

Self-Directed Pedagogy and Visual Learning

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Abstract

It has been shown that interacting with content directly can improve memory for what is being studied (Kane & Anderson, 1978; Markant, DuBrow, Davachi, & Gureckis, 2014). One way that this is possible is through sentence creation. However, it has also been shown that visual depictions of information offer a significant benefit to memory (Yen, Lee, & Chen, 2012; Smith, Hunt, & Dunlap, 2015; Hockley & Bancroft, 2011). The purpose of this study was to examine whether memory effects of self-created content might be more successful when combined with visual learning. Participants utilized one of four different study methods to memorize fifteen **cue-target** pairs of words. It was hypothesized that those creating their own content would have a higher rate of recall than those who were given their study materials, particularly those that created images. However, participant generated sentences resulted in greater recall than participant generated pictures after both the short $t(47) = -9.47, p < .001$, and after long retention intervals $t(47) = -2.56, p = .014$, indicating there might be some sort of performance anxiety leading to recall issues. This could be a form of “art anxiety.”

Back to the Drawing Board: A Study on Self-Directed Pedagogy and Visual Learning

Since the rise of the internet, self-directed study has become more commonplace in a learning setting. Classes often have students teach themselves via the internet, and online courses are fully self-directed. Now that people have access to vast amounts of information, they are teaching themselves. Self-directed study might actually be beneficial to learning, as students are not simply listening, but rather working with the content directly. However, students sometimes have trouble figuring out the best method of teaching themselves (Bjork, Dunlosky, & Kornell, 2013). My study will focus on students creating their own study materials, but will also examine which method produces better memory results- visual learning or verbal learning. This research could change the way students approach their study techniques.

The idea of people creating their own learning materials is not a novel one, students have to read textbook chapters, make flash cards, and do homework on their own time. But this form of study can be greatly beneficial to memory, as people are more likely to remember things they created than they are to remember learning material that is handed to them (Kane & Anderson, 1978; Markant, DuBrow, Davachi, & Gureckis, 2014). For example, Kane and Anderson (1978) conducted an experiment examining levels of processing in which they asked participants to either read a sentence that was complete, or fill in the blank spot in an incomplete sentence. Upon later memory testing, researchers found that the greatest memory retention happened when participants had to make up the end of the sentence, even if they originally guessed incorrectly and had to be given feedback. This was most likely because they had to process the information on a deeper level in order to guess how the sentence would end. They had to compare it to knowledge that they already had, which created more connections for memory. It has also been

suggested that self-directed study can be useful because students can tailor the learning process to meet their own needs (Markant, DuBrow, Davachi, & Gureckis, 2014). Students can set more individualistic goals than if they were in a classroom learning setting going at the pace of the other students. These studies indicate that self-guided learning might be an effective strategy in memory retention.

There are other ways to improve the rate of recall for information. Visual cues can also help retention and overall academic performance (Yen Lee and Chen, 2012). False memories for word lists were shown to decrease when participants were provided with a picture (Smith, Hunt, & Dunlap, 2015). In this study, providing supplemental visual information in the form of pictures helped increase memory, even when compared to those who were provided supplemental information in the form of text. This indicates that it is not simply the activation of the visual cortex that creates a memory boost, but the image of the object itself and the activation of its semantic meaning. More specifically, the Picture Superiority Effect describes the enhanced memory effects that occur when participants study pictures (Hockley & Bancroft, 2011). This is present both in photographs and line drawings, and is potentially caused by faster recognition times of semantic meaning of each item. This indicates that there is potential for drawings to be used as supplemental material for memory.

Drawing is the primary example of visual content that is self-created. Researchers have even studied drawings in the context of memory, and found that drawing does boost memory when compared to writing (Wammes, Meade, & Fernandes, 2016; Jonker, Wammes, & MacLeod 2018). This is because this process of encoding involves multisensory information, which can enhance retention levels. Not only is this taking principles from the Picture

Superiority Effect, but participants must also interact with muscle memory, as well as the conceptualization of what they would like to draw before they even put their pencil to the page. This indicates that drawing could provide a memory boost due to the use of multiple areas of the brain, creating more connections for later recall.

While drawing effects may have been studied in the past, the control conditions focused on writing words out (Jonker, Wammes, & MacLeod 2018; Wammes, Meade, & Fernandes, 2016). No research on drawing currently exists in which students are responsible for generating their own sentences as a comparison to drawing images. The current study will utilize sentence creation as a self-directed verbal study method. Creating sentences involves a much deeper level of processing than simply reading or copying words down (Kane & Anderson, 1978), and this might be more analogous to the memory advantage of drawing images, which uses that multisensory encoding.

On top of this, the current study also involves a comparison between drawing or writing and more standard study methods like being given sentences or images. Even studies on drawing have not examined all four of these study techniques in unison. The present study is also unique because it involves more complex processing of materials. Participants will not simply be drawing or writing each word individually as studies have done in the past, but will be crossing over multiple words into a more integrated memory approach, which mirrors more realistic learning settings.

Overall this study could have implications for what kinds of classroom learning tools create the highest level of memory retention. If students can boost their memory by drawing in their notes, or creating drawings as a method of study, they might show a great improvement in

the classroom. Additionally this could be useful for students that feel as though traditional learning methods do not serve them- students that are neurodivergent or feel left behind in classroom settings.

Methods

Participants

A total of 162 students from a small private university in the Southeastern United States participated in this study. The participants were sampled from the psychology research participation pool. Students received course credit or extra credit in exchange for their time, as determined by their instructor. Those opting not to participate in research were offered an alternate assignment through their instructor. They received two thirds of the credit upon their first attendance for memory acquisition, and the rest of the credit upon return for long term interval testing two weeks later.

The average age of the experimental sample ($n = 105$) was 19.64 ($SD = 3.26$) years. The average GPA of the experimental sample was 3.47 ($SD = .54$), the average amount of sleep the night before the experiment was 6.54 ($SD = 1.70$) hours and the average reported optimal amount of sleep was 7.59 ($SD = 1.67$) hours. The average amount of study time for exams was 4.03 hours ($SD = 3.08$). The sample consisted of a relatively even distribution of class standings. The sample was 75.2% female, 22.9% male, and 1.9% other. Finally, the sample was 75.2% white, 8.6% hispanic, 6.7% black, 4.8% other, 2.9% who selected more than one racial/ethnic category, and 1.9% asian.

Materials

Word List: The present study utilized a word list of fifteen word couplets, for a total of thirty words. All of the words on the list were nouns with two syllables. Additionally, it is difficult to portray abstract concepts through drawings (i.e. dread, tension, collaboration) and doing so would be too subjective. Having abstract words might also lead to confounding variables. In order to ensure every word was tangible and able to be illustrated, the word list was examined using Brysbaert, Warriner, and Kuperman's concreteness ratings (2014). Each word is rated on a scale of one to five with one being the least concrete and five being the most concrete. The concreteness rating for every word included was above a 3.5 (out of 5). This would include words like mailbox, trousers, or flashlight. A complete word list can be found in Appendix B.

In order to reduce confounding effects of memory, the number of direct and indirect associations between all thirty words was kept to a minimum. In order to do this, a word association norming database available through the University of South Florida was used to ensure a minimal amount of associations between words. There were zero direct associations between any of the words on the list. No word cued any other words on the list through either forward or backward (direct) association.

Indirect association is a bit harder to control, but the goal was to keep the number of mediating words to a minimum. Indirect association occurs when both words cue a mutual word (Overlap), or when one word on the list cues something that cues another word on the list (Mediator). Any indirect associations were checked to ensure that all of them were present through overlap, and not as mediators (which would create a stronger association). Overlap

mediators were also checked for association strength, and the strength (from 0.0-1.0) of indirect associations was kept at or below 0.05 (five percent).

Powerpoint presentations: Memory acquisition was presented via powerpoint. This was to ensure that **cue-target** pairs could be randomized to reduce sequence effects of memory. This also ensured that participants would have a set amount of time to study each item and allowed general instructions to be identical across conditions.

Distractor Task: Participants were given a three minute distractor task. This was to control for ceiling effects that are often present in memory experiments. Without a distractor task, memory scores would be relatively high across all conditions, making it difficult to differentiate the performance of each study method. The distractor task is a conceptual shift of attention that took place in the form of six pages of two-by-two multiplication problems. The present study used multiplication problems so that there would not be a confound with visual or verbal learning. There were a total of two hundred and fifty-two problems, and participants were instructed to complete as many of the problems as quickly and as accurately as they can (although participants should not be able to complete all of the questions in the amount of time given). The average number of correct math problems completed on the distractor task was 4.57 problems ($SD = 3.38$).

Memory tests: The short term memory test was also included in the same powerpoint as memory acquisition. This was also randomized to reduce sequence effects of memory. The memory test

powerpoint slides were also on a timer to give a set amount of time of ten seconds per item. The powerpoint slide included the **cue**, and a blank where the target was supposed to be. Participants were given a written test and instructed to write down the **cue**, followed by the target. When the slide changed there was an auditory cue to alert participants that were busy writing, so that they would be aware that their time was up.

The same test was given at the two week interval for a long term retention test. These slides were also on a timer and also randomized to reduce sequence effects.

Demographics Survey: In order to fully examine data, a series of questions were distributed with the short term retention test. This included questions that could explain why certain results were found, and help determine if there were any confounds in the study (such as the amount of sleep each participant got the previous night).

Design and Procedures

This study formed a 2x2x2 mixed factorial design with content type (visual, verbal) and study method (experimenter generated, participant generated) as the between subjects factors, and test of memory (short retention interval, long retention interval) as the repeated measure and dependent variable.

Norming Conditions: In order to ensure that participants would have enough time to process each pair of words and follow the instructions they were given, two norming conditions were run to evaluate an appropriate amount of time to give for each pair. One norming condition was

created to establish how much time students would need to write a sentence connecting the two words. The other norming condition was created to establish how much time students would need to draw a picture connecting the two words. These memory tools were generated in a packet of fifteen half sheets of paper. Since the participants were only present to establish an amount of time to give other conditions, they were not given either memory test, and participation generally took less than twenty minutes.

There were 25 participants in the norming condition for images. They sat at individual computers in a computer lab, and were given the following instructions:

You are in the phase of the study where we are trying to determine how long, on average, it takes people to create an image that illustrates a meaningful connection between two words. I will show you two words on the screen and your task will be to draw a picture that meaningfully connects the two words.

There were 28 participants in the norming condition for sentences. They sat at individual computers in a computer lab, and were given the following instructions:

You are in the phase of the study where we are trying to determine how long, on average, it takes people to create sentences that illustrate a meaningful connection between two words. I will show you two words on the screen and your task will be to write down a sentence that meaningfully connects the two words.

Researchers timed how long it took each participant to complete the word list, and each participant was able to flip through the slides at their own pace. Each participant's individual time score was written on the back of their packet, and later averaged together. In order to ensure

that all participants had enough time to create materials, researchers decided to default to the longer average found for the drawing condition, and it was rounded down to sixty seconds per item.

Participants that took part in the actual study were run in batches in a classroom setting. The largest number of participants generally allowed in each time slot was 15, but there were a few batches of close to 40 students. All instructions were also read aloud.

Instructions and powerpoints were put up on the projector, and a small speaker was used to ensure that participants could hear the auditory cue. The title slide of the presentation instructed participants to,

“Please have a seat, the researcher will begin the study shortly.”

Once all of the scheduled participants arrive, or five minutes after the scheduled start time (whichever came first), participants were instructed:

*“You are going to study a fairly long list of **cue**-target pairs. Each of these **cue**-target pairs will be presented one at a time on a single slide. Your task will be to read each **cue**-target pair as it appears at the top of the slide, and then study that pair via the instructions provided on the next slide. The **cue** will appear in bold print on the left and the target will appear in italics on the right, for example, [**data**-saltine]. Following the study phase, you will be given the **cue** and asked to produce the target word. You will have a limited time to study each **cue**-target pair. The slide will change every sixty seconds. If you consent to participate in this study, please sign the informed consent form*

The informed consent can be found in Appendix A. The general instructions and a complete word list can be found in Appendix B. After everyone had signed their informed consent and any questions were answered, participants were read their specific study instructions.

Participants were randomly assigned to one of five conditions (1. Verbal -sentences/Experimenter-generated content, 2. Visual -pictures/ Experimenter-generated content, 3. Verbal -sentences/ Participant-generated content, 4. Visual -pictures/ Participant-generated content, 5. Control group). Prior to arriving to the study, batches of participants were randomly assigned to a condition. There was one **cue**-target pair per slide, with any supplementary experimenter generated content appearing directly below the pairing on the slide.

The verbal sentences/ experimenter-given condition contained sentences on each slide connecting each **cue**-target pair. See Appendix C for specific study instructions and the sentences participants received. The **cue** appeared in the sentence before the target, to reduce confounding memory effects.

The visual-pictures/experimenter-given condition contained line drawings produced by the researcher on each slide that connect icons of each **cue**-target pair. See Appendix D for specific study instructions and the drawings participants received.

The verbal-pictures/participant-generated condition received packets of half sheets of blank paper in which participants were instructed to form their own sentence connecting each **cue**-target pair. Specific study instructions for this condition can be found in Appendix E.

The visual-pictures/participant-generated will also receive a packet of half sheets of blank paper in which participants will be instructed to create their own drawing connecting the words

in the **cue-target** pairs. Specific study instructions can be found in Appendix F.

A final control condition was added for a comparison in data analysis. These participants only received general instructions and the powerpoint of the word list. They did not receive or create any supplementary materials, their instructions were to simply memorize each cue-target pair.

The following slide indicated when participants had finished studying the **cue-target** pairs:

*“You have finished studying the **cue-target** pairs”*

Before taking a memory test, participants were given a distractor task, which can be found in Appendix G. Participants had three minutes to complete as many multiplication problems as possible, and they were not expected to finish. The following slide was read aloud as instructions to the distractor task:

“Before we test your memory, we need to assess your processing speed. Please complete as many of these multiplication problems as quickly and as accurately as you can. When you hear the auditory cue, please stop and set aside this packet.”

The slide that follows will be a slide with a set duration of three minutes, and will

“Assessment of Processing Speed”

After the three minutes are up, an auditory cue will play, indicating that their time is up. The slideshow will transition to a slide that states,

“You have finished the assessment of processing speed.”

Immediately following this distractor task will be the short term retention test, which can be found in Appendix H. The instructions will read:

*“We will now assess your memory of the targets you studied in the study phase of the experiment. You will see **cues** on the screen and your job will be to write down the **cue** in the first blank, and then, in the second blank, you will write down the target that went with that **cue**. If you cannot remember the target, then make your best guess. You will have ten seconds to write down the **cue** and the target. You will hear a beep when time is up, prompting you to move on to the next **cue**.”*

Upon completion of the test, the next slide will have the following instructions for the demographics questionnaire, which can be found in Appendix I

“We will now collect some demographics information, which can be found attached to your memory test.”

Once participants finish filling out these packets, participants will see the following slide, which will be read aloud. After this slide, participants were allowed to leave, and reminded of the date of their two-week follow-up.

*“Congratulations, you have completed the first part of the study! You will need to return to complete the second half of the study, at which time we will debrief you. Thank you for your time, and we look forward to seeing you again soon. **Please do not share any information about this experiment with anyone. Telling others about what happened in this study will ruin collection of further data.**”*

Two weeks later, participants will return for a long term retention test (Appendix J). This test will be identical to the previous one, showing only the **cue** for the **cue-target** pairs in a Powerpoint presentation in randomized order. Participants will be given ten seconds per pairing on both the short and long term retention tests. The powerpoint slide will read as follows,

*We will now assess your memory of the **cue**-target pairs you studied in the study phase of the experiment two weeks ago. You will see **cues** on the screen and your job will be to write down the **cue** in the first blank, and then, in the second blank, you will write down the target that went with that **cue**. If you cannot remember the target, then make your best guess. You will have ten seconds to write down the **cue** and the target. You will hear a beep when time is up, prompting you to move on to the next **cue**.*

After the long term retention test is finished, participants will be debriefed (Appendix K). It will read as follows,

Thank you so much for your participation in this experiment. Your data will help us to explore how different kinds of study methods can help memory. Some of you received instructions to read a sentence or examine an image, while others wrote their own sentences or drew their own images.”

Please do not share any information about this experiment with anyone. Telling others about what happened in this study will ruin collection of further data.

Thank you again for your help with this experiment, and have a great day.”

Analysis and Results

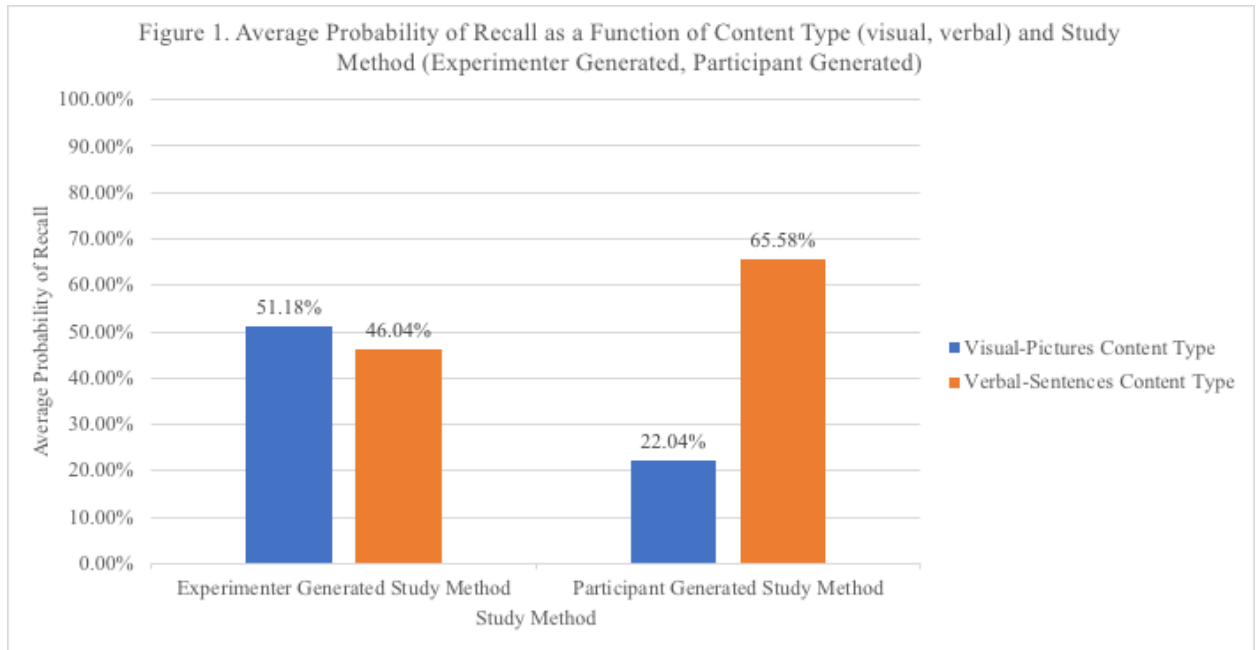
A 3 x 3 x 2 mixed factorial ANOVA was conducted with content type (visual, verbal, control) and study method (experimenter generated, participant generated, control) as the

between subjects factors, and test of memory (short retention interval, long retention interval) as the repeated measure and dependent variable.

There was a significant main effect of content type (visual, verbal, control) on probability of recall, $F(1, 100) = 15.14, p < .001, \eta_p^2 = .13$. Overall (collapsed across retention interval) participants in the verbal-sentences condition ($M = 56.95, SD = 15.48$) recalled significantly more than those in the visual-pictures condition ($M = 36.19, SD = 28.99$), $t(80) = -4.18, p < .001, d = .89$, and those in the control condition, ($M = 44.78, SD = 21.65$), $t(68) = 2.7, p = .009, d = 0.65$. However, those in the visual - pictures condition did not recall significantly more ($M = 36.19, SD = 28.99$) compared to those in the control condition ($M = 44.78, SD = 21.65$), $t(56) = -1.22, p = .23, d = -0.34$. There was no significant effect of study method (experimenter generated, participant generated, control) on probability of recall, $F(1, 100) = 1.92, p = .17, \eta_p^2 = .019$. Overall, there was no significant difference in recall scores between participants in the control condition ($M = 44.78, SD = 21.65$), the experimenter generated condition ($M = 48.69, SD = 17.30$), and the participant generated condition ($M = 47.69, SD = 28.38$), $ps > .46, d = 0.04$.

The interaction between content type (visual, verbal) and study method (experimenter given, participant given) was significant, $F(1, 100) = 25.20, p < .001, \eta_p^2 = .20$, indicating that the main effect of content type depended on whether the content was experimenter generated or participant generated (see Figure 1). For participants in the experimenter generated study method, there was no significant memory advantage for either content type: memory in the verbal-sentences condition ($M = 46.04, SD = 15.21$) did not differ significantly from visual-picture condition ($M = 51.18, SD = 19.18$), $t(31) = 0.85, p = .40, d = -0.3$. However, for participants in the participant generated study method, there was significant memory advantage

verbal-sentences condition ($M = 51.18$, $SD = 19.18$) over the visual-picture condition ($M = 46.04$, $SD = 15.21$), $t(31) = 0.85$, $p = .40$, $d = 0.3$.



There was a significant main effect of retention interval (short, long) on probability of recall, $F(1, 100) = 444.71$, $p < .001$, $\eta_p^2 = .82$. Participants recalled significantly more after the short-retention interval ($M = 72.00$, $SD = 32.96$) compared to after the long retention interval ($M = 22.73$, $SD = 20.31$). However, as shown in Figure 2, the main effect of retention interval was qualified by a significant three-way interaction between retention interval, content type, and study method, $F(1, 100) = 17.69$, $p < .001$, $\eta_p^2 = .15$. Specifically planned pairwise comparison (paired-samples t-tests) revealed that regardless of content type and study method, participants recalled more after the short retention interval than after the long retention interval. In other words, recall dropped significantly between the short and long retention interval in all of the content type by study method conditions, $ps < .01$.

Additional planned pairwise comparisons (independent samples t-tests) between experimenter generated and participant generated study methods revealed that experimenter generated visual-pictures resulted in greater recall ($M = 76.47$, $SD = 26.36$) than participant generated visual pictures ($M = 30.00$, $SD = 35.81$) after the short retention interval, $t(33) = 4.35$, $p < .001$, $d = 1.47$ but not after the long retention interval (Experimenter-visual: $M = 25.88$, $SD = 17.14$ vs. Participant-visual: $M = 14.07$, $SD = 25.66$), $t(33) = 1.59$, $p = .12$, $d = 0.54$. However participant generated verbal-sentences resulted in greater recall than experimenter generated verbal-sentences after both the short (Experimenter-verbal: $M = 73.75$, $SD = 24.88$ vs. Participant-verbal: $M = 94.40$, $SD = 9.90$), $t(45) = -4.071$, $p < .001$, $d = -1.09$, and after long retention intervals (Experimenter-verbal: $M = 18.33$, $SD = 13.00$ vs. Participant-verbal: $M = 30.75$, $SD = 19.68$), $t(45) = -2.275$, $p = .028$, $d = -0.74$. Additional planned pairwise comparisons (independent samples t-tests) between visual-pictures and verbal-sentences content types revealed that experimenter generated visual-pictures did not result in greater recall ($M = 76.47$, $SD = 26.36$) than experimenter generated verbal-sentences ($M = 73.75$, $SD = 24.88$) after either the short retention interval, $t(31) = 0.304$, $p = .76$, $d = 0.11$ or after the long retention interval (Experimenter-visual: $M = 25.88$, $SD = 17.14$ vs. Experimenter-verbal: $M = 18.33$, $SD = 13.00$), $t(31) = 1.42$, $p = .17$, $d = 0.50$. However participant generated verbal-sentences resulted in greater recall than participant generated visual-pictures after both the short (Participant-verbal: $M = 94.41$, $SD = 9.90$ vs. Participant-visual: $M = 30.00$, $SD = 35.81$), $t(47) = -9.47$, $p < .001$, $d = 2.45$ and after long retention intervals (Participant-verbal: $M = 30.75$, $SD = 19.68$ vs. Participant-visual: $M = 14.07$, $SD = 25.66$), $t(47) = -2.56$, $p = .014$, $d = 0.73$.

Discussion

First and foremost, this study was not run in the way it was intended to be upon its design. Instead of students sitting at a single computer, the study consisted of groups of students in a classroom setting. The word list and instructions were shown through the same powerpoints, but it had to be put up on the projector screen for students to study, instead of using individual computers in a computer lab. This was due to computer lab problems throughout the semester, and might create a different memory effect. There are a few problems with the switch away from individual computers. The auditory cue might vary in volume depending on the participants' distance from the speaker, and those seated in the back might not be able to see the screen as well. There is also a higher chance of participants being distracted by noise from other events or classrooms. A few sorority events were going on in the building next door at the start of data collection, and sometimes the cheering could be a distraction to participants.

One of the unanticipated confounds in the results was the use of the word “drawer.” Unfortunately some students perceived the word “drawer” as a noun representing an artist, someone who draws, a “draw-er.” In reality, this word was intended as drawer, as in a desk drawer. Several participants, both in the norming data and in the study, interpreted the word this way. “Draw-er” would have a direct association to another word on the list, “painting.” This definitely could have influenced the rate of recall for both words, even though those words were not paired together.

“Lumber,” “Lighter,” and “Nickel” also have multiple meanings, and even though they were intended and, for the most part, interpreted as nouns, they might have been interpreted differently. For example, lumber means both wood and to move in a slow, awkward, heavy way.

No one conflated the two meanings of the word, but it still might have an influence on rate of recall. Lighter can be a device used to start a fire, or an adjective, as if something were lighter in hue. The word “lighter” was also paired with the word “toothpaste,” and some participants might have had a higher rate of recall for this word, since toothpaste can make your teeth lighter.

With any word list, there will inevitably be some level of unpredictable association, since many words are associated indirectly with just a few degrees of separation. Sometimes words can be associated with each other through outside influences that are beyond the scope of researcher control. For example, the words “hammer” and “baby” are associated in a pop culture reference (McElroy, Griffin & McElroy, Justin, 2015). The youtube gamers are doing a silly playthrough of a popular video game, *Fallout 4*, and create a character called “Ultimate Pam.” In the game, players can tour the house and see that there is a baby in the house. The McElroy brothers continue to browse the house in their playthrough, and when there is a hammer on screen, one of them makes a joke saying “Hammer fix the baby...” While this joke may seem like an esoteric reference, the youtube video has over three million hits. If someone plays video games or follows youtube accounts like the McElroy brothers, they might have already had a stronger association between these two words, or remember this reference as a memory tool, leading to a higher rate of recall for the **cue-target** pair, “**hammer-baby**.” There could be countless other examples of memory confounds brought on by pop culture, or associations outside of the scope of control that researchers have.

Participants in the condition that drew their own study images had a very wide range of memory scores, and performed significantly worse than those in other conditions, going directly against the hypotheses for the group. All of the data in the literature review suggested that

drawings would offer a memory benefit. When administering this time slot, I had participants ask me what they should do if they cannot draw, and they were instructed to try their best. It seemed as though a lot of participants were nervous to have their art skills judged and assessed.

This seems comparable to the phenomena of math anxiety, in the sense that students feel as though they are being judged for lacking certain skills, and this increases anxiety. This might explain why so many participants performed poorly on the memory test in that condition. If they were experiencing a form of art-related performance anxiety, they might have had a decrease in attention to the word list, as well as a decrease in memory scores. This could be an interesting area for further research- examining whether asking people to create art induces a similar form of anxiety to math anxiety.

This art anxiety effect might have been intensified due to the fact that participants were explicitly told that they would have to recall the words in some form of memory test. Additionally, if the participants had any form of math anxiety (on the distractor task), having this compounded with art anxiety might have led to an anxiety level that reduced memory scores by such a strong amount. Further research could explore what conditions induce artistic anxiety- whether or not simultaneously inducing math anxiety would bolster this effect, how instructing participants differently might negate this effect, and whether this effect carries over into real world situations and not just a laboratory setting. It would be interesting to examine the studies that other researchers have conducted, to see what conditions their participants were under when creating drawings, and what might have led to art anxiety in this study but not in others' studies.

Overall, there were some unexpected results in this research study. Participants actually struggled immensely in the condition that was predicted to have the highest level of success and

memory. While these results were unexpected, they are also extremely compelling and prompt further investigation of performance anxiety and what kinds of subjects are susceptible to these anxieties- such as art and math.

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Appendix A: Letter of Informed Consent

Informed Consent to Participate in Undergraduate Research Information to Consider before Taking Part in the Research Study

Project Title: Visual Learning and Self-Directed Content

Project Investigators: Chloe Kindell

Faculty Advisors: Dr. Leilani Goodmon

PURPOSE OF THE STUDY: You are being asked to participate in this research study because this information can help us better understand how different forms of study can enhance learning.

STUDY PROCEDURES: As part of this study, you will be asked to examine a slideshow of word pairs and study them as instructed. You will then complete an assessment of processing speed. Finally you will be given a short examination of the materials you were asked to study. In two weeks upon your return, you will receive another short examination of the materials.

RISKS AND DISCOMFORTS: There are no more risks than those involved in everyday activities.

POTENTIAL BENEFITS: You will receive credit towards your grade for a course as determined by your course instructor. You will not directly benefit from participating in this study, however the results may help researchers better understand cognitive abilities.

CONSENT: By signing this consent form, you agree that you understand the procedures and any risks and benefits involved in this research.

CONFIDENTIALITY: As far as confidentiality for your participation, participant data will be assigned a number code and will be kept in a locked cabinet. No records will be kept with participant's name on them, except for the informed consent form that will be stored in the lock cabinet separate from the data. The obtained information will be kept for 5 years and will be shredded at that time. However, certain people may need to see the study records (including IRB officials). By law, anyone who looks at the data records must keep them completely confidential. Otherwise, no one will have access to these records.

VOLUNTARY PARTICIPATION / WITHDRAWAL: Your participation is completely voluntary and you are free to refuse to participate or to withdraw your consent to participate in this research at any time without penalty or prejudice.

Questions, concerns, or complaints: If you have any questions, concerns or complaints about this study, contact Dr. Leilani Goodmon, at lgoodmonriley@flsouthern.edu.

Consent to Take Part in this Research Study

It is up to you to decide whether you want to take part in this study. If you want to take part, please sign the form, if the following statements are true.

I freely give my consent to take part in this study. I understand that by signing this form I am agreeing to take part in research.

Signature of person taking part in survey

Date

Printed name of person taking part in survey

Instructor (Date/Time of class)

Appendix B: General Instructions and Complete Word List

The following paragraph will be at the beginning of the slides for all conditions. These are instructions that every participant will receive.

You are going to study a fairly long list of **cue**-*target* pairs. Each of these **cue**-*target* pairs will be presented one at a time on a single slide. Your task will be to read each **cue**-*target* pair as it appears at the top of the slide, and then study that pair via the instructions provided on the next slide. The **cue** will appear in bold print on the left and the *target* will appear in italics on the right, for example, [**data**-*saltine*]. Following the study phase, you will be given the **cue** and asked to produce the *target* word. You will have a limited time to study each **cue**-*target* pair. The slide will change every sixty seconds.

The following is an inclusive list of every **cue**-*target* pair that participants will be expected to memorize. These **cue**-*target* pairs will appear in random order for every participant, which will reduce sequence effects on memory.

1. **reindeer**-*trousers*
2. **doctor**-*island*
3. **nickel**-*hornet*
4. **mailbox**-*cobweb*
5. **coffee**-*earring*
6. **dustpan**- *mushroom*
7. **shoelace**-*blanket*
8. **elbow**-*painting*
9. **hammer**-*baby*
10. **scarecrow**-*dartboard*
11. **flashlight**-*lumber*
12. **donkey**-*notebook*
13. **toaster**-*window*

14. **toothpaste-** lighter

15. **army-**drawer

Appendix C: Materials for Participants in the Researcher-Given Verbal Condition

General Instructions

You are going to study a fairly long list of **cue**-*target* pairs. Each of these **cue**-*target* pairs will be presented one at a time on a single slide. Your task will be to read each **cue**-*target* pair as it appears at the top of the slide, and then study that pair via the instructions provided on the next slide. The **cue** will appear in bold print on the left and the *target* will appear in italics on the right, for example, [**data**-*saltine*]. Following the study phase, you will be given the **cue** and asked to produce the *target* word. You will have a limited time to study each **cue**-*target* pair. The slide will change every sixty seconds.

Experimenter-Given Sentence Instructions

You will study each pair by studying a sentence that contains the **cue** and *target*. This sentence will appear directly below the **cue**-*target* pair on the screen. The sentence will be available for you to study for sixty seconds. After the specified amount of study time, you will hear an auditory cue and you will see the next **cue**-*target* pair and study sentence.

Sentences Given to Participants:

1. **reindeer**-*trousers*

The **reindeer** stood on his hind legs and pulled on his *trousers*.

2. **doctor**-*island*

The top of the **doctor**'s balding head resembled a deserted *island*.

3. **nickel**-*hornet*

The **nickel** appeared to be too heavy to be carried by a *hornet*.

4. **mailbox**-*cobweb*

The **mailbox** stuck to the *cobweb* was filled with letters.

5. **coffee**-*earring*

It would be fun if **coffee** cups could wear earrings.

6. **dustpan**- mushroom

My **dustpan** was so dirty it had mushrooms growing in it.

7. **shoelace**-blanket

The **shoelace** poked out from under the blanket.

8. **elbow**-painting

The **elbow** was a great subject for a painting.

9. **hammer**-baby

Each **hammer** starts off as just a baby.

10. **scarecrow**-dartboard

The **scarecrow** had a dartboard in the center of its chest.

11. **flashlight**-lumber

The **flashlight** sat atop the pile of lumber, shedding light into the dark.

12. **donkey**-notebook

The **donkey** ate the notebook in just a few bites.

13. **toaster**-window

The **toaster** had a window sticking out of its slot.

14. **toothpaste**- lighter

My **toothpaste** tube flips open to reveal a secret lighter.

15. **army**-drawer

The **army** man's head stuck out of my small drawer.

Appendix D: Materials for Participants in the Researcher-Given Visual Condition

General Instructions:

You are going to study a fairly long list of **cue**-target pairs. Each of these **cue**-target pairs will be presented one at a time on a single slide. Your task will be to read each **cue**-target pair as it appears at the top of the slide, and then study that pair via the instructions provided on the next slide. The **cue** will appear in bold print on the left and the target will appear in italics on the right, for example, [**data**-saltine]. Following the study phase, you will be given the **cue** and asked to produce the target word. You will have a limited time to study each cue-target pair. The slide will change every sixty seconds.

Experimenter-Given Image Instructions:

You will study each pair by studying a drawing that contains images of the **cue** and target. This drawing will appear directly below the **cue**-target pair on the screen. The drawing will be available for you to study for sixty seconds. After the specified amount of study time, you will hear an auditory cue and you will see the next **cue**-target pair and study drawing.

Drawings Given to Participants:

1. reindeer-trousers



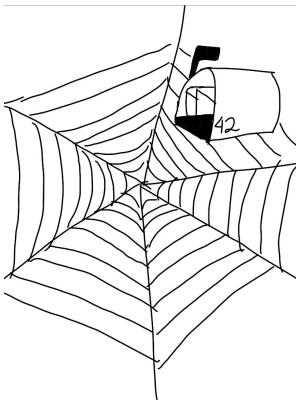
2. **doctor-island**



3. **nickel-hornet**



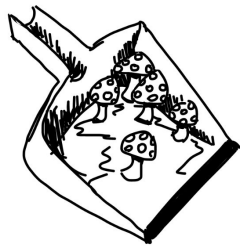
4. **mailbox-cobweb**



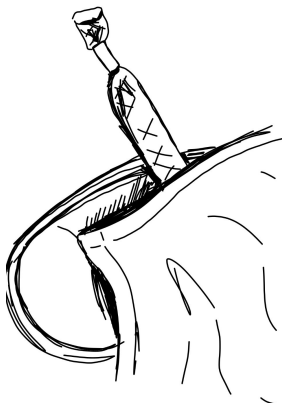
5. **coffee-**earring



6. **dustpan-**mushroom



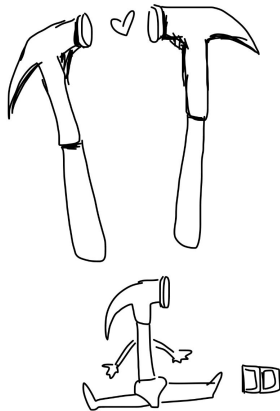
7. **shoelace-**blanket



8. elbow-painting



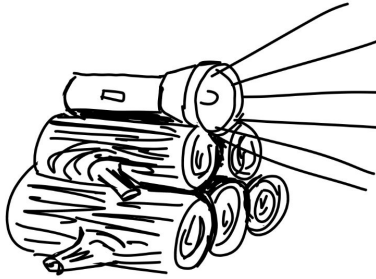
9. hammer-baby



10. scarecrow-dartboard



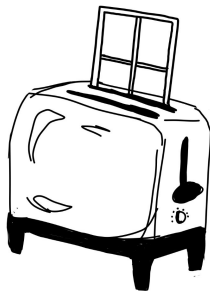
11. **flashlight-**lumber

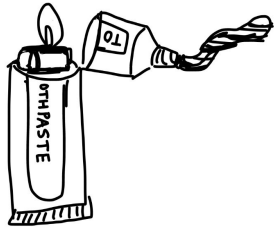


12. **donkey-**notebook



13. **toaster-**window



14. toothpaste- lighter**15. army-drawer**

Appendix E: Materials for Participants in the Participant-Generated Verbal Condition

General Instructions:

You are going to study a fairly long list of **cue**-*target* pairs. Each of these **cue**-*target* pairs will be presented one at a time on a single slide. Your task will be to read each **cue**-*target* pair as it appears at the top of the slide, and then study that pair via the instructions provided on the next slide. The **cue** will appear in bold print on the left and the *target* will appear in italics on the right, for example, [**data**-*saltine*]. Following the study phase, you will be given the **cue** and asked to produce the *target* word. You will have a limited time to study each cue-*target* pair. The slide will change every sixty seconds.

Participant-Generated Sentence Instructions:

You will study each pair by generating a sentence that contains the **cue** and *target*. You will write each sentence in a booklet provided for you next to the keyboard. You will have sixty seconds to generate each sentence. After the specified amount of study time, you will hear an auditory cue prompting you to flip to the next page of the booklet, and then you will generate a sentence for the next **cue**-*target* pair that you see on screen.

Appendix E: Materials for Participants in the Participant-Generated Visual Condition

General Instructions:

You are going to study a fairly long list of **cue**-*target* pairs. Each of these **cue**-*target* pairs will be presented one at a time on a single slide. Your task will be to read each **cue**-*target* pair as it appears at the top of the slide, and then study that pair via the instructions provided on the next slide. The **cue** will appear in bold print on the left and the *target* will appear in italics on the right, for example, [**data**-*saltine*]. Following the study phase, you will be given the **cue** and asked to produce the *target* word. You will have a limited time to study each **cue**-*target* pair. The slide will change every sixty seconds.

Participant-Generated Drawing Instructions:

You will study each pair by generating a picture that contains the **cue** and *target*. You will draw each image in a booklet provided for you next to the keyboard. You will have sixty seconds to generate each drawing. After the specified amount of study time, you will hear an auditory cue prompting you to flip to the next page of the booklet, and then you will generate a drawing for the next **cue**-*target* pair that you see on screen.

Appendix G: Distractor Task/ “Assessment of Processing Speed”*

*the title of this document was originally included in the header, but could not be included due to formatting. This has shifted around the rows of multiplication tables

Before we test your memory, we need to assess your processing speed. Please complete as many of these multiplication problems as quickly and as accurately as you can. When you hear the auditory cue, please stop and set aside this packet.

24	78	36	46	75	65
<u>x 29</u>	<u>x 57</u>	<u>x 56</u>	<u>x 20</u>	<u>x 98</u>	<u>x 80</u>

51	47	33	39	28	63
<u>x 25</u>	<u>x 88</u>	<u>x 63</u>	<u>x 49</u>	<u>x 77</u>	<u>x 86</u>

79	25	36	93	34	48
<u>x 29</u>	<u>x 26</u>	<u>x 52</u>	<u>x 21</u>	<u>x 56</u>	<u>x 45</u>

20	48	43	54	94	61
<u>x 73</u>	<u>x 13</u>	<u>x 84</u>	<u>x 43</u>	<u>x 34</u>	<u>x 25</u>

19	69	55	85	63	77
<u>x 71</u>	<u>x 90</u>	<u>x 17</u>	<u>x 23</u>	<u>x 89</u>	<u>x 16</u>

53	51	95	46	32	71
<u>x 75</u>	<u>x 81</u>	<u>x 64</u>	<u>x 11</u>	<u>x 44</u>	<u>x 48</u>

$$\begin{array}{r} 39 \\ \times 50 \\ \hline \end{array}$$

$$\begin{array}{r} 46 \\ \times 68 \\ \hline \end{array}$$

$$\begin{array}{r} 63 \\ \times 13 \\ \hline \end{array}$$

$$\begin{array}{r} 72 \\ \times 40 \\ \hline \end{array}$$

$$\begin{array}{r} 54 \\ \times 62 \\ \hline \end{array}$$

$$\begin{array}{r} 27 \\ \times 79 \\ \hline \end{array}$$

$$\begin{array}{r} 77 \\ \times 59 \\ \hline \end{array}$$

$$\begin{array}{r} 84 \\ \times 32 \\ \hline \end{array}$$

$$\begin{array}{r} 91 \\ \times 55 \\ \hline \end{array}$$

$$\begin{array}{r} 16 \\ \times 88 \\ \hline \end{array}$$

$$\begin{array}{r} 87 \\ \times 74 \\ \hline \end{array}$$

$$\begin{array}{r} 66 \\ \times 12 \\ \hline \end{array}$$

$$\begin{array}{r} 72 \\ \times 31 \\ \hline \end{array}$$

$$\begin{array}{r} 91 \\ \times 57 \\ \hline \end{array}$$

$$\begin{array}{r} 30 \\ \times 13 \\ \hline \end{array}$$

$$\begin{array}{r} 26 \\ \times 55 \\ \hline \end{array}$$

$$\begin{array}{r} 76 \\ \times 24 \\ \hline \end{array}$$

$$\begin{array}{r} 62 \\ \times 77 \\ \hline \end{array}$$

$$\begin{array}{r} 82 \\ \times 87 \\ \hline \end{array}$$

$$\begin{array}{r} 44 \\ \times 53 \\ \hline \end{array}$$

$$\begin{array}{r} 24 \\ \times 62 \\ \hline \end{array}$$

$$\begin{array}{r} 22 \\ \times 21 \\ \hline \end{array}$$

$$\begin{array}{r} 16 \\ \times 87 \\ \hline \end{array}$$

$$\begin{array}{r} 32 \\ \times 26 \\ \hline \end{array}$$

$$\begin{array}{r} 39 \\ \times 21 \\ \hline \end{array}$$

$$\begin{array}{r} 69 \\ \times 16 \\ \hline \end{array}$$

$$\begin{array}{r} 40 \\ \times 22 \\ \hline \end{array}$$

$$\begin{array}{r} 89 \\ \times 52 \\ \hline \end{array}$$

$$\begin{array}{r} 56 \\ \times 38 \\ \hline \end{array}$$

$$\begin{array}{r} 39 \\ \times 14 \\ \hline \end{array}$$

$$\begin{array}{r} 14 \\ \times 88 \\ \hline \end{array}$$

$$\begin{array}{r} 24 \\ \times 78 \\ \hline \end{array}$$

$$\begin{array}{r} 95 \\ \times 64 \\ \hline \end{array}$$

$$\begin{array}{r} 84 \\ \times 94 \\ \hline \end{array}$$

$$\begin{array}{r} 59 \\ \times 75 \\ \hline \end{array}$$

$$\begin{array}{r} 37 \\ \times 40 \\ \hline \end{array}$$

$$\begin{array}{r} 11 \\ \times 92 \\ \hline \end{array}$$

$$\begin{array}{r} 71 \\ \times 77 \\ \hline \end{array}$$

$$\begin{array}{r} 22 \\ \times 17 \\ \hline \end{array}$$

$$\begin{array}{r} 67 \\ \times 91 \\ \hline \end{array}$$

$$\begin{array}{r} 25 \\ \times 39 \\ \hline \end{array}$$

$$\begin{array}{r} 57 \\ \times 32 \\ \hline \end{array}$$

$$\begin{array}{r} 63 \\ \times 64 \\ \hline \end{array}$$

$$\begin{array}{r} 27 \\ \times 71 \\ \hline \end{array}$$

$$\begin{array}{r} 89 \\ \times 43 \\ \hline \end{array}$$

$$\begin{array}{r} 86 \\ \times 23 \\ \hline \end{array}$$

$$\begin{array}{r} 19 \\ \times 48 \\ \hline \end{array}$$

$$\begin{array}{r} 41 \\ \times 58 \\ \hline \end{array}$$

$$\begin{array}{r} 88 \\ \times 18 \\ \hline \end{array}$$

$$\begin{array}{r} 21 \\ \times 31 \\ \hline \end{array}$$

$$\begin{array}{r} 76 \\ \times 30 \\ \hline \end{array}$$

$$\begin{array}{r} 95 \\ \times 52 \\ \hline \end{array}$$

$$\begin{array}{r} 85 \\ \times 48 \\ \hline \end{array}$$

$$\begin{array}{r} 35 \\ \times 65 \\ \hline \end{array}$$

$$\begin{array}{r} 34 \\ \times 76 \\ \hline \end{array}$$

$$\begin{array}{r} 95 \\ \times 25 \\ \hline \end{array}$$

$$\begin{array}{r} 62 \\ \times 98 \\ \hline \end{array}$$

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$$\begin{array}{r} 63 \\ \times 49 \\ \hline \end{array}$$

$$\begin{array}{r} 97 \\ \times 72 \\ \hline \end{array}$$

$$\begin{array}{r} 16 \\ \times 52 \\ \hline \end{array}$$

$$\begin{array}{r} 78 \\ \times 51 \\ \hline \end{array}$$

$$\begin{array}{r} 59 \\ \times 66 \\ \hline \end{array}$$

$$\begin{array}{r} 49 \\ \times 60 \\ \hline \end{array}$$

$$\begin{array}{r} 86 \\ \times 37 \\ \hline \end{array}$$

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$$\begin{array}{r} 57 \\ \times 44 \\ \hline \end{array}$$

$$\begin{array}{r} 64 \\ \times 26 \\ \hline \end{array}$$

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$$\begin{array}{r} 35 \\ \times 26 \\ \hline \end{array}$$

$$\begin{array}{r} 64 \\ \times 45 \\ \hline \end{array}$$

$$\begin{array}{r} 62 \\ \times 32 \\ \hline \end{array}$$

$$\begin{array}{r} 93 \\ \times 47 \\ \hline \end{array}$$

$$\begin{array}{r} 26 \\ \times 49 \\ \hline \end{array}$$

$$\begin{array}{r} 53 \\ \times 98 \\ \hline \end{array}$$

$$\begin{array}{r} 24 \\ \times 17 \\ \hline \end{array}$$

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$$\begin{array}{r} 63 \\ \times 35 \\ \hline \end{array}$$

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$$\begin{array}{r} 77 \\ \times 24 \\ \hline \end{array}$$

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$$\begin{array}{r} 82 \\ \times 45 \\ \hline \end{array}$$

$$\begin{array}{r} 55 \\ \times 82 \\ \hline \end{array}$$

$$\begin{array}{r} 19 \\ \times 79 \\ \hline \end{array}$$

$$\begin{array}{r} 39 \\ \times 59 \\ \hline \end{array}$$

$$\begin{array}{r} 96 \\ \times 92 \\ \hline \end{array}$$

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$$\begin{array}{r} 72 \\ \times 54 \\ \hline \end{array}$$

$$\begin{array}{r} 16 \\ \times 60 \\ \hline \end{array}$$

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$$\begin{array}{r} 88 \\ \times 19 \\ \hline \end{array}$$

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$$\begin{array}{r} 58 \\ \times 21 \\ \hline \end{array}$$

$$\begin{array}{r} 67 \\ \times 65 \\ \hline \end{array}$$

$$\begin{array}{r} 95 \\ \times 18 \\ \hline \end{array}$$

$$\begin{array}{r} 77 \\ \times 14 \\ \hline \end{array}$$

$$\begin{array}{r} 88 \\ \times 24 \\ \hline \end{array}$$

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$$\begin{array}{r} 82 \\ \times 29 \\ \hline \end{array}$$

$$\begin{array}{r} 77 \\ \times 32 \\ \hline \end{array}$$

$$\begin{array}{r} 70 \\ \times 19 \\ \hline \end{array}$$

$$\begin{array}{r} 35 \\ \times 25 \\ \hline \end{array}$$

$$\begin{array}{r} 65 \\ \times 15 \\ \hline \end{array}$$

$$\begin{array}{r} 22 \\ \times 39 \\ \hline \end{array}$$

$$\begin{array}{r} 72 \\ \times 82 \\ \hline \end{array}$$

21	58	78	93	41	63
<u>x 93</u>	<u>x 72</u>	<u>x 68</u>	<u>x 49</u>	<u>x 60</u>	<u>x 64</u>

14	53	48	46	31	92
<u>x 26</u>	<u>x 42</u>	<u>x 56</u>	<u>x 80</u>	<u>x 45</u>	<u>x 41</u>

19	31	15	90	75	62
<u>x 24</u>	<u>x 65</u>	<u>x 14</u>	<u>x 26</u>	<u>x 90</u>	<u>x 59</u>

35	97	34	63	45	69
<u>x 81</u>	<u>x 67</u>	<u>x 15</u>	<u>x 43</u>	<u>x 10</u>	<u>x 81</u>

88	72	66	15	75	86
<u>x 14</u>	<u>x 58</u>	<u>x 50</u>	<u>x 77</u>	<u>x 24</u>	<u>x 44</u>

91	76	45	12	90	56
<u>x 53</u>	<u>x 34</u>	<u>x 78</u>	<u>x 74</u>	<u>x 55</u>	<u>x 44</u>

28	92	12	27	56	84
<u>x 22</u>	<u>x 28</u>	<u>x 40</u>	<u>x 47</u>	<u>x 18</u>	<u>x 89</u>

$$\begin{array}{r} 40 \\ \times 42 \\ \hline \end{array}$$

$$\begin{array}{r} 88 \\ \times 39 \\ \hline \end{array}$$

$$\begin{array}{r} 86 \\ \times 34 \\ \hline \end{array}$$

$$\begin{array}{r} 33 \\ \times 84 \\ \hline \end{array}$$

$$\begin{array}{r} 65 \\ \times 12 \\ \hline \end{array}$$

$$\begin{array}{r} 89 \\ \times 99 \\ \hline \end{array}$$

$$\begin{array}{r} 52 \\ \times 33 \\ \hline \end{array}$$

$$\begin{array}{r} 28 \\ \times 85 \\ \hline \end{array}$$

$$\begin{array}{r} 28 \\ \times 72 \\ \hline \end{array}$$

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$$\begin{array}{r} 73 \\ \times 77 \\ \hline \end{array}$$

$$\begin{array}{r} 60 \\ \times 90 \\ \hline \end{array}$$

$$\begin{array}{r} 50 \\ \times 87 \\ \hline \end{array}$$

$$\begin{array}{r} 93 \\ \times 25 \\ \hline \end{array}$$

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$$\begin{array}{r} 63 \\ \times 46 \\ \hline \end{array}$$

$$\begin{array}{r} 98 \\ \times 26 \\ \hline \end{array}$$

$$\begin{array}{r} 97 \\ \times 49 \\ \hline \end{array}$$

$$\begin{array}{r} 63 \\ \times 23 \\ \hline \end{array}$$

$$\begin{array}{r} 42 \\ \times 38 \\ \hline \end{array}$$

$$\begin{array}{r} 49 \\ \times 25 \\ \hline \end{array}$$

$$\begin{array}{r} 62 \\ \times 27 \\ \hline \end{array}$$

$$\begin{array}{r} 72 \\ \times 11 \\ \hline \end{array}$$

$$\begin{array}{r} 43 \\ \times 33 \\ \hline \end{array}$$

$$\begin{array}{r} 44 \\ \times 34 \\ \hline \end{array}$$

$$\begin{array}{r} 56 \\ \times 46 \\ \hline \end{array}$$

$$\begin{array}{r} 91 \\ \times 33 \\ \hline \end{array}$$

$$\begin{array}{r} 20 \\ \times 15 \\ \hline \end{array}$$

$$\begin{array}{r} 93 \\ \times 68 \\ \hline \end{array}$$

$$\begin{array}{r} 49 \\ \times 56 \\ \hline \end{array}$$

$$\begin{array}{r} 38 \\ \times 86 \\ \hline \end{array}$$

$$\begin{array}{r} 59 \\ \times 13 \\ \hline \end{array}$$

$$\begin{array}{r} 97 \\ \times 19 \\ \hline \end{array}$$

$$\begin{array}{r} 48 \\ \times 18 \\ \hline \end{array}$$

$$\begin{array}{r} 16 \\ \times 22 \\ \hline \end{array}$$

$$\begin{array}{r} 23 \\ \times 59 \\ \hline \end{array}$$

$$\begin{array}{r} 16 \\ \times 36 \\ \hline \end{array}$$

$$\begin{array}{r} 89 \\ \times 50 \\ \hline \end{array}$$

$$\begin{array}{r} 97 \\ \times 48 \\ \hline \end{array}$$

$$\begin{array}{r} 16 \\ \times 81 \\ \hline \end{array}$$

$$\begin{array}{r} 73 \\ \times 27 \\ \hline \end{array}$$

$$\begin{array}{r} 48 \\ \times 10 \\ \hline \end{array}$$

$$\begin{array}{r} 73 \\ \times 95 \\ \hline \end{array}$$

$$\begin{array}{r} 93 \\ \times 92 \\ \hline \end{array}$$

$$\begin{array}{r} 94 \\ \times 29 \\ \hline \end{array}$$

$$\begin{array}{r} 10 \\ \times 16 \\ \hline \end{array}$$

$$\begin{array}{r} 82 \\ \times 59 \\ \hline \end{array}$$

$$\begin{array}{r} 11 \\ \times 27 \\ \hline \end{array}$$

Appendix H: Long Term Retention Interval Test

We will now assess your memory of the **cue**-target pairs you studied in the study phase of the experiment two weeks ago. You will see **cues** on the screen and your job will be to write down the **cue** in the first blank, and then, in the second blank, you will write down the target that went with that **cue**. If you cannot remember the target, then make your best guess. You will have ten seconds to write down the **cue** and the target. You will hear a beep when time is up, prompting you to move on to the next **cue**.

	cue		<u>target</u>
1.	_____	-	_____
2.	_____	-	_____
3.	_____	-	_____
4.	_____	-	_____
5.	_____	-	_____
6.	_____	-	_____
7.	_____	-	_____
8.	_____	-	_____
9.	_____	-	_____
10.	_____	-	_____
11.	_____	-	_____
12.	_____	-	_____
13.	_____	-	_____
14.	_____	-	_____
15.	_____	-	_____

Appendix I: Demographics Questionnaire

1. Age: _____
2. Class standing:
 - Freshman
 - Sophomore
 - Junior
 - Senior
3. Gender:
 - Male
 - Female
 - Other: _____
 - Prefer not to specify
4. Race:
 - African American
 - Hispanic/ Latino
 - American Indian or Alaskan Native
 - Native Hawaiian or Other Pacific Islander
 - Asian
 - White
 - Other
 - Prefer not to specify
5. GPA (to the best of your knowledge): _____
6. Major(s): _____
7. Minor(s): _____

8. I would consider myself to be most productive during:
- Early Morning
 - Late Morning
 - Afternoon
 - Evening
 - Night
9. I would consider myself to be more of a:
- More of a Visual Learner
 - More of an Auditory Learner
 - Both a Visual and Auditory Learner
 - Not sure
10. Approximately how many hours of sleep did you get last night? _____
11. How many hours of sleep do you require to function at your best? _____
12. How would you rate your memory as a whole?
- I have a horrible memory
 - I don't have the best memory
 - I have an alright memory
 - I have a pretty good memory
 - I have a fantastic memory
 - I have a photographic/eidetic memory
13. How do you usually study for an exam? Circle all that apply.
- I make flash cards
 - I skim or read my notes
 - I highlight in my notes
 - I copy my notes down again
 - I use quizlet or some other online format
 - Other (please specify): _____
14. What is the average amount of time you usually spend studying for a test? _____

15. On a scale of one to seven, how much did you enjoy the time you spent studying the materials given in this experiment? Please circle one of the following.

- 1- Strongly disliked
- 2- Moderately disliked
- 3- Slightly disliked
- 4- Neither disliked nor enjoyed
- 5- Slightly enjoyed
- 6- Moderately enjoyed
- 7- Strongly enjoyed

16. On a scale of one to seven, how difficult was it to study in the way you were directed? Please circle one of the following

- 1- Extremely difficult
- 2- Moderately difficult
- 3- Slightly difficult
- 4- Neither difficult nor easy
- 5- Slightly easy
- 6- Moderately easy
- 7- Extremely easy

Appendix J: Long Term Retention Interval Test

We will now assess your memory of the **cue**-target pairs you studied in the study phase of the experiment two weeks ago. You will see **cues** on the screen and your job will be to write down the **cue** in the first blank, and then, in the second blank, you will write down the target that went with that **cue**. If you cannot remember the target, then make your best guess. You will have ten seconds to write down the **cue** and the target. You will hear a beep when time is up, prompting you to move on to the next **cue**.

	cue		<u>target</u>
16.	_____	-	_____
17.	_____	-	_____
18.	_____	-	_____
19.	_____	-	_____
20.	_____	-	_____
21.	_____	-	_____
22.	_____	-	_____
23.	_____	-	_____
24.	_____	-	_____
25.	_____	-	_____
26.	_____	-	_____
27.	_____	-	_____
28.	_____	-	_____
29.	_____	-	_____
30.	_____	-	_____

Appendix K: Debriefing Script

Thank you so much for your participation in this experiment. Your data will help us to explore how different kinds of study methods can help memory. Some of you received instructions to read a sentence or examine an image, while others wrote their own sentences or drew their own images. If you would like to know how you scored on the memory tests we gave you, please speak to me afterwards and I would be happy to provide you with your individual data.

Please do not share any information about this experiment with anyone. Telling others about what happened in this study will ruin collection of further data.

Thank you again for your help with this experiment, and have a great day.