

### **The Present Research**

The present research investigates the possibility that accessing information stored online—particularly through the transactive memory partner of Google—causes people to blur the boundaries between their own minds and the cloud mind of the internet. If this is the case, then people may both misattribute internet-related outcomes to the self and assimilate characteristics of the internet into their own self-perceptions. If people believe that they themselves are responsible for performance outcomes that are better explained by internet use,

they may believe that they will continue to perform well even without the internet (e.g., Chance, Norton, Gino & Ariely, 2011); thus, predictions of future performance will be used as a measure of the propensity to misattribute internet-related outcomes to the self. If people assimilate characteristics of the internet (and Google) into their own self-perceptions, they may experience increased confidence in their own ability to think about, remember, and locate information; thus, internet affects on self-perception will be measured using relative differences on the CSE scale developed in Pilot Studies 1 and 2.

Blurring the boundaries between the self and the internet may be dependent on three related factors. First, people may only blur these boundaries when the internet is accessed through a well-known transactive memory partner (i.e., Google). Second, the immediate accessibility of the internet may cause people to look up information for which they already have a “feeling of knowing” (e.g., Nelson & Narens, 1990). Third, the speed of the internet may produce information so quickly and so unobtrusively that this feeling of knowing is never disconfirmed, leaving people with the belief that they “knew it all along” (e.g., Fischhoff & Beyth, 1975). The combination of a “feeling of knowing” and the “knew it all along” effect may “confirm” that people know what they never actually knew. When these factors combine, people who have recently used the internet to complete a task may believe that they themselves are better at thinking about, remembering, and locating information, *and* that they will continue to perform well on a subsequent task completed without the internet—when, in fact, they have simply accessed an external source typified by these attributes and enabling high levels of task performance. When any of these factors are interrupted, however, the illusion of oneness with the internet may be shattered, leaving instead a clear impression of the internet as an external information source.



The current set of experiments will address the importance of each of these three factors in creating a sense of blurred boundaries between the internet and the self. These experiments will explore the importance of connecting to the internet through a well-known transactive memory partner (Experiment 1), as well as the extent to which internet effects on self-perceptions are unique to CSE (Experiment 2). The importance of an a priori “feeling of knowing” will be examined in Experiment 3, and the role of the internet’s speed will be tested in Experiments 4 and 5. Finally, a potential alternate explanation—that any boosts in CSE and/or confidence are simply due to increased performance (as opposed to something unique about connecting to the internet)—is assessed in Experiment 6.

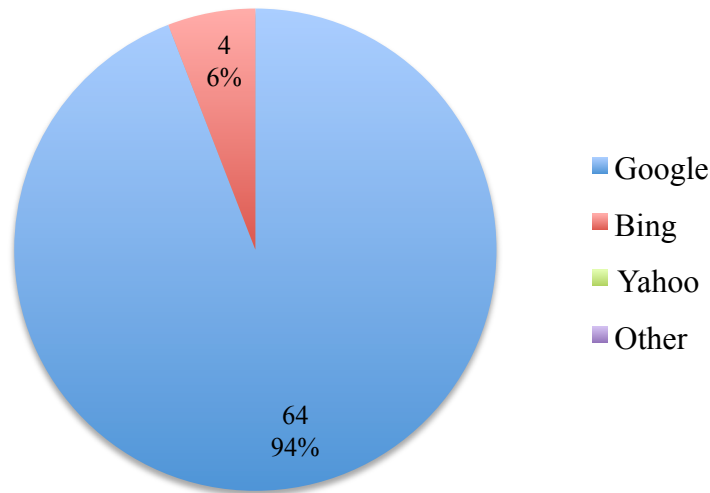
### **Experiment 1: Source Confusion**

Prior research (e.g., Hinsz, 1990; Wegner, 1995) suggests that blurred boundaries between individuals in a transactive memory structure may cause each individual to lose track of which memories are stored internally (in one’s own mind) and which are stored externally (in a partner’s mind). This experiment explores whether or not this internal/external source confusion may occur between users and the internet, as well as whether any source confusion is dependent on the specific access point—or transactive memory partner—used to access online information. This experiment tests the possibility of blurred boundaries between the self and the internet by comparing two equally useful—but unequally used—access points, Google and Lycos. Both websites do the same thing—search, index, and present information from the internet—and both provide seemingly identical information (all questions in this experiment were pretested to ensure that the correct answer appeared within the first three results provided by each search engine). However, Google is a much more commonly used access point than Lycos (see Appendices A and B, as well as results from part 1 of this experiment). This experiment tests the

importance of accessing the internet through a transactive memory partner for creating blurred boundaries between the self and the cloud mind.

This experiment makes use of the concept of “source confusion,” or the inability to keep track of where information came from, to test for differences between familiar and unfamiliar access points to the internet. Although both Google and Lycos serve the same function, Google is a more familiar source than Lycos (see Figure 1). Transactive memory systems should only form with repeated use; thus, people should experience source confusion more when using a familiar source (i.e., Google) than an unfamiliar source (i.e., Lycos).

Experiment 1: Preferred search engine



*Figure 1.* Preferred search engines of 68 participants in Experiment 1. Data labels represent absolute number of responses, followed by percentage of total responses.

## Method

Participants (68<sup>6</sup>, 55 female;  $M_{age} = 36.81$ ) were assigned to either a “Google” condition or a “Lycos” condition. All participants were then asked to answer 60 trivia questions, 30 on their own and 30 using either Google or Lycos (depending on condition). Trivia sets (self, other) were matched for pre-rated fairness, sureness, and difficulty; see Appendix E.1 for a list of all trivia questions and pre-test results. The order of all trivia questions was randomized.

Participants then completed a brief (approximately 5 minute) filler task.

Next, participants were shown 80 trivia questions: all 60 original questions along with 20 new (never before seen) questions. Questions were presented one at a time, in random order.

Participants were provided with the following instructions:

In this part of the study, you will be shown all 60 of the trivia questions from part one, as well as 20 new questions. For each question, you will be asked to indicate whether:

- (1) you have not seen the question before (it is one of the 20 new questions)
- (2) you have seen the question before, but you do not know the answer
- (3) you have seen the question before, you do know the answer to the question, and you didn't use (Google/Lycos)
- (4) you have seen the question before, you do know the answer to the question, and you checked your answer using (Google/Lycos)

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Put another way, you will select (1) if you have never seen the question before, (2) or (3) if you saw the question in part one and did not check your answer with (Google/Lycos),

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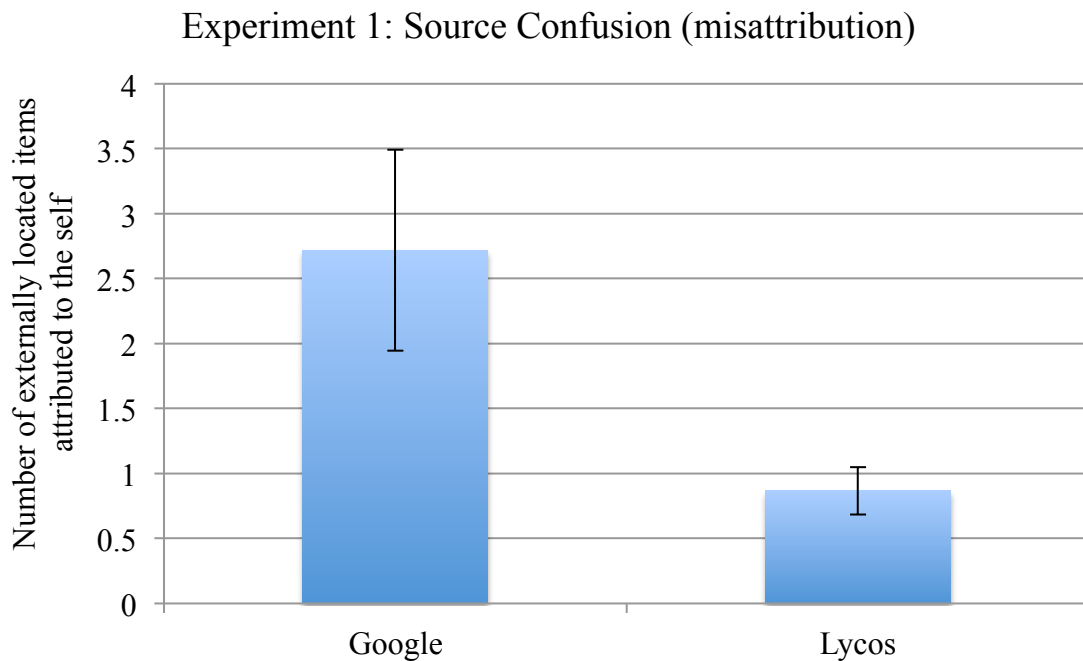
<sup>6</sup> Original n = 80; 12 participants were excluded for failing to follow task instructions—either using a search engine when not instructed to do so or failing to use a search engine when instructed to do so.

or (4) if you saw the question in part one and did check your answer with (Google/Lycos).

Participants then classified the source they used to find the answer to each question by selecting one of these four options for all 80 questions. Source confusion was operationalized as any time participants mistakenly categorized a question that they had looked up using an external source (4) as a question that they had not looked up (2 or 3)—that is, classifying knowledge obtained from an external source as knowledge contained within the self. Before finishing the survey, participants completed a brief demographic questionnaire.

## **Results**

A one-way ANOVA (Google, Lycos) on source confusion (i.e., questions answered using Google/Lycos, but attributed to the self) revealed a significant difference between conditions,  $F(1,67) = 4.25, p = .043$ , such that people attributed information found using Google to the self more often than they did for information found using Lycos; see Figure 2 for means.



*Figure 2.* “Source Confusion” in Experiment 1. Source confusion is operationalized as trivia items answered using Google/Lycos, but attributed to the self. Although both Google and Lycos provide access to the same information, misattribution of information to the self is higher when using Google than when using Lycos.

Additional one-way ANOVAs revealed no significant differences for any other possible types of misattribution: external source as new ( $p = .13$ ), new as self ( $p = .46$ ), new as external source ( $p = .39$ ), self as new ( $p = .90$ ), or self as external source ( $p = .34$ ). The source confusion effect associated with internet use is selective: it seems to occur only with a commonly used partner (i.e., Google), and entails attributing that partner’s “memories” to the self rather than vice versa.

## Discussion

Results from this experiment suggest that boundaries between the self and the internet are more likely to be blurred when people are accessing this cloud mind through a familiar, commonly used source—one that has become a transactive memory partner. Although both Google and Lycos perform the same function, source confusion occurs significantly more often when using Google than when using Lycos; people are more likely to claim information gleaned from Google as their own than they are for the same information when it is delivered by Lycos. These differences may simply be due to the fact that Google is a well-known source—or partner—and Lycos is not. When two people are connected in a transactive memory system, the boundaries between their minds blur (Wegner, 1995), almost as if they are able to see through each other's physical bodies to the ideas contained within; but when two strangers ask each other for information, this is unlikely to be the case—even if the information provided is identical to that provided by a transactive memory partner. Similarly, it may be that people's minds blur with the cloud mind of the internet when this mind is accessed through a familiar transactive memory partner (i.e., Google), but not when it is accessed through a seldom-used source (i.e., Lycos). Google may allow people to look through it, connecting almost instantaneously to the information it provides; Lycos, on the other hand, may call attention to itself as a tool—not necessarily because it is less capable, but because it is unfamiliar.

People's unfamiliarity with using Lycos may make this source seem more obtrusive, thus undermining the possibility of blurring boundaries between the self and the internet—and, as a result, potentially precluding both artificial elevations in CSE and heightened estimates of future performance after using this unfamiliar source to access the internet. When using Lycos (or some other unfamiliar access point), people are aware that they are consulting an external entity,

and are therefore less likely to attribute this entity's output—and perhaps its attributes—to the self. Broadly, these results highlight the importance of accessing the internet through a well-known access point—one that is less a tool, and more a partner. Accessing the internet through an unfamiliar portal seems to highlight the fact that people are connecting to something external—it may be that people's minds only merge with the mind of the internet when this distinction is diminished, and people are able to access the wealth of information available on the internet without becoming explicitly aware that they are gathering this information from anywhere other than their own minds.

### **Experiment 2: Internet Use Selectively Affects CSE**

If accessing the internet truly leads to blurred boundaries between the minds of users and the mind of the cloud, the effect of internet use on self-perceptions should be specific to those attributes associated with the internet. Because blurring the boundaries between the self and the internet—or becoming one with the cloud mind—entails an overlap between the individual self-concept and ideas about a specific entity, only those attributes associated with this specific entity (in this case, the internet) should be adopted as descriptors of the self (Galinsky, Ku, & Wang, 2005). The CSE scale, which measures perceptions of attributes associated with the internet broadly—such as the ability to think about and remember information—as well as those associated with the specific access point of Google—the ability to locate information—should be sensitive to internet use; other esteem-related scales should be unaffected.

If internet use simply elevates self-esteem and positive mood more generally, suggesting any CSE-related effects of internet use may be due to general processes affecting a wide range of esteem-related phenomena, rather than blurred boundaries between the self and the cloud mind. This experiment addresses these competing possibilities by testing the effects of internet use on

CSE as well as a host of other esteem-related measures, including Rosenberg Self-Esteem (Rosenberg, 1965), positive and negative affect (PANAS; Watson, Clark, & Tellegen, 1988), the Fleming-Courtney trait self-esteem scale (Fleming & Courtney, 1984), the Adult Sources of Self-Esteem Inventory (ASSEI; Elovson & Fleming, 1989), and the general, physical, social, mathematical, and verbal subscales of the Personal and Academic Self-Concept Inventory (PASCI; Fleming & Whalen, 1990).

This experiment also follows up on questions raised by Pilot Studies 1 and 2, as well as Experiment 1. First, it adds a control condition to the paradigm used in Pilot Study 1. This allows insight into whether differences between conditions are due to elevated feelings of cognitive ability in the “Google” condition or deflated feelings of cognitive ability in the “No Google” condition—it examines whether using Google makes people feel particularly capable or the inability to use Google makes people feel particularly incapable. It also provides a test of the hypothesis that accessing Google causes some sort of conceptual overlap between the individual self-concept and the idea of the internet; if this is the case, then accessing Google should result in greater attribution of Google-related abilities to the self (that is, CSE should be higher in the Google condition than in all conditions not involving Google). Second, it uses the three-factor CSE scale developed in Pilot Study 2 and assesses the factor structure suggested by this pilot study with a larger sample size. Third, it includes questions asking about participants’ preferred search engines as a way of confirming the usage statistics reported in Appendix A and Experiment 1.



## Method

Participants ( $n = 511$ <sup>7</sup>, 301 female;  $M_{\text{age}} = 34.02$ ) were recruited through Amazon mTurk and placed into one of three conditions before completing a 10-item free-response trivia quiz: a “Google” condition in which they were instructed to use Google to check their answers (“Please use Google to double-check your answers”), a “No Google” condition in which they were explicitly instructed to not use Google (“Although you may be tempted to Google the answers, do not do so”), and a “Control” condition in which they were given no explicit instructions about how to complete the quiz. Quiz items were pretested ( $n = 27$ ) for fairness with a separate participant sample using the question “to what extent do you feel like you should have known the answer?” and response choices “there’s no way I could have known the answer,” “I had a fair chance of knowing the answer,” and “I definitely should have known the answer;” all quiz items ranged from a 1.87 to a 2.22 on this 3-point scale, indicating that people felt the questions were fair, but not entirely obvious (e.g., “what is the most spoken language on earth?”). See Appendix E.2 for a full list of trivia items used in this experiment, along with fairness ratings.

Following completion of the trivia quiz, all participants completed the 14-item CSE Scale developed in Pilot Study 2. Participants then answered one of nine questionnaires potentially related to CSE or self-esteem more broadly (see study description above). Participants were randomly assigned one questionnaire each in order to guard against participant exhaustion and the possibility of diminishing effects over time, which could artificially deflate any effects of accessing information on the internet. Participants then answered demographic questions assessing variables such as age, gender, and patterns of internet use.

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<sup>7</sup> Original  $n = 560$ ; 49 participants were excluded for either disobeying instructions (using Google in the “no Google” condition or failing to use Google in the “Google” condition) or failing an attention check. See Appendix F for the attention check.

## Results

**Factor analysis of the three-factor CSE scale.** Responses to the 14-item CSE scale developed in Pilot Study 2 were subjected to a principal components factor analysis with Varimax rotation. This factor analysis yielded a three-component solution explaining 72.66% of the variance. Factor one explained 28.62% of the variance and was related to confidence in the ability to think; factor two explained 23.91% of the variance and was related to confidence in the ability to remember; factor three explained 20.13% of the variance and was related to transactive memory skills. Reliability analyses revealed excellent reliability for the CSE scale overall, as well as high reliability for each subscale: thinking, memory, and transactive memory. See Table 1 for reliability scores for each of the three subscales for Experiments 2-6.

*Table 1.* Overall reliability ( $\alpha$ ) and reliability for each subscale of the three-factor CSE measure for Experiments 2-6.

	$\alpha_{\text{Overall}}$	$\alpha_{\text{thinking}}$	$\alpha_{\text{Memory}}$	$\alpha_{\text{TransactiveMemory}}$
Experiment 2	.92	.91	.91	.84
Experiment 3	.94	.94	.92	.85
Experiment 4	.92	.90	.92	.78
Experiment 5	.91	.89	.89	.78
Experiment 6	.92	.90	.91	.81

An additional factor analysis combining items from the CSE Scale with those from the Rosenberg Self-Esteem Scale provided evidence that CSE measures a construct distinct from

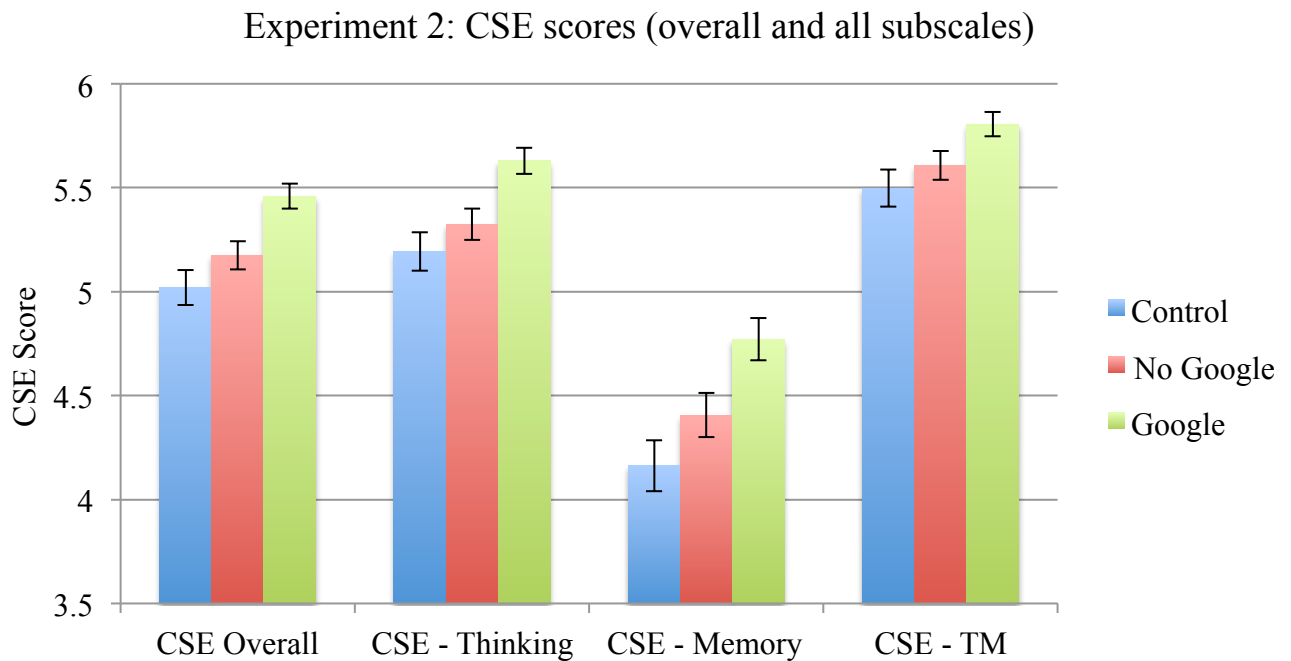
general self-esteem<sup>8</sup>. A principal components factor analysis with Varimax rotation yielded five factors, together explaining 72.62% of the variance. Factors one (23.40% of the variance) and five (7.97%) were comprised of items from the Rosenberg Self-Esteem Scale (factor one consisted of negatively-worded items, whereas factor five consisted of positively-worded items), and factors two (15.50%), three (13.44%), and four (12.30%) replicated the three factors of the CSE scale (factor two was related to thinking, factor three to memory, and factor four to transactive memory).

**Google effects on CSE.** A one-way ANOVA (condition: control, No Google, Google) revealed a significant main effect of condition, such that people had higher overall CSE scores in the “Google” condition than in both the “no Google” and “control” conditions,  $F(2,508) = 10.21$ ,  $p < .001$ . Follow-up analyses confirmed that CSE scores were higher in the Google condition than in both the no Google ( $p = .003$ ) and control ( $p < .001$ ) conditions, and that there were no differences between the latter two conditions ( $p = .14$ ). All means are represented in Figure 3, as well as Appendix G.1

Further one-way ANOVAs revealed significant differences between conditions for all three subscales: thinking,  $F(2,508) = 8.95$ ,  $p < .001$ ; memory,  $F(2,508) = 7.93$ ,  $p < .001$ ; and transactive memory,  $F(2,508) = 4.80$ ,  $p = .009$ . As with the overall CSE measure, CSE scores were higher for each subscale in the Google condition than in both the no Google ( $p_{Thinking} = .003$ ;  $p_{Memory} = .015$ ;  $p_{TransactiveMemory} = .045$ ) and control ( $p_{Thinking} < .001$ ;  $p_{Memory} < .001$ ;  $p_{TransactiveMemory} = .003$ ) conditions, and there were no differences between the latter two conditions ( $p_{Thinking} = .24$ ;  $p_{Memory} = .13$ ;  $p_{TransactiveMemory} = .30$ ).

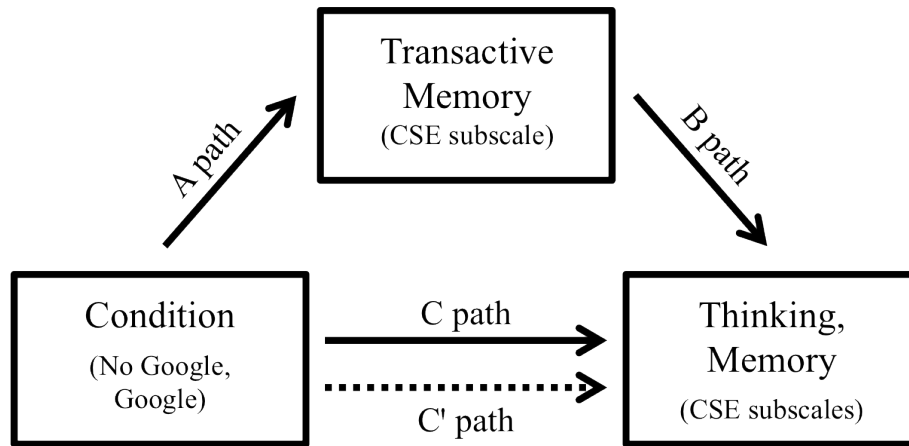
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<sup>8</sup> Other scales were not analyzed because the wording of the scale items/responses was not directly comparable.



*Figure 3.* Mean CSE scores for Experiment 2: overall and all three subscales (thinking, memory, transactive memory).

Finally, results from a bootstrapping mediation analysis (5000 samples; Preacher & Hayes, 2008) indicated that, although the transactive memory subscale of CSE partially mediated the effects of internet use on the remaining subscales (thinking, memory), this direct effect was not completely mediated. Internet use continued to have a direct effect on the thinking and memory subscales of CSE even after accounting for the mediating role of the transactive memory subscale, as demonstrated by the fact that the *c'* path remains significant. See Figure 4 for a complete mediation model, as well as parallel results for Experiments 3-5.

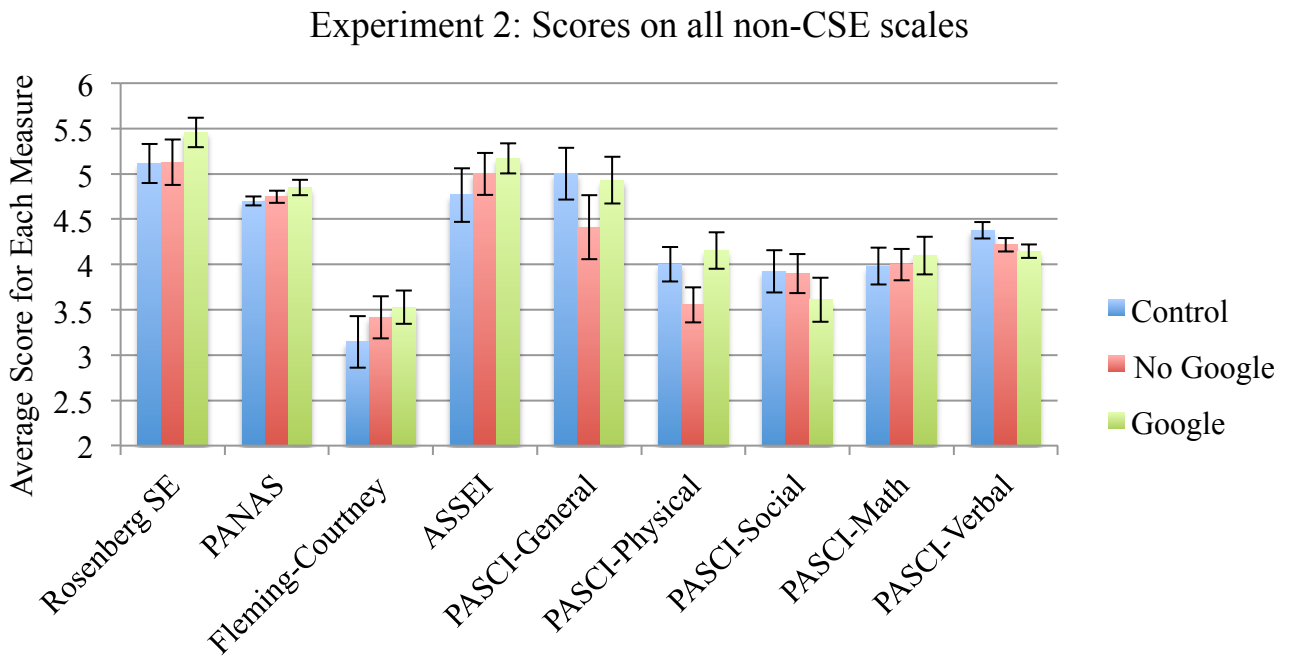


	A path	B path	C path	C' Path	Model Significance
Expt 2: CSE validation	.20*	.73***	.33**	.18*	$F(2,360) = 138.68,$ $p < .0001$
Expt 3: Question Difficulty	.45**	.43***	.54**	.35*	$F(2,111) = 12.79,$ $p < .0001$
Expt 4: Slow Google	.42*	.53***	.85***	.63**	$F(2,79) = 20.33,$ $p < .0001$
Expt 5: Write Answers	.46*	.51***	.73***	.50**	$F(2,88) = 27.65,$ $p < .0001$

\* =  $p < .05$   
 \*\* =  $p < .01$   
 \*\*\* =  $p < .001$

Figure 4. Transactive memory partially mediates the relationship between Google and the other two subscales of CSE (thinking, memory). Although the overall mediation is significant for all studies, the direct relationship between condition and the thinking and memory subscales of the CSE (the C' path) also maintains significance. This indicates that there is a direct effect of condition on these subscales, as well as an indirect effect mediated by transactive memory. For all experiments, only the Google and No Google conditions were compared; for Expt 3, only the “medium” difficulty condition was used.

**Google effects on non-CSE measures.** One-way ANOVAs (condition: control, No Google, Google) on all nine other esteem-related scales revealed no significant differences. A marginal difference ( $p = .08$ ) was found for the physical subscale of the PASCI inventory. See Figure 5 for all means.



*Figure 5.* Mean scores for all non-CSE scales in Experiment 2. Note that  $n$  varies for each study due to randomization procedures:  $n_{\text{Rosenberg}} = 103$ ;  $n_{\text{PANAS}} = 113$ ;  $n_{\text{Fleming-Courtney}} = 62$ ;  $n_{\text{ASSEI}} = 53$ ;  $n_{\text{PASCI-General}} = 53$ ;  $n_{\text{PASCI-Physical}} = 104$ ;  $n_{\text{PASCI-Social}} = 104$ ;  $n_{\text{PASCI-Math}} = 115$ ;  $n_{\text{PASCI-Verbal}} = 115$ .

**Preferred search engines.** This experiment confirmed that Google serves as people’s primary access point for the internet. When asked to indicate their favorite search engine (“What is your favorite search engine (that is, the search engine you use most often)?”), participants overwhelmingly chose Google (Figure 6).

### Experiment 2: Preferred search engine

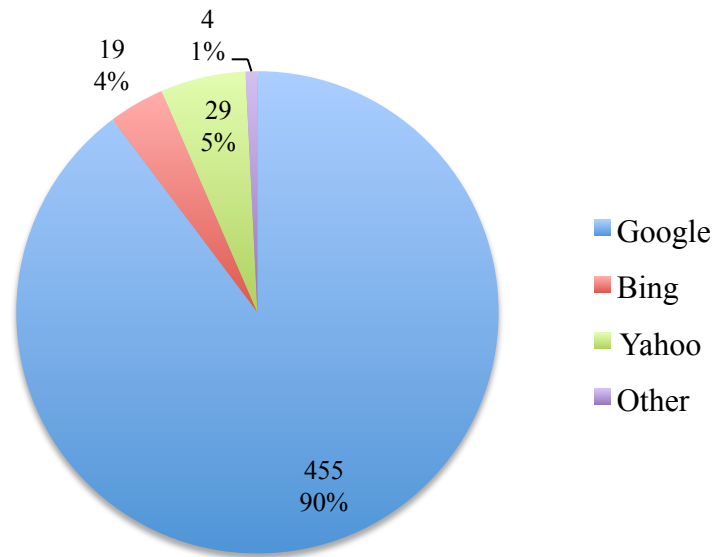


Figure 6. Preferred search engines for participants in Experiment 2; 507 out of 511 participants responded to this optional question. Data labels represent absolute number of responses, followed by percentage of total responses.

### Discussion

This experiment indicates that the internet's effects on self-perceptions are domain-specific; accessing the internet through Google increases perceptions of one's own abilities *only* in domains relevant to the internet: the capacity for thinking about, remembering, and locating information (i.e., CSE). It does not elevate self-perceptions unrelated to the internet, such as the ability to interact with others socially (i.e., PASCIS-social) or solve math problems (i.e., PASCIS-math). This supports the hypothesis that accessing the internet causes a blurring of the boundaries between individual human minds and the mind of the cloud. Accessing the internet does not simply cause people to feel better about themselves in general, it causes a specific in

self-perceptions of internet-related attributes, suggesting that an overlap between the self and the internet may make people see the attributes of this external source as being self-descriptive.

This experiment also provides support for Pilot Studies 1 and 2, as well as confirming both the underlying logic and preliminary results shown in Experiment 1. It shows a robust effect of internet use on CSE (Pilot 1), confirms a three-factor structure for CSE (Pilot 2), and corroborates the predominance of Google as an internet-related transactive memory partner (Experiment 1).

Taken together, these results suggest that when people use Google to find information, they blur the boundaries between themselves, their transactive memory partner (Google), and the sources indexed and delivered by this transactive memory partner (the internet more broadly). People feel like they themselves are better at thinking about, remembering, and locating information—three phenomena that are associated with the internet broadly and Google in particular. The specificity of these effects—internet use elevates CSE, but not general self-esteem, mood or any of the seven other esteem-related measures tested—suggests that these effects are, in fact, due to blurred boundaries and misattribution of both attributes and outcomes. Using the internet does not make people feel happier or more capable in a general diffuse sense; rather, it makes them feel like they possess the specific attributes of this powerful information source, as well as the transactive memory partner they use to access it (i.e., Google).

### **Experiment 3: Manipulating Task Difficulty**

Experiments 1 and 2 establish both the importance of accessing the internet through a familiar transactive memory partner, and the specificity of the effects of internet use on self-perceptions—namely, that using the internet changes perceptions only of those parts of the self that are related to the abilities of the internet. Taken together, these experiments suggest that



accessing the internet, particularly through an established transactive memory partner, can result in a merging of the individual mind with the cloud mind of the internet. When people use the internet, they assimilate the internet's attributes into their own self-concepts, seemingly losing site of where the internet ends and where they begin.

The following experiments—Experiments 3-5—build on this work in two ways. First, they test whether or not using the internet causes people to assume ownership not just over the attributes of this cloud mind, but also of the outcomes of internet-based performance. Second, they outline the parameters—or boundary conditions—of internet effects on both self-perceptions and attributions of performance. In exploring these boundary conditions, these experiments do not just explore how to reduce the effects of the internet; they also illuminate what causes these effects. Knowing how to eliminate an effect can also shed light on how to create this effect—not just for purposes of merging the mind of the individual with the mind of the internet, but perhaps also for creating similar effects with other external entities.

Specifically, these experiments test the hypothesis that internet effects on perceptions of both outcomes and attributes are due to a falsely confirmed “feeling of knowing.” When people feel like they know a given piece of information but cannot immediately locate it within their own memories, the extraordinary ability of the internet to produce this information quickly and unobtrusively may corroborate this feeling of knowing—whether or not people actually knew the information in the first place. The internet may “confirm” that people knew what they never did and, as a result, people may be left with the illusion that they “knew it all along.”

The present experiment manipulates the feeling of knowing by moderating task difficulty—in this case, the difficulty of questions asked in a trivia quiz—which should in turn affect the perceived need for the internet. If questions are particularly easy, then people should

know the answers almost immediately—the internet is of no use, and should not be seen as providing any particularly groundbreaking or exciting information. If questions are particularly difficult, people may be aware that they could not ever know the answer—in this case, it is clear that answers are coming from the internet and not from the self; no boundaries will be blurred. However, when questions are of moderate difficulty—a level of difficulty when people feel like the answer resides somewhere in their memories, but cannot be immediately accessed—then people should be predisposed to take credit for their success after using the internet, as this success suggests that they knew things they might never have actually known (or never been able to retrieve); it falsely “confirms” that they “knew it all along.” Additionally, and in line with Experiments 1 and 2, participants being asked moderately difficult questions may need the internet (unlike those asked easy questions), but be unaware of this need (unlike those asked difficult questions); as a result, they may be inclined to incorporate this unobtrusive external information source into their own self-concepts (as evidenced by increased CSE). This experiment tests the moderating effect of the “feeling of knowing” on the propensity to take personal credit for both the outcomes and attributes of the internet.

## **Method**

Participants for Experiments 3, 5, and 6 were recruited at the same time through Amazon mTurk in order to ensure that no individual participated in more than one study. All participants signed up using a single study link, then were randomly assigned to one of these three experiments. Because these studies were performed online, all participants were asked to describe their current surroundings before beginning the study in order to ensure that they were not multi-tasking or otherwise distracted from the study (see Appendix H for activity check

prompt); participants who were not fully focused (e.g., watching TV, having a conversation) were excluded from analysis.

Participants ( $n = 359^9$ , 199 female;  $M_{age} = 32.25$ ) were randomly assigned to one of 6 trivia quiz conditions; this experiment followed a 2 (Google: no, yes)  $\times$  3 (question difficulty: easy, moderate, hard) between-subjects design. Participants in the “No Google” condition were instructed not to use Google, whereas those in the “Google” condition were instructed to use Google, even if they didn’t feel like they needed it. Quiz items for Experiments 3-6 were selected from an initial list of 130 trivia questions, pretested using a separate sample ( $n=116$ ) on three dimensions: confidence in answer (“How sure are you of your answer?” on a 5-degree scale), fairness of question (“How fair do you think this question was—that is, to what extent do you feel like you could have possibly known the answer?” on a 5-degree scale), and question difficulty (“What best describes how you felt about the question?” on a 3-degree scale with answers ranging from “I knew the answer immediately” to “I never could have known the answer”). Separate trivia quizzes for each of the three question difficulty conditions were constructed based on ratings of these pretested questions. Participants in the “Easy” condition received trivia questions with an average sureness rating of 4.75, an average fairness rating of 4.57, and an average difficulty rating of 1.05; those in the “Moderate” condition received the same trivia questions as participants in Experiment 2, with an average sureness rating of 2.31, an average fairness rating of 3.22, and an average difficulty rating of 2.07; those in the “Hard” condition received trivia questions with an average sureness rating of 1.37, an average fairness rating of 2.54, and an average difficulty rating of 2.88. Each participant answered one of these three trivia quizzes, either with or without Google. See Appendix E.3 for a full list of trivia

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<sup>9</sup> Original  $n = 390$ ; 31 participants were excluded for failing an attention check (Appendix F) or reporting that they were engaging in other tasks while doing the study (Appendix H)

questions used in Experiment 3, as well as sureness, fairness, and difficulty ratings for each question.

Immediately following the trivia quiz, participants completed the 14-item CSE measure. They then predicted how well they would do on a second quiz of similar difficulty without the use of any external sources and completed a demographic questionnaire.

## **Results**

**Reliability of each factor of the three-factor CSE scale.** As in Pilot Study 2 and Experiment 2, the three-factor CSE scale showed high overall reliability, as well as high reliability within each subscale (see Table 1).

**Google effects on CSE.** A 2 (Google: no, yes)  $\times$  3 (question difficulty: easy, moderate, hard) ANOVA revealed a significant main effect of question difficulty on overall CSE,  $F(2,347) = 12.16, p < .001$ , as well as a significant interaction effect,  $F(2,347) = 4.91, p = .008$ . The main effect of Google was not significant ( $p = .16$ ).

Follow-up simple effects analyses revealed that Google use had no effect on overall CSE in the easy,  $F(1,347) = .014; p = .905$ , or hard,  $F(1,347) = .639; p = .425$ , difficulty conditions, but did have a significant effect in the moderate difficulty condition,  $F(1,347) = 10.97; p = .001$ . These results support the hypothesis that question difficulty—a proxy for the “feeling of knowing”—moderates internet effects on self-perceptions; only when people need the internet, but are unaware of this need, do they appropriate the internet’s attributes to themselves. All means are shown in Figure 7.

### Experiment 3: CSE scores (overall)

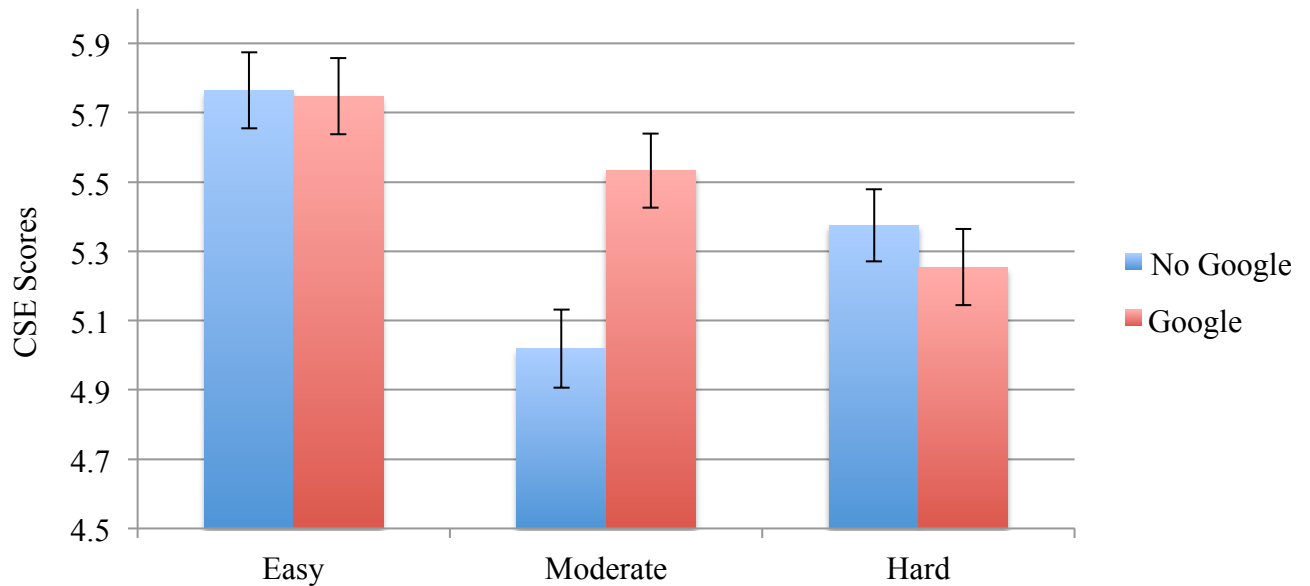


Figure 7. Mean overall CSE scores for Experiment 3.

Additional 2 (Google: no, yes)  $\times$  3 (question difficulty: easy, moderate, hard) ANOVAs were performed on each CSE subscale (thinking, memory, transactive memory). Like the results for the overall CSE scale, these results indicate that questions of moderate difficulty—those that are likely to produce a feeling of knowing in the absence of immediate knowledge—are most likely to have effects on each subscale of the CSE scale. See Table 2 for all means.

Table 2. Mean scores for each subscale of the CSE scale in Experiment 3.

Google Condition	Difficulty Condition	Mean, Thinking	Mean, Memory	Mean, Transactive Memory
No Google	Easy	5.90	5.31	6.03
	Moderate	5.12	4.26	5.63
	Hard	5.42	4.67	6.00
Google	Easy	5.79	5.43	6.00
	Moderate	5.58	4.92	6.08
	Hard	5.19	4.80	5.81

These analyses revealed a significant main effect of question difficulty on the thinking subscale of CSE,  $F(2,347) = 12.64, p < .001$ , as well as a significant interaction effect,  $F(2,347) = 4.71, p = .01$ . The main effect of Google was not significant ( $p = .67$ ). Follow-up simple effects analyses revealed that Google use had no effect on the thinking subscale of CSE in the easy,  $F(1,347) = .365; p = .55$ , or hard,  $F(1,347) = 1.98; p = .16$ , difficulty conditions, but did have a significant effect in the moderate difficulty condition,  $F(1,347) = 7.21; p = .008$ .

A  $2 \times 3$  ANOVA on the memory subscale of CSE revealed a significant main effect of question difficulty on this subscale,  $F(2,347) = 11.67, p < .001$ , as well as a significant main effect of Google condition,  $F(1,347) = 4.69, p = .03$ . The interaction effect was not significant ( $p = .21$ ). Follow-up simple effects analyses revealed that Google use had no effect on the memory subscale of CSE in the easy,  $F(1,347) = .260; p = .61$ , or hard,  $F(1,347) = .281; p = .597$ ,

difficulty conditions, but did have a significant effect in the moderate difficulty condition,  $F(1,347) = 7.16; p = .008$ .

A third  $2 \times 3$  ANOVA on the transactive memory subscale of CSE revealed a significant interaction effect between question difficulty and Google condition on this subscale,  $F(2,347) = 4.77, p = .009$ . There were no significant main effects, for either question difficulty,  $F(2,347) = 1.07, p = .35$ , or Google condition,  $F(1,347) = .698, p = .40$ . Follow-up simple effects analyses revealed that Google use had no effect on the transactive memory subscale of CSE in the easy,  $F(1,347) = .049; p = .83$ , or hard,  $F(1,347) = 1.68; p = .20$ , difficulty conditions, but did have a significant effect in the moderate difficulty condition,  $F(1,347) = 8.40; p = .004$ .

Finally, a bootstrapping mediation analysis with 5000 samples indicated that the transactive memory subscale of CSE partially, but not fully, mediated the link between Google condition and the other two subscales of CSE (thinking, memory); see Figure 4 for complete results.

**Predictions of future performance.** A  $2$  (Google: no, yes)  $\times 3$  (question difficulty: easy, moderate, hard) ANOVA revealed a significant main effect of question difficulty on predictions of performance on a second quiz,  $F(2,345) = 154.85, p < .001$ , as well as a significant main effect of Google condition,  $F(2,345) = 13.43, p < .001$ , and a significant interaction effect,  $F(2,345) = 10.75, p < .001$ .

Follow-up simple effects analyses revealed that Google use had no effect on quiz 2 predictions in the easy difficulty condition,  $F(1,345) = 1.76; p = .19$ , but did have a significant effect in the moderate,  $F(1,345) = 6.12; p = .014$ , and hard,  $F(1,345) = 27.08; p < .001$ , difficulty conditions. These results support the hypothesis that people are particularly likely to take credit for internet-based outcomes when faced with moderately difficult questions, but also suggest that

people may take personal credit for internet-related outcomes when answering difficult questions—questions that should make it obvious that the answers are originating from the internet, and not from the self. All means are shown in Figure 8.

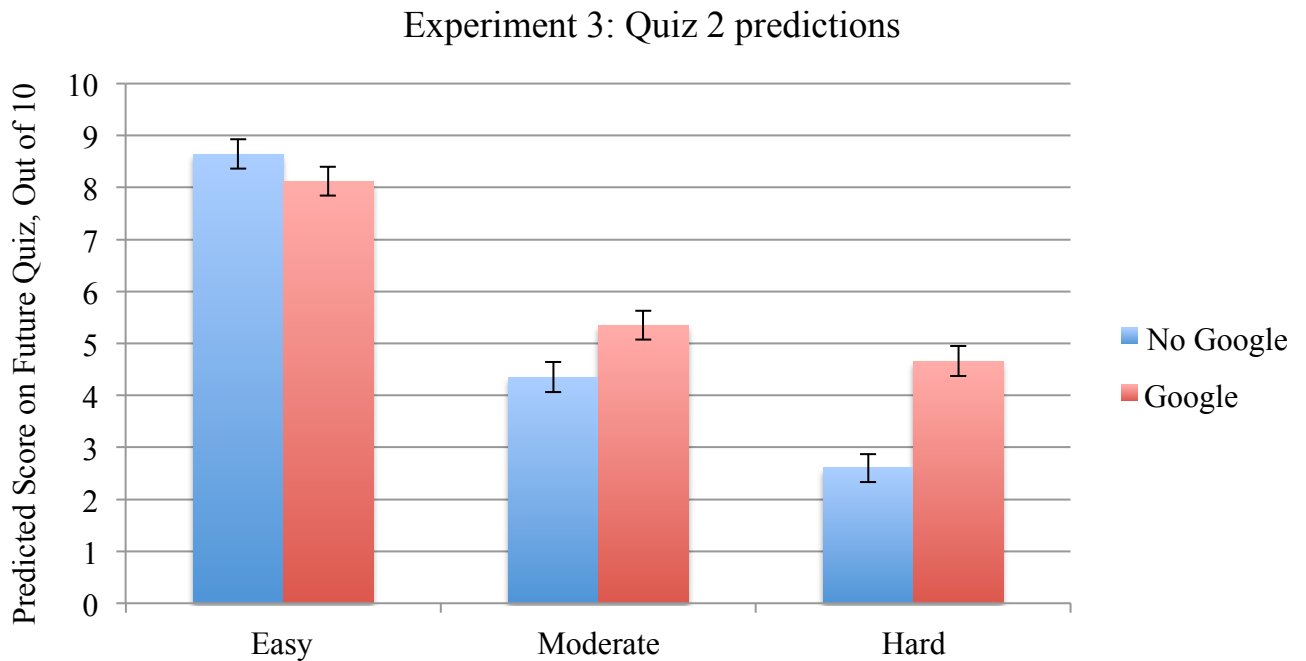


Figure 8. Quiz 2 predictions for Experiment 3.

## Discussion

The results of Experiment 3 provide evidence in support of the hypothesis that a “feeling of knowing,” confirmed by internet search, plays a key role in allowing the boundaries between the self and the internet to blur. When people are asked questions of moderate difficulty—questions that they feel like they know, even if they can’t immediately produce the answer—they both assimilate the internet’s attributes into the self and take credit for the internet’s answers as if they were their own; the internet “confirms” that people knew what they might have never known. In situations where people’s knowledge is not so ambiguous—when they either know



the answer immediately (easy questions) or know that they absolutely do not know the answer (hard questions)—accessing information on the internet does not increase CSE, perhaps because both easy and difficult questions eliminate the “feeling of knowing” and make the external nature of the internet relatively obvious (when asked easy questions, using the internet feels like an extra and unnecessary step; when asked difficult questions, the role of the internet may be impossible to downplay).

Predictions of future performance also seem to be most biased when people first use the internet to answer questions of moderate difficulty. In these cases, people may possess metamemory in the absence of memory (e.g., Nelson & Narens, 1990), or experience a feeling of knowing in the absence of actual knowledge. When the internet confirms that people know what they never knew, they take credit for this knowledge and assume that their performance was due to internal rather than external causes (a misattribution that is reflected in predictions of future performance).

The higher predictions of future performance for people in the “Google” than those in the “No Google” conditions when asked hard questions seems to throw a wrench in this seemingly straightforward explanation, however. Those in the hard difficulty condition should be acutely aware that they have used the internet to answer questions, and thus should be unlikely to predict that they will do nearly as well when taking a similar quiz without the aid of the internet. This apparent wrench, however, turns out to be an interesting wrinkle: it seems that, at least in some cases, using the internet may change people’s strategies for predicting future performance.

People who have used Google when performing a prior task (in this case, an initial trivia quiz) seem to use different inputs than those who have not used Google for predicting future performance; specifically, Google users predict future performance based on CSE, whereas non-

users predict future performance based on past performance. This pattern holds across all difficulty conditions. For Google users (collapsed across all difficulty conditions), the correlation between CSE and future performance,  $r(175) = .37, p < .001$ , seems to be stronger than the correlation between past performance and future performance,  $r(175) = .11, p = .149$ . For non-users, on the other hand, the correlation between past performance and future performance,  $r(176) = .84, p < .001$ , seems to be stronger than the correlation between CSE and future performance,  $r(176) = .28, p < .001$ . These apparent differences are confirmed by a series of Fisher's (1915)  $z$  tests, whereby correlation coefficients ( $r$ ) are transformed to a statistic exhibiting more stable patterns of variance ( $z$ ); the resulting  $z$  values can then be subjected to a significance test, which indicates whether one correlation is stronger than the other. For the present data, these significance tests confirm that Google users are more likely to base their future predictions on CSE,  $z = 2.58, p < .01$ , whereas non-users are more likely to base their future predictions on past performance,  $z = 8.55, p < .001$ .

These differences in weighting of predictive input hold for those in the "hard" difficulty condition. For Google users in the hard condition, the correlation between CSE and future performance,  $r(56) = .34, p = .01$ , seems to be stronger than the correlation between past performance and future performance,  $r(56) = -.22, p = .107$ . For non-users, on the other hand, the correlation between past performance and future performance,  $r(63) = .51, p < .001$ , seems to be stronger than the correlation between CSE and future performance,  $r(63) = -.006, p = .961$ . Fisher's  $z$  tests confirm these apparent differences: Google users are more likely to base their future predictions on CSE,  $z = 2.97, p < .01$ , and non-users are more likely to base their future predictions on past performance,  $z = 3.08, p = .001$ .

These results suggest a nuanced relationship between internet use, CSE, and predictions of future performance. Although CSE and predictions of future performance ostensibly measure separate concepts—the assimilation of the internet’s attributes into the self concept and the attribution of internet-based outcomes to the self, respectively—these concepts doubtless go hand in hand. These results suggest that, beyond simply being conceptually related—two outcomes of a single process—taking credit for internet-related outcomes may be caused by increased self-perceptions due to assimilating the internet’s attributes. It may be that using the internet makes people feel like they are better at thinking about, remembering, and locating information (the abilities assessed by the CSE scale); people’s increased confidence in their own information-related abilities may then lead people to believe that they will do well on a second quiz. If internet use increases people’s estimations of their own abilities, these elevated estimations may in turn increase predictions of future success.

A bootstrapping mediation analysis with 5000 samples suggests that this is the case. When using only participants in the “moderate” difficulty condition—that is, those in the condition that showed a significant difference in CSE as a result of accessing the internet—CSE completely mediates the link between Google condition and predictions of future performance,  $F(2,115) = 5.22, p < .01$ . After taking into account the mediating role of CSE, the direct effect of internet use on predictions of future performance (that is, the *c'* path) loses significance,  $t(118) = 1.23, p = .219$ . These results do not undermine the principles originally theorized to create dispositional explanations for internet-based outcomes (e.g., the correspondence bias), but they do shed light on an additional process that may work in tandem with such cognitive tendencies.

### **Experiment 4: Manipulating Google Speed**

Experiment 3 suggests that the “feeling of knowing” can be manipulated by adjusting question difficulty, or the perceived need for the internet as an external information source. When people don’t need an external information source—when this information can be immediately found within their own minds—they do not incorporate the source into the self. People also fail to incorporate sources into the self when they are acutely aware of their need for them; when the task is hard, the information is unknown, and the need is obvious, the “feeling of knowing” is undermined and the source becomes obtrusive by virtue of the individual’s awareness of its necessity.

This experiment explores another potential determinant of obtrusiveness that may play a role in internet effects on self-perceptions: the speed of internet search. When people have a feeling of knowing, speedy information delivery may prevent them from realizing that they don’t, in fact, know what they thought they knew; they may be left with the belief that they knew this information all along, and the external information source—if noticed at all—may be seen as simply confirming their own internal knowledge. However, if a source is slow to deliver information, people may have the time to search their own memories and realize that they cannot recall the desired information—thus making it clear that this information comes from an external, rather than internal, source. In this experiment, the speed of Google is artificially slowed, in the expectation that this change in speed will undermine the effects of internet use on the misattribution of both abilities and outcomes.

## Method

Participants ( $n = 118^{10}$ , 69 female;  $M_{age} = 25.71$ ) were recruited for a lab-based study on “Knowing and Remembering.” This experiment followed a three condition design (No Google, Slow Google, Google). Participants in the “No Google” condition were instructed not to use Google, whereas those in the “Slow Google” and “Google” condition were instructed to use Google, even if they didn’t feel like they needed it. Participants in the “Slow Google” accessed Google through a web site constructed to look and act like Google (Appendix J), but delay search results by 25 second using a hidden javascript timer<sup>11</sup>. Participants in this condition were warned that Google on this computer may take a bit longer than usual and instructed to “please make sure you are trying to think of the answer to the trivia question the entire time you are waiting on Google to return an answer.”

Participants in all 3 conditions first answered 10 free-response trivia questions drawn from the same pretested list of questions described in Experiment 3. See Appendix E.4 for a full list of trivia questions used in this experiment, as well as sureness, fairness, and difficulty ratings for each question.

Immediately following the trivia quiz, participants completed the 14-item CSE measure. They then completed a demographic questionnaire.

## Results

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<sup>10</sup> Original  $n = 130$ ; 12 participants were excluded according to comments by Research Assistants (e.g., the participant was not paying attention, the participant seemed to be under the influence of mind-altering substances, the equipment malfunctioned); see Appendix I for examples of comments that led to exclusion.

<sup>11</sup> The length of the delay was determined by analyzing average response times from the 130-item trivia pilot used to develop items for Experiments 3-6. The amount of time needed to answer each question without using Google ( $M = 20.83$  seconds) represents the amount of time people tend to take when searching their own minds for information. Approximately 5 seconds were added to this time to ensure that people would have the chance to fully search their memories before getting answers from the internet.

**Reliability of each factor of the three-factor CSE scale.** As in Pilot Study 2 and Experiments 2 and 3, the three-factor CSE scale showed high overall reliability, as well as high reliability within each subscale (see Table 1).

**Google effects on CSE.** A one-way ANOVA (condition: No Google, Slow Google, Google) revealed a significant main effect of condition, such that people had higher overall CSE scores in the “Google” condition than in both the “No Google” and “Slow Google” conditions,  $F(2,115) = 8.57, p < .001$ . Follow-up analyses confirmed that CSE scores were higher in the Google condition than in both the No Google ( $p < .001$ ) and Slow Google ( $p = .009$ ) conditions, and that there were no differences between the latter two conditions ( $p = .21$ ).

Additional one-way ANOVAs revealed significant differences between conditions according to all three subscales: thinking,  $F(2,115) = 6.07, p = .005$ ; memory,  $F(2,115) = 7.32, p = .001$ ; and transactive memory,  $F(2,115) = 3.13, p = .047$ . As with the overall CSE measure, CSE scores were higher for each subscale in the Google condition than in both the No Google ( $p_{Thinking} = .001; p_{Memory} < .001; p_{TransactiveMemory} = .027$ ) and Slow Google ( $p_{Thinking} = .048; p_{Memory} = .018; p_{TransactiveMemory} = .041$ ) conditions, and there were no differences between the latter two conditions ( $p_{Thinking} = .179; p_{Memory} = .214; p_{TransactiveMemory} = .931$ ). All means are represented in Figure 9, as well as Appendix G.2.

As in Experiments 2 and 3, a bootstrapping mediation analysis (5000 samples; Preacher & Hayes, 2008) revealed that the transactive memory subscale of CSE partially, but not fully, mediated the effects of internet use on the remaining subscales (thinking, memory. Internet use continued to have a direct effect on the thinking and memory subscales of CSE even after accounting for the mediating role of the transactive memory subscale. See Figure 4 for complete results.

### Experiment 4: CSE Scores (overall and all subscales)

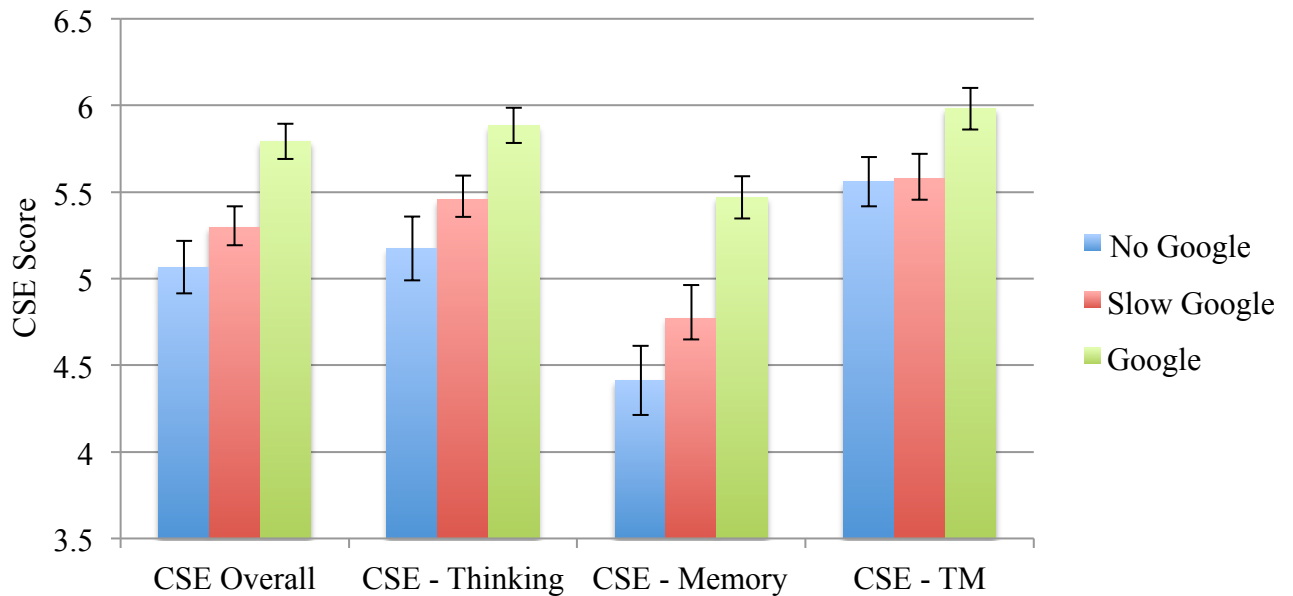
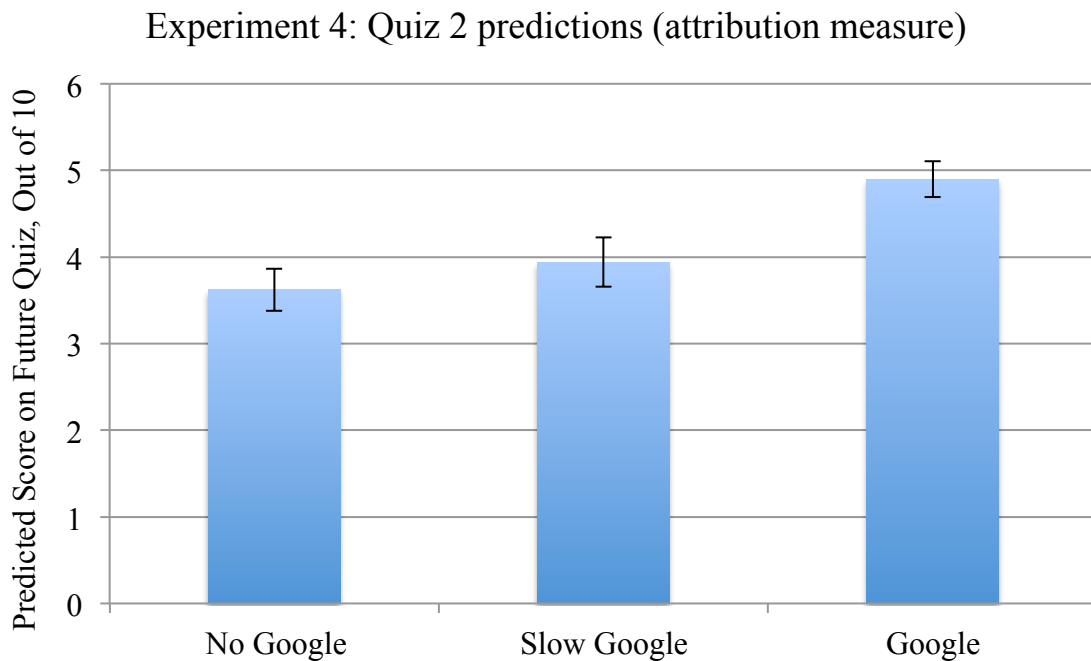


Figure 9. Mean CSE scores for Experiment 4: overall and all three subscales (thinking, memory, transactive memory).

**Predictions of future performance.** Predictions of performance on a second quiz to be taken *without* external resources (e.g., Google) served as a measure of misattributing internet-based outcomes to the self. A one-way ANOVA (condition: No Google, Slow Google, Google) revealed a significant main effect of condition,  $F(2,115) = 5.90, p = .004$ . Follow-up analyses indicated that participants in the Google condition predicted higher future performance than those in both the No Google ( $p = .001$ ) and Slow Google conditions ( $p = .019$ ), and there was no difference in predictions between participants in the latter two conditions ( $p = .413$ ). See Figure 10 for all means.



*Figure 10.* Quiz 2 predictions for Experiment 4; predictions of future performance indicate the extent to which people judge prior performance to result from internal abilities (as opposed to external sources).

As in Experiment 3, a bootstrapping mediation analysis with 5000 samples was performed in order to test whether or not CSE (that is, a measure of the assimilation of internet-related abilities into one's own self-perception) mediated the link between condition (No Google, Google) and predictions of future performance. This analysis revealed that CSE partially mediated the direct effect of condition on predictions. Although the overall mediation model was significant,  $F(2,79) = 6.47, p < .01$ , both the total effect ( $c$ , or the effect of condition on predictions without taking CSE into account as a possible mediator) and direct effect ( $c'$ , or the direct effect of condition on predictions after accounting for the mediating role of CSE) of condition on predictions were significant,  $t_c(82) = 3.30, p < .01$ ;  $t_{c'}(82) = 2.47, p = .02$ . This



suggests that the CSE partially, but not completely, mediates the relationship between internet use and predictions of future performance.

## **Discussion**

This experiment suggests that the speed of the internet is crucial for producing internet effects on both CSE and predictions of future performance. When people are given time—even a mere 25 seconds—to think before looking up answers, the effects of internet use on boundary-blurring outcomes disappears; it seems that this time allows people to realize that they didn't know what they thought they knew, thus disconfirming the “feeling of knowing.” This suggests that internet effects on CSE and predictions of performance may be unique to the internet, unshared by other large sources of information (or at least sources of information that are currently available). Imagine, for example, a set of encyclopedias that contained an amount of information equal to that stored on the internet; searching these encyclopedias would ostensibly take far longer than 25 seconds, and people would probably be far less likely to experience effects similar to those resulting from internet use. The internet may be the only large source of information that can be accessed more quickly than searching our own memories; as a result, it may be the only source of information—at least at present—that allows users to mistake the knowledge it contains for knowledge contained within their own minds. Any disruptions of this speed, however—such as slowing down the process of internet search—may eliminate this effect.

Further results shed insight into the relationship between the two conceptually distinct, but fundamentally related, variables measured in these studies: the belief that attributes representative of the internet are representative of the self (CSE) and that outcomes enabled by internet use are actually caused by the self (predictions of future performance). Whereas

Experiment 3 suggested that CSE completely mediated the link between condition and future predictions, this experiment suggests that increases in CSE may not be completely responsible for the link between internet use and predictions of future performance—a significant direct effect between the two still remains. This indicates that, although the two outcome variables are certainly linked and increases in CSE may be responsible for some increases in future predictions, these changes in self-perception as a result of internet use may not be responsible for *all* such increases.

#### **Experiment 5: Explicitly Disconfirming the “Feeling of Knowing”**

Experiment 4 tested the importance of speed and unobtrusiveness by slowing down the internet search process. This experiment takes the ideas first tested in Experiment 4 one step further by forcing participants to write down their answers—instead of just thinking about them—before looking them up with Google. In one sense, this experiment is simply an explicit extension of Experiment 4; instead of simply thinking through possible answers, participants are forced to explicitly indicate one. In another sense, this experiment may represent a different process. When people think about their answers, they may still be able to keep *multiple* potential answers in mind; when people write their answers down, however, they are forced to decide on *one* answer before checking this answer with Google. This explicit comparison between one’s own final answer and the answer provided by Google may be particularly likely to highlight the distinction between the self and the internet, thus clearly painting the internet as an external source and preventing inclusion of the internet’s cloud mind into the individual mind of the self.

## Method

Participants (135<sup>12</sup>, 68 female;  $M_{age} = 31.92$ ) in this experiment were recruited as in Experiment 3 (see methods, Experiment 3). Participants were first placed into one of three conditions: a “No Google” condition (participants were not allowed to use Google), a “Write Answers” condition (participants were allowed to use Google, but were asked to write down their own answers first), and a “Google” condition (participants were allowed to use Google); all participants in the “Write Answers” condition reported that they did, in fact, check their answers using Google. Participants then took a 10-item free-response trivia quiz gleaned from the pretested questions described in Experiment 3 (see Appendix E.5 for a full list of questions). All participants then completed the 14-item CSE measure, as well as a short demographic questionnaire. Finally, participants predicted how well they would do on a second quiz of similar difficulty, taken without using any external sources.

## Results

**Reliability of each factor of the three-factor CSE scale.** As in Pilot Study 2 and Experiments 2-4, the three-factor CSE scale showed high overall reliability, as well as high reliability within each subscale (see Table 1).

**Google effects on CSE.** A one-way ANOVA (condition: No Google, Write Answers, Google) revealed a significant main effect of condition, such that people had higher overall CSE scores in the “Google” condition than in both the “No Google” and “Write Answers” conditions,  $F(2,132) = 6.56, p = .002$ . Follow-up analyses confirmed that CSE scores were higher in the Google condition than in both the No Google ( $p = .001$ ) and Write Answers ( $p = .012$ ) conditions, and that there were no differences between the latter two conditions ( $p = .37$ ).

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<sup>12</sup> Original  $n = 150$ ; 15 participants were excluded for failing an attention check (Appendix F) or reporting that they were engaging in other tasks while doing the study (Appendix H)

Additional one-way ANOVAs revealed significant differences between conditions according to the thinking,  $F(2,132) = 5.52, p = .005$ , and memory,  $F(2,132) = 6.00, p = .003$ , subscales, as well as a marginal difference between conditions in the transactive memory subscale,  $F(2,132) = 2.51, p = .08$ . As with the overall CSE measure, CSE scores were higher for the thinking and memory subscales in the Google condition than in both the No Google ( $p_{Thinking} = .003; p_{Memory} < .001$ ) and Write Answers ( $p_{Thinking} = .008; p_{Memory} = .01$ ) conditions. CSE scores for the transactive memory subscale were significantly different between the Google and No Google conditions ( $p_{TransactiveMemory} = .031$ ), but were not significantly different between the Google and Write Answers conditions ( $p_{TransactiveMemory} = .53$ ). There were no differences between the No Google and Write Answers conditions for any subscale of the CSE ( $p_{Thinking} = .741; p_{Memory} = .536; p_{TransactiveMemory} = .127$ ). All means are represented in Figure 11, as well as Appendix G.3.

Experiment 5: CSE Scores (overall and all subscales)

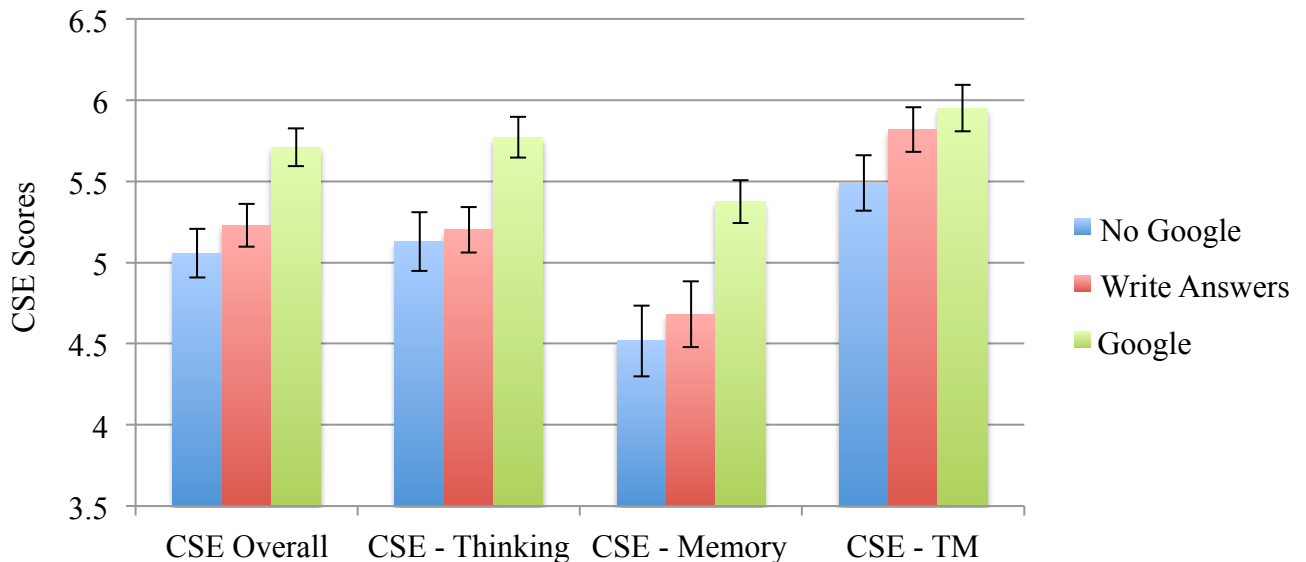
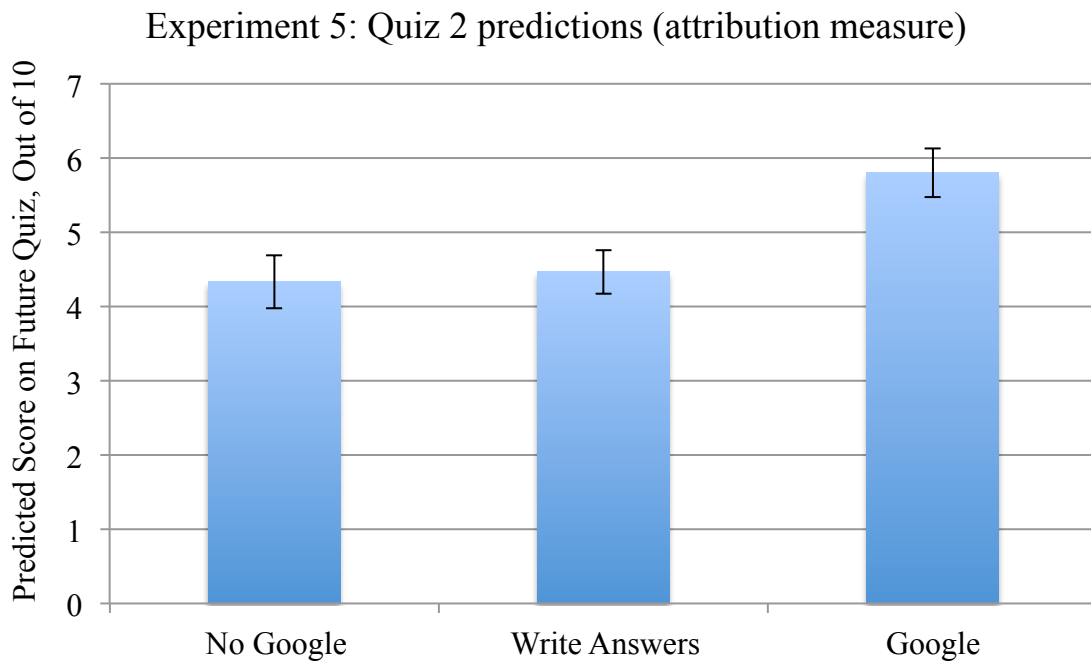


Figure 11. Mean CSE scores for Experiment 5: overall and all three subscales (thinking, memory, transactive memory).

As in Experiments 2-4, a bootstrapping mediation analysis (5000 samples; Preacher & Hayes, 2008) suggested that the transactive memory subscale of CSE partially mediates the effects of internet use on the remaining subscales (thinking, memory). Internet use continues to have a direct effect on the thinking and memory subscales of CSE even after accounting for the mediating role of the transactive memory subscale. See Figure 4 for complete results.

**Predictions of future performance.** Predictions of performance on a second quiz to be taken *without* external resources (e.g., Google) served as a measure of attributing internet-based outcomes to the self. A one-way ANOVA (condition: No Google, Write Answers, Google) revealed a significant main effect of condition,  $F(2,130) = 6.14, p = .003$ . Follow-up analyses indicated that participants in the Google condition predicted higher future performance than those in both the No Google ( $p = .002$ ) and Write Answers conditions ( $p = .005$ ), and there was no difference in predictions between participants in the latter two conditions ( $p = .778$ ). See Figure 12 for all means.



*Figure 12.* Quiz 2 predictions for Experiment 5; predictions of future performance indicate the extent to which people judge prior performance to result from internal abilities (as opposed to external sources).

As in Experiments 3 and 4, a bootstrapping mediation analysis with 5000 samples was performed in order to test whether or not CSE completely mediated the link between condition (No Google, Google) and predictions of future performance. This analysis revealed that CSE partially mediated the direct effect of condition on predictions. Although the overall mediation model was significant,  $F(2,87) = 12.97, p < .001$ , both the total effect ( $c$ , or the effect of condition on predictions without taking CSE into account as a possible mediator) and direct effect ( $c'$ , or the direct effect of condition on predictions after accounting for the mediating role of CSE) of condition on predictions were significant,  $t_c(90) = 3.03, p < .01$ ;  $t_{c'}(90) = 1.70, p = .09$ . This suggests that CSE partially, but not completely, mediates the relationship between

internet use and predictions of future performance (although the remaining direct effect between condition and predictions is only marginally significant).

## **Discussion**

The overall results of this experiment reiterate the findings first suggested by Experiment 4: the speed of the internet is integral to its unobtrusiveness and, as such, is fundamentally related to the likelihood that people will take credit for the internet's attributes and outcomes. The "Write Answers" condition in this experiment may be nothing more than a physical manifestation of the mental operations likely underpinning the results found in the "Slow Google" condition of Experiment 4; however, the necessity of writing down one particular answer may also force people to explicitly decide on this answer, something they may be able to avoid in Experiment 4 by simply holding multiple answers in mind.

One interesting—and new—effect in Experiment 5 is the equality of the "Google" and "Write Answers" conditions for the transactive memory component of the CSE scale. In all previous experiments, all 3 subscales of CSE were equally affected by the Google manipulation (means, F-values, and p-values for all subscales and all experiments are provided in Appendices G.1-G.4). However, the results from this experiment suggest that subscales of the CSE may move independently. Although scores on both the thinking and memory subscales of the CSE scale differ between participants in the "Write Answers" condition and those in the "Google" condition, scores on the transactive memory subscale are not significantly different. It may be that the design of the present experiment is responsible for this effect; specifically, it may be that participants in the "Write Answers" condition wrote their answers, realized they were wrong, then were able to find the correct answers—thereby increasing their beliefs about their ability to locate information, but leaving their perceptions regarding thinking and memory unchanged. In

this sense, the outcome between the two conditions (Write Answers, Google) is the same, but the cause is different; participants in the “Write Answers” condition based their self-perceptions on their own search behaviors and abilities, whereas those in the “Google” condition may have simply assimilated the search capabilities associated with Google into their own self-perceptions.

### **Experiment 6: False Feedback**

Experiments 1-5 suggest that connecting to the internet through a commonly used access point—one that may serve as a transactive memory partner—causes people to take on the attributes of both the internet and this access point, and claim personal responsibility for internet-related performance. However, these results may not be due to the internet at all. It may simply be the case that people who use the internet perform better than those who do not, and increased performance leads to both an increase in CSE (self-perceptions related to the ability to think about, remember, and locate information) and a belief that they will continue to do well in the future (this seems to entail taking credit for internet-based outcomes, but—as shown in Experiments 3-5—predictions of future performance are also at least partially due to increases in CSE).

Across conditions, participants perform better when using the internet (Appendix K). It may be that these performance enhancements—and not the method by which they are achieved (i.e., accessing the internet)—can fully explain the apparent misattribution effects demonstrated in all prior experiments.

This experiment addresses this alternate explanation by providing participants with false success feedback. Participants in a false feedback condition were not allowed to use Google, but were told that they had completed 8 out of 10 questions correctly (in line with the average score



of 8.48 out of 10 achieved by participants using Google in all other experiments, corrected for the number of participants in each study; see Appendix K).

If participants receiving false feedback report CSE scores and predictions of future performance equal to those in the Google condition, this suggests that the effects demonstrated in Experiments 2-5 may simply due to increased performance. Although this pattern of responses would not fit with the theoretical underpinnings of the current set of studies, they would not be entirely uninteresting. Similar increases in CSE for both the false feedback and Google conditions would indicate that feedback based on personal performance and feedback based on performance achieved as a result of joint efforts between the self and the internet have the same effects on CSE; this pattern would suggest a failure to correctly attribute the reasons for performance in the Google condition to the internet rather than to one's own mind. If people correctly attributed the reasons for their elevated performance to the internet, they should not believe that they themselves are better at the skills measured by the CSE scale, and participants in the false feedback condition should have higher CSE scores than those in the Google condition.

Results for the future predictions measure may also yield insight into the relative effects of personal performance (that is, performance that cannot be attributed to an external resource) and internet-aided performance (that is, performance that should objectively be attributed to the external resource of the internet) on beliefs about future performance in the absence of external resources. If people believe that they have done well in the past, they should believe that they will continue to do well in the future; thus, participants in the false feedback condition are likely to have high predictions for future performance. However, if people in the Google condition have similarly high predictions for future performance, this suggests that people who use the

internet to perform well on tasks are just as confident about their future performance—on tasks performed without internet access—as those who performed well without using this external resource. This suggests that these people are failing to recognize the influence of the internet, an external resource, on their performance.

Taken together, this suggests a variety of potentially interesting results. If people in the Google condition show higher outcomes than those in the false feedback condition on both dependent measures (CSE, future performance), then it seems that internet use is uniquely responsible for both effects, and that these effects cannot be replicated even when people perform well (or believe that they have performed well) and have no external resource that could possibly be identified as the true source of this performance. If people in the Google and false feedback conditions show similar results for CSE, this suggests that performing well on one's own and performing well with the help of Google results in similar increases in self-perceptions related to cognitive abilities. If, on the other hand, people in the Google condition display higher CSE scores than those in the false feedback condition, this suggests that connecting to Google has a special effect on these self-perceptions; it may be that boosts in CSE after Google use are not simply due to the performance enhancements Google provides, but to assimilating Google's attributes into one's own self-concept as the mind of the individual merges with the cloud mind of the internet. If people in the Google and false feedback conditions show similar results for predictions of future performance, this suggests that people who have done well as a result of using an external source are just as confident about future performance as those who have done well on their own; this would support the hypothesis that people are likely to overlook the situational factor of Google when evaluating their performance, instead making dispositional inferences about the self. Finally, if people in the Google condition display higher predictions

for future performance than do those in the false feedback condition, this would make little sense, particularly in light of preliminary findings that people who have not used Google tend to predict future performance based on past performance (Experiment 3) and have received feedback that their past performance was exemplary.

## **Method**

Participants ( $n = 155$ <sup>13</sup>, 85 female;  $M_{\text{age}} = 30.30$ ) were recruited using the same methods as Experiments 3 and 5 (see Experiment 3 for a full explanation). They were then randomly assigned to one of three conditions: a “No Google” condition (participants were not allowed to use Google), a “False Feedback” condition (participants were not allowed to use Google, but were given false positive feedback about their performance), and a “Google” condition (participants were allowed to use Google). They then completed a 10-item free-response trivia quiz. Quiz items were selected from the same list described in Experiment 5. See Appendix E.5 for a full list of trivia questions used in this experiment, as well as sureness, fairness, and difficulty ratings for each question.

After answering the trivia quiz, participants in the No Google and Google conditions were shown the correct answers and asked to grade their quizzes; participants in the False Feedback condition were simply told that they had gotten 8 out of 10 questions correct. All participants then completed the 14-item CSE scale. Participants next predicted how well they

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<sup>13</sup> Original  $n = 200$ ; 45 participants were excluded for failing an attention check (Appendix F) or reporting that they were engaging in other tasks while doing the study (Appendix H). In addition, participants in the False Feedback were excluded if they indicated that they did not believe their score was accurate (e.g., “I put ‘I don’t know’ on a few questions, yet still got 8/10. I think that the results calculation does not work properly. FYI.”); while some others expressed surprise (e.g., “Very interesting study, I was actually surprised I got 8 out of 10 correct!”), participants were not excluded unless they indicated that they were suspicious.

would do on a second quiz much like the first, taken without the use of any external resources. Finally, participants were asked a series of demographic questions.

## Results

**Reliability of each factor of the three-factor CSE scale.** As in Pilot Study 2 and Experiments 2-5, the three-factor CSE scale showed high overall reliability, as well as high reliability within each subscale (see Table 1).

**Google effects on CSE.** Scores on the CSE scale served as a measure of self-perceptions in internet-related domains. A one-way ANOVA (condition: No Google, False Feedback, Google) revealed a significant main effect of condition, such that people had higher overall CSE scores in the Google condition than in both the No Google and control conditions,  $F(2,151) = 7.63, p = .001$ . Follow-up analyses confirmed that CSE scores were higher in the Google condition than in both the No Google ( $p < .001$ ) and False Feedback ( $p = .006$ ) conditions, and that there were no differences between the latter two conditions ( $p = .42$ ).

Additional one-way ANOVAs revealed significant differences between conditions in all three subscales: thinking,  $F(2,151) = 5.42, p = .005$ ; memory,  $F(2,151) = 4.23, p = .02$ ; and transactive memory,  $F(2,151) = 8.38, p < .001$ . As with the overall CSE measure, CSE scores were higher for each subscale in the Google condition than in both the No Google ( $p_{Thinking} = .002; p_{Memory} = .006; p_{TransactiveMemory} < .001$ ) and False Feedback ( $p_{Thinking} = .013; p_{Memory} = .042; p_{TransactiveMemory} = .007$ ) conditions, and there were no differences between the latter two conditions ( $p_{Thinking} = .658; p_{Memory} = .514; p_{TransactiveMemory} = .251$ ). All means are represented in Figure 13, as well as Appendix G.4.

### Experiment 6: CSE scores (overall and all subscales)

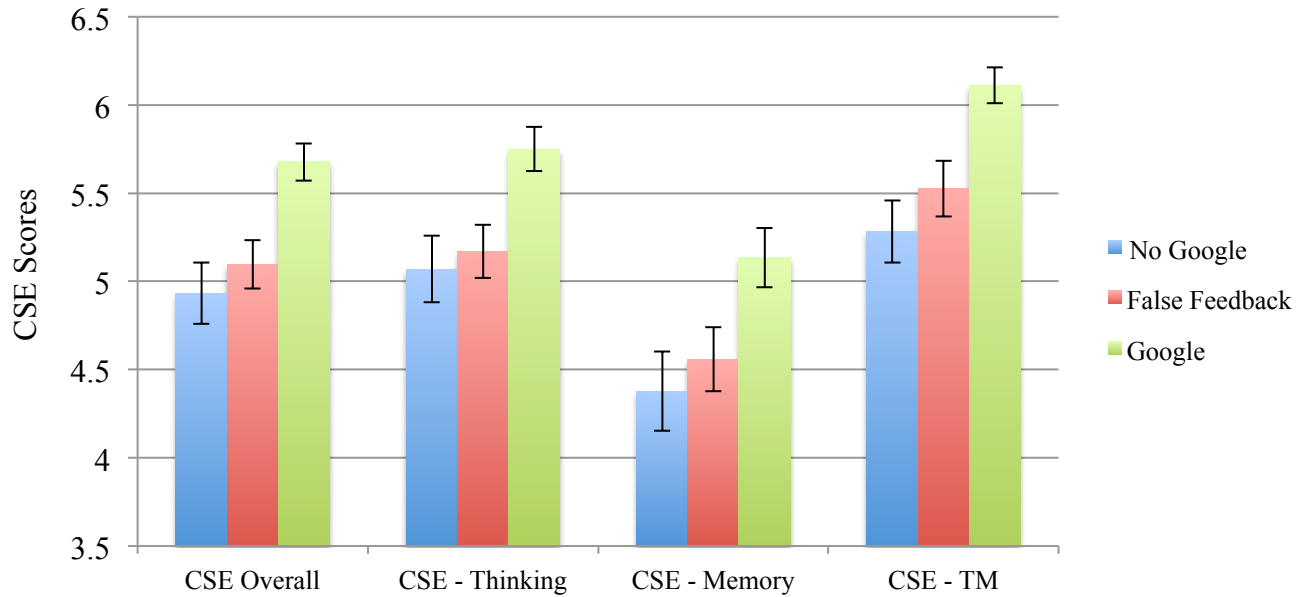


Figure 13. Mean CSE scores for Experiment 6: overall and all three subscales (thinking, memory, transactive memory).

As in Experiments 2-5, a bootstrapping mediation analysis (5000 samples; Preacher & Hayes, 2008) suggested that the transactive memory subscale of CSE partially mediated the effects of internet use on the remaining subscales (thinking, memory). Internet use continued to have a direct effect on the thinking and memory subscales of CSE even after accounting for the mediating role of the transactive memory subscale. See Figure 4 for complete results.

**Predictions of future performance.** Predictions of performance for a second quiz to be taken *without* external resources (e.g., Google) served as a measure of attributing internet-based outcomes to the self. A one-way ANOVA (condition: No Google, False Feedback, Google) revealed a significant main effect of condition,  $F(2,150) = 7.23, p = .001$ . Follow-up analyses indicated that participants in the No Google condition predicted lower future performance than

those in both the Google ( $p = .01$ ) and False Feedback conditions ( $p < .001$ ), and there was no difference in predictions between participants in the latter two conditions ( $p = .265$ ). See Figure 14 for all means.

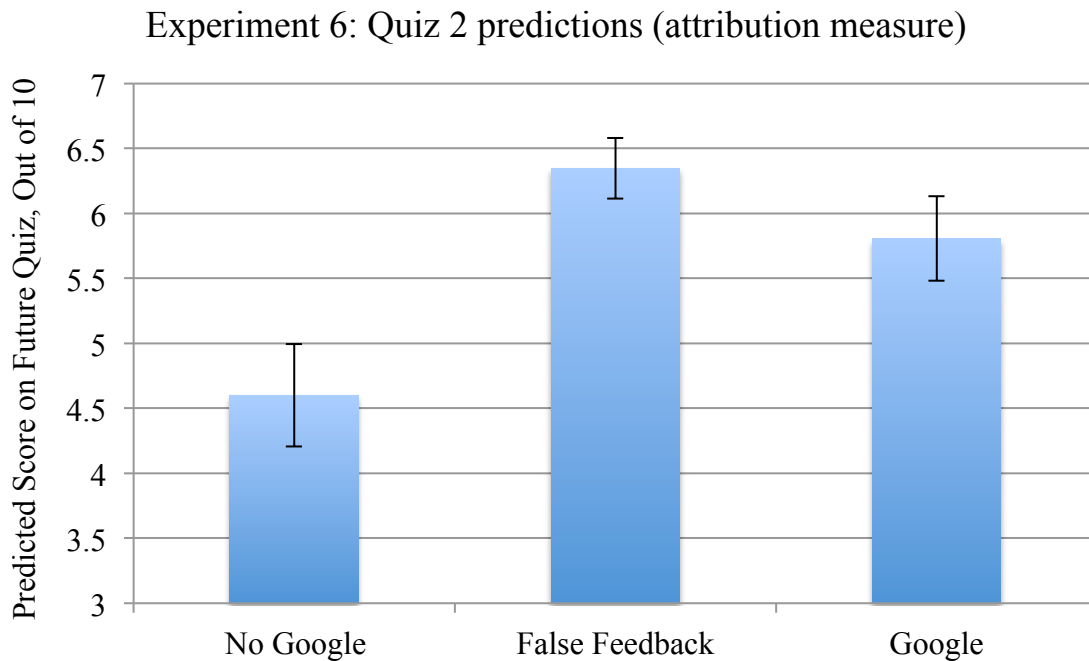


Figure 14. Quiz 2 predictions for Experiment 6; predictions of future performance indicate the extent to which people judge prior performance to result from internal abilities (as opposed to external sources).

As in Experiments 3-5, a bootstrapping mediation analysis with 5000 samples was performed in order to test whether or not CSE completely mediated the link between condition (No Google, Google) and predictions of future performance. This analysis revealed that CSE fully mediated the direct effect of condition on predictions. The overall mediation model was significant,  $F(2,104) = 10.37, p < .001$ . Moreover, the significant total effect ( $c$ , or the effect of condition on predictions without taking CSE into account as a possible mediator),  $t(107) = 2.35$ ,

$p = .02$ , became insignificant when analyzed as a direct effect ( $c'$ , or the direct effect of condition on predictions after accounting for the mediating role of CSE),  $t(107) = 1.08, p = .28$ . This suggests that CSE mediates the relationship between internet use and predictions of future performance, and offers a complex picture of this relationship when considered along with the effects of Experiment 3 (full mediation), Experiment 4 (partial mediation), and Experiment 5 (partial mediation).

## **Discussion**

Results from Experiment 6 suggest that there's something special about connecting to the internet—simple performance-based explanations cannot fully explain the demonstrated pattern of results. CSE scores were significantly higher for those in the Google condition than those in the False Feedback condition, suggesting that perceiving the self to be better at thinking about, remembering, and locating information isn't merely due to successful completion of tasks related to these abilities; rather, these self perceptions do seem to be a consequence of overlaps between the internet and the self, and a subsequent tendency to see the internet's attributes as being self-descriptive (Galinsky, Ku, & Wang, 2005). Predictions of future performance were equal for those in the False Feedback and Google conditions, suggesting that self-generated performance results in precisely the same amount of future confidence as performance that could be attributed to an external source (the internet); this suggests that people may be completely overlooking the internet as a cause of their behavior, instead treating this behavior as being entirely self-generated. Taken together, these results paint a nuanced picture: using the internet causes people to adopt its attributes, while simultaneously remaining unaware of the internet's influence on their performance.

The results for CSE scores have additional implications for potential influences of internet use on self-perceptions. Even though participants in both the Google and False Feedback conditions received positive feedback related to their performance, only those in the Google condition reported elevated levels of CSE. This suggests that people may be blurring the boundaries between the internet and the self not just for specific tasks (e.g., a trivia quiz), but also more generally; when people access the internet, they experience elevated CSE not just because they are able to improve their performance, but also because they are—in a sense—merging with a seemingly unending compendium of knowledge. Simply performing well on a trivia quiz does not have the same effect, and those who receive false feedback thus do not show elevated levels of CSE—despite the fact that their performance is entirely attributable to themselves (as opposed to those in the Google condition, for whom elevated CSE levels reflect *misattribution* of ability to the self).

Predictions of performance on Quiz 2 also seem to speak to broader processes potentially at work when people make these predictions. Predicting high levels of future performance in the False Feedback condition makes sense; people believe they have done well in the past, and can use this past performance as a reasonably accurate predictor of future performance. Predicting high levels of future performance in the Google condition also makes sense, but could be explained as the result of either (or both) of two complementary processes. First, it could be that people simply fail to notice the influence of the internet on their performance, instead attributing this performance entirely to the self (much like those in the False Feedback condition, who have no other potential explanation for their performance). Second, these predictions may be based on the elevated CSE levels that stem from connecting to the internet; this interpretation is supported by CSE's full mediation of the condition-prediction link. Again, it may be that both of these



processes are at work—people have greater confidence in their ability to perform well in the future due to both misattribution of initial performance and inferring ability from artificially elevated CSE.

Taken together, these results suggest that changes in self-perceptions and predictions of future performance ostensibly after using the internet cannot be fully explained by inferences based on past performance. Although high levels of past performance do lead to relatively high predictions for future performance (and rightfully so), they are no higher than the predictions made by those who have used the internet to achieve high levels of past performance. Furthermore, a strictly performance-based manipulation has no effect on self-perceptions as measured by CSE. It seems that connecting to the internet leads people to alter their self-perceptions in a way that performance does not, assimilating many internet-related attributes into the self; this effect, along with a potential tendency to overlook the internet as an external cause of behavior, may in turn cause internet users to overestimate their ability to perform well in the future (as opposed to those in the False Feedback condition, whose predictions for future performance seem to be based on high levels of past performance that cannot be attributed to any external or situational factor).

### **General Discussion**

Six experiments, supported by two pilot studies, suggest that accessing information online causes the boundaries between the mind of the individual and the cloud mind of the internet to blur. This merging of the minds seems to be dependent on three key factors, all of which are related to the typically unobtrusive process of quickly gathering information from the internet: the use of a well-known transactive memory partner as an access point, an initial “feeling of knowing,” and an inability to disconfirm this feeling of knowing, resulting in a “knew

it all along” effect. When these factors are present, connecting to the internet seems to result in two separate, but related, effects: a tendency to assimilate the internet’s attributes into one’s own self-concept, and a tendency to misattribute internet-related outcomes to the self.

Experiments 1 and 2 explore the importance of accessing the internet through a well-known transactive memory partner—in this case, Google. Experiment 1 demonstrates that “source confusion,” or the misattribution of information gathered online to information originally contained within one’s own mind, occurs significantly more frequently when using a common access point to the internet (i.e., Google) than when using an uncommon access point (i.e., Lycos), even though each website serves the same purpose and produces nearly identical adults. It is as if the relative familiarity of Google allows people to forget its presence, experiencing information rather than the process of searching for this information; Lycos, on the other hand, may seem more like a tool, an obviously external resource for navigating the internet. This difference doubtless influences the relative obtrusiveness of each source, which may in turn account for the demonstrated differences in source confusion. Experiment 2 explores another aspect of connecting with or through a transactive memory partner. When people interact closely with transactive memory partners, the lines between them may blur (Wegner, 1995) and they may attribute this partner’s attributes to the self (Galinsky, Ku, & Wang, 2005). Embedded in these ideas is the expectation that only attributes related to the partner in question should be adopted into the self-concept. Experiment 2 showed that this is the case; when accessing the internet through Google, people incorporate attributes related to both the internet (thinking, memory) and the access point of Google (transactive memory skills) into the self, but do not experience changes in self-perceptions related to global self-esteem, mood, or various other sorts

of localized self-esteem (e.g., esteem related to physical prowess, social skills, or academic ability).

Experiment 3 explores whether or not internet-related effects on both self-perceptions and predictions of future performance require an initial “feeling of knowing.” This experiment revealed that internet effects are most likely to occur when this feeling of knowing is present—specifically, when people are faced with the need for information that they feel like they know, but cannot immediately recall. Easy questions, which can generally be recalled relatively quickly, do not spark a need for the internet; as a result, using the internet seems extraneous and—consequently—obtrusive. Hard questions also increase the obtrusiveness of the internet, but for different reasons; with these questions, it is painfully obvious that answers come not from the self, but from this external source. Only when answers come from the internet, but can be easily attributed to the self, do people seem to blur the boundaries between self and internet, both assimilating its attributes into their self-perceptions and taking personal credit for performance enabled by its vast knowledge base.

Whereas Experiment 3 undermined the initial feeling of knowing, Experiments 4 and 5 aimed to disconfirm this feeling before it could be (falsely) confirmed. Operating under the assumption that the remarkable speed of the internet allows people to “confirm” that they know what they never actually knew (thereby creating a “knew it all along” effect), these experiments interfered with this false confirmation by slowing down internet search processes (Experiment 4) and forcing people to indicate their own answer before they “checked” this answer online (Experiment 5). In both cases, internet effects on both CSE and predictions of future performance were eliminated. This suggests that such effects are at least partially due to the internet’s speed, which allows people to find an answer online and attribute this answer to

themselves—all before they are forced to realize that they themselves do not actually know the answer. Slowing down internet search may emphasize people’s underlying uncertainty, and forcing people to explicitly write their answers makes this uncertainty (and, often, inaccuracy) unambiguously apparent.

Taken together, these experiments suggest that the speed and unobtrusiveness of the internet, when accessed through a commonly used transactive memory partner (e.g., Google), often falsely confirms that people know what they never knew, then quickly fades from awareness—leaving dispositional abilities as the only explanation for this knowledge. As a result, people may attribute both internet-based outcomes and internet-related characteristics to the self. In merging the mind of the individual with the mind of the internet, people may not just think that they are capable of achieving internet-enabled performance in the absence of this external source, but may in fact think that they possess the qualities of the internet—qualities that, at least to a certain extent, people believe will enable particularly high levels of future performance.

### **Implications**

The effects of internet use on self-perceptions and predictions of performance appear to be dependent on the recency of access; Pilot Study 2 reveals no correlation between general frequency of internet use and CSE, but both CSE and performance predictions are consistently elevated after people use the internet. However, the internet is so pervasive that incorporation of the internet into the self may be the norm rather than the exception. Like a spouse who is always there, keeping track of information, taking responsibility for important processes, and finishing half-baked ideas, people may not realize how little they know—and how dependent they are—until this spouse disappears. Luckily, this rarely happens, but that hasn’t stopped people from

worrying about it; George Dyson, a science historian, recently wrote about the inevitability of a “catastrophic breakdown of the internet” (2013), one which will disrupt nearly all forms of communication and—perhaps more importantly—bring to light the lack of knowledge possessed by individual human minds. In this way, over-reliance on the internet may lead to catastrophic outcomes, not just for the individual but also for the world at large.

The omnipresence of the internet may also lead to negative outcomes by fostering a sort of “Google Dependence,” one in which people’s first instinct is to “check” the internet for information before searching their own memories. As this constant checking continues to confirm false feelings of knowing, people may live the bulk of their lives with artificially inflated perceptions of their own cognitive abilities. And, as suggested by mediation analyses in Experiments 3-6, CSE seems to be at least partially responsible for predicting performance on future tasks. Taken together, these artificially inflated levels of CSE may have negative consequences for decision-making related to future performance. These experiments suggest that using the internet often causes people to make predictions regarding future performance not by looking at past performance—a seemingly logical approach—but by extrapolating from their (potentially inaccurate) feelings about their own abilities (as measured through the CSE scale). If these self-ascribed abilities are actually the abilities of the internet, coopted by the individual as the lines between the two blur, people may tend to make judgments based on inflated perceptions of their own knowledge—judgments that may turn out to be to be wildly inaccurate.

Consistently offloading information to the internet may also have negative consequences for memory-related skills and phenomena. For example, constant exposure to the internet may create consistently high levels of CSE; people may believe that they themselves know many things which are actually stored online. If people always feel like they know everything, they

may fail to develop metamemory—or accurate insight into what they do and do not know (Nelson & Narens, 1990). A classic example of metamemory comes from work comparing the children and adults on this skill (Samuel, 1978). If both children and adults are provided with a list of items to remember, then asked to freely recall the items on the list once it is taken away, their patterns of responses differ in consistent ways. For adults, there is a correlation between recall position (e.g., the first item remembered, the second item remembered, and so on) and accuracy, such that items recalled earlier are more likely to be correct; this suggests that adults know what they do and do not know—they know which items are actually accessible using their own memory. For children, however, there is no such correlation; the pattern (or, rather, lack of pattern) of their free-recall responses suggests that they have little insight into what they do and do not know. It could be that constant access to information—and the resulting feeling that this information is one’s own—eliminates the need for metamemory; people do not need to keep track of what they do and do not know, because they feel like they know nearly everything. If this is the case, then chronic internet users may have metamemory skills equivalent to those found in children; constant access to the internet may prevent them from ever developing fully-formed metamemory skills.

Metamemory failures—such as the inability to know what information is and is not accessible when only using one’s own memory—suggest that people may live most of their lives unaware of the ways in which they are affected by constant connection to the cloud mind. Like a recently divorced partner (Wegner, 1986), the importance of the internet for performing basic cognitive operations may only become clear when the internet is suddenly unavailable—when an individual loses power, travels abroad, or experiences a catastrophic and large-scale breakdown of the internet (like the one predicted by George Dyson). Although offloading responsibility for

information to the internet may tend to have positive effects when the internet is available, interruptions in internet access could have negative cognitive effects. In general, the internet allows people to let many kinds of information pass them by; people separated from the internet may adjust their information storage techniques to account for the loss of this transactive memory partner, but they may also continue to let important information go in one ear and out the other. More broadly, potential long-term effects of Google dependence (such as impaired metamemory) may have long-lasting effects on individuals attempting to perform cognitive operations without using the internet. It is easy to rely on a tool as marvelous as the internet, and the present research suggests that this tool is so useful and so unobtrusive that it may even be incorporated as a part of the self; but the loss of this tool—or part of the self—may have serious consequences for human memory, cognition, and overall functioning.

Using the internet as a transactive memory partner may also have positive effects, however. After all, people have likely been offloading memory to external sources for eons; the only difference is that the internet is both better than any other partner, and less obtrusive. According to the theory behind transactive memory, one major benefit of offloading responsibility for information to external sources is the ability to free up cognitive resources that would have been devoted to memory storage for other tasks, such as acquiring deeper knowledge of a specific topic or even engaging in problem-solving or creative exercises. Thus, if people tend to offload responsibility for nearly all factual information to the internet (a likely possibility, given the internet's high levels of expertise and accessibility relative to other transactive memory partners), people may be able to use their newly available cognitive resources for other tasks. For example, ongoing research suggests that people who have access to the internet perform better at creative problem-solving tasks, and this increased performance can be explained by

decreased memory for the factual information involved in the task<sup>14</sup>. Offloading information to the internet may allow people to use their cognitive resources for cognitively demanding tasks such as creative problem-solving, assimilating and incorporating information from multiple sources to create new ideas, and perhaps even exert higher levels of cognitive control as their cognitive resources are less taxed by the tasks of encoding, storing, and retrieving memories.

Internet use may also increase performance because of, not just in spite of, artificially elevated CSE. These self-perceptions—though largely inaccurate—may lead to an increase in cognition-related self-efficacy (Pajares, 1996), or high levels of confidence about one’s ability to perform well in specific cognitively demanding tasks. This elevated sense of self-efficacy may then increase motivation to perform on such tasks (Bandura, 1993), leading to increased effort and subsequent performance enhancements. This effect should only occur for upcoming tasks, especially in the domain of memory—increased effort, stemming from heightened self-efficacy, is much more likely to cause people to excel at encoding new memories than miraculously recall information that they never encoded in the first place. As people strive to live up to their artificially inflated self-perceptions, they may actually experience *real* performance boosts as an indirect effect of *false* ideas about the self.

### **Limitations and Future Directions**

Although the present experiments suggest that people who have recently used the internet experience elevated CSE and predict more success on future tasks than people who have not used the internet—and, in Experiment 2, than people in a control condition—these experiments still do not clearly delineate a “true” baseline. Although the equivalence of the control and No Google conditions in Experiment 2 suggest that accessing the internet increases outcomes related

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<sup>14</sup> This research is being conducted by Betsy Sparrow at Columbia University.



to self-perceptions and future predictions (as opposed to the possibility that abstaining from internet use impairs these outcomes), CSE in this control condition is assessed only *after* people have been asked to complete to a reasonably difficult trivia quiz (without using the internet, people average a score of only 2.58 out of 10 on this quiz). Thus, it may be that apparent increases due to internet use do not reflect increases per se, but simply that using the internet guards against decreases associated with being asked difficult questions. This distinction may not be terribly important for practical purposes—if people’s CSE and predictions of future performance suffer decreases when asked difficult questions in the absence of the internet, internet use is still artificially inflating these outcomes by serving as a buffer between the individual and reality. Furthermore, statistics indicating that people are almost always within reach of an internet access point suggest that a buffering function of the internet may have similar effects on long-term internet dependence and artificial elevations of CSE. However, this distinction—whether the internet increases CSE or simply prevents it from being decreased—does matter in theoretical terms. One way to address this issue may be to simply ask people to report CSE either before or after being exposed to a quiz like those used in Experiments 2-6. If pre- and post-quiz CSE scores are not affected for people not using the internet, but CSE is raised after people use the internet to answer this quiz, the original hypothesis that internet use raises CSE (and increases predictions for future performance) will be confirmed. If, on the other hand, post-quiz CSE scores are lower than pre-quiz CSE scores for people not using the internet, but CSE remains the same for people who do use the internet, this suggests that CSE merely serves as a buffer, preventing people from coming to terms with the gaps in their knowledge and failings of their cognitive abilities.

The present research also leaves open questions about how people make predictions regarding future performance. Some evidence suggests that, after taking an initial quiz, people who have not used the internet tend to base predictions of future performance on past performance and people who have used the internet tend to base predictions of future performance on CSE (see Experiment 3); additional evidence suggests that the link between internet use and future predictions is either partially or completely mediated by CSE scores (Experiments 3-6), suggesting that internet use raises CSE, which in turn leads to higher predictions of future performance (or at least explains a significant portion of the difference between internet users and non-users). All of these insights into how people predict future performance are based in situations in which people can draw directly from prior experience on a similar task. Although this experimental design makes the reliance of internet users on CSE particularly surprising (they have tangible feedback about their performance, but seem to ignore it), it also precludes the possibility of seeing how people predict task performance when they have not recently completed a similar task. It may be that people generally use CSE to predict future performance, but who have not used the internet adopt the new strategy of predicting future performance based on past performance—and internet users do not. Similarly to limitations regarding people’s “true” baseline levels of CSE, this limitation brings into focus the question of people’s baseline techniques for predicting performance. It could be that using the internet alters the inputs people use, causing them to predict future performance from CSE rather than past performance; on the other hand, it could be that all people use CSE to predict future performance unless they are provided with a more representative input (e.g., past performance), and internet use simply stops this switch from occurring. One way to solve this would be to first measure people’s CSE, then ask them to predict their performance on an upcoming quiz; if CSE

is correlated with predictions of future performance, it may be that people generally tend to use self-perceptions of cognitive ability when estimating future performance, and Google simply allows this tendency to persist, even in the face of potentially relevant information such as past performance.

A third limitation deals with the three-part structure of the CSE scale. Although this may not be a limitation with the current research, it is a potential limitation with this key dependent variable, as well as the conclusions that can be drawn from it. Factor analyses reveal three distinct subscales within the CSE scale (Pilot Study 2 and Experiments 2-6; Appendix D); these three subscales seem to move together as one unit—with the notable exception of the transactive memory subscale in Experiment 5. The question remains, however, whether these factors are descriptively distinct (as revealed by a factor analysis) or functionally distinct (that is, capable of moving independently). In the current set of experiments, it is not surprising that these factors tend to move together; they are all clearly connected to the key influences being examined (the internet, as well as Google). However, describing the thinking, memory, and transactive memory components of the CSE scale as true subscales loses some of its luster when these subscales always seem to show the same effects. This limitation could be addressed by a series of studies independently aimed at producing targeted changes in each of these subscales—for example, administering easy and hard logic problems and checking for differences on the thinking subscale, administering easy and hard memory tests and checking for differences on the memory subscale, and administering easy and hard tests related to locating information and checking for differences on the transactive memory subscale. The unique predictive value of each subscale could be assessed using similar methods, but reversing the order; analyzing CSE and then administering tests related to thinking, memory, and transactive memory could allow

insight into the potential discriminant validity of each subscale in predicting outcomes (assuming, of course, that CSE scores are a somewhat accurate indicator of actual ability).

A fourth limitation deals with the unobtrusive nature of the internet, and of Google in particular. These experiments assume that Google is unobtrusive—that its efficiency, availability, and familiarity make it virtually invisible. They assume that people are so used to using Google that they often fail to realize that they are doing so, or quickly forget that they have done so (an assumption that is at least partially supported by the results of Experiment 1). However, this assumption of unobtrusiveness is never explicitly tested. Although these assumptions seem to make sense on logical grounds, they should be tested empirically. However, directly asking people about the relative obtrusiveness of Google and/or the internet may yield invalid responses—either drawing the generally subtle presence of Google into sharper focus, thereby artificially exaggerating its noticeability, or producing researcher-desired effects, thereby artificially downplaying its obtrusiveness (e.g., Feldman & Lynch, 1988). The ostensible quality of Google and/or the internet, then, should be assessed using indirect measures—but measures that are directly concerned with the obtrusiveness of these external sources, as opposed to the role this supposed obtrusiveness may play in creating some other primary effect (such as the blurring of the boundaries between the internet and the self).

A final limitation—and ripe area for future research—concerns whether or not the effects explored here are unique to the internet. The factors explored in the preceding experiments—Google as a transactive memory partner, the feeling of knowing, the inability to disconfirm this feeling—may be applicable to other transactive memory partners. For example, a close friend who provides answers to a moderately difficult question almost instantaneously seems indistinguishable from the internet according to the factors manipulated in Experiments 1-6. It

may be, then, that other transactive memory partners can have similar effects on CSE and predictions of future performance, at least under an ideal set of circumstances. However, there are other qualities of the internet—ones mentioned, but not explicitly tested—that may make these effects specific to the internet. First and foremost may be the internet’s unique combination of speed with an utter lack of personality. Even the quickest friend is likely to infuse her answers with a dash of her own personality or, at the very least, remind people of this personality simply by inhabiting a physical body; these factors—personality, physical presence, and so on—may make it difficult to ignore that human transactive memory partners necessarily exist as external entities. Other external sources may lack many of these physical cues, but deliver information in a relatively slow manner; rifling through filing cabinets or leafing through books likely serves the same purpose through different means, bringing into focus the fact that these sources are external to the self. Still, it may be that other transactive memory partners are capable of having internet-like effects on people CSE scores and predictions of future performance; certainly not all partners, and perhaps not at all times even for those partners that are capable of inducing these effects, but it may be that the internet is not unique in producing the demonstrated effects on self-perceptions of attributes and predictions of future outcomes. Future research could test for CSE effects as people gather information from a variety of familiar information sources (i.e., transactive memory partners), including favorite books, knowledgeable relatives and personal information-storage devices. The internet, if unique, is probably not unique simply because it is the internet, but because of its inherent characteristics. Exploring the effects of other transactive memory partners could uncover which of these characteristics are most important for changing self-perceptions and future projections, allowing both insight into

what makes the internet so effective at producing these effects and a clearer idea of whether or not the internet is, in fact, unique.

Future research could also focus on the strength of these internet effects. In the current experiments, people were ostensibly unaware that using the internet increased their judgments of their own cognitive abilities and predictions for future performance. It may be, however, that the effect of connecting to the internet—of tapping into a seemingly endless stream of information, and having this information presented quickly and efficiently by a digital librarian turned transactive memory partner (e.g., Google)—is so powerful that it persists even when people are made aware of the typical effects of this experience. Making people aware of the distinction between the internet and the self in some ways, like increasing task difficulty (Experiment 3) or forcing people to compare their own answers with answers gleaned from the web (Experiments 4 and 5), clearly undermines internet effects on self-perceptions and attributions of performance. But asking people to use the internet in ways that typically increase these outcomes (for example, as in the “Google” conditions of Experiments 2-6) may be effective even if people are made aware of typical internet effects a priori. It may be that the internet is so powerful and so unobtrusive that no amount of vigilance against internet-related effects on self-perceptions can stop them from occurring.

### **Conclusion**

Internet effects related to self-perceptions of both attributes and performance seem to result from the collision of a relatively “old” cognitive process—transactive memory—with a relatively “new” technological advancement—the cloud mind of the internet. Although the tendency to form transactive memory structures has long served an adaptive purpose, both cognitively—when people offload responsibility for information to others, they are left with

more cognitive resources for themselves—and socially—transactive memory networks bind together social groups through a web of jointly useful, but independently useless, stores of knowledge—this adaptive tendency is now being hijacked by the internet, an external memory storage device that far exceeds human transactive memory partners in terms of both information storage capacity and ease of accessibility. As people turn from their old memory partners—friends, family, and neighbors—to the new cloud mind of the internet, they seem to lose sight of where their own minds end and the mind of the internet begins. They become one with the cloud, believing that they themselves are spectacularly adept at thinking about, remembering, and locating information—and that they will continue to possess these attributes even if they are disconnected from the internet. These effects may or may not be unique to relationships formed with the internet, and the implications of these effects may be positive or negative, but the fact remains that this process of becoming one with the cloud is happening, whether or not we are aware of it—and whether or not we like it.

A pressing question remains: what now? Do we flee society, eschew any contact with technology, and focus on cultivating our own memories? Or do we embrace the “information age” and attempt to use the powers of the internet to our advantage? Study of the effects of pairing the human mind with the mind of the internet is in its infancy, but preliminary research is already beginning to suggest that working alongside the internet can lead to cognitive enhancements, such as less fallible memories and more creative problem-solving. So do we hide away in caves and spend our days remembering what once was? Or do we step into this new and rapidly evolving world, boldly but not brashly, and discover how to harness the cloud mind of the internet to improve the human experience?

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Wegner, D.M., Giuliano, T. & Hertel, P. (1985). Cognitive interdependence in close relationships. In W.J. Ickes (Ed.), *Compatible and incompatible relationships* (pp. 253-276). New York: Springer-Verlag.

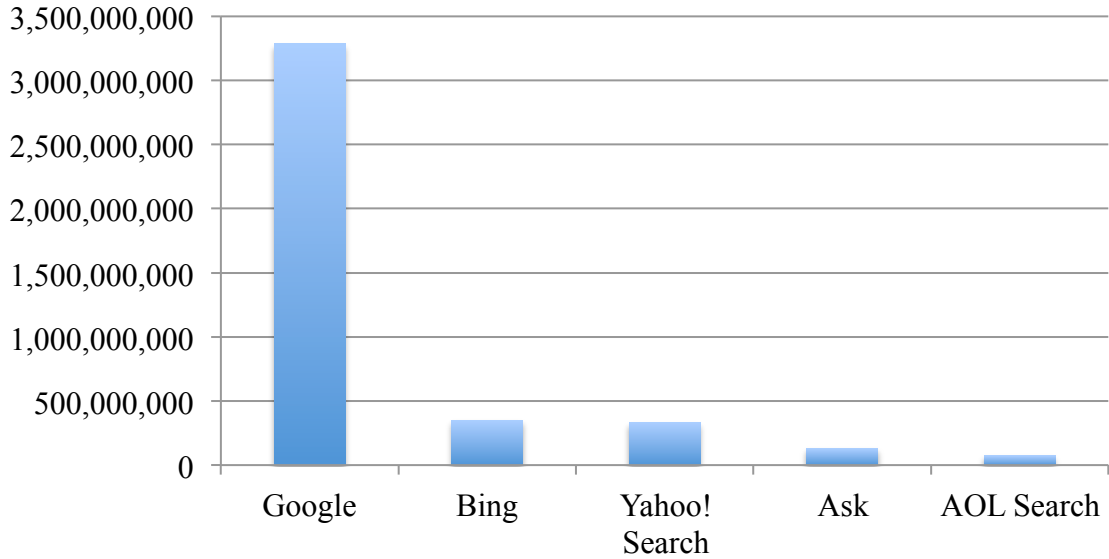
Wylie, R.C. (1989). *Measures of self-concept*. Lincoln, Nebraska: University of Nebraska Press.

## Appendix A: Google Use Statistics

Data source: Experian

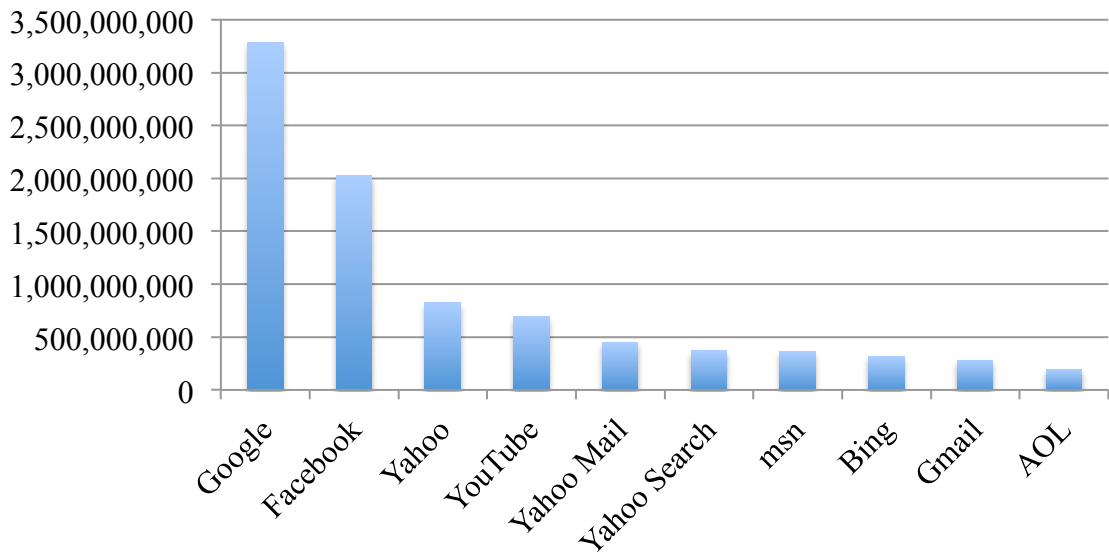
### Weekly page views for each of the top 5 US search engines.

Top 5 search engines, according to page views per week



### Weekly page views for each of the top 10 US websites.

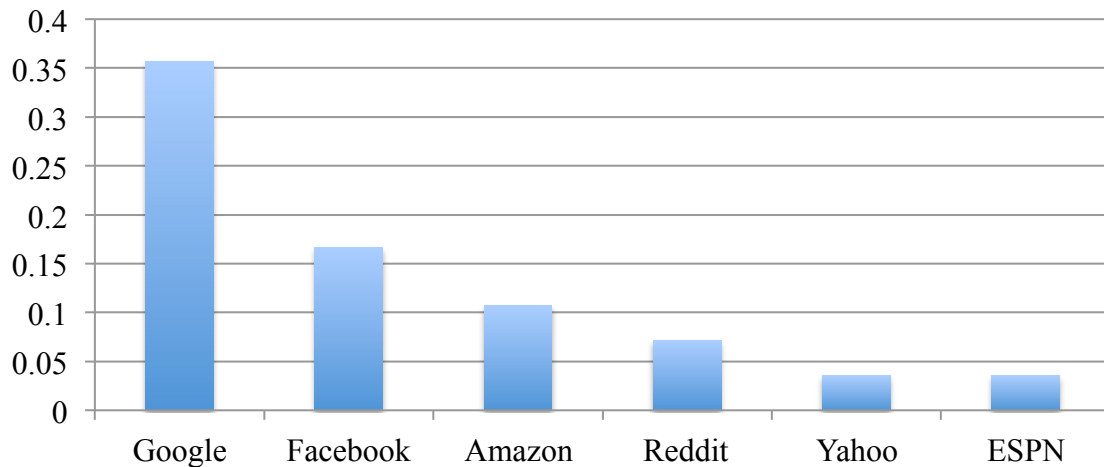
Top 10 websites, according to page views per week



## Appendix B: Websites Associated with the Internet

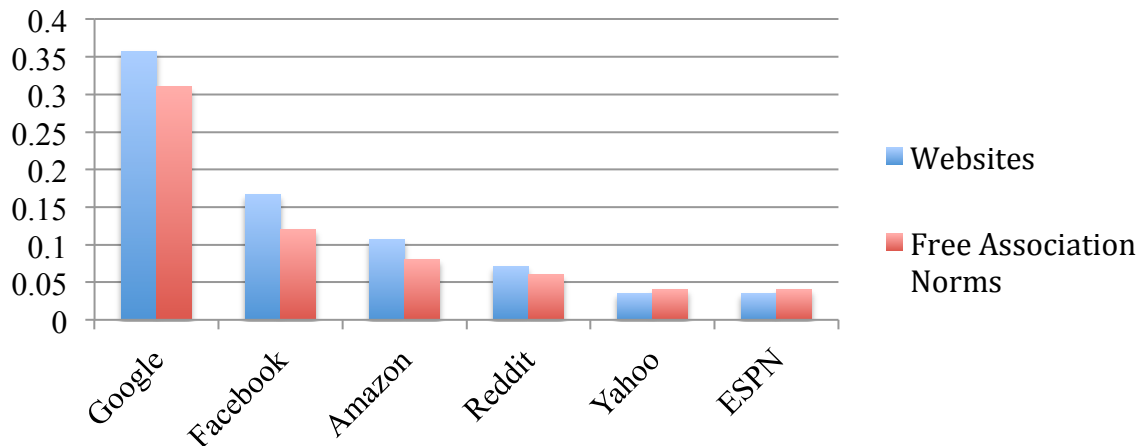
Participants ( $n = 85$ , 49 female;  $M_{age} = 34.76$ ) were asked to name the first website that came to mind when they saw the word “internet.” Much like a free association task (e.g., Nelson, McEvoy & Schreiber, 2004), the first word (or, in this case, website) mentioned is likely to be the website that has the most semantic overlap with the idea of the internet. Google was mentioned as a first associate more than any other website.

Percent of users who listed each website as first associate



This pattern of results is nearly identical to previously identified norms for concepts with a large set of associates dominated by one primary associate (Nelson & McEvoy, 2000). This standard of comparison seems appropriate when evaluating the relationship between the internet and Google, given the plethora of websites available and the hypothesis that Google is the main website associated with the internet.

Percent of users who listed each website as first associate  
(with comparison data from Nelson & McEvoy, 2000)



### Appendix C: Two-Factor CSE Scale

Cognitive Self-Esteem Scale (version 1—two factors)

	Component	
	1	2
I am smart	.80	
I feel good about my ability to think through problems	.80	
I am capable of solving most problems without outside help	.75	
My mind is one of my best qualities	.75	
I am smarter than the average person	.71	
I am good at thinking	.70	
I am proud of my memory		.91
I feel good about my ability to remember things		.87
I have a better memory than most people		.86
I have a good memory for recalling trivial information		.69

### Appendix D: Three-Factor CSE Scale

Cognitive Self-Esteem Scale (version 2—three factors)

	Component		
	1	2	3
I am smart	.83		
I am smarter than the average person	.82		
My mind is one of my best qualities	.75		
I am good at thinking	.72		
I feel good about my ability to think through problems	.65		
I am capable of solving most problems without outside help	.60		
I am proud of my memory		.90	
I feel good about my ability to remember things		.90	
I have a better memory than most people		.90	
I have a good memory for recalling trivial information		.74	
I know where to look to answer questions I don't know myself			.82
When I don't know the answer to a question right away, I know where to find it			.79
I know which people to ask when I don't know the answer to a question			.72
I have a knack for tracking down information			.71



## Appendix E.1: Trivia Questions, Experiment 1 (Page 1)

Trivia questions – Self	Sure (1-5)	Fair (1-5)	Difficulty (1-3)
How many squares are there on a chess board—including squares of all possible sizes?	2.29	3.35	2.18
What element is always added in a combustion reaction?	2.33	2.72	2.17
Coffee is only produced in one US state. What is it?	2.35	2.94	2.12
What country gave the state of Florida to the US in 1891?	2.35	3.59	1.94
What song from South Korea charted on Billboard's top 100 in 2012?	2.38	2.56	2.13
"Lutz" and "Axel" are terms associated with what sport?	2.41	3.29	2.06
In what language does "obrigado" mean "thank you"?	2.47	2.60	1.93
In what Colorado town was there a shooting at the opening of The Dark Knight Rises?	2.53	4.07	1.87
What is the most abundant element in the earth's atmosphere?	2.67	3.72	1.89
In US government, what body must pass federal bills before they are sent to the president?	2.75	3.38	2.00
Who is the current CEO of Apple, Inc?	2.81	3.81	1.94
What number does the roman numeral "C" represent?	2.89	3.89	1.83
What is the most spoken language on Earth?	3.00	3.82	1.65
Which state is called the volunteer state?	3.06	3.29	1.76
What is the capital of Peru?	3.13	3.88	1.75
What is the capital of Alaska?	3.19	4.25	1.56
What is the name of the longest river in the world?	3.22	3.61	1.39
According to common nomenclature, what is the first color of the rainbow?	3.25	3.81	1.63
In what country did the Olympic Games originate?	3.31	3.81	1.44
What is the capital of California?	3.40	4.33	1.67
What male athlete has won the most Olympic medals?	3.43	3.93	1.71
In which city is Hollywood located?	3.59	4.24	1.41
Who directed the movie Titanic?	3.63	3.88	1.44
In what country is Toyota headquartered?	3.64	3.86	1.29
What is a baby kangaroo called?	3.65	4.12	1.53
Who wrote the horror book The Shining?	3.69	3.56	1.56
What movie features the song Somewhere Over the Rainbow?	3.89	4.28	1.33
Who painted the Mona Lisa?	3.94	4.44	1.31
What is the name of the currency used in Japan?	4.00	3.87	1.20
Gingivitis is an infection of what part of the body?	4.13	4.06	1.25
Average	3.11	3.70	1.70

## Appendix E.1: Trivia Questions, Experiment 1 (Page 2)

Trivia questions – External source (Google, Lycos)	Sure (1-5)	Fair (1-5)	Difficulty (1-3)
What is the profession of Annie Leibovitz?	2.31	3.06	2.19
In what state was pop star Madonna born?	2.35	2.88	2.06
What is the name of the currency used in Denmark?	2.35	3.47	2.06
In which month does the Kentucky Derby take place?	2.35	4.12	1.94
What is the name of the scale used to measure the strength of tornadoes?	2.41	3.06	2.12
What nationality was Marco Polo?	2.44	3.25	2.13
How many minutes long is a round in men's pro boxing?	2.50	3.38	2.19
What is the main system of measurements used in the United States?	2.63	3.81	1.94
For which movie did Steven Spielberg win his first Oscar for Best Director?	2.71	3.65	1.82
What animal represents the astrological sign of Cancer?	2.76	3.24	1.76
In what country was the precursor to Pizza invented?	2.88	3.53	1.18
How many red stripes are on the American flag?	2.94	3.72	1.78
Who directed the film Psycho?	3.06	3.00	1.76
Who wrote the children's book The Chronicles of Narnia?	3.07	3.43	1.71
In what US city were the 2002 winter Olympics held?	3.14	4.07	1.64
Which fast food restaurant chain was established by Ray Kroc?	3.22	3.39	1.78
What is the fastest land animal in the world?	3.25	3.44	1.69
What animal's diet is made up almost entirely of eucalyptus leaves?	3.27	3.13	1.80
How many days are there in April?	3.35	4.00	1.47
Who painted the Sistine Chapel?	3.41	3.88	1.53
What is the capital of Australia?	3.53	3.88	1.59
During games, how many basketball players from one team are on the court at any given time?	3.63	3.75	1.69
What is the smallest state in the USA (in terms of land area)?	3.63	3.94	1.56
What is the name of the highest mountain in the world?	3.65	3.94	1.47
What currency is used in Germany?	3.69	3.50	1.50
Who was the first man on the moon?	3.88	4.24	1.29
In what time zone is the state of Maine?	3.94	4.06	1.31
What is the title of the United States National Anthem?	3.94	4.33	1.50
What is the largest mammal in the world?	4.06	4.22	1.22
What popular internet service announced new e-mails by saying "You've Got Mail"?	4.18	3.94	1.53
Average	3.15	3.64	1.71

## Appendix E.2: Trivia Questions, Experiment 2

Trivia question	Fairness rating (1-3)
What is the most populous city in the country of India?	1.87
If you were born on May 22 <sup>nd</sup> , what is your Zodiac symbol?	1.87
As of 2011, what actor or actress has been <i>nominated</i> for the most Oscars?	1.70
What is the densest planet in our solar system?	1.83
Which US President served the shortest term in office?	2.09
What is the best selling <i>fiction</i> book of all time?	1.70
What is the most spoken language on earth?	2.22
Worldwide, what is the most popular religion?	2.17
What is the best-selling beer in the US?	1.78
What is a baby shark called?	1.70
Average	1.89

### Appendix E.3: Trivia Questions, Experiment 3

	Sure (1-5)	Fair (1-5)	Difficulty (1-3)
Trivia questions – Easy difficulty			
Who is the current president of the United States?	5.00	4.82	1.00
Who is credited with writing Romeo and Juliet?	4.50	4.19	1.00
What does the "F" stand for in the law enforcement acronym FBI?	4.76	4.65	1.06
What season comes after Fall?	5.00	4.63	1.00
In what state is the Empire State Building located?	5.00	4.80	1.00
What computer brand shares its name with a fruit?	4.94	4.38	1.06
What color comes from mixing together yellow and red?	4.47	4.47	1.06
What car company produces the Mustang?	4.39	4.50	1.17
From what city is the "Red Sox" baseball team?	4.44	4.31	1.13
How many seconds are in a minute?	5.00	4.94	1.00
Average	4.75	4.57	1.05
Trivia questions – Moderate difficulty			
What is the name of the scale used to measure the strength of tornadoes?	2.41	3.06	2.12
"Lutz" and "Axel" are terms associated with what sport?	2.41	3.29	2.06
What is the name of the smallest ocean in the world?	2.00	3.53	2.12
What is the most abundant element in the universe?	2.67	3.72	1.89
In what language does "obrigado" mean "thank you"?	2.47	2.60	1.93
What is the capital of Austria?	2.19	3.25	2.06
What is the profession of Annie Leibovitz?	2.31	3.06	2.19
What country gave the state of Florida to the US in 1891?	2.35	3.59	1.94
In what state was pop star Madonna born?	2.35	2.88	2.06
The cause of what "fever" was discovered in 1900?	1.94	3.19	2.38
Average	2.31	3.22	2.07
Trivia questions – Hard difficulty			
What is the national flower of Australia?	1.07	2.57	2.79
Which country declared independence on February 18th, 2008?	1.56	2.78	2.61
What is the scientific name of Vitamin C?	1.31	2.56	2.69
What brothers invented the hot-air balloon?	1.24	2.71	2.65
Of what country is Ulaanbaatar the capital?	1.44	2.00	2.67
What is the molecular formula for caffeine?	1.50	1.81	3.00
How much does one liter of water weigh, in kilograms?	1.50	2.56	2.72
What is the name of the first dog to orbit the earth?	1.39	2.56	2.72
What is the third best-selling soft drink in the UK (behind Coke, Pepsi)?	1.25	2.63	2.94
In what year did the Spanish Civil War end?	1.44	3.19	2.88
Average	1.37	2.54	2.77

### Appendix E.4: Trivia Questions, Experiment 4

Trivia question	Sure (1-5)	Fair (1-5)	Difficulty (1-3)
What is the name of the scale used to measure the strength of tornadoes?	2.41	3.06	2.12
The computer program "Deep Blue" was programmed for what purpose?	2.29	2.94	2.24
In what state was pop star Madonna born?	2.35	2.88	2.06
Who is the Greek god of the sea?	2.29	3.29	2.00
In what country is Mt. Vesuvius located?	2.22	2.78	2.06
What is the name of the smallest ocean in the world?	2.00	3.53	2.12
The cause of what "fever" was discovered in 1900?	1.94	3.19	2.38
For which movie did Steven Spielberg win his first Oscar for Best Director?	2.71	3.65	1.82
What is the most abundant element in the universe?	2.67	3.72	1.89
Who regulates the quality and safety of municipal tap water?	1.88	2.94	2.19
<b>Average</b>	<b>2.28</b>	<b>3.20</b>	<b>2.09</b>

### Appendix E.5: Trivia Questions, Experiments 5 and 6

Trivia question	Sure (1-5)	Fair (1-5)	Difficulty (1-3)
What is the name of the scale used to measure the strength of tornadoes?	2.41	3.06	2.12
"Lutz" and "Axel" are terms associated with what sport?	2.41	3.29	2.06
What is the name of the smallest ocean in the world?	2.00	3.53	2.12
What is the most abundant element in the universe?	2.67	3.72	1.89
In what language does "obrigado" mean "thank you"?	2.47	2.60	1.93
What is the capital of Austria?	2.19	3.25	2.06
What is the profession of Annie Leibovitz?	2.31	3.06	2.19
What country gave the state of Florida to the US in 1891?	2.35	3.59	1.94
In what state was pop star Madonna born?	2.35	2.88	2.06
The cause of what "fever" was discovered in 1900?	1.94	3.19	2.38
<b>Average</b>	<b>2.31</b>	<b>3.22</b>	<b>2.07</b>

## Appendix F: Attention Check

Used in Experiment 1

In order to facilitate our research, we are interested in knowing certain factors about you. Specifically, we are interested in whether you actually take the time to read the directions; if not, then the data we collect based on your responses will be invalid. So, in order to demonstrate that you have read the instructions, please ignore the next question, and simply write “I read the instructions” in the box labeled “Any comments of questions?” Thank you very much.

How difficult did you find this survey?

- Very Difficult
- Difficulty
- Somewhat Difficult
- Neutral
- Somewhat Easy
- Easy
- Very Easy
- Any comments or questions?  
[free response text box]

## Appendix G.1: Average CSE Scores, Experiment 2

### Experiment 2: Specificity of Google Effects

Condition	CSE: Total	CSE: Thinking, Memory	CSE: Thinking	CSE: Memory	CSE: TM
Control	5.02	4.78	5.19	4.16	5.50
No Google	5.18	4.96	5.32	4.41	5.61
Google	5.46	5.29	5.63	4.77	5.81
<i>F</i> -value	10.21	11.35	8.95	7.93	4.80
<i>p</i> -value	<.001	<.001	<.001	<.001	.009

Note: *F* and *p* values refer to omnibus ANOVAs



## Appendix G.2: Average CSE Scores, Experiment 4

### Experiment 4: Slow Google

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Condition	CSE: Total	CSE: Thinking, Memory	CSE: Thinking	CSE: Memory	CSE: TM
No Google	5.07	4.87	5.17	4.41	5.56
Slow Google	5.30	5.18	5.46	4.77	5.58
Google	5.79	5.72	5.88	5.47	5.98
<i>F</i> -value	8.57	8.70	6.07	7.32	3.13
<i>p</i> -value	<.001	<.001	.003	.001	.047

---

Note: *F* and *p* values refer to omnibus ANOVAs

### Appendix G.3: Average CSE Scores, Experiment 5

#### Experiment 5: Write Answers

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Condition	CSE: Total	CSE: Thinking, Memory	CSE: Thinking	CSE: Memory	CSE: TM
No Google	5.06	4.88	5.13	4.52	5.49
Write Answers	5.23	4.99	5.20	4.68	5.82
Google	5.71	5.61	5.77	5.38	5.95
<i>F</i> -value	6.56	7.26	5.52	6.00	2.51
<i>p</i> -value	.002	.001	.005	.003	.085

---

Note: *F* and *p* values refer to omnibus ANOVAs

### Appendix G.4: Average CSE Scores, Experiment 6

#### Experiment 6: False Feedback

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Condition	CSE: Total	CSE: Thinking, Memory	CSE: Thinking	CSE: Memory	CSE: TM
No Google	4.93	4.79	5.07	4.38	5.28
False Feedback	5.10	4.93	5.17	4.56	5.53
Google	5.68	5.50	5.75	5.13	6.11
<i>F</i> -value	7.63	5.84	5.42	4.23	8.38
<i>p</i> -value	.001	.004	.005	.016	<.001

---

Note: *F* and *p* values refer to omnibus ANOVAs

## Appendix H: Activity Check

Note: participants were excluded prior to data analysis if they reported doing multiple activities at once (e.g., watching a movie, working in their cubicles) or simultaneously completing multiple mTurk HITs.



Before we begin this study, please briefly describe your setting:

Where you are, what's happening around you, what else (if anything) you are doing at the moment, etc.

There are no right or wrong answers--I'm just interested in where and how people use mTurk.

Thanks!

[free response text box]

## Appendix I: Exclusions in Experiment 4

Comments such as these led to a priori exclusion from data analysis; the comments listed below are copied verbatim from the participant logs of research assistants.

“Participant had a strong body odor and moved very slowly. However, he was cooperative and seemed to understand all instructions. He completed the study in 45 min.”

“Very hasty, had a whole routine before being ready (went to bathroom, pulled up hair, got water out, rolled up sleeves). Requested that I keep the door slightly open as she has a heat problem (she said she does not get distracted by noise). Very nervous at the end, was freaking out about not knowing how to answer the questions on the keyboard, she was fine after I explained it to her. She asked me for my name a few times throughout the study.”

“A few questions into the first task, the participant complained that the mouse was not working. She seemed very frustrated, so I cleaned the mouse and gave her a mouse pad. Immediately after I left the room, she opened the door and said that the quiz had disappeared and she didn't know why. I think it's because she accidentally closed the tab. She was upset that she had to start over again. After the experiment, she apologized for being upset earlier and said that her temper is short when it comes to mouses because she has the same problem at home and she has had to buy several of them. She was much nicer at the end, and I believe she followed all the instructions.”

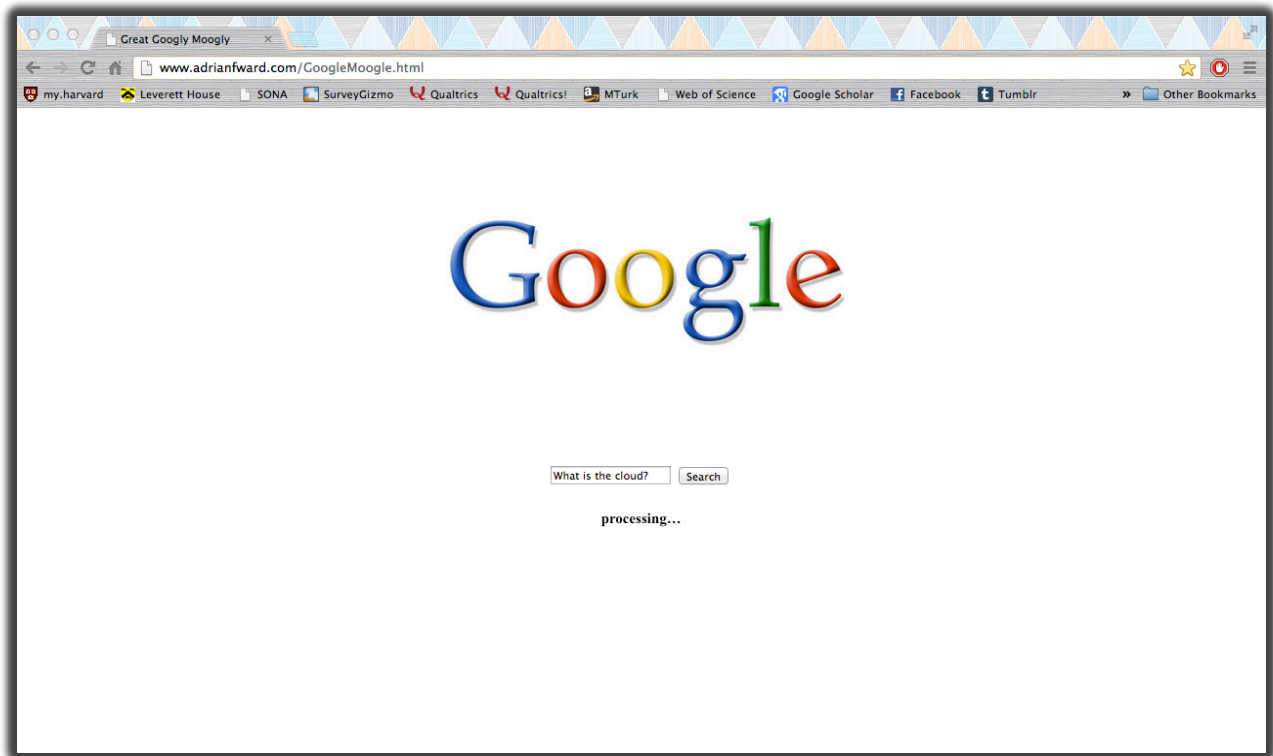
“Experienced several technical difficulties. First, he did not know how to switch between tabs, so he accidentally closed the window with the survey. I had to restart it. Then, there was a connection error with the server. After clicking the refresh button several times, the next question appeared and the survey seemed to be functioning properly again. The participant was older than our average participant and seemed to have a difficult time operating the computer.”

“Participant was 15 min late. He was wearing headphones around his neck. They were on and very loud when he first got here, but then he turned them off. It took him 30 min to complete both experiments. He seemed to be in a hurry. I also noticed that he had another tab open with a Wikipedia page.”

“Although he seemed friendly, he definitely did not seem in a normal state. He smelled bad, was clearly homeless (carrying a lot of plastic bottles/bags with his clothes), was itching/twitching and repeating everything I said. He seemed to understand the directions and wrote his consent form/payment form neatly, but his mannerisms weren't all there. He DID however get a perfect score on the trivia quiz so he is very intelligent (he definitely did not use outside sources). He even corrected number 1 (its evidently 1819 not 1891!).”

“Participant was 15 min late. She was apologetic, although she still seemed distracted. She mentioned that today she was "all over the place." She took over an hour to complete the first portion (without Trivia Quiz 2), so I thanked her for participating and gave her payment. She did not complete the second quiz. The entire time she complained about having a severe cold.”

## Appendix J: Slow Google Screenshot (Experiment 4)



## Appendix K: Quiz 1 Performance with and without Internet Use

### Quiz 1 performance

Experiment	No Google	Google	<i>Significance Test</i>
Expt 2: CSE Specificity	2.58	7.74	$F(1,361) = 1014.56,$ $p < .001$
Expt 3: Question Difficulty	3.75	9.61	$F(1,117) = 271.90,$ $p < .001$
Expt 4: Slow Google	2.69	9.23	$F(1,80) = 411.80,$ $p < .001$
Expt 5: Write Answers	3.71	9.28	$F(1,89) = 166.89,$ $p < .001$
Expt 6: False Feedback	3.82	9.56	$F(1,90) = 213.73,$ $p < .001$