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The Effects of Computer Reliance and Relationships on Memory

Denise Beyer

THE EFFECTS OF COMPUTER RELIANCE AND RELATIONSHIPS ON MEMORY

by

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(Under the Direction of Rebecca Ryan)

ABSTRACT

Research supports the notion that the internet may serve as a transactive memory source for many individuals. Because, for many, information from technology is so accessible, humans may be less likely to encode and store information in their memory, potentially resulting in a smaller knowledge base over time (Sparrow, Liu, & Wegner, 2011). The current study examined the effects of exposing participants to a computer, friend, or neutral prime. Procedure order was also varied among the groups to determine whether potential memory failure would occur due to an encoding failure or a retrieval failure. Participants were asked to write out a list of trivia statements either before or after learning while receiving either a computer, friend, or neutral prime. The data were analyzed with a 2 x 3 (before/after learning by type of prime) ANCOVA with age, gender, year in college, ethnicity, high school GPA, college GPA, relationship status, hours online per day, and purpose of time online as covariates. No significant results were found. This information is still very important in determining how technology and environmental social factors impact memory performance and where future efforts should be placed in terms of strengthening and preserving our knowledge base.

INDEX WORDS: Transactive Memory, Priming, Long-term Memory, Encoding, Retrieval

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DEDICATION

I dedicate my thesis work to my family and friends. A special feeling of gratitude to my loving parents, Mark and Anne Beyer, for their love and support throughout my life. Thank you both for giving me the strength to reach for the stars and chase my dreams.

I also dedicate this work to my best friend and soon-to-be husband Eric. I give my deepest expression of love and appreciation for the encouragement that you gave and the sacrifices you made during this graduate program. Thank you for the support and company during the many late nights of research and typing.

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CHAPTER 1

INTRODUCTION

Computer Priming

Today the internet and mobile devices give many individuals constant access to information. These portable devices with internet access have made it possible to look up information virtually any time, anywhere, with the simple touch of a button. The internet (via search engines and databases) has become a kind of external memory source. This effect was observed by Sparrow, Liu, and Wegner (2011), who investigated whether having access to online search engines has become a form of transactive memory.

Transactive Memory

Wegner, Giuliano, and Hetel (1985) described transactive memory as a group of individuals engaging in a three part process: encoding (learning), storage, and retrieval (information recall). This process describes how an individual's knowledge is constructed, categorized, and accessed, and can also be applied to groups. This system, sometimes referred to as a group mind, is a combination of each group member's knowledge. The information is accessible to all members, which may include friends, families, or teams (Wegner, 1995). Over time group members learn which members specialize in certain areas, as well as effective means of communication for retrieving that knowledge. For example, a group member may think, "I don't need to remember or learn that, I can just go ask X". This feature of transactive memory allows individuals to reduce their cognitive load because they can have access to information that they do not have to possess themselves.

According to Wegner et al. (1985), in the encoding stage, group members learn each other's areas of expertise through group interaction. Any new information entering the group is passed on to a specific team member with matching expertise. According to Liang and Rau (2000), this first stage is highly important in the development of transactive memory, because it lays the basis for an effective system. In the storage stage, only the group member with expertise relevant to the presented information stores the information in their memory. Once group members learn each other's specializations, all incoming information will be automatically categorized and passed on to the corresponding individual. In the retrieval stage, a group member consults the individual with the specialized knowledge to acquire needed information (Wegner, 1995).

Information Technology and Transactive Memory

Sparrow et al. (2011) hypothesized that the internet is now a transactive memory source for many individuals. Similarly to how if there is a gap in one's knowledge one can turn to his or her "group mind" (i.e., other members of their group) for expertise, when individuals are presented with a question they cannot answer, they may to turn to the internet, and then be less likely to feel the need to remember that information, thus not adding to their knowledge base. The process of using information becomes "looking up" as opposed to learning. For example, the authors posed the question, "If asked the question whether there are any countries with only one color in their flag…do we think about flags – or do we immediately think to go online and find out?" (Sparrow et al., 2011, p. 1).

In order to investigate this effect, Sparrow et al. (2011) conducted a series of experiments to test participants in two conditions in which they answered either easy or

hard yes/no trivia questions. Each trial was followed by a modified Stroop task in which words were presented in either blue or red, to test reaction times to matched computer and non-computer based words (e.g., "internet" versus "townhouse"). They predicted that participants who were presented with a series of hard trivia questions that they did not know the answers to would show slower reaction times in naming the color of the computer based word because the word itself was distracting (i.e., the word cued participants to think of looking the trivia question up on the computer). Paired within-subject t-tests were used to compare reaction times to word category after the easy or hard trivia questions. As was predicted, participants showed slower reaction times when naming the color of the computer based words following a series of questions that they could not answer, compared to trials in which they were presented with easy questions or non-computer based words. The authors concluded that when faced with a gap in our knowledge, we are primed to rely on a computer to supply us with the needed information, even when a computer is not present during the priming session or the actual task (i.e., exposure to computer based words).

In their second experiment, Sparrow et al. (2011) tested whether participants would remember information they believed they would have access to later on, compared to information they would not have access to. They compared a control group of participants to a group of participants who were told that they would have later access to information. The authors hypothesized that participants with this expectation would perform poorer on a recall task because they would be less likely to store the information. Participants were asked to read 40 memorable trivia statements that could easily be verified online (e.g., "The space shuttle Columbia disintegrated during re-entry over

Texas in Feb. 2003."). The participants then typed all of the statements on a computer to assure they were exposed to the information. Half of the participants were told their computer file would be saved, and half were told the computer would erase their file. In addition, half of the participants in each of the two conditions were asked to try to remember the information they typed, while the other half were given no explicit instructions. Immediately following the typing task, the participants were asked to write down as many of the statements as they could remember, but none were allowed to refer to their computer file.

The results showed that those who believed their file would be erased recalled more statements than those who believed their file would be saved. The results showed that people who believe information will be available to them later are not able to recall it as well as those who believe that the information will not be available. Because search engines are available a majority of the time, we may often be in a state of not feeling that we need to encode information. There was no main effect of instruction (to remember or not) nor an interaction of saved/erased and explicit instruction. These results indicate that participants were affected by the cue of whether the information would be available later, regardless of whether or not they thought they would need it later, and demonstrates that when people do not believe they will need information for a test, they are not able to recall it as well as those who believe they will need it.

Because the prime was presented before the learning task in the study described above, the results may suggest a potential encoding failure. These findings are congruent with transactive memory theory that suggests that the system itself relies on external coding rather than the usual internal. Instead of encoding the information itself, the

individual encodes the location of the information. This encoding of a meta-memory (i.e., the memory of someone else's memory) replaces the encoding of the information itself (Wegner, 1995). The internet may also be labeled as a location of information, thus serving as a memory source.

Transactive memory has also been shown to have many positive features, such as increased group performance. It may also reduce cognitive load and free up cognitive resources for more creative thinking. On the other hand, this lack of encoding may lead to smaller knowledge bases. Individuals who possess less knowledge may in turn be less able to engage in more abstract thinking and may not be able to engage in creative thinking, which requires putting known information together in new ways.

Friend Priming

Friends often impact levels of motivation and guide behavior on both conscious and unconscious levels. For example, Bargh (1990) investigated whether behavior could be influenced by the actions of others. When participants were asked to remember the general behavior of a confederate, they tended to remember the overall intention of the behavior, rather than the behavior itself. The participant would then use information to assess and change their own behavior, using the perceived intention as a guide. Similarly, Chartrand and Bargh (1996) found that that primed goals influence memory in a similar way as consciously directed goals. They primed their participants with either "form impression" words (e.g. judge, evaluate) or "memorize" words (e.g., retain, hold) during a lexical decision task. The participants then read a series of phrases that appeared on a computer screen. After a three minute filler task, the participants were asked to recall as many of the phrases as they could. They found that participants primed with

impression words scored significantly higher compared participants who received the memorize prime.

These results demonstrate that explicit priming can result in an explicit behavior change. This research was extended by Bargh, Gollwitzer, Lee-Chai, Barndollar, and Trotschel (2001) who found that participants primed with achievement words during a lexical decision task both worked harder and outperformed in the word search task compared to control participants. These findings demonstrate that unconsciously primed motives have a similar effect on behavior as conscious motives. It may also be possible then that partners can influence goals that operate subconsciously and subsequently influence behavior.

Fitzsimons et al. (2003) investigated whether the representation of a partner (i.e., a partner not physically present, but present in the mind of the individual) can automatically trigger goal-achieving behavior. They based their hypothesis on research that suggests that partners have the power to influence individuals even when they are not present or when the individual is not consciously thinking of said partner. Specifically, subliminal exposure to the name of someone who wanted the individual to do well on a test (e.g., their mother) would result in the individual scoring higher than those who were primed with the name of someone who would not want them to score well (e.g., someone they did not know) (Shah et al., in press, as cited in Fitzsimons & Bargh, 2003). Fitzsimons et al. (2003) assessed priming and its interaction with unintentional goal-achieving behavior. The experimenters utilized yoking, in which one participant was partnered to another. Half of the participants were subliminally primed with their best friend's name (retrieved from a survey the participants completed at the start of the

session) and the other half were subliminally primed with their yoked partner's best friend's name. The participants were then given an attribution test consisting of 10 scenarios involving an individual displaying a negative or positive behavior or action. The name of the in-test individual was either the participant's best friend or their yoked partner's best friend. The participants were asked to name a cause for the action, and whether it had to do with the individual, or whether other people or the environment caused the action. The participants were then asked to evaluate the in-test individual on how well they liked him and/or her, how likeable he and/or she was, and the likelihood of becoming friends with him and/or her on a 12-point scale.

They found that those who received the friend prime (i.e., were primed with the name of their friend) made more external attributions (i.e., the target's environment caused the action) to the in-test target's (either their best friend or their partner's best friend) behavior, whether the behavior was negative or positive, compared to those who received the prime of a presumed strangers name. In other words, they found that these individuals tried to understand both the positive and negative behaviors of their friend (the in-test target) by attributing behavior to a situational cause. These results show that friend priming is possible, even when the friend is not present. Because thinking of both external and internal causes of behavior and thus evaluating the situation from multiple angles requires more mental effort, the authors concluded that individuals will unconsciously make more of a mental effort when they are thinking of someone close to them, and thus expend higher rates of mental effort overall when performing a task.

Other research supports the notion that social interaction facilitates cognitive functioning. For example, Ybarra et al. (2000) discussed how a simple conversation may

require paying attention, keeping the conversation in memory, considering the other person's argument, formulating a counter-argument, and so on. Through regular social interaction, people get practice at engaging and utilizing these processes. The authors also found a significant positive interaction between social contact and cognitive functioning in three different age groups, demonstrating that regular social interaction may benefit cognitive functioning by "exercising" cognitive processes.

The effects of relationships on memory can also be extended to couples. Hakansson et al. (2009) conducted a study in Finland and tested 1,449 participants at mid-life (about 54 years old), and then again 21 years later. They assessed marital status (married/cohabitating, single, divorced, or widowed) and diagnostic measures of cognitive impairment such as Alzheimer's disease and dementia. Cognitive impairment measures also included a questionnaire on health behavior, health status, signs of depression and medical history, as well as the mini-mental state examination (MMSE). Results showed that participants living without a partner during the time of the second examination had twice the risk of developing cognitive impairment compared to those living with a partner. Participants who lived without a partner during both examinations had three times the risk for cognitive impairment compared to those who were cohabitating or married in the second examination. On the other hand, those who were divorced or widowed only at time two only reached borderline significance. These results were still significant after gender, education, and smoking were controlled for. They authors concluded that there is a substantial association between marital/partner status and cognitive functioning later in life.

Friendships may also impact mental health and even physical health. Although

very few would argue against friendships enhancing an individual's happiness and overall wellbeing, there are also a number of studies that support the notion of friendships contributing to good physical health and longevity. Conversely, previous research has found "links between loneliness and lack of social support with increased risk of heart disease, viral infections, cancer, and higher mortality rates" (Sias & Bartoo, 2007, p. 470). This is thought to be the case because "friends might have a protective effect by influencing health behaviors and help seeking, as well as self-efficacy, self-esteem, coping, and morale" (Jorm, 2005, p. 538). Given this information, recent data on the decline of close friendships in the general population in the United States (McPherson, Smith-Lovin, & Brashears, 2006) is troubling.

According to McPherson et al. (2006), Americans have been steadily declining in their average number of close friendships since 1985. Based on a general social survey completed via the International Social Survey Programme, in 1985 and 1,467 in 2004, 25% of Americans in 2004 reported no close friends, a figure which has nearly tripled since 1985. The average number of close friends has dropped from four to two. The number of individuals who have a close friend who is not blood related dropped significantly from 80% to 57% from 1985 to 2004, and there was a 4% increase (from 5% to 9%) of individuals who named their spouse as their only close contact (McPherson et al., 2006). Putnam (2000) also reported that individuals in general in the United States are less likely to attend meetings in which they must interact face-to-face with others, less likely to join clubs and sponsored activates, and are less likely to hold family dinners or invite guests into their homes. These figures demonstrate the decline of social ties in the United States and this trend may lead to a decline in the physical and mental wellbeing of

Americans. With research like Fitzsimons (2003) demonstrating the importance social support with regards to memory, an overall worsening of memory in the United States as social ties decrease is likely, as well as fewer chances to access a transactive memory system.

The Current Study

The internet can potentially serve as a substitute for our primary form of transactive (external) memory because, for many, it is so easy to access. Due to this easy access, humans may be less likely to encode information to their memory, resulting in a worsening knowledge base over time (Sparrow et al., 2011), or humans may be less able to retrieve information. Technology may be preventing us from encoding and/or retrieving information, and thus, may be preventing us from committing as much information to memory. Alternatively, long term memory seems to be improved by utilizing a partner. Partners can help direct and focus cognitive goals, resulting in a stronger collective long term memory, as demonstrated in a meta-analysis by Hakansson et al. (2009), in which cognitive functioning was found to be bolstered by having a marital or cohabitating partner in later life. Though it is known that both search engines and human interaction affect long-term memory, the strength of each effect remains unknown.

It is also unclear during which cognitive stage memory failure is occurring (encoding or retrieval). It may be the case that priming affects the encoding process resulting in poor learning and retrieval failure, or encoding may be successful and priming interferes with the ability to retrieve the information from our long term memory. In this day and age where reliance on technology is on the rise and core social networks

are dwindling, understanding how these variables interact to affect memory is vital.

Currently we know when an interfering prime is presented before learning, individuals demonstrate lower rates of memory recall (Sparrow et al. 2011), but to our knowledge no study exists directly comparing primes presented during various stages of the learning process. I seek to extend this research by simplifying (i.e., having participants read 20 trivia statements rather than 40) the methodology used by Sparrow et al. (2011) and examining the effects computer priming, friend priming, and neutral priming before and after a learning task. Furthermore, because the current study utilizes a simpler, more straightforward design compared to the methodology used by Sparrow et al. (2011), I will also be investigating whether these primes are impactful enough to produce an effect similar to that of previous research. By comparing computer, friend, and neutral primes presented before and after learning, I will examine whether there are differences between technological and social influences on memory, where memory failure occurs during learning, and whether friend priming positively or negatively affects information recall (and therefore could potentially buffer against the negative effects of computer priming as found by Sparrow et al., 2011).

The goal of the current study is to further understand the mechanics of human memory and how it is impacted by technology and environmental social factors. We also seek to understand whether impaired memory due to this kind of priming is related to encoding failure or retrieval failure. We will compare the memory performance of participants primed to rely on a search engine to those primed to rely on a human partner.

It is predicted that recall scores will be lowest in participants receiving the computer prime. Priming participants to think about computers and leading them to

believe they will have future access to information results in lower rates of information recall (Sparrow et al., 2011). I also predict that information recall rates will be highest in participants receiving only the friend prime, as demonstrated in several priming studies (Fitzsimons & Bargh, 2003; Bargh, 1990). Furthermore, because memory failure occurred when a prime was presented before learning (Sparrow et al., 2011), I hypothesize that memory failure takes place during the encoding stage of learning rather than the retrieval stage, and that participants receiving priming before learning will show lower scores compared to those who receive priming after learning because the prime will interfere with the encoding process. Differences between the groups who receive their prime before the learning task and groups who receive their prime after the learning task will indicate whether encoding or retrieval is responsible for memory failure. Low scores among groups that received the prime before the learning task relative to other groups indicate encoding failure, whereas low scores among groups that received the prime after the learning task relative to other groups indicate retrieval failure.

A lack of encoding information may lead to a worsening knowledge base over time. Furthermore, differences between friend and neutral prime groups will indicate the positive or negative effect of the prime. It may be possible that priming an individual to think of a smart friend may act as a memory inhibitor (i.e., "I don't know this. I'll have to ask X about this later") rather than a facilitator as demonstrated by Fitzsimons and Bargh (2003). This information is very important in informing us of the impact of today's ready access to technology, search engines, and the internet. Less knowledge may lead to less creativity if we are less able to make connections between existing information. It will also determine where future efforts should be placed in terms of

strengthening and preserving our knowledge base.

CHAPTER 2

METHODS

Participants

The participants included 140 (107 women, 34 men) undergraduate students ranging from 18 to 44 years of age (M_{age} = 19.83, SD_{age} = 3.16) from a university in the southeastern United States. The majority of the participants were first year students from introductory level psychology classes. Participants were recruited by means of the university's online recruitment system. Participants were given class credit and/or extra credit as compensation.

Design and Materials

A between subjects design was used, utilizing six conditions, varying the position and type of prime. They include Learning/Computer, Learning/Friend, Learning/Neutral, Computer/Learning, Friend/Learning, and Neutral/Learning

Priming was used to simulate having a partner. All primes were explicit, and participants had time to consciously process the prime. Individuals in the friend prime conditions thought of who they perceive to be their smartest friend, due to research that demonstrates friend priming is possible with only the mental representation of said friend (Fitzsimons et al., 2003). Participants indicated their friend's initials to assure that they were primed to think of a specific person. They also indicated the extent of their relationship with that friend (see Appendix A).

Participants in computer priming conditions were lead to believe that they would be moving to a computer lab partway through the experiment. They were told they

would have access to the internet during the trivia quiz, but in fact they did not (see Appendix B for a script).

Neutral priming was also used, in which participants unscrambled words as best as possible in 2 minutes (see Appendix C). All words were neutrally charged, the same length, and the first and last letters were consonants and were placed correctly. This methodology was used in other studies for neutral priming (Williams, Nocera, Gray, & Bargh, 2009).

The participants read through 20 trivia statements (see Appendix D), as outlined in Sparrow et al. (2011) (e.g., "The space shuttle Columbia disintegrated during re-entry over Texas in Feb. 2003"). During the learning task, participants were given a list of 20 trivia statements and wrote out the statements by hand. All participants then recalled and wrote down as many of the trivia statements as possible in 5 minutes, without using their written lists or the internet. The number correct out of 20 was used as the data for long term memory performance. Answers deemed correct contained all key elements of the original statement. For example, in the sample statement provided above, the participant needed to write an answer including "space shuttle", "Columbia", "disintegrated" (or a similar word like "destroyed"), "Texas", and "Feb. 2003". Participants who remembered at least half of the target words were scored with half credit, but all credit was assigned on either a full credit or half credit basis.

Participants also completed a filler task. In accordance with other literature utilizing priming and filler tasks, the task involved the participants drawing their family tree as best as possible in two minutes. This task did not allow for any expression of a performance goal, and kept participants interested (i.e., another survey or more writing

may tax them before completing the trivia quiz) (Bargh et al., 2001). Lastly, all participants completed a brief demographics survey (see Appendix E).

Procedure

Participants were recruited by means of the university's online recruitment system. The study took place in a normal classroom. Participants were either run by themselves or in groups of up to 5. When participants arrived they were thanked for coming and given the informed consent form to read and sign. Participants were then randomly assigned to one of six groups:

1) Learning phase, computer prime, filler task, quiz, and demographics survey

2) Learning phase, friend prime, filler task, quiz, and demographics survey

3) Learning phase, neutral prime, filler, quiz, and demographics survey

4) Computer prime, learning phase, filler task, quiz, and demographics survey

5) Friend prime, learning phase, filler task, quiz, and demographics survey

6) Neutral prime, learning phase, filler task, quiz, and demographics survey.

Participants in the Learning/Computer Group first read through the trivia statements and copied them by hand to assure attention. They were then told that they would be moving to a computer lab for the remainder of the experiment, and that they would be able to use the computer on upcoming tasks. Participants then completed the filler task outlined above, took the trivia quiz, and completed the demographics survey. Participants in the Learning/Friend Group had a procedure identical to the Learning/Computer group, but received the friend priming survey (see Appendix A) instead of the computer prime. Participants in the Learning/Neutral Group had a procedure identical to the previous Learning/X Groups, but received a neutral prime.

Participants in the Computer/Learning Group first received their computer prime by being told that they would eventually be moving to a computer lab to take an upcoming quiz on the trivia statements provided. They then read through the trivia statements and copied them by hand to assure attention. Participants then completed the filler task outlined above, took the quiz, and completed the demographics survey. Participants in the Friend/Learning Group had a procedure identical to the Computer/Learning group, but received the friend prime instead of the computer prime. Participants in the Neutral/Learning Group had a procedure identical to the previous X/Learning Groups, but received a neutral prime.

Following the completion of the experiment, the participants were thanked and given a short debriefing statement to inform them of the deception that took place during the session (see Appendix F), and were told that they would be sent a complete debriefing statement after data collection was completed. Once data collection was completed, all participants received the complete debriefing document via email (see Appendix G). This was done to help assure that no incoming participants had prior knowledge of the experiment, and helped eliminate observation bias. Participants were told the true nature of the experiment and were informed why deception was necessary in the computer prime and computer/friend prime conditions, as well as why the complete debriefing document was withheld until after data collection. Various procedural orders for these measures and manipulations are outlined in the next section.

CHAPTER 3

RESULTS

The statistical analysis required comparing the effect of prime position (before or after) and prime type (computer, friend, or neutral) on the trivia quiz scores; while accounting for the influence of additional variables. These additional variables included age, gender, year in college, ethnicity, high school GPA, college GPA, relationship status, hours online per day, and purpose of time online. In order to determine whether it was appropriate to use these as covariates and thus conduct an ANCOVA, the following tests were performed to assure that the corresponding assumptions were not violated.

Pearson's *r* correlation statistics were examined among all of the covariates and none were found to be highly significant (higher than .5), thus addressing issues of multicollinearity. Also, Levene's test for equality of variances was not significant ($p = .325$), thus addressing homogeneity of variance. Lastly, to assess for independence of covariates and treatment effects a series of t-tests with prime position and a series of ANOVAs with prime type were conducted with each covariate and none of these analyses were found to be significant, thus establishing the independence of the covariates and the independent variables.

It was thus deemed appropriate to conduct the ANCOVA and so the data was examined with a 2 (before/after learning) x 3 (computer, friend, or neutral prime) ANCOVA to compare scores on the trivia quiz between the six groups with age, gender, year in college, ethnicity, high school GPA, college GPA, relationship status, hours online per day, and purpose of time online included as the covariates.

The main effect of prime position was not significant, indicating that participants

who received the prime before studying the material (M = 5.88, SD = 2.32) did not significantly differ from participants who received the prime after studying the material (M = 6.33, SD = 2.49) on information recall scores, $F(1, 123) = 2.70$, p = ns, partial η^2 = .024. The main effect of prime type was also not significant, indicating that priming with computers (M = 6.49, SD = 2.62) , friends (M = 6.11, SD = 2.49), or neutral stimuli (M = 5.75, SD = 2.06) did not impact information recall, $F(2, 123) = 1.56$, p = ns, partial η^2 = .028. Lastly, there was no significant interaction between prime position and prime type, indicating that the combined influence of prime position and prime type did not impact information recall, $F(2, 123) = 2.41$, p = ns, partial η^2 = .042 (see Figure 1). The mean scores and standard deviations of the before/after groups by prime type are shown in Table 1. Though these results were not significant, the effect sizes were all within the range of a small effect size (Cohen, 1988).

Table 1

Descriptive statistics for scores on the trivia quiz

	Before	After
Computer	M = 6.00, SD = 2.72	M = 6.97, SD = 2.51
Friend	M = 6.34, SD = 2.25	M = 5.90, SD = 2.72
Neutral	M = 5.20, SD = 1.95	M = 6.36, SD = 2.06

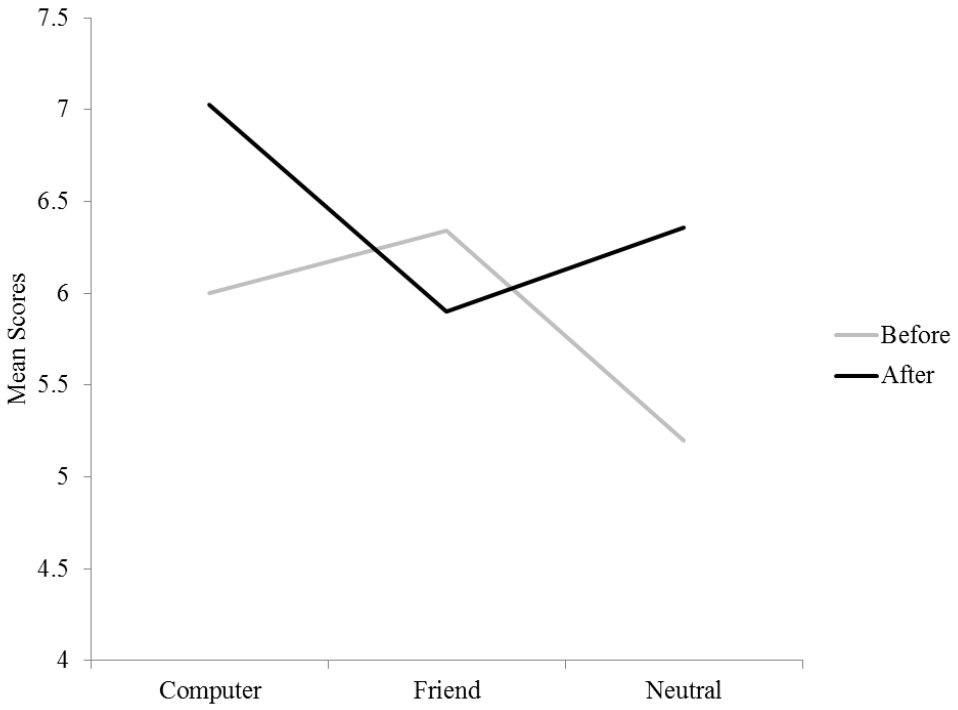

Figure 1. The mean number of trivia statements recalled in computer, friend, and neutral conditions before and after learning, $F(2, 123) = 2.41$, p = ns, partial $\eta^2 = .042$.

CHAPTER 4

DISCUSSION

Interaction of Prime Type and Prime Position

There was no significant interaction of prime type and prime position. This may have been the case because the measure was not sensitive enough to reveal a range of scores that would reveal significant differences. Many participants scored relatively low (usually no higher than 7 out of 20), indicating a potential issue with floor effects. Furthermore, the prime manipulations may not have had enough of an impact to result in group differences. The sample may have also impacted the results. The majority of the participants were Introductory Psychology college students, but many were mid-semester and had already participated in research before and had already learned about basic concepts and ethics. Furthermore, because data collection took place mid semester, and many of the participants may have had experience with deception and may not have believed that they would actually be moving to a computer lab.

The effect size for the interaction approached a medium level (i.e., .06) (Cohen, 1988) and was the highest effect size found (partial $\eta^2 = .042$). A future study using a more diverse sample population and more sensitive measures, such as may result in significant group differences. The direction of the means did reveal an interesting pattern. In the "before" condition, trivia scores were highest for the friend, computer, and then neutral groups, respectively. However, in the "after" condition, mean directions reversed, and trivia scores were highest in the computer, neutral, and friend groups respectively. Since participants primed with a computer performed worse than those primed with a friend in the "before" condition, perhaps thoughts of the computer before

learning interfered with learning. It may be the case that those in the "before" group were more impacted by the type of prime during their learning task compared to the "after" group. Therefore, those receiving the computer prime in the "after" group were not distracted from learning by the computer prime, and also experienced a confidence boost by being told they could use the internet for their quiz and believing they would have help for the quiz. Furthermore, those receiving the friend prime in the "before" condition may have reaped the benefits of friend priming as discussed by Fitzsimons et al. (2003), whereas those receiving the friend prime after learning may have found it distracting, as friends may prime social thoughts more often than academic ones, therefore hindering performance.

Main Effect of Prime Type

There was no significant main effect of prime type, indicating that memory recall was not influenced by computer, friend, or neutral primes. However, these results conflict with the findings of Sparrow et al. (2011) and Fitzsimons et al. (2003), who found that computer and friend primes did influence memory performance. This may be due to the case that neither of these studies used a filler task in between learning and recall, therefore reducing the amount of interference. With regards to the computer prime specifically, Sparrow et al. (2011) utilized a within subjects design while the present experiment utilized a between subjects design. This difference in study design may have led to the difference in the results due to the greater power of within subjects designs. While within study designs can be beneficial in some cases because participants can serve as their own control group, thus removing individual error, a between subjects design was used in the current experiment to reduce carryover effects. Since the

methodology involved a memory task, carryover effects were determined to be potentially more problematic than individual error, hence the design of the present study. It may be beneficial, however, to directly compare the effects of computer primes within different designs.

Sparrow et al. (2011) also had participants type the trivia statements and told them they would be able to save their work on a computer file, which may have increased the impact of the prime. Due to location restraints, this manipulation was not possible in the present study, and participants were asked to write out the statements by hand, and told that they would move to a computer lab later. Because their study suggested a reliance on the internet rather than on a general computer, it may also be beneficial to prime participants to the internet specifically. For example, it may be beneficial to present participants with trivia questions rather than statements, and have the learning session consist of them using the internet to answer the questions. Then, during the recall task, they could be asked to recall either the answers or the questions themselves. Because the current study revealed that basic primes such as merely mentioning the priming subject are not impactful enough to create a significant difference, future studies should focus on more realistic, impactful primes. However, there is also little research available on using the internet as a prime. An establishing study of using the internet as a prime should be conducted before combining with other variables.

Participants also did not demonstrate improved memory in friend priming conditions compared to control conditions. These data conflict with the conclusions of Fitzsimons et al. (2003), who found that when participants were primed with a friend they tended to make more external attributions to explain a target behavior, regardless of

whether the behavior was positive or negative. The authors concluded that because external attributions require more mental effort, those primed with a friend exhibited more mental effort overall. Since these results could not be replicated in the present experiment (i.e., more mental effort was not observed in those receiving a friend prime), either this conclusion was erroneous and individuals do not exhibit more mental effort after receiving a friend prime, or the friend prime used in the current experiment was not sufficiently strong to lead to enough to result in group differences. Fitzsimons et al. (2003) based their priming methodology on a priming study that primed thoughts of someone who would want the participant to perform well (Shah et al., in press, as cited in Fitzsimons & Bargh, 2003), and primed the participant to their mother. While Fitzimons et al. (2003) did find significant results, their effect sizes were small. It may be the case that priming a friend who would want the participant to do well is not as salient as priming their mother in terms of memory performance, and therefore these two primes are not interchangeable. It may also be the case that the filler task, which involved drawing a family tree and was done in all conditions, may have inadvertently primed families, and therefore relationships, causing a friend priming in all participants regardless of condition. In the future, more research should be done investigating the effects of priming different relationships before assuming all primes yield equal results. It may also be helpful to observe the effects of having the friend physically present, using the same measures as Fitzsimons et al. (2003) (i.e., attribution tests), having the participant do a writing sample on the target friend, or using a different filler task.

Main Effect of Prime Position

There was no significant main effect of prime position. There is little information

available as to whether memory failure is due to encoding or retrieval failure. Again, this may have been the case because the measure used was not sensitive enough to detect significant differences. It may have been case that the list of trivia statements was too challenging, resulting in a floor effect. Participants may also have not been putting significant effort into the task. A future study using a shorter list of trivia statements, both to reduce the time between learning and recall and to reduce the amount of newly learned statements interfering with older ones may be beneficiary. Different tasks within the quiz and offering a reward to the highest scorer to increase effort may also be helpful in determining the impact of prime position on memory performance.

CHAPTER 5

CONCLUSIONS

The results of the present experiment were not statistically significant, suggesting little influence of external stimuli on our knowledge base. The friend prime did not boost performance as expected, but the computer prime also did not worsen performance as expected, suggesting perhaps that constant exposure to computers and the internet does not necessarily hinder memory processes overall. In conclusion, the data suggests no significant effect of prime position or prime type with regards to memory performance. These data are not consistent with previous research that suggests that the presence of a computer prime decreases memory performance while the presence of a friend prime boosts memory performance. Future research should include different memory tasks and other, more impactful priming methods.

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APPENDIX A

FRIEND PRIME SURVEY

1. Who do you believe is the smartest of your friends? Please write their initials:

_____

2. How long (in months) have you known this friend? _____

3. How did you meet this friend?

_____

_____

_____

_____

APPENDIX B

SCRIPTS FOR PRIMING CONDITIONS

Script for Friend Priming and Neutral Condition

Please read through the provided 20 trivia statements and copy them down by hand on the paper provided. When everyone is finished, we will continue with the experiment and you will be later be quizzed on these trivia statements.

Answers deemed correct will contain all key elements of the original statement. For example, in the statement, "The space shuttle Columbia disintegrated during re-entry over Texas in Feb. 2003", the participant would need to write an answer including "space shuttle", "Columbia", "disintegrated" (or a similar word like "destroyed"), "Texas", and "Feb. 2003". Those who remember at least half of the target words will be scored with half credit, but all credit will be assigned on either a full credit or half credit basis.

Script for Computer Priming Conditions

Please read through the provided 20 trivia statements and copy them down by hand on the paper provided. When everyone is finished, we will move to a computer lab down the hall where you will be quizzed on these trivia statements. You will be able to use the internet to search for the answers during the quiz.

Answers deemed correct will contain all key elements of the original statement. For example, in the statement, "The space shuttle Columbia disintegrated during re-entry over Texas in Feb. 2003", the participant would need to write an answer including "space shuttle", "Columbia", "disintegrated" (or a similar word like "destroyed"), "Texas", and "Feb. 2003". Those who remember at least half of the target words will be scored with

half credit, but all credit will be assigned on either a full credit or half credit basis.

Note: Both scripts inform the participants they will be quizzed later on the statements to remove a potential confound of only the computer prime groups anticipating a quiz. The same information will also be provided in the in-test instructions.

APPENDIX C

SURVEY FOR NEUTRAL PRIMING CONDITIONS

DIRECTIONS: Please unscramble as many of the following words as you can. (NOTE: Answers were not included on the actual survey)

1. felwor flower
2. btetur butter
3. fearmr farmer
4. hhgiet height
5. kettin kitten
6. bkoeod booked
7. ppeepr pepper
8. rosret resort
9. robibn ribbon
10. cepart carpet

APPENDIX D

TRIVIA STATEMENT LIST

DIRECTIONS: Please read the following trivia statements and write them out by hand on the paper provided.

1. The space shuttle Columbia disintegrated during re-entry over Texas in Feb. 2003.
2. Smell is the sense most closely linked to memory.
3. A five-zone archery target has four rings.
4. Horse-racing was America's first organized sport, established in 1664.
5. The killer whale is the fastest swimming marine animal.
6. There are eight furlongs in one mile.
7. Woodrow Wilson was the only president to earn a Ph.D.
8. The three colors of the German flag are red, black, and gold.
9. French is the most commonly spoken language in Belgium.
10. Oreo cookies are the top selling college snack.
11. Washington D.C. is also known as the "Federal City".
12. The brand "Tupperware" debuted in 1946.
13. Maine is the only state whose name is just one syllable.
14. "Stewardesses" is the longest word that is typed with only the left hand.
15. Cats have over one hundred vocal sounds while dogs have only ten.
16. Peanuts are one of the ingredients of dynamite.
17. There are 366 dimples on a regulation golf ball.
18. Almonds are a member of the peach family.
19. An ostrich's eye is bigger than its brain.

20. The tallest mountain on earth is Hawaii's Mauna Kea, 31,800 above sea level.

APPENDIX E

DEMOGRAPHIC SURVEY

1. What is your age (in years)? _____.

2. What is your gender (please circle one)?

    Male

    Female

3. What is your year in school (please circle one)?

    Freshman

    Sophomore

    Junior

    Senior

    Other (please specify) _____

4. Please specify your race/ethnicity (please circle all that apply)

    European American

    African American

    Hispanic American

    Asian American

    Pacific Islander American

    Native American

    International Student (please specify) _____

    Other (please specify) _____

5. Please indicate your high school GPA (out of a 4.0) _____

6. Please indicate your college GPA (out of 4.0) _____

7. What is your relationship status?

Single

Engaged

Cohabitating (living together)

Married

Separated (from spouse)

Divorced

Widowed

8. How many hours per day are you online?

0-2

3-5

6-8

More than 8

9. The majority of your time spent online is (please circle one):

Business/School Work

Entertainment

Social Networking

Online Shopping

APPENDIX F

INITIAL DEBRIEFING DOCUMENT

The Effects of Computer Reliance and Partnerships on Information Recall

Thank you very much for your participation in this study. The following document is meant to provide information and insight on the experiment. If you have any questions, please feel free to contact me at db03909@georgiasouthern.edu. Thank you.

I. Initial Probe (Questions to be asked verbally be the researcher)

- Do you have any questions?
- Was everything about this study clear to you?
- Different people respond to things in different ways, and it's useful to hear your feelings about and reactions to this study. Did you find any aspect of the study odd or confusing?
- What do you think we were looking for in this study?

Your feedback on this experiment will be helpful for future studies. If you have any questions or concerns, please feel free to e-mail me at db03909@georgiasouthern.edu. Unfortunately, due to the nature of the study, I cannot release details regarding this experiment until data collection is finished. When I am finished collecting data, I will e-mail a complete debriefing document that will disclose all the details of the experiment. Until the experiment is complete, please do not discuss it with anyone.

If you feel concerned or uneasy about anything that occurred during your testing session, talk about your concerns with close friends, family members, or people you respect and feel comfortable with. If you're still feeling concerned, you should feel free to make an appointment with someone at the Counseling Center:

Counseling and Career Development Center

Forest Drive

P.O. Box 8011

Georgia Southern University

Statesboro, GA 30460-8011

PHONE: (912) 478-5541

FAX: (912) 478-083

APPENDIX G

COMPLETE DEBRIEFING DOCUMENT

The Effects of Computer Reliance and Partnerships on Information Recall

Thank you very much for your participation in this study. The following document is meant to provide information and insight on the experiment. If you have any questions, please feel free to contact me at db03909@georgiasouthern.edu. Thank you.

I. Explanation of Experiment

We were interested in studying some things that we could not discuss with you in advance. If you were to know the true purpose in advance, you might try your best to "help out" by behaving in ways that fit the experimental hypotheses. This could have jeopardized the research results.

A. What we were really interested in here was how priming individuals to think of a computer/friend (depends on condition) affect their memory. During your testing session, you received either a computer prime, a friend prime, or no prime (control)

i. The hypothesis for this study was that priming you to think of a computer would worsen your memory, because you would be concerned with where to look up the information rather than on memorizing the information itself. (Computer prime condition)

ii. The hypothesis for this study was that priming you to think of your friend would boost your memory, because some research shows that when primed to think of someone who would want you to do well on a test, you actually perform better than if not. (Friend prime condition)

B. We were also interested in investigating whether memory failure occurs due to encoding or retrieval failure. During your testing session, you either learned and then were primed (encoding group), or were primed and then learned (retrieval group).

II. Rationale for Withholding Information About the Hypotheses

You weren't explicitly told at the outset that the study was about the effects of the priming. The priming used in this experiment was to take place subconsciously. Telling you we were priming you would have negated the effects. The reason for this is that it might have led you to generate hypotheses that might have affected your behavior.

III. Assess Participant's State of Mind

Talk about your concerns with close friends, family members, or people you respect and feel comfortable with. If you're still feeling concerned, you should feel free to make an appointment with someone at the Counseling Center:

Counseling and Career Development Center

Forest Drive

P.O. Box 8011

Georgia Southern University

Statesboro, GA 30460-8011

PHONE: (912) 478-5541

FAX: (912) 478-0834

If you have any other questions, concerns, or heard about the study beforehand, please feel free to contact me at db03909@georgiasouthern.edu. Thank you for participating!