Caffeine and Short-term Memory: A Cognitive Enhancer?

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Abstract

It is currently not known whether caffeine consumption improves short-term memory, or acts as a cognitive enhancer. The purpose of the present study will be to examine the affect of caffeine consumption on short-term memory, in the context of a word-recall task. In this experiment participants will be instructed to consume caffeine via a caffeine pill. I predict my findings will suggest that caffeine consumption does improve short-term memory, as measured by word-recall ability.

*Keywords:* caffeine, memory, short-term memory, working memory, cognitive enhancement

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Human’s memory capability is altering. This can especially be noted amongst adolescents and young adults who participate in extended social media use as well as earlier consumption of caffeine stimulants (Temple, 2009). Caffeine consumption in children and adolescents specifically can cause detrimental effects on their health and influence a variety of factors in their life such as causing difficulty in sleeping (Bryant & Gomez, 2015) or recalling information. The rise of social media use has had negative effects on human’s memory (Alloway, Horton, Alloway, & Dawson, 2013), specifically their short-term memory, or somewhat interchangeably their working memory. Working memory has been regarded and defined in three different, slightly different ways: as short-term memory applied to cognitive tasks, as a multi-component system that holds and influences information in short-term memory, and as the use of attention to manage short-term memory.

Short-term memory is processed in the pre-frontal lobe and is than translated into long-term memory in the hippocampus, located in the medial temporal lobe of the brain. Short-term memory is the ability to hold small amounts of information, which are usually easy to retrieve, for short periods. The duration of short-term memory is between 15 and 30 seconds, according to Atkinson and Shiffrin (1971). Miller’s (1956) magic number seven (plus or minus two) provided evidence that suggests that most adult humans can store between 5 and 9 items in their short-term memory at any given time. However, various memory strategies can be utilized to allow someone to increase their short-term memory capacity.

Along with the surplus of social media use, many people now frequently consumes caffeine. Caffeine (a methylxanythine) is one of the most widely consumed psychoactive substances in the world, with coffee generally accounting for the majority of dietary caffeine intake (Nehlig, 1999). However, caffeine also appears as an active ingredient in various other consumables such as teas, chocolates, sodas, and energy drinks. Research suggests that herbal, caffeinated chewing gum is effective in supporting memory (Davidson, 2011). Because of its stimulant properties, caffeine is often consumed in an attempt to enhance performance and combat the detrimental effects of fatigue. The effects of caffeine on learning, memory, performance and coordination are relatively related to the methylxanthine action on arousal, vigilance, and fatigue (Nehlig, 1999). However, although caffeine has consistently been shown to diminish tiredness, increase energy and improve mood, findings regarding its ability to enhance cognitive performance are more complex.

Researchers found further evidence of coffee consumption’s relation to cognitive functioning as seen among older adult women. (Johnson-Kozlow, Kritz-Silverstein, Barrett-Conner, & Morton, 2002). Previous research has suggested that caffeine administration is interrelated to memory enhancement in humans (Borota et al., 2014). The effects of caffeine on word lists were studied and findings from this research suggested that the effects of caffeine were not influenced by the participants’ typical caffeine consumption or verbal ability; the results also suggest that caffeine may impair working memory in females (Erikson et al., 1985). Researchers determined that acute doses of caffeine, the amount typically seen in a cup of coffee, produce stimulating effects and improve performance in light, nondependent caffeine consumers. The researchers’ findings support the idea that the caffeine has psychoactive effects (Childs & Wit, 2006).

Based on a direct comparison of caffeine (200 mg) with napping (60-90 minutes) and a placebo on three distinct memory processes (declarative verbal memory, procedural motor skills, and perceptual learning) experimenters found that caffeine significantly impaired motor learning compared to placebo and naps. These findings provide evidence of the limited benefits for memory improvement compared with napping (Mednick, Cai, Kanady & Drummond, 2008). Herz (1999) conducted a research experiment to assess whether a dosage of psychoactive caffeine would have any effect on memory and mood. Her findings suggested that caffeine does not have a significant effect on memory; however, the caffeine was seen to be useful in manipulating arousal without any explicit interactions on memory performance (Herz, 1999). Similarly, the effects of caffeine on memory and mood were also examined in another study (Loke, 1988). Loke’s research findings also suggested that there was not any significant relations or effects.

In one study examining caffeine’s influence on object recognition and working memory in prepubertal mice, researchers’ findings suggest that acute caffeine injection improves non-spatial working memory retention in only female mice while spatial working memory retention only improves in male mice (Onaolapo & Onaopapo, 2015). Likewise, according to Gulick and Gould’s (2009), which also involves mice, caffeine impairs learning and increases anxiety when administered alone. Findings suggested that caffeine does not reverse ethanol-induced learning deficits, noting that caffeine is frequently consumed concurrent to or immediately following ethanol, commonly found in alcoholic beverages, consumption. In one study regarding the effect of caffeine on working memory in middle-aged males, the researchers’ findings suggested an effect of caffeine on the frontal-parietal network involved in top-down cognitive control of working memory processes during encoding as well as an effect on the prefrontal cortical-thalamic loop involved in the interaction between arousal and the top-down control of attention during memory preservation (Klaassen et al., 2012).

Research has shown that extraverts performing a working memory task benefit more from caffeine than introverts. In one study, researchers presented participants with both 200 mg of caffeine and a placebo in a counterbalanced-order over two separate sessions (Smillie & Gokcen, 2010). Findings revealed that caffeine administration relative to the placebo condition resulted in improved working memory performance, but only for extraverted participants (Smillie & Gokcen, 2010). Similarly, Smith (2013) also describes correlations among caffeine, extraversion, and working memory. The results showed that caffeine interacted with extraversion in the predicted direction for serial recall and running memory tasks. Caffeine improved simple reaction time and the speed of encoding new information, effects which were not modified by extraversion, suggesting possible biological mechanisms underlying effects of caffeine on cognitive performance (Smith, 2013). James (2014) notes the potential challenges and complications that can arise in caffeine studies. He emphasizes the importance of minimizing confounding variables while studying the correlation between caffeine and cognitive performance (James, 2014).

In the current research, therefore, I will compare three groups’ (no treatment group, caffeine group and placebo group) recall abilities in a short-term memory task. The research will be conducted as an experimental design meant to establish if there is a cause and effect relationship between the two variables: short-term memory and caffeine consumption. The present study will investigate the relation of caffeine consumption, and short-term memory capability via the number of words recalled after a 30 second period dependent on the prior treatment provided. I hypothesized that the caffeine group would be significantly more proficient at recalling items from the short-term memory test. If participants consume 200 mg of caffeine prior to a short-term recall task then short-term memory will be at a higher rate than that of a participant who took nothing or received a placebo.

**Method**

**Participants**

Young adult participants (56 men, 69 women, *M*age = 21.5 years, *SD* = 1.53, age range: 18-25) at a four-year, mid-sized liberal arts university located in central Virginia will voluntarily participate in the research. Participants were compensated for their participation in the study and received scholastic credit. Participants will be randomly assigned into one of three groups: the no treatment group (15 men, 22 women, *M*age = 21.5, *SD* = 1.46, age range 19-24), the caffeine group (19 men, 23 women, *M*age = 21, *SD* = 1.61, age range: 18-24), or the placebo group (22 men, 24 women, *M*age = 21.5, *SD* = 1.49 age range: 18-25). Medical history will be gathered prior so as not to include participants who have any memory impairments, attention disorders, allergies or hypersensitivities in the experiment. All participants reviewed and signed consent forms, as well as received ethical treatment. Participants were made aware that they could withdraw from the study at any time without repercussion. The purpose of the research will be explained to the students during debriefing.

**Materials and Procedure**

For my experiment I will use a Hanhart Stopstar 2 digital stopwatches, a sheet of paper with a list of words (see Appendix A), a sheet of paper with spaces to write down the recalled words (see Appendix B), 200-milligram caffeine pills, and placebo pills. Participants who receive the caffeine pill and the placebo pill will not be told what the specific pill was and each participant, regardless of group, will wait 5-minutes before being allowed to start the actual test. The participants will bring their own writing utensils (pens and pencils). Participants will be directed to put away any distracting material and then escorted into a quiet room that will be similar to a traditional college classroom. Participants will be given nothing, a caffeine pill, or a placebo pill before being directed into the testing room. There will be deception used in the experiment, as those who will receive something will simply be told that pill is a supplement meant to regulate mood. Each participant regardless of what they will be given prior will be tested under the same conditions. One seated the experimenter will place the sheet of paper with a list of words (see Appendix A) faced down on the participants desk. The participant will be told that they will have 30 seconds to look over the sheet (see Appendix A). When the participant notifies that they are ready to start they will turn over their sheet of paper (see Appendix A) and the experimenter will start timing the participant via stopwatch.

Once the 30-second time limit is completed the participant will be instructed to turn over memorization word list (see Appendix A) so that it will be in its original position. After collecting the sheet of paper (see Appendix A) the experimenter will present the participant with a sheet of paper with blank spaces (see Appendix B). Participants will then be instructed to write down as many of the items that they can recall from the previous word list (see Appendix A) within a 2-minute period. After the experimenter notes that the designated time period is up the experimenter will ask the participant to turn over the sheet of paper (see Appendix B) and record their age and gender. Participants will be debriefed on the true nature of the experiment and will be asked not to share any information regarding the study until the overall experiment is complete. The experimenter will thank the participants for their assistance and will allow them to leave. Each participant group, based on what they will have or will have not been given prior to the test, will be noted by an additional experimenter who will not be in direct contact with the participants. Data collected from the three groups of participants will be recorded and compared analytically.

**Proposed Analysis and Results**

I will be using a one-way analysis of variance (ANOVA) to analyze my results and determine if there is an overall difference between the groups. I will be using a one-way ANOVA because I will be conducting a between subjects design with one independent variable, caffeine consumption, and three groups: No Treatment Group, Placebo Group, and Caffeine Group. Following my one-way ANOVA I will run a post-hoc test to determine which specific groups differed. I predict that the Caffeine group will recall a greater number of words than the No Treatment group or the Placebo group, and that there will be limited difference between the number of words recalled by the No Treatment group and the Placebo group (see Figure 1). Due to past research and the inclusion of deception in my study, it is suggested that caffeine does have benefits in relation to short-term memory and that even though the placebo group will receive something they will still not be aware that it was meant to test short-term memory capacity.

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*Figure 1.* Average number of words recalled based on caffeine consumption.

Appendix A

Institutional Review Board (IRB) Forms

**LONGWOOD UNIVERSITY**   
**Institutional Review Board**   
**Committee Action Form**

(To Be Completed By Researcher)

Proposal Title:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Principal   
Investigator:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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(For IRB Use Only)

[  ]  Meets the criteria for making research exempt from obtaining written informed consent and Committee review.

[  ]  Approved by the Longwood University Institutional Review Board.

[  ]  Approved with revisions by the Longwood University Institutional Review Board.

[  ]  Rejected by the Longwood University Institutional Review Board.

Date:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Signature of IRB (circle one) Member/Chair:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Comments:

**Longwood University Institutional Review Board**   
**Research Proposal Submission Form**

**I. Proposal**

All Longwood University administration, faculty, and students conducting investigations involving human subjects, and all other researchers conducting investigations involving human subjects at Longwood University, must submit a research proposal to be reviewed and approved by the Human Subject Research Review Committee prior to the commencement of research.  Research involving children should conform to the ethical standards found at <http://www.srcd.org/ethicalstandards.html>. **Some types of human subjects research are exempt from the provisions of state and federal law, however, even research exempt from these provisions must be reviewed by the committee to determine that they are indeed exempt.**  Research proposals submitted to the committee must follow the protocols contained in this form and include the following information.  *Check those that are included*.

[ ]  A description of the research, including:

1) A Title,   
2) The purpose of the research, and   
3) The methods or procedures to be employed including descriptions of:   
    a) The human subjects and the criteria for including them in the research,   
    b) What is to be done with or to them,   
    c) Any possible risks, stress, or requests for information subjects might consider personal or sensitive, or which may be illegal, and whether or not the only risk to the subjects is the harm resulting from a breach of confidentiality,  
    d) the steps that will be taken to ensure the anonymity and confidentiality of the subjects,   
    e) the permissions from other institutions, if required, that will be obtained.

[ ]  A signed, completed copy of this submission form.

In addition, the research proposal may have to include the following documents.  *Check those that are included*.

[ ] A copy of the test, survey, or questionnaire, if employed, and if it is not a standardized professional diagnostic tool otherwise specified in the proposal.

[  ]   A copy of the written statement explaining the research indicating that participation is voluntary, if required. (See III. A. below.)

[ ]  A copy of what will be said to subjects before and after the research is conducted, if the methodology requires that the subjects be misled in any way.  (See III. B.)

[ ] A copy of the informed consent statement that will be used, if required.  (See Sec. IV. below.)  A model informed consent statement can be found at the end of this form.   
    
 **II. Exemptions**

If your research falls into any of the categories of research below, it is exempt from the requirement of obtaining written informed consent and being reviewed by the entire Committee, and only 1 copy of the proposal need be submitted. All others must submit 3 copies of their proposal. If your project conforms to any of the following descriptions, check those which apply:

[ ] Research or student learning outcomes assessments conducted in educational settings involving regular or special education instructional strategies, the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods, or the use of educational tests, whether cognitive, diagnostic, aptitude, or achievement, if the data from such tests are recorded in a manner so that subjects cannot be identified, directly or through identifiers linked to the subjects.

[ ] Research involving survey or interview procedures unless responses are recorded in such a manner that the subjects can be identified, directly or through identifiers linked to the subjects, and either (i) the subject's responses, if they became known outside the research, could reasonably place the subject at risk of criminal or civil liability or be damaging to the subject's financial standing or employability or (ii) the research deals with sensitive aspects of the subject's own behavior, such as sexual behavior, drug or alcohol use, or illegal conduct.

[ ] Research involving survey or interview procedures, when the respondents are elected or appointed public officials or candidates for public office.

[ ] Research involving solely the observation of public behavior, including observation by participants, unless observations are recorded in such a manner that the subjects can be identified, directly or through identifiers linked to the subjects, and either (i) the subject's responses, if they became known outside the research, could reasonably place the subject at risk of criminal or civil liability or be damaging to the subject's financial standing or employability or (ii) the research deals with sensitive aspects of the subject's own behavior, such as sexual behavior, drug or alcohol use, or illegal conduct.

[ ] Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in a manner so that subjects cannot be identified, directly or through identifiers linked to the subjects.

**III. Special Types of Research**

A. In addition to the above types of research that are exempt from the requirement to obtain written informed consent and full committee review, the committee may waive the requirement that the investigator obtain written informed consent for some or all subjects for the following type of research. If your research conforms to the following description, indicate by checking.

[ ] Research in which the only record linking the subject and the research would be the consent document, and the principal risk would be potential harm resulting from a breach of confidentiality.

In the forgoing type of research, the committee may require the investigator to provide the subjects with a written statement explaining the research and indicating that their participation is voluntary. In addition, each subject shall be asked whether s/he wants documentation linking him or her to the research, and the subject’s wishes shall govern. In the case that the subject agrees to be identified in the research, her or his written permission to do so shall be obtained by the researcher.

B. Some research methodologies may require that the subjects be initially misled regarding the purpose of the research, and so require that the consent procedure omit or alter some or all of the basic elements of informed consent, or waive the requirement to obtain informed consent. If your research conforms to the following description, indicate by checking.

[ ] Research involves no more than "minimal risk" or risk of harm not greater than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests, research could not practicably be performed without the omission, alteration or waiver, and the omission, alteration or waiver will not adversely affect the rights and welfare of the subjects.

Inthe forgoing type of research, the committee requires the researcher to provide the subjects with an adequate post-investigative explanation of the purpose and methods of the research, or explanatory debriefing procedure to be undertaken immediately after the conclusion of each subject's participation. The committee requires investigators undertaking this sort of research to furnish the committee with copies of the information that will be supplied to the subject before and after the investigation.

**IV. Written Informed Consent**

    Research engaged in all other types of research must obtain written informed consent from the research subjects. Informed consent means the knowing and voluntary agreement, without undue inducement or any element of force, fraud, deceit, duress, or other form of constraint or coercion, of a person who is capable of exercising free power of choice.

    The basic elements of information necessary to such consent are:

 1. A reasonable and comprehensible explanation to the person of the proposed procedures of protocols to be followed, their purposes, including descriptions of any attendant discomforts, and risks and benefits reasonably to be expected;

 2. A disclosure of any appropriate alternative procedures or therapies that might be advantageous for the person;

 3. An instruction that the person may withdraw his consent and discontinue participation in the human research at any time without prejudice to her or him;

 4. An explanation of any costs or compensation which may accrue to the person and, if applicable, the availability of third party reimbursement for the proposed procedures or protocols; and

 5. An offer to answer and answers to any inquiries by the person concerning the procedures and protocols.

    Informed consent must be obtained in the following manners for the following types of human subjects: (a) competent, then it shall be subscribed to in writing by the person and witnessed; (b) not competent at the time consent is required, then it shall be subscribed to in writing by the person’s legally authorized representative and witnessed; or (c) a minor otherwise capable of rendering informed consent, then it shall be subscribed to in writing by both the minor and her or his legally authorized representative.   
    Legally authorized representative means (a) the parent or parents having custody of a prospective subject, (b) the legal guardian of a prospective subject, or (c) any person or judicial or other body authorized by law or regulation to consent on behalf of a prospective subject to such subject’s participation in the particular human research.   
    Any person authorized by law or regulation to consent on behalf of a prospective subject to such subject’s participation in the particular human research shall include an attorney in fact appointed under a durable power of attorney, to the extent the power grants the authority to make such a decision. The attorney in fact shall not be employed by the person, institution, or agency conducting the human research. No official or employee of the institution or agency conducting or authorizing the research shall be qualified to act as a legally authorized representative.   
    A legally authorized representative may not consent to nontherapeutic research, or research in which there is no reasonable expectation of direct benefit to the physical or mental condition of the human subject, unless it is determined by the human subject research review committee that such research will present no more than a minor increase over minimal risk to the human subject.   
    Notwithstanding consent by a legally authorized representative, no person who is otherwise capable of rendering informed consent shall be forced to participate in any human research.   
    In the case of persons suffering from organic brain diseases causing progressive deterioration of cognition for which there is no known cure or medically accepted treatment, the implementation of experimental courses of therapeutic treatment to which a legally authorized representative has given informed consent shall not constitute the use of force.   
    No informed consent form shall include any language through which the person who is to be the human subject waives or appears to waive any of her or his legal rights, including any release of any individual, institution, or agency or any agents thereof from liability for negligence.   
    Human subject research investigators are responsible for obtaining written informed consent from research subjects in accordance with these specifications, and for obtaining permissions from any other institutions that may be involved in informed consent statement which conforms to these specifications.

    The Longwood University Institutional Review Board must be informed of any violation or alteration of the research protocol.  Continuing research projects must be re-approved annually.

    The undersigned researcher(s) indicate that the information provided to the committee is accurate and true to the best knowledge of the researcher(s), and that the researcher(s) have conformed to the above guidelines to the best abilities of the researcher(s).

Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_  Signed (legibly): \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_  Signed (legibly):\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

If this research is being completed in partial fulfillment of a Masters degree, the thesis committee must approve of your project prior to submission of these forms. The signature(s) of your committee chair/advisor on the appropriate form constitutes acknowledgement of this prior approval by your committee.

Please indicate the address where you would like the approval form sent (along with phone # and/or e-mail address):

Further information of the status of proposals may be found at the following:     
  
          Dr. Eric Laws, Department of Psychology; Phone:  (434)395-2841; e-mail:  lawsel@longwood.edu

<!doctype html public "-//w3c//dtd html 4.0 transitional//en">

**DESCRIPTION OF RESEARCH**

Title of Research: **Caffeine and Short-Term Memory: A Cognitive Enhancer?**

1. Purpose of Research: The goal of this research is **to examine the relationship between caffeine consumption and short-term memory**. The research is being conducted as an **experimental design meant to establish if there is a cause- and- effect relationship between the two variables**, under the supervision of **Dr. Eric Laws**
2. Methods and Procedures:
3. Participants: Participants will be Longwood University students who agree to voluntarily participate in the research. The purpose of the research will be explained to the students and they will be asked to participate with the provision that they are free to withdraw at any time without penalty.
4. Procedures:  **After participants have read the informed consent form and understand the potential risks they will be assigned into three different groups. Medical history will be gathered prior so as not to include participants who have any memory impairments, attention disorders, allergies or hypersensitivities in the experiment. For this experiment short-term memory is being operationally defined as the number of words recalled from a list previously viewed. The first group (the no treatment group) will be shown a sheet of paper with several words listed. The no treatment group will be given asked to wait 5-minutes before being allowed to start the actual task. The no treatment group will then be given 30 seconds to look over the sheet. Once ready they will be given a fill in the blank style sheet of paper and instructed to write down as many of the words they can recall in whatever order. The experimenter will record the number of words correctly recalled along with demographic information. The second group (the caffeine group) will be given a single 200-milligram caffeine pill and given the same instructions as the previous group (the no treatment group). After waiting 5-mintues they will be given the memorization word list and allowed to start the task. All participants regardless of group will be allowed the same amount of time, 30 seconds, to look over the list. The third group (the placebo group) will be given a placebo pill in place of the caffeine pill and then asked to perform the same task under the same instructions. All three groups will have their test scores (the number of words that can be recalled) compared. Following the actual experiment, experimenters will debrief the participants of the true nature of the study.**
5. Possible Risks:  Because of the sensitive nature of the study, it is anticipated that participants may experience some emotional discomfort.  Participants will be informed of the nature of the study ahead of time, they will be told that they are free to participate or not participate, and that they can withdraw from the study at any time without penalty. No physical harm is anticipated. Nor is it anticipated that participation in the research will place the participants at any risk of criminal or civil liability, or damage the participants' financial standing or employability.
6. Assurance of Anonymity and Confidentiality: Participants will be informed of the voluntary and confidential nature of the research via instructions on the data collection instrument. Participants will also be instructed not to put their name or any identifying information on the instrument. When collecting data from participants, the researcher will immediately place the data in a large envelope, and will not examine any of the data until all data have been collected. Once collected, the raw data will only be accessible to **Lindsey Sparrock** **& Dr. Eric Laws**. In the event that any information provided by a participant should become known outside the research, it is unlikely that any harm would come to the participant.

**Longwood University**   
**Consent for Participation in Social and Behavioral Research**

I consent to participate in the research project entitled:

**Written Words: The Effect on Mood**

being conducted in the Department of **Psychology** by

**Lindsey Sparrock**

* I understand that my participation in this research is voluntary, and that I am free to withdraw my consent at any time and to discontinue participation in this project without penalty.
* I acknowledge that the general purpose of this study, the procedures to be followed, and the expected duration of my participation have been explained to me.
* I acknowledge that I have the opportunity to obtain information regarding this research project, and that any questions I have will be answered to my full satisfaction.
* I understand that no information will be presented which will identify me as the subject of this study unless I give my permission in writing.
* I acknowledge that I have read and fully understand this consent form. I sign it freely and voluntarily.  A copy of this form will be given to me.

Name (Print): \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_        Signed: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

I understand that if I have concerns or complaints about my treatment in this study, I am encouraged to contact the Office of Academic Affairs at Longwood University at (434) 395-2010.

**Institutional Review Board, Research Proposal Submission Form**

If this research is being completed in partial fulfillment of a Masters degree, the thesis committee must approve of your project prior to submission of these forms.  The signature(s) of your committee chair/advisor below constitutes acknowledgement of this prior approval by your committee.

Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_ Signed: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_ Signed: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_ Signed: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Appendix B

Memorization Word List

|  |  |  |
| --- | --- | --- |
| Jacket | Elephant | Soccer |
| Beach | Popsicle | Television |
| Tennis | Apple | Stove |
| Yogurt | Butterfly | Laptop |
| Jungle | Sneakers | Orange |
| Grapes | Textbook | Purse |
| Policeman | Kitten | Strawberry |
| Dog | Dress | Bug |
| Purple | Chicken | Cookie |
| Leaf | Keys | Bird |
| Diary | Horse | Flower |
| Owl | Egg | Globe |

Appendix C

Memorization Recall Fill in the Blank

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