

**Thinking about my amazing (photos of) vacation:
On the relationship between cognition and technology**

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Abstract

With its enormous store of information and ubiquitous use, the Internet and its users have potential to enter an intellectual partnership that influences how people process information. One possible manifestation of this intellectual partnership is a shift from reliance on one's own memory to the Internet for information storage. Previous research finds that people "outsource" declarative memories to web-based search engines like Google (Sparrow et al., 2011). In a similar way, might people outsource *affective* memories to social networking sites, in which people typically post and discuss photos of happy personal events? To test this possibility, I observed whether priming participants with thoughts of vacation (an affective memory that is likely to be stored online in the form of shared photos) or an academic experience (control) influenced their response times to words in a Stroop task (vacation words, social media words, or neutral words). I found that participants in the vacation-priming condition responded most quickly to vacation words *and* to social media words, although the differences did not reach full significance below the $p = .05$ threshold. Nonetheless, these findings may provide initial evidence that thinking about a positive event might not only make content-related thoughts more accessible, but also thoughts related to "where" memories of that event are "stored" (i.e., in online social media). Future research might fruitfully explore this possibility in greater detail.

KEYWORDS: Photosharing; social media; memory; technology; cognition

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Much of what we know about basic cognitive processes such as attention and memory stems from classic psychological experiments of the mid-to-late 20th century. For example, Tolman's (1948) groundbreaking work on cognitive maps first described our ability to rapidly and effortlessly comprehend the spatial organization of nearby objects; Loftus's (1975) early findings challenged the notion that autobiographical experiences are objectively stored in memory; and Kahneman and colleagues (1993) revealed systematic biases in how we overvalue only a few aspects of personal events while neglecting many others.

Although this influential research has helped lay the foundation for a basic scientific understanding of how the human mind works, times have changed. The worlds in which those seminal participants lived are much different than of their contemporaries. Perhaps most notably, people today live in an era of unique, personalized, and pervasive technology. Phones that fit in pockets can take high-definition photos and videos, which can be posted to online social profiles, which can be viewed by hundreds of friends and millions in the public domain – all for free, with little effort, and in a matter of seconds. Everyday experience is now digitalized and documented.

Thus, in my thesis project I sought to answer the following question: *How might our basic cognitive processes be affected by such unprecedented technology?* I focused on one specific cognitive process (i.e., thought accessibility) and one specific form of technology (i.e., photo-sharing). Given today's high degree of digitalization and documentation, I predicted that when people are asked to think about a happy past experience, not only are concepts of that experience activated but also concepts of *photographs* of that experience. In other words, when

people think back to a recent vacation, they might not only think about the actual trip (e.g., “that amazing view”) but also *where* that experience is now “stored” (e.g., “that photo of the amazing view”). By examining this relationship between cognition and technology, I hope to expand previous research by highlighting ways by which basic mental processes may be changing and updating to fit modern life.

In the first section of this paper, I will discuss the explosion of personalized technology in recent years, with a focus on social media and photo-sharing. Next, I will summarize recent research that examines various effects of this technology on psychology, with a focus on cognitive processes. Then, I will outline my specific hypothesis that relates thought accessibility to online photo-sharing, and present the results of a laboratory study that tested my predictions. Finally, I will discuss my findings and relate them back to older models of basic cognitive processing, emphasizing possible future implications as personalized and digitized technology continues to develop and pervade everyday life.

Explosion of personalized technology

The advent of the personal computer is generally attributed to Apple’s original preassembled, mass-produced computer that made its debut in 1977. Since then, the personal computer industry has grown dramatically. By 2000, over 50% of United States households contained a personal computer, and this number rose significantly when the Internet became widespread (“Personal Computer,” 2012). Today, it is estimated that there are over one billion personal computers in use among people worldwide (Petty, 2008). More recently, smartphones and tablets that further enable Internet use have also been increasing in popularity (“Personal Computer,” 2012).

Indeed, the Internet was an especially monumental step in the development of personalized technology. Originally used for governmental networking, the Internet experienced growth along with the development of the personal computer. Starting in 1993, the Internet became available for commercial use and experienced accelerating growth since. By 2005, 68% of adults and 90% of teenagers in the United States had used the Internet and regularly communicated among “online” portals and networks (“Internet,” 2012). As of March 31, 2011, there were an estimated 2.095 billion Internet users worldwide (“Internet Usage,” 2012).

In recent years, social networking sites – websites characterized by user-generated content that allow users to connect and interact with each other (Lee & Ma, 2012) – have especially exploded in popularity among Internet users. Facebook, one of today’s leading social networking sites, has almost ubiquitous use on college campuses (Lampe et al., 2008). Created in 2004, Facebook had over 845 million users worldwide as of December 31, 2011 (Ellison et al., 2007; Protalinski, 2012).

What do people tend to do on Facebook? First and most generally, Facebook is primarily used to maintain friendships, and most users cite school friends as their primary audience (Ellison et al., 2007). However, Lee and Ma (2012) also identified four specific major motivations for using Facebook: information seeking, socializing, status seeking, and entertainment. Across all of these categories, one of the most widely cited reasons for using Facebook is to upload personal photos (Lampe et al., 2008). As of 2010, Facebook users were uploading over 2 billion pictures per month (Stefanone et al., 2011), with younger people and females posting the highest number of photos (Stefanone & Lackaff, 2009).

Photosharing was preceded by the development of digital photography. Starting in 2004, digital cameras outsold film cameras (Stefanone et al., 2011). Cameraphones also entered use in

the late 1990s (Miller & Edwards, 2007) and began to outsell stand-alone digital cameras by 2005 (Stefanone et al., 2011). And this recent explosion of online photo-sharing is perhaps even further rooted in photography's rich history as a social activity. Before digital photography became widespread, people often interacted with physical copies of photos—for example, friends would sit together and view a photo album.

Taken together, the simultaneous rise of digital photography and the Internet's photo-sharing capabilities has shifted how photos are used socially in modern times. Rather than physical photo albums, social networking sites such as Facebook have become the primary viewing platforms for shared photos. Photo-sharing sites greatly increase the size of one's potential audience for a photo. As a consequence of photo-sharing sites' popularity, photo sharing has become a remote, rather than collocated, activity (Lindley et al., 2009). Further, Lampe and colleagues (2008) found that presence of photos on one's profile were associated with more articulated friendships. People share photos to indicate social presence, inviting a means to communicate with friends and family. Shared photos signal the presence of relationships and events (Counts & Fellheimer, 2004). As a consequence, online photo-sharing through websites such as Facebook allows for an unprecedented, rapid, and immediate spread of social and emotional connections with those around us.

Technology and cognition

With such a pervasive influence, does technology have the ability to affect cognition? Content delivered through electronic media play an important role in shaping one's sense of reality. For instance, Internet usage influences people's perceptions of space. With electronic mail, users can communicate instantly with someone who lives thousands of miles away. News

sites provide real-time accounts of events all over the world. If someone wishes to view some part of the world, an online image search will yield numerous pictures.

Internet usage also has the capability to influence people's sense of time. The speed of communication facilitated by the Internet leads people to expect instantaneous returns when seeking information. This expectation of quick information delivery can lead Internet users to feel anxious when their information inquiries are not met immediately. Consequently, people feel a need for instant gratification, and feel frustrated by information that takes longer to process. For example, teachers have reported that students now struggle to read long, complicated articles (Moellinger, 2011).

Moreover, with the expanded audience and instant feedback provided by the Internet, many users feel a need to maintain a positive psychological presence online. Websites such as blogs and Twitter might even help promote egocentrism, because such sites provide a platform for superficial interactions and allow users to maintain highly controlled images of themselves (Moellinger, 2011). Perhaps as a consequence of these effects, Konrath, O'Brien, & Hsing (2011) found that college students have declined in empathy: today's cohort of American college students (i.e., in college since the year 2005) report significantly lower trait empathy than any other cohort of American college students since the 1970s; moreover, this decline is most sharp right after the year 2000, which happens to coincide with many of the technology advancements that I have discussed. This effect might further be demonstrated behaviorally by a significant decline in face-to-face interactions, such as family dinners and community organizations, concurrent with the rise of social media (Putnam, 2000; Putnam & Feldstein, 2004).

The specific role of photos

The focus of my paper is to complement this literature on the intersection between cognition and technology by examining the specific role of online photo-sharing. In particular, I am interested in examining the extent to which self-related autobiographical concepts (e.g., memories) are affected by people's interactions with photographs of their own experiences.

There is some existing related research along these lines. Namely, Lindley et al. (2009) described a number of ways in which people's memories interact with photos. Firstly, people use photos to remember and reflect upon a scene they have visited. The act of taking a photo serves to mark an event as significant in one's memory, and this moment tends to be elevated because a photo has been taken. People also take pictures to provide authorship over a moment they have captured. With the increasing popularity of digital photography, people have become less selective about which moments they choose to capture (Van House et al., 2005) and are more likely to rely on others for capturing photographs (Van House, 2009).

Photography also serves our social selves. When shared with others, photos can reinforce social roles and expectations. Thus, photosharing is comparable to a performance where one asserts her identity to an audience (Lindley et al., 2009). With the opportunities to share pictures on photosharing sites, the size of one's potential audience increases drastically (Miller & Edwards, 2007).

Online photosharing for therapeutic purposes provides an example of how photosharing sites can influence cognition. Sharing photos allows users to express aspects of themselves that are not easily verbalized, and might even bring unconscious aspects of themselves to light. Thus, online photosharing provides opportunities for increased self-insight and gaining support from others, which can be beneficial for one's mental health (Suler, 2009).

Why exactly might online photo-sharing have such an intimate connection with psychology and cognition? Salomon (1990) suggests some mechanisms through which computer technology might influence cognition. One is interactivity—computer users directly interact with the computer programs, as opposed to passively watching a television which shifts the degree of engagement in the activity, and thus, how one thinks about the activity (Rafaeli, 1988). In a similar vein, computer programs have the ability to provide feedback towards a user's actions. Users and computers can mutually influence each other to achieve a goal (Salomon, 1990).

Photo-sharing as psychological storage

More importantly for my current purpose, computers have also been shown to shift the cognitive demands of carrying out a task. Consequently, due to their information storage capabilities, computers can assist in completing tasks by reducing a user's memory load. Thus, computers and users can form an intellectual partnership where the burden of storing information falls on the computer rather than the user's memory. With fewer cognitive demands on memory, users can more easily process concepts in a higher-order manner (Salomon, 1990).

When recording a vacation through photos, people appear to take advantage of their ability to deposit memories into a computer. While visiting an aquarium in Japan, Foster (2009) observed many tourists watching the sea creatures through a cameraphone screen. The tourists were apparently placing greater energy into digitally recording the fish tanks than experiencing the fish tanks themselves. He suggests that taking pictures provides ownership over a place or moment.

To empirically explore the purposes of photo sharing, Van House (2005) conducted a study where they gave camera phones with online photo sharing capabilities to a group of friends. Van House (2005) found that the participants posted photos online to preserve functional

memories (i.e. the price of an item of clothing) and emotional memories (i.e. capturing the fun of a day on the beach). Furthermore, once many images were shared, they were forgotten—further supporting the idea of unloading memories onto photo sharing sites.

Most relevant to my thesis, Sparrow et al. (2011) investigated the intriguing possibility of a “transactive memory system” in which people pass the burden of remembering information onto the Internet, instead of relying on their own memories. To do this, they conducted a series of experiments addressing whether people think of the Internet when primed by the need to obtain information. Their findings supported a reliance on the Internet for storing information.

In one of their experiments, Sparrow et al. (2011) asked participants to view either an easy or difficult set of trivia questions, and then gave them a reaction time test to either computer-related or general words. The results indicated that questions with unknown answers prime thoughts of computers, where presumably the missing information is located. For example, when participants were given a hard (versus easy) trivia question, their reaction times to words related to Google and online search engines became much quicker. This was presumably because exposure to a difficult trivia question not only activates concepts related to the topic, but also concepts related to where people today are able to logically find the answer: the Internet.

The present research

In my study, I sought to use a similar method to investigate whether people rely on the Internet for “transactive” storage – however, rather than looking at declarative memory, I wanted to examine the role of more affectively-based memories. Given the explosive rise of online photo-sharing and the use of photography to capture life’s most important and exciting social moments, might concepts related to online photos be activated when people think about a positive past experience (and not just concepts related to the content of the experience itself)?

Building off of the “Google effects” framework (Sparrow et al., 2011), I first hypothesized that being primed to think about a recent vacation would bring to mind vacation-related thoughts, and thus would lead to quicker reaction times to vacation words compared to neutral words (replicating standard priming effects: Higgins, 1996). However, I further predicted that being primed with vacation would lead to quicker reaction times to social media words. By thinking about vacation, people might also be primed to think about *where* those vacation-related thoughts are “stored” (i.e., online photo albums and social media).

Method

Participants

I recruited 93 undergraduates (76.3% female, $M_{age}=18.83$, $SD_{age}=1.15$, 60% Caucasian) to participate in exchange for course credit as part of a subject pool requirement. My study lasted approximately 15 minutes. Sessions were held in a campus laboratory in groups of 1-4 participants per session.

Procedure

First, participants were seated at an individual computer. They were told that we were interested in studying the relationship between attention and memory, and that they would be completing a variety of different tasks on the computer, by themselves. All participants provided their informed consent to participate before any other instructions were given.

Next, participants were given a thought induction about a positive memory from their pasts. They were randomly assigned to spend a few minutes and answer a few questions about either “a recent vacation” or “a recent positive academic experience.” I included the “academic experience” condition as a control group, in order to address the possible confound that thinking about *anything* positive might have certain effects above and beyond something specific about

online photos. Because most people should relate photography to a vacation but *not* photography to an academic experience, I hoped to tease apart the specific effect of thinking about a positive photography-relevant event from a more general effect of thinking about an event with positive valence.

After the thought induction, all participants completed a standard Stroop task (Stroop, 1935; see also Williams, Mathews, & MacLeod for a review). In a typical Stroop task, people are exposed to a list of words presented in varying colors. The goal is to identify the correct color as quickly as possible. Researchers can adapt the words themselves to fit a variety of research questions, all of which involve pitting a fluent reaction time to colors with potentially distracting information in the words themselves. For example, if the word “blue” were written in blue ink, most people would be able to say the name of the color (“blue”) very quickly and easily. However, if the word “brown” was written in blue ink, most people would be much slower to accurately respond because the content of the word conflicts with the expected color.

In my study, all participants were exposed to 8 individual words, flashed one at a time in the middle of a screen following an “xxx” fixture point flashed for approximately 1 second. However, they were randomly assigned to 1 of 3 groups (see Figure 1). Participants were exposed to either 8 neutral words (water, long, number, little, something, different, every, always; taken from O’Brien, Anastasio, & Bushman, 2011), 8 vacation words (airplane, suitcase, beach, hotel, Disneyworld, tourism, travel, museum), or 8 social media words (pictures, posting, comment, Facebook, Twitter, profile, like, friends). Words were matched according to length.

Each word was presented in a random order and color – either blue, green, yellow, or red. We color-coded 4 keys on the keyboard to represent each color, so that when a participant

wanted to respond, he or she would click the appropriate color key as quickly as possible. As we explained to them, their goal was to accurately click the appropriate color as fast as possible.

Finally, participants provided demographic information (e.g., sex, gender, age), were thanked, and were debriefed about the purposes of the study.

Results

I had 2 primary predictions. First, I predicted that thinking about a positive past vacation would make vacation-related thoughts more accessible, thus leading people to react more quickly to vacation words in the Stroop task compared to the neutral-word control group. Second, if my theory is correct, then thinking about a positive past vacation should also make social media-related thoughts more accessible, thus leading people to also react more quickly to social media words in the Stroop task compared to the neutral-word control group. Further, none of these effects should apply to participants who simply thought about a positive academic experience because no thoughts of photography should be activated.

To test these predictions, I employed a 2 (prime: vacation or academic) x 3 (reaction-time words: neutral, vacation related, social media related) design.

I collapsed the individual reaction times across the 8 words into a composite reaction time index for each group (Cronbach's $\alpha = .69$) and used this composite score as my primary dependent variable. I conducted a univariate ANOVA analysis with prime (academic or vacation), word type (neutral, vacation, or social media), and the prime*word type interaction predicting reaction time.

I found no main effect of prime ($p = .46$) or word type ($p = .67$). However, as expected, I did find a marginally significant interaction, $F(1, 88) = 1.97, p = .146$ (see Figure 2). Thinking about a recent academic experience did not significantly change reaction times between any of

the word types; however, thinking about vacation made people respond much more quickly to vacation words ($M=695.56$, $SD=155.57$, $n=15$) and moderately more quickly to social media words ($M=772.12$, $SD=142.64$, $n=16$) when compared to reaction time to neutral words ($M=805.74$, $SD=145.44$, $n=13$).

Thus, my hypothesis seems to be confirmed, at least partially with this initial evidence. Thinking about a positive past vacation made it easier to respond to vacation-related words *and* made it easier to respond to social media-related words compared to responses to neutral words; thinking about a positive non-photography memory did not result in these patterns.

Discussion

My results provide evidence that thinking about vacations—events where people usually take many photos—affects processing of words related to social media. Participants who thought about an academic experience showed little difference in reaction time between vacation words, social media words, and neutral words. Participants who recalled a vacation, however, had the quickest reactions to vacation words, then social media words, and finally neutral words. This evidence supports the idea that thinking about a photo-worthy event, like a vacation, primes people to think about where these photos are stored, i.e. on social media websites.

If memories of vacation indeed prime thoughts of where these memories are stored, which for many people is social media sites, then this study's results suggest that people might “outsource” affective memories online by uploading memories to photo-sharing websites, similar to previous research that suggests people “outsource” declarative memories to online search engines like Google (Sparrow et al., 2011). Therefore, uploading and viewing pictures on social media sites could play a role in the construction of memory, particularly affective memories.

The results may have been limited by the small sample size. With $n = 93$, each of the six experimental groups contained about 15 members. The size of the experimental groups may have been small enough that our results occurred by chance. Conducting this study with a larger sample size would increase the reliability of my results. Moreover, follow-up studies might improve on some of my methodological limitations. For instance, it would have been helpful to include academic-related words in the Stroop task, in order to demonstrate that academic memories facilitate academic words but not other types of words. Further, by including a scale that assesses amount of social media use, a future study could run a correlational analysis to test whether people who use social media more often are also more likely to show the memory effect. Although most of my sample likely regularly used social media (i.e., American college students), it would still be valuable to even directly compare a sample of heavy social media users (e.g., college students) with a sample that uses less social media (e.g., older adults). It would be interesting to see whether similar patterns of reaction times to the different Stroop task words occur among a vacation-primed sample that is less likely to regularly use social media.

It would also be interesting to study whether photographs on a social networking site can retroactively influence memories of an event. A future study could address whether comments on an online photo can influence one's emotional memory of an event in a bidirectional fashion. For example, perhaps positive comments cause one to remember an event more positively, while negative comments lead to more negative memories of an experience.

As technology further develops, will its effects on memory become even more pronounced? In recent years, the Internet has become more portable than ever. The development of smartphones, tablets, and wireless technology make the Internet accessible from almost anywhere with cell phone service. With the ability to carry the Internet in one's pocket, it may

become less and less necessary to commit information to memory. If people wish to relive their emotions from a vacation, all they have to do is pull their smartphone out of their pocket, open their photo album, and let the memories pour in.

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Figure 1. A photograph of the laboratory set-up for the Stroop task.

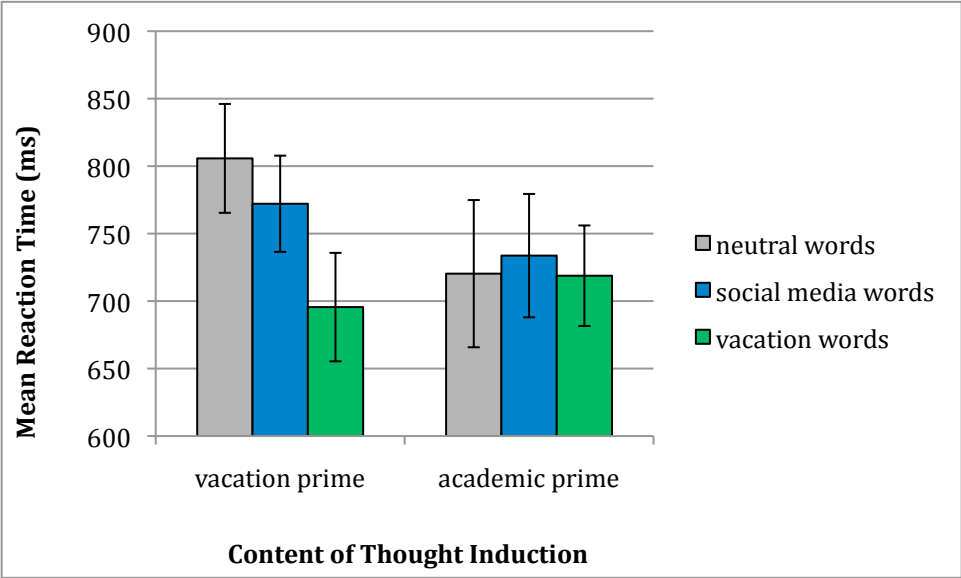


Figure 2. Mean reaction times to each word category after thinking about a recent vacation or about a recent academic experience (between subjects). Error bars represent ± 1 standard error.