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MUSICAL MNEMONIC DEVICES OR METHOD OF LOCI: WHICH PROMOTES HIGHER RECALL OF CONCRETE AND ABSTRACT WORDS?

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ABSTRACT

MUSICAL MNEMONIC DEVICES OR METHOD OF LOCI: WHICH PROMOTES HIGHER RECALL OF CONCRETE AND ABSTRACT WORDS?

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Mnemonic devices are excellent learning tools to aid in the recall of information. Literature has shown that musical mnemonic devices and the method of loci are two particularly useful mnemonic devices. The literature has also shown that there seems to be some discrepancy as to which one aids in the higher recall of information. This study investigated which learning device— musical mnemonic devices, the method of loci, or rote memorization— promotes a higher recollection of concrete or abstract words after immediate and 5 min recall tasks. The study consisted of 86 participants who were Central Washington University students, ages 18 to 59 years old. The participants were randomly assigned to one of six conditions: the musical mnemonic device condition with concrete words, the musical mnemonic device condition with abstract words, the method of loci with concrete words, the method of loci with abstract words, rote memorization with concrete words or rote memorization with abstract words. The researcher hypothesized that 1) method of loci using concrete words during the immediate recall will result in more words recalled compared to other methods of memorization for concrete and abstract words and times, 2) more concrete words will be recalled than abstract words during the immediate recall, 3) method of loci during the immediate recall

will result in the most words recalled, 4) participants using method of loci to recall concrete words will result in the most words recalled compared to other methods of memorization of concrete and abstract words, 5) the method of loci will yield the most words recalled, 6) more concrete words will be recalled than abstract words, and 7) more words will be recalled during the immediate recall than the 5 min delay recall. The results suggested that there was a main effect of time, suggesting that the scores differed between the immediate recall and the 5 min recall task. No significant results were found for the other hypotheses. Future research should include the investigation of a long term delayed recall task and multiple scoring methods.

Keywords: Mnemonic devices, method of loci, musical mnemonic devices, concreteness, recall

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CHAPTER I

INTRODUCTION

Memory is the process where information is encoded, stored, and retrieved (Miller, 1956). One of the most important aspects of memory is working memory, which is "the retention of small amounts of information over brief time intervals" (Baddeley, 2000b, p. 77). The purpose of working memory is to provide a temporary capacity system where information can be stored, manipulated, and organized to allow people to plan behavior (Cowan, 2008). According to Miller (1956), the amount of information that can be held in one's memory is seven bits of information, plus or minus two bits of information. For example, one's phone number demonstrates the seven bits of information plus or minus two bits of information. It has been hypothesized that we combine these smaller units of information into larger and more meaningful units referred to as chunking (Tulving & Craik, 2000). Later research determined that chunking is not a constant as Miller originally hypothesized. The number of chunks a person can recall depends on a number of factors such as one's intelligence, motivation, and attention span (Baddeley, 2000b).

In the last decade, there has been debate as to whether the term short-term memory or working memory is a more accurate term to describe the concept. Some researchers think the word, short-term memory and working memory are the same concept (Gathercole & Alloway, 2006). According to Aben, Stapert, and Blokland (2012), others claim that the short-term memory and working memory are different components of memory. Short-term memory is the capacity for holding information, like movement and cognitive information, for a small window of time without manipulation

or organization (Aben et al., 2012). Working memory is seen as a theoretical framework that is responsible for processing new and old information and can manipulate, store, and organize information (Cowan, 2008; Diamond, 2013). Working memory is also made up of four components: the phonological loop, visuospatial sketch pad, the episodic buffer, and the central executive system (Baddeley, 2000b). Similar to short-term memory, working memory also has a capacity limitation of just a few seconds (Aben et al., 2012; Cowan, 2008). It has been hypothesized that working memory is comprised of short-term memory in the form of the episodic buffer (Cowan, 2008). According to Baddeley (2000a; 2003), the episodic buffer allows for the connection between the phonological loop and visual-spatial sketch-pad. The episodic buffer aids in the connection between working memory and long-term memory as well as explains short-term memory features that cannot be fully explained through just the phonological loop and the visual-spatial sketch-pad (Baddeley, 2000a; Baddeley, 2003). After a review of the literature on the debate between the use of working and short-term memory, the term working memory will be used throughout this thesis as it incorporates short-term memory and allows for manipulation, organization, and storage of information where short-term memory only incorporates storage.

There are different ways to help improve the management of information by working memory as well as the recall of this information, with one of those ways being mnemonic devices. Mnemonic devices are learning tools that aid in the retention of information by organizing information into meaningful units or chunks and allowing the information to be recalled more efficiently. Mnemonic devices have been shown to be beneficial tools for learning a foreign language (Ludke, Ferreira, & Overy, 2014),

learning scientific definitions (Rosenheck, Levin, & Levin, 1989), and memorizing the names of paintings from various artists (Carney & Levin, 1991, 1994). There are a variety of mnemonic devices that can improve one's recall of information such as keyword mnemonic devices, musical mnemonic devices, first letter mnemonic devices, rhyming mnemonic devices, the method of loci, and the peg system. The current study focuses on musical mnemonic devices and the method of loci. Before diving into those two types of mnemonic devices, it is important to understand what makes a successful mnemonic device and how mnemonic devices work.

CHAPTER II

LITERATURE REVIEW

Explanation of How Mnemonic Devices Work

Mnemonic devices are a popular tool to aid in the recall of information, but there has been a lack of research in describing exactly how they work. One explanation is that they reinforce the "four Rs" of mnemonic devices: recoding, relating, retrieving, and rehearsing (Carney & Levin, 1998). Recoding refers to the converting of unfamiliar information into something more familiar and concrete. For example, say a participant must remember that Hogwarts is the school Harry Potter attends. First, the information must be recoded into something more familiar and concrete (like the name Hogwarts could be recoded to a hog covered in warts). Relating refers to the use of concrete representations and relating it to the mnemonic device. This could be shown when the participant must make a meaningful connection between Harry and the hog (like picturing Harry Potter chasing a hog covered in warts). Retrieving refers to the use of the mnemonic device to recall the information. This occurs when one is recalling the information, he/she remembers Harry Potter chasing a hog covered in warts, which cues him/her to remember that Hogwarts is the school Harry Potter attends. Rehearsing refers to the repetition of the information in the form of the mnemonic device. Reciting the mnemonic device once is not enough (Carney & Levin, 1998).

The most thorough explanation of how mnemonic devices work comes from Laing (2010). Laing wanted to "provide a method to examine the design and the potential usefulness of any memory cue (such as the mnemonic device)" (Laing, 2010, p. 350). Laing's (2010) model identified steps by which a mnemonic device should be

evaluated. The first step in the model was to identify a set of attributes or whatever information the participant has targeted for recall. These attributes, for example, could be a list of words, places, or random items. The second step in the model was memory cues, which were the mnemonic devices themselves. Memory constraints state that the mnemonic device needs to "be kept to a reasonable size to accommodate an individual's capacity for memorization" (p. 350). Distinctiveness of memory cues are the next step and Laing (2010) stated that mnemonic devices work best when they are distinct in some way. The third step was retention, which was based on how ordered and built the information was; retention increases when the mnemonic device was organized and straightforward. If the mnemonic device was straightforward, then it would be easy to understand. The fourth step of Laing's (2010) model was the identification of the three levels of processing: visual processing, auditory processing/phonemic structure, and semantic processing. Visual processing emphasizes the physical structure of the list of words and is the shallowest processing level. Auditory processing/phonemic structure emphasizes sound and is an intermediate processing level. Semantic processing emphasizes meaning and connection and is the deepest processing level. If a mnemonic device can reach the deeper levels of processing, like the auditory processing/phonemic structures or semantic processing, then the participants are more likely to remember the material. The fifth and final step in Laing's model was retrieval/recall which works best when the participants were highly familiar with the memory cue/mnemonic device. The model Laing created is presented in Figure 1. A comparison of Laing (2010) and Carney and Levin's (1998) explanations revealed that Laing's stepwise explanation was more

detailed, however Laing's model excluded the component of rehearsal, which was key in aiding the participant's recall of information.

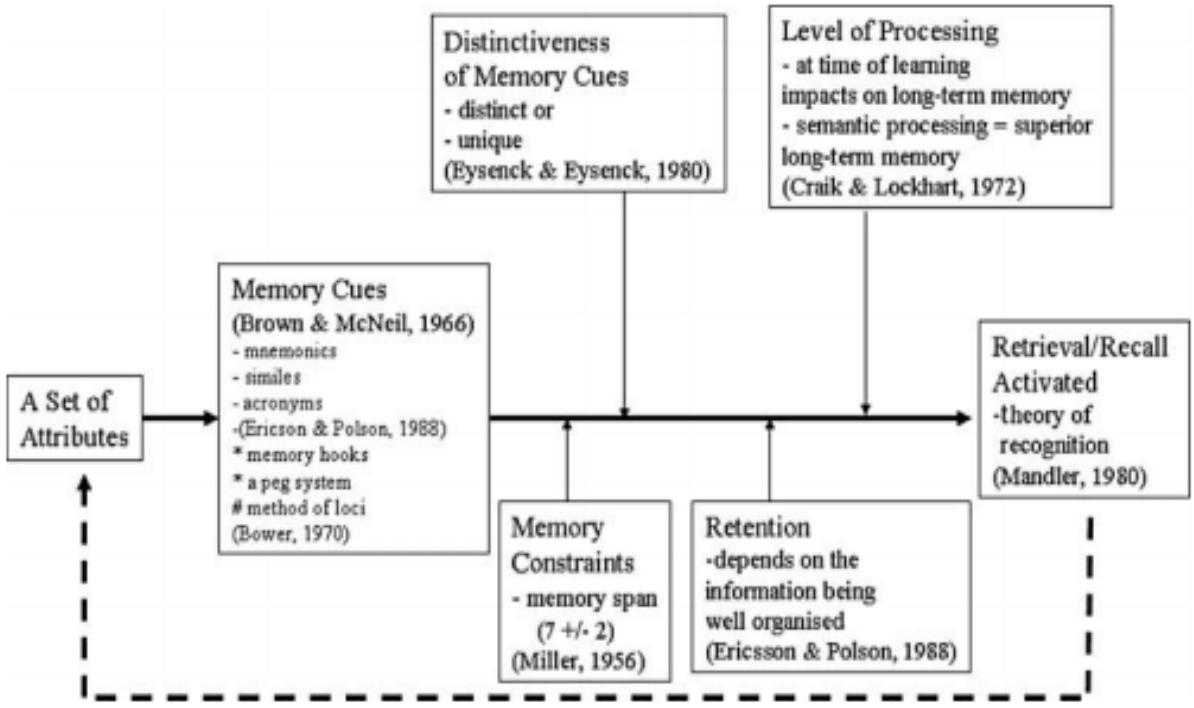

FIGURE 1 Model for assessing characteristics of a memory cue.

Figure 1. Laing's (2010) model for assessing why mnemonic devices work.

Properties of a Successful Mnemonic Device

Bellezza (1996) hypothesized that a mnemonic device must contain constructability, associability, discriminability, and bidirectionality of associations in order to be a successful mnemonic device. Constructability refers to the ability to access the mnemonic device when the participant is learning and the ability to retrieve the mnemonic device when the participant is recalling the items. Associability is the connection between the information one is trying to recall and the mnemonic device. An example of associability would be having the participant link one piece of information they are trying to remember to one aspect of one's mnemonic device. Discriminability is

the idea that if the participants are trying to recall multiple lists, then each list should have its own separate mnemonic device attached to it so that it will not be confused with other lists. Bidirectionality of associations means that the items need to be useable for the mnemonic device and that the mnemonic device needs to aid in remembering the items. For example, when the participants are trying to remember the word "Hogwarts" by visualizing a hog with warts covered all over its body. When trying to recall the information, the participants use the visualization of a hog with warts covered all over its body to remember the word "Hogwarts." These four concepts aid with moving information from working memory to long term memory because they force the participants to pay closer attention to the material they are trying to remember, which increases the chance of successful recall of material (Bellezza, 1981; Qureshi, Rizvi, Syed, Shahid, & Manzoor, 2014).

Effectiveness of Musical Mnemonic Devices

Music has been shown to reorganize the sensorimotor cortex in stroke patients (Rojo et al., 2011), help autistic children with recognizing emotions (Heaton, 2009), aid others in learning a second language and pronunciation skills (Ludke et al., 2014; Slevc & Miyake, 2006), and improve the verbal memory of children (Bennett, 2009; Chan, Ho, & Cheung, 1998; Ho, Cheung, & Chan, 2003). Music may also aid in the recall of information in the form of musical mnemonic devices. Musical mnemonic devices may aid in the recall of information by turning the information into a song. Musical mnemonic devices allow participants to remember items in sequential order, which should allow for ordered recall (Wallace, 1994). An example of a musical mnemonic device would be the "ABC Song" that children learn when they are first learning the

English alphabet; the children connect the letters of the alphabet to the song and when the children try to recall the alphabet, the song will aid in the recall of the letters. Another example of a musical mnemonic device would be the "Fifty Nifty United States" song that uses the list of the United States in alphabetical order in combination with an easy song to recall. When the children try to recall the states later, the song aids in the recall of the states in alphabetical order.

Some studies have shown that musical mnemonic devices promote a higher recall of information than rote memorization (VanVoorhis, 2002). Rote memorization requires the participants to only read the items they are trying to recall and repeat the list. There is no aid, like a song or loci, to help the participants in the recall of information. VanVoorhis (2002) was interested in determining if musical mnemonic devices would promote higher recall of the scores or information for a statistics test than rote memorization. Members of a college statistics class were randomly assigned into one of two conditions. The participants in condition one sang three statistical jingles to help them remember the statistic definitions; the participants in condition two used rote memorization where they read statistical definitions out loud and repeated them. The results demonstrated that those who learned the songs scored significantly higher on the test items that were related to the songs than those who used rote memorization.

Claussen and Thaut (1997) also investigated musical mnemonic devices, but used third, fourth, and fifth graders as their participant pool. The participants were randomly assigned to one of two types of mnemonic device conditions: verbal mnemonic device or musical mnemonic device. The researchers wanted to determine which would promote the higher recall of multiplication tables. A pretest was conducted to identify a baseline

for recall prior to the participants being taught the musical mnemonic device or verbal mnemonic device. One day later, the participants were taught the musical mnemonic device or verbal mnemonic device and were immediately tested for recall of information using the assigned mnemonic device. The results of the posttest showed that the participants that were in the musical mnemonic device condition had a higher recall rate of multiplication tables than the participants in the verbal mnemonic device condition.

Research has shown that musical mnemonic devices help children as well as college students with recall of information (Calvert, 2001). Calvert (2001) conducted two studies on musical mnemonic devices. In the first study, Calvert investigated whether songs or spoken word as well as visual or non-visual aid would benefit children and college students' memory. The researcher used a School House Rock video and song titled, "Shot Heard Around the World," which was about the American Revolution. The experiment had four conditions: visual presentation of the information with the song, visual presentation of information with spoken word, only listened to the song, or only heard spoken word. Immediately after watching and/or listening to the song, the participants took part in a multiple choice recognition task and a picture sequencing task. The multiple-choice recognition task involved participants answering 13 verbal multiple choice questions that measured the participants' memory of the material. The picture sequencing task had the participants place a set of five pictures in the chronological order. In both the picture sequencing task and multiple choice recognition task, the results showed that college students recalled more of the content than the children in all of the conditions. The results also showed that the participants in the spoken word condition had higher recall scores than the participants in the singing condition. The

participants in the visual presentation of the information conditions had higher recall scores than the participants in the conditions where participants only listened to the song or spoken word for both the picture sequencing task and multiple choice recognition task. The researcher concluded that participants in the spoken word conditions had higher recall scores than the participants in the singing conditions because of modality specific processing. Calvert suggested that the picture-sequencing task assessed visual memory and the multiple-choice task measured verbal memory, but lacked a task that specifically assessed singing memory.

A second study by Calvert (2001) investigated a modality of processing that was specific for singing. Calvert (2001) used "a multiple-choice recognition task to assess verbal memory, a picture sequencing task to assess visual memory, and a verbatim free-recall task to assess a sung memory" (p. 334). It has been suggested that verbatim memory is a measure that fits the structures of songs the best, which should aid in recall (Rubin, 1977). Calvert (2001) was also interested in studying whether multiple exposure to the material would lead to higher scores in the picture-sequence task, multiple-choice task, and verbatim task than a single exposure to the material. Again, Calvert used children and adults as the participant pool. The vignette the participants watched/heard was another School House Rock video/song, "I'm Just a Bill" (Calvert, 2001). The researcher added an exposure condition to improve the ecological validity (Calvert, 2001; Wallace, 1994). The participants were randomly assigned to be in one of two conditions: they either viewed "I'm Just a Bill" once or four times. In the four times condition, participants watched "I'm Just a Bill" two times each week over the course of 2 weeks. The participants in the once condition watched the video on the final day of the

experiment. Two days after the final showing, the participants answered memory tests that incorporated the three recall tasks (Calvert, 2001). The results showed that both the children and adults in the four times exposed condition scored higher on the verbatim recall task than the participants who were exposed just once. The repeated exposure did not increase performance on the multiple-choice task or the picture-sequencing task. The researcher concluded that the participants' "memories of sung material [were] influenced by the form of the presentation and the form of the retrieval task" (p. 337). It was important to note that a pretest was not used in this study because the current study did not use a pretest as well; this shows that musical mnemonic devices can lead to significant results even when no pretest was used.

Similar to Calvert (2001), McElhinney and Annett (1996) demonstrated how musical mnemonic devices were beneficial in the recall of song lyrics. The goal of the study was to determine whether or not learning a song with music and singing would promote a higher recall of song lyrics over just reading the song lyrics aloud without musical accompaniment in a free recall task. The participants were randomly assigned to the either the music condition or the verbal condition. The results of this study showed that the participants who were in the music condition displayed a higher over all recall of the song lyrics compared to the participants in the verbal condition for the free recall task.

Musical mnemonic devices have also been found to facilitate foreign language learning, specifically Hungarian, in college students (Ludke et al., 2013). The participants were randomly assigned to the singing, rhythmic speaking, or speaking condition (Ludke et al., 2013). The participants in the singing condition heard the speaker singing the Hungarian phrases. The participants in the rhythmic speaking

condition heard the speaker speaking the Hungarian phrases using syncopation. The participants in the speaking condition heard the speaker speaking the Hungarian phrases with no singing or syncopation. The participants in each condition listened to 20 English paired-associate phrases in Hungarian during three learning periods for a total of 15 min (Ludke et al., 2013). To further break down the learning period, each paired-associate phrase was structured in the following way: "English Phrase 1, pause (1 s), Hungarian Phrase 1, pause (1 s), Hungarian Phrase 1, pause (8 s) for the participants to repeat the Hungarian Phrase 1 as best as he or she could, followed by English Phrase 2, and so on, up to Phrase 20" (p. 44). To view an example of how the English-Hungarian paired associations were presented, see Figure 2.

Figure 2. Ludke's (2013) example of procedures

The test phase included the completion of five different tests by the participants to measure learning for the English-Hungarian paired associate phrases. The first test was a multiple-choice Hungarian vocabulary test where the participants were provided a Hungarian word and had to choose which of the four English meanings was the correct match to the Hungarian word. The vocabulary test contained 20 multiple-choice questions. The second test was a Hungarian production test where the participants heard 20 English phrases and recalled the Hungarian phrase that matched it. This was a verbatim recall task. The third test was an English recall test, which consisted of 20 Hungarian phrases and the participants had to recall the English phrase. This was also a verbatim recall task. The fourth test was a Hungarian recognition test where the participants had to state whether the Hungarian phrases had the correct or incorrect

spelling and pronunciation. The final test consisted of the participants' having a conversation in Hungarian; it was a delayed recall task and took place 20 minutes after they had finished the last learning period. The results showed that singing was a better tool for learning a new language than the other two conditions in four of the five recall tasks. The participants in the singing condition scored the highest on the verbatim recall tasks for the paired-associated foreign language phrases, which suggests that those in the singing condition were the best at verbatim recall compared to those in speaking and rhythm speaking conditions.

According to Yalch (1991), musical mnemonic devices aid in the recall of advertisements, but only when the recall task was difficult. Yalch examined the ability of participants to recall brand names in advertisements that incorporated singing jingles and brand names that did not incorporate singing jingles and only spoke their jingle. The researcher hypothesized that the singing jingles would create a musical mnemonic device for the participants and thus allow the participants to recall more brand names with jingles than brand names without jingles. The researcher tested this hypothesis by using a recognition task and an aided recall task. In the recognition task, the participants matched the brand name to the jingle, with both the brand name and the jingle written out available to the participant during recall. In the aided recall task, the participants were only presented with the jingle and were told to match them with the brand name by memory. The results supported Yalch's hypothesis, but only in the aided recall task. The researcher concluded the specific results were found because the recall task, specifically the recognition task, was too simple to benefit using the musical mnemonic devices to aid

in recall of the jingles. The recognition task had too many cues to aid in recall, which made the use of the musical mnemonic devices not useful in recall.

As seen above, musical mnemonic devices have been shown to aid recall in mathematics, verbal memory, and more. Musical mnemonic devices are important for college students especially; they can be used as a beneficial studying technique for students to remember test items or something as mundane as grocery lists. Musical mnemonic devices allow people a quick and efficient way to memorize large amounts of information, which enables people to learn other material that require a bit more critical thinking.

Effectiveness of Method of Loci

Another type of mnemonic device that produces a higher recall than other mnemonic devices is the method of loci (Raz, Packard, Alexander, Buhle, Zhu, Yu, & Peterson, 2009; Roediger, 1980). According to Yates (1966), the method of loci, developed by Simonides of Ceos in 477 BC, has been used since ancient Greece (as cited in Bower, 1970). According to historical accounts, Simonides of Ceos was at a banquet giving a speech; after giving his speech he decided to step outside and when he was outside the banquet hall collapsed. Everyone at the dinner party died and the only way people could identify the bodies was because Simonides of Ceos remembered the seating arrangement of his guests in relation to parts of his speech and thus could recall who was who. Yates (1966) also stated that the method of loci was a common way for Greek orators to remember their long speeches (as cited in Bower, 1970). The phrases “in the first place” and “in the second place” can still be seen in today’s English as a marker for spatial order that Greek orators used in their speeches (Bellezza, 1981). The method of

loci has remained popular today. It is a common method used by memorists, individuals who compete in memory competitions (Maguire, Valentine, Wilding, & Kapur, 2003; Raz et al., 2009).

Ultimately, the method of loci associates the to-be-learned information by mentally applying it to specific physical locations/landmarks in a spatial order. The person then forms images of their loci and tries to connect one piece of information to one landmark in their route. To recall the information, one has to mentally go through one's path and when he/she gets to a particular landmark, one should recall the information that is associated with the landmark. The method of loci works best when the participants create bizarre images between their landmarks and the information they are trying to remember (Bower, 1970). For example, when a person is trying to recall a grocery list of milk, eggs, and fish and he/she uses three items in his/her bedroom (desk, computer, and lamp) as one's loci. The person connects the milk with the desk (by picturing a giant glass of milk spilled all over his/her desk), eggs with the computer (by imagining eggs being pelted to the computer), and fish with the lamp (by picturing a huge fish flopping around on top of the lamp). When the person recalls the grocery list later, he/she mentally goes back into his/her bedroom and will visualize the desk and will see the giant glass of milk and remember that he/she needs to buy milk. The person will visualize the computer and he/she will imagine the eggs being pelted to the computer, which will remind him/her to buy eggs. And lastly, the person will visualize the lamp and will also imagine the flopping fish on top of the lamp and will remember that he/she needs to buy fish.

The method of loci has been shown to increase the recall of information in college students (Roediger, 1980) as well as older adults (Sharps & Price-Sharps, 1996). The method of loci has also been shown to aid people with depression by helping them recall happier memories more quickly (Dalgleish, Navrady, Bird, Hill, Dunn, & Golden, 2013). This method has been a tool that memorists, people who compete in memory competitions, use to recall the digits of pi among other things as well (Raz, et. al, 2009). While memorists use this technique, the method of loci has been shown to be a beneficial way to recall items for those with normal intelligence and working memory capacities, like college students for example (Bower, 1970). The method of loci has been shown to be an effective way to improve one's memory because it combines imagery, spatial information, and verbal information (Raz, et al., 2009; Roediger, 1980).

Some research has shown that the method of loci works best when the participants create the loci themselves (Bellezza & Reddy, 1978; Bower, 1970; Massen, Vaterrodt-Plunnecke, Krings, & Hilbig, 2009; Roediger, 1980). Roediger (1980) investigated whether the use of imagery, the link method, a peg system method, rehearsal, or the method of loci would promote the highest lenient scores and strict scores for an immediate recall task and a 24 hour delayed recall task. In the imagery method condition, the participants were told to visualize mental images of the objects and not the words themselves. For example, if the participants had the word "ball," they would visualize a big bouncy ball. In the link method condition, the participants created a visualization between each item on the list and linked the visualizations together, when they tried to recall the items, one image should lead to the next item and so forth. For example, if the participants have a recall list of "bear," "shoes," "cat," and "water bottle,"

they could remember a bear wearing shoes but then giving the shoes to a cat who then picks up a water bottle. In the peg system condition, the participants learned a rhyming scheme or hook and attached and visualized the information to the hook. A common peg system is using numbers and rhymes. For example, using the peg system to recall a list of five items, the participants could use this common rhyming words and numbers: one is bun, two is shoe, three is tree, four is door, and five is hive. The participant would then visualize the first item between a bun, the second item inside a shoe, the third item on top of a tree, the fourth item on top of a door, and the fifth item inside a hive. In the method of loci condition, the participants created a list of familiar locations and then connected one piece of information to each location. When the participants were trying to recall the information, they would mentally go through their locations one at a time and recall the information attached to each location. The loci was self-created. In the rehearsal condition (the control condition), the participants were told to study the words by saying each one over and over and focus on the meaning of the words. The participants were also told to repeat the words in the correct order.

Roediger's (1980) experiment consisted of three sessions. In the first session, the participants studied 20 words on a screen and were then given 5 min to recall the words in order to the best of their ability, which was a pretest/baseline. The participants were then randomly assigned to one of five conditions (imagery, the link method, a peg system method, rehearsal, or the method of loci), were taught their mnemonic device, and were told to practice their mnemonic device at home. The participants were given the opportunity to create their own method of loci and peg system instead of having the researchers providing one for them. The first session lasted an hour. The next day

(session two) the participants were told to practice their learning tool to themselves and were then given three lists of twenty words and were told to memorize the words using their mnemonic device. For each list, the participants were given 5 min to recall the items. This second session was an immediate recall task and lasted an hour. On the third and final day, the participants were given a recall sheet and were given 15 min to recall the words from the previous session. The third session lasted 15 min and was a 24 hour delay recall task. The researcher measured words correctly using strict scoring and lenient scoring. Strict scoring meant that the words needed to be in the correct position to be counted as correct while lenient scoring meant that the words the words were counted as correct regardless of order. The results of this experiment showed that the participants in the peg system condition and the participants in the method of loci condition exhibited the highest recall of words using strict scoring compared to the other three conditions for both the immediate recall task and the 24 hour delayed recall task. While the differences between the different mnemonic devices were minuscule, statistically significant results did show that the participants in the method of loci, peg word, and link method conditions recalled the most amount of words for both the immediate recall task and the 24 hour delayed recall task using lenient scoring. These results demonstrated that the method of loci could be a valid tool for aiding recall of information, especially for ordered scoring.

Massen, Vaterrodt-Plunnecke, Krings, and Hilbig (2009) investigated the use of the method of loci using two different loci (route from home to work and route around their house). The purpose of the study was to determine what pathway (work or home) worked best in recalling information. The first study involved the random assignment of

participants to either the "street-loci" condition (route from home to work) or the "house-loci" condition (route around their house). The participants were asked to practice their method of loci and write down 20 locations on their path to work or on their path around the house. The loci were self-created. The participants were given a practice lists of 20 pieces of information and were told to connect the pieces of information to their different landmarks in their method of loci in 2 min (Massen et al., 2009). Next, the participants were instructed to recall the information using their specific method of loci by mentally retracing their path. The participants had an unlimited amount of time to recall the words. The participants were then given a second practice list and were instructed to do the same thing. The next day the participants were asked to recreate the method of loci they used the day prior. This time the participants were exposed to three different grocery lists with 20 items on each list. The participants were instructed to use their method of loci for each list and recall as much of the information in order as possible. Each list was separated by a 2 min interval break. The results demonstrated that the participants in the "street-loci" condition recalled significantly more of the three grocery lists than the participants in the "house-loci" condition (Massen et. al, 2009). The researchers suggested that these results could have occurred because of the bizarre connections between the "street-loci" and grocery lists. For example, a person is more inclined to see potato chips in a cupboard than in the middle of an intersection, which makes it more bizarre and easier to remember.

Massen et al. (2009) conducted a second study to replicate the findings found in the first study and to see if using other items other than grocery lists could change which method of loci condition promoted the highest recall. The researchers used two lists of

items: “house-items” and “street items.” The participants were randomly assigned to be in one of four conditions: “street-loci” with “street items,” “street loci” with “house-items,” “house-loci” with “house-items,” and “house-loci” with “street-items.” The first session in the second study was identical to the first session in the first study. For the second session the next day, the participants were given two practice lists of grocery items to learn and attach to landmarks in their loci. They were then instructed to recall items using their loci. Next, the participants were either given the “street-items” or the “house-items” depending on which condition they were randomly assigned. The participants then recalled the words in the correct order as best as they could. The results of the second study showed that the participants who were in the “street-loci” conditions recalled more items than those in the “house-loci” conditions regardless of whether the participants had the “house-items” or the “street-items.” The researchers suggested that the results found in both studies were due to the fact that the “street-loci” had more distance between each spatial landmark compared to the “house-loci,” which could have made each landmark more distinct and memorable.

Massen et al. (2009), Raz et al. (2009) and Roediger (1980) had their participants create their own loci rather than using a researcher-generated loci. According to Massen et al. (2009), “participant-generated [loci] have the advantage of referring more to autobiographical elements that aid memory” recall that researcher-generated loci lack (p. 725). Bellezza and Reddy (1978) investigated the recall of participants who either created their own loci or had the researcher create their loci; the results demonstrated that participants were able to recall more items when the participants created their own loci compared to when the researchers created the loci. However, other research has

suggested that the use of researcher-generated locis are an effective way to have participants learn the technique (Legge, Madan, Ng, & Caplan, 2012; Qureshi et al., 2014).

Qureshi, Rizvi, Sted, Shahid, and Manzoor (2014) conducted a study to determine if the use of the method of loci aids in the learning of endocrinology, specifically the concepts of insulin and diabetes mellitus. First the participants were exposed to a lesson on what diabetes mellitus and insulin were in a 60 min lecture. Next, the participants were randomly assigned to be in one of two conditions: the self-directed learning condition or the method of loci condition. In the self-directed learning condition, the participants were instructed to complete worksheets and study their textbook. In the method of loci condition, the participants were instructed to connect one piece of information to each landmark. The researchers created the method of loci for the participants and used the campus layout as the loci. The researchers created the loci instead of having the participants create the loci because the researchers believed that it would be difficult for the participants to create a loci in a short amount of time with such difficult material. The participants in both groups had four learning sessions. The first learning session was an introductory learning period to the topics. The second and third learning session were scheduled 4 days apart and the last learning session was scheduled 7 days later. In the second, third, and final learning session, the participants were instructed to practice their mnemonic device and or learning strategy and learn the material. After the final learning session, the participants took a multiple choice quiz with ten questions regarding insulin and diabetes mellitus. The results showed that the participants in the method of loci condition had higher scores on the quiz than those in

the self-directed learning condition. The authors stated that the method of loci was an efficient way for students to learn new concepts in comparison to just having the students learn via worksheets.

Legge, Madan, Ng, and Caplan (2012) also conducted a study to determine whether the conventional method of loci would promote more accurate recall scores than the virtual method of loci or a control condition. The participants were randomly assigned to one of three conditions: the conventional method of loci, the virtual method of loci, or a control condition. In the conventional method of loci, the participants were instructed to create their own loci using a layout that was familiar to them, like the layout of their home or campus. In the virtual method of loci condition, the participants used a keyboard and a mouse to navigate a virtual landscape on a computer that was not personally familiar to them and one that the researchers created. The participants in the control condition were not given any instructions to use a specific method to help them remember the words. The researchers were interested in using the virtual method of loci because it incorporated the researcher-generated loci and thus added more control to the experiment than the conventional method of loci.

After being randomly assigned to one of three conditions, the participants in each condition were given a practice set of highly imaginative nouns and low imaginative nouns that came from Madan, Glaholt, and Caplan's research (2010, p. 61). The researchers believed that high imaginable words like "cigar," "limb," and "toilet" should be quicker and easier to recall than low imaginative words like "muck," "void," and "quote" (Madan et al., 2010, p. 61). According to Madan et al. (2010),

> Each [set of highly imaginative nouns and low imaginative nouns] contained 110 English words, ranging between four and six letters in length (inclusive). Between each pair of pools of a given type (i.e., high-frequency and low-frequency), the words were matched on letter length, mean positional bigram frequency, and orthographic neighbourhood size using phonological data and frequency counts from the CELEX Lexical Database. Imageability ratings were also matched. (p. 49)

The participants in the method of loci conditions were given 5 min to learn the words and 2 min to recall the words in serial order (Legg et al., 2012). The participants in the control condition were not given any instructions to use a specific method to help them remember the words and were given 5 min to learn the words and 2 min to recall the words in serial order. The practice set was designed to familiarize the participants with their learning strategy to aid in the recall. The researchers made the entire practice set only 7 min, which was a much shorter time period than Massen et al. (2009) and Roediger (1980) used. After the practice set, the participants were handed the same instructions as before and given another set of highly imaginative and low imaginative words. Depending on what condition the participants were assigned, they were either told to use their loci or no strategy to study the list of words for 5 min. After the 5 min had past, the participants were given 2 min to recall the words. The researchers used strict-item scoring and lenient scoring to score the items. With strict-item scoring, the items had to be in the correct position while with lenient scoring, the items just had to be on the list regardless of order.

The results showed that the participants in the all three conditions were able to recall highly imaginative words more accurately than low imaginative words. The results of the study demonstrated that the participants in both the conventional method of loci condition (participant-generated loci) and virtual method of loci condition (researcher-generated loci) were more accurate in recalling the list of words than the participants in the control condition for both the strict-item scoring and lenient scoring. The participants in the conventional method of loci condition were equally as accurate as the participants in the virtual method of loci condition on both the strict-item scoring and lenient scoring for the word list. These results suggest that having the researcher create the method of loci for the participants can still lead to high scorings on recall, which contradict Bellezza and Reddy's (1978) findings. Also, it is important to note the timing of the practice condition. As stated above, other studies call for multiple hour long practice periods while Legge et al.'s (2012) study only allotted for 7 min in total. Even short practice periods with the method of loci can result in efficient recall.

According to Bower (1970), the imagery value of words is important when using the method of loci. Bower suggested that concrete words have a higher rating of imagery value than abstract words. Bower (1970) demonstrated that because of the visual imagery needed for the method of loci to work, recalling concrete words should be more accurate than recalling abstract words. Also, the more vivid the association between the loci and words, the more likely the participants are to recall the words (Bower, 1970).

Recall Rate of Concrete and Abstract Words

Concrete words are words that are experienced through one's senses, which can be easily imagined. Abstract words, however, lack the physical or concrete aspect and

are harder to imagine. Behavioral studies have shown that participants comprehend faster and recall more concrete words than abstract words (Belmore, Yates, Bellack, Jones, & Rosenquist, 1982; Bower, 1970; Gullick, Mitra, & Coch, 2013; Klee & Eyesenck, 1973).

There are a variety of theories to explain the different processes in recall that occur with abstract and concrete words. The most common explanation is the dual code theory by Paivio (1991). The dual code theory explains that the reason concrete words are recalled faster and more accurately is because concrete words elicit both a verbal processing and an image processing when recalling the word or sentence (Bower, 1970; McCabe, 2011; Paivio, 1991). Abstract words lack the image and thus solely rely on verbal processing, which leads to abstract words being comprehended more slowly than concrete words.

Another popular theory to explain the processing of abstract words and concrete is the context-availability model, which states that there is only one semantic processing system for both abstract and concrete words; concrete words just happen to be easier to put into context than abstract words (Schwanenflugel, 1991). Schwanenflugel (1991) suggested that this is the case because "abstract words possess weaker connections to associated contextual information in knowledge base than concrete words do" (p. 243). Bower (1970), also suggested that abstract words are more difficult to recall because participants substitute the abstract word with something more concrete. For example, instead of recalling the abstract word "freedom," the participants instead recall the concrete word "flag" because it is a tangible and concrete way to think of freedom.

Current Study

This study investigated whether musical mnemonic devices or the method of loci was a better tool for recalling concrete and abstract words. The method of loci and musical mnemonic devices have been shown to be effective in aiding recall (Legge et al., 2012; Ludke et al., 2012; Qureshi et al., 2014; Vanhooris, 2002). The participants were instructed to use either a musical mnemonic device, the method of loci, or rote memorization to aid in their recall of a list of either abstract or concrete nouns. Recall was tested immediately and after a 5 min delay. Following Bellezza's (1996) properties for a successful mnemonic device, this study incorporated the properties a mnemonic device must contain in order to be successful. The study used constructability, associability, discriminability, and bidirectionality of associations (Bellezza, 1996). The mnemonic devices in the current study used a familiar song, "Twinkle Twinkle Little Star," and familiar pictures of famous landmarks in the United States. Because of the familiarity of these mnemonic devices, participants should be able to easily retrieve these devices during recall. The participants were randomly assigned to use one mnemonic device with either abstract or concrete words. The researcher hypothesized that the word list using any of the methods was difficult enough, so there should not be any ceiling effects. This study used bidirectionality of associations as well because the participants had to use the list of words with their mnemonic device and during recall they had to use the mnemonic device to recall the list of words. As described by Bellezza (1996), this study used the four properties necessary to have successful mnemonic devices, so it stands to reason that the mnemonic devices used in this study would be successful and aid in participants having high recall scores.

Similar to Laing's (2010) study, participants in this study used one list of concrete nouns and one list of abstract nouns as the recall stimuli. The lists of words were kept to a reasonable size, so that the memory constraints were not too strenuous for participants, which also helped avoid any ceiling or floor effects. The mnemonic devices were distinct and easy to remember. In this study, the participants in the method of loci conditions were instructed to use spatial memory as well as bizarre imaging to link the pictures to the words. For example, the participants might have had a picture of the statue of liberty with the word "cradle." Perhaps the participants pictured the statue of liberty holding a cradle and crying. This would be a unique scenario and would help with recall later. Also, the participants in the musical mnemonic device conditions listened to a singer singing/using vocables for the song of "Twinkle Twinkle Little Star." Vocables, according to the Merriam-Webster's dictionary online, are "a word composed of various sounds or letters without regard to its meaning" (Merriam Webster Dictionary Online, n.d.). The song was distinctive and most adults have heard this song multiple times throughout their lives. Using this familiar song, participants should be able to recall words attached to the song. Both of the mnemonic devices were structured and organized and should have allowed for retention to be relatively high. For example, the method of loci was organized using spatial order, so it would seem that because the method of loci was well organized, then the participant's retention would be high. The levels of processing were used in the current study as well. The researcher hypothesized that the method of loci and musical mnemonic devices were both achieving the deepest level of processing, semantic processing. With semantic processing, participants must really think about the items or concepts they are trying to learn as well as connect the new

items/concepts to older concepts. With the method of loci, the participants are connecting the new items to familiar and famous US landmarks and with the musical mnemonic device, the participants are connecting the new items to a familiar song, "Twinkle Twinkle Little Star." Both of these mnemonic devices should lead to a deeper level of processing, which should aid in a higher recall. For retrieval, familiarity of memory cue/mnemonic device is key, and the mnemonic devices utilized should be familiar to the participants. Because the method of loci and the musical mnemonic devices used in this study follow Laing's (2010) model, it could be hypothesized that these mnemonic devices should be successful in aiding the participants learning and recall.

The researcher chose to use 5 min for the delayed recall tasks. Previous research has shown that 5 min is an adequate amount of time to test for delayed recall (Carlson, Zimmer, & Glover, 1981; Carney & Levin, 2008; Roediger & Karpicke, 2006; Wheeler, Ewers, & Buonanno, 2003). The researcher also opted to create the method of loci and musical mnemonic devices for the participants because it was shown to be a successful way to teach these mnemonic devices, add more control to the experiment, and be just as effective as having the participants create the mnemonic device themselves (Legge et al., 2012; Ludke et al., 2014; Qureshi et al., 2014; VanVoorhis, 2002). With regard to concrete and abstract words, the method of loci used visualizations in order for participants to recall the words while musical mnemonic devices used a familiar song, not imagery, in order for participants to recall the words. Because of the dual code theory/context-availability model of abstract words and concrete words, the inclusion of abstract and concrete words for this study provided insight as to which method lead to a

more successful recall of the words. From the literature review, there seemed to be few mnemonic device studies that used concrete and abstract word lists as the items the participants were supposed to remember and recall. The concrete and abstract words for this study were taken from Brysbaert, Warriner, and Kuperman's (2014) research. There also seemed to be few studies that investigated both musical mnemonic devices and the method of loci, which was why those mnemonic devices have been chosen.

Hypotheses:

1) Method of memorization, Word Type, and recall Time (time 1 immediate recall, time 2, 5 min delay recall) will affect the number of words recalled. Specifically, method of loci using concrete words at time 1 (immediate recall) will result in more words recalled compared to other methods of memorization for concrete and abstract words at time 1 (immediate recall) and time 2 (5 min delay recall) (three-way interaction; Method x Word Type x Time).
2) Word Type and recall Time will affect the number of words recalled. It is hypothesized that more concrete words will be recalled than abstract words at time 1 (immediate recall), followed by concrete words at time 2 (5 min delay recall), respectively (two-way interaction; Word Type x Time).
3) Method of memorization and recall Time will affect the number of words recalled. It is hypothesized that method of loci at time 1 (immediate recall) will result in the most words recalled, followed by musical mnemonic device at time 1 (immediate recall), rote memorization at time 1 (immediate recall), method of loci at time 2 (5 min delay), musical mnemonic device at time 2 (5

min delay recall), and rote memorization at time 2 (5 min delay recall), respectively (two- way interaction; Method x Time).

4) Method of memorization and Word Type will affect the number of words recalled. It is hypothesized that participants using method of loci to recall concrete words will result in the most words recalled compared to other methods of memorization of concrete and abstract words (two-way interaction; Method x Word Type).
5) Overall, the method of loci will yield more words recalled, followed by the musical mnemonic device, and rote memorization, respectively (main effect).
6) Overall, more concrete words will be recalled than abstract words (main effect).
7) Overall, more words will be recalled at time 1 (immediate recall) than at time 2 (5 min delay recall) (main effect).

This study used a 3 (Method— musical mnemonic devices, method of loci, and rote memorization) x 2 (Word Type— concrete or abstract) x 2 (Time— time 1, immediate recall and time 2, 5 min delay recall) mixed ANOVA design, where Method and Word Type were between subjects variables and Time was the within subjects variable.

The dependent variable was the recall of correct words, defined as the number of words the participants recalled overall (item scoring). The scoring was based on Drewnowski and Murdock (1980). Items or words were scored as correct when participants correctly identified a word from the word list, regardless of order. For scoring, two spelling mistakes per one word were allowed where the participants either

added an extra letter, forgot a letter, or swapped letters. For example, some participants spelled “reverence” as “reverance,” or spelled “apendage” instead of “appendage.” However, it is important to note that words that were changed from singular to plural (ie. “councilmen” instead of councilman” or plural to singular “moral” instead of “morals”) were counted as incorrect. These were counted as incorrect because the participants identified a real word that was not located on the list, even though only one letter was incorrect.

CHAPTER III

METHODS

Participants

A convenience sample of students (approximately 18 years old and older), enrolled in Psychology courses at Central Washington University was used for this study. According to a power calculator, the sample required was 90 participants (Faul, Erdfelder, Lang, & Buchner, 2007). Only 86 participants participated in the study, resulting in a slightly reduced power. Participants were recruited through the Central Washington University's Department of Psychology's Sona system, an online recruitment tool. Fliers were posted around campus and in the Psychology Building to recruit more participants but all participants accessed the study through Sona. Participants had the option of earning extra credit in their psychology courses if it was offered by individual instructors. In order to participate in this study, the participants had to have English as their first language because they had to be able to read and comprehend the consent form, demographics information, and instructions. The participants could not have visual impairments that would impair their ability to see the instructions or the pictures for the study. Those with corrected visual impairments such as contacts and glasses, were allowed to participate so long as they wore the glasses/contacts during the entire study. Additionally, participants had to be able to hear the musical mnemonic devices. Participants with corrected hearing impairments, like those individuals with hearing aids, were allowed to participate in this study so long as they wore their hearing aids during the entire study.

Measures

Word list. The researcher used words from Brysbaert et al.'s (2014) research on English word lemmas. This word list was chosen because it was an updated version of concreteness and abstractness ratings compared to Paivio, Yuille, and Madigan's (1968) word list study, a popular source used by researchers. Brysbaert et al (2014) specifically measured concreteness and abstractness of words while other scales measured high imaginability ratings or low imaginability ratings (Clark and Paivio, 2004). Some researchers suggested that the imaginability and concreteness measure the same construct (Connell & Lynott, 2012; Madan, Glaholt, & Caplan, 2010; Reilly & Kean, 2006) while others do not consider the two to be the same (Dellantonio, Mulatti, Pastore, & Job, 2014). Additionally, this word list was chosen because it consisted of a large the sample of words. Brysbaert et al.'s wordlist contained roughly 40,000 words, which is the largest sample of concreteness and abstractness ratings available. The words on the Brysbaert et. al.'s list were rated by 25–30 raters using a five-point Likert scale from one to five with one representing how abstract the word was and five representing how concrete the word was. See http://crr.ugent.be/archives/1330 for the concrete and abstract nouns used.

Brysbaert et al.'s concreteness rating was validated by correlating the words to other popular rating scales. A comparison of 3,935 words from the Brysbaert et al. wordlist compared the same words found in Coltheart's (1981) MRC database for concreteness and abstractness (r = .919). Additionally, 615 words from the Brysbaert et al. wordlist were compared to the same words found in Lynott and Connell's (2013) and Lynott and Connell's (2009) word lists for perceptual strength (r = .898). While

Brysbaert et al.'s (2014) word list covers 40,000 words ranging from adjectives to prepositions, the current study focused on the concreteness and abstractness of nouns, which limited the number of potential words to roughly 14,000. This study used only 19 concrete and 19 abstract nouns because of the song, "Twinkle Twinkle Little Star." Because of the song, the word lists had to be tailored in order to fit the right amount of syllables in the song. The researcher was interested in matching the characteristics of the abstract noun word list as closely as possible to the concrete noun word list. For this study, the number of syllables for each word, the first letter of each word, as well as the number of letters for each word matched. Additionally, for each word on the word list, the mean of "concreteness" and mean of "abstractness" was matched. For example, the noun "splendor" had a concreteness mean of 1.59 while its concrete counterpart, "splinter," had a concreteness mean of 4.41 (a score of one representing how abstract the word was and five representing concrete the word was).

Demographic information. The participants read a consent form for the study and indicated that they "agreed." See Appendix A for the consent form. The participants filled out a background questionnaire regarding age, ethnicity, gender, year in school, first and last name, and student email address. See Appendix B for the background questionnaire. The participants received two points of extra credit.

Song selection for musical mnemonic devices. Based on previous literature, this study incorporated a musical mnemonic device that was created by the researcher for the participants because it allowed for the most control (Ludke et al., 2013; Van Voorhis, 2002). According to Wallace (1994), a sung presentation of the list of items the participants tried to recall could hinder verbal learning and memory if the song melody

and rhythm were too difficult for the participants to learn. This meant that the song melody and rhythm needed to be simple and clear for participants to understand. This study used the song of "Twinkle Twinkle Little Star," which the participants should be familiar with. The song of "Twinkle Twinkle Little Star" was public domain, copyright permission was not needed. A trained musician sang the songs and vocables that participants heard in the musical mnemonic device conditions (Caskey, 2016a, 2016b, 2016c). The study used "la la la" vocables during the recall task. The pitches of the song ranged from C4 to A4, all within one octave. The song was played at specifically 72 beats per minute using a metronome. Seventy-two beats per minute was chosen because researchers stated that a song may aid in verbal memory only if the song was presented at a rate that was slower than the rate of normal speech, 150 words per minute (Kilgour, Jakobson, & Cuddy, 2000; Ludke et al., 2013; National Center for Voice and Speech, n.d.). Also, according to Yalch (1991), for musical mnemonic devices to be the most efficient, it was important that the number of notes matched the number of syllables in the lyrics, which was accomplished in this study. The song was recorded on an iMac and edited using GarageBand. The songs were then transferred to Soundcloud and added to the Qualtrics survey. See Appendix C for links to the three sound checks, sung concrete list, sung abstract list, and the vocable of the song used in the recall portion of the test.

Pictures selected for method of loci. Based on previous literature, the researcher opted to create the loci used by the participants rather than allowing the participants to create their own. The pictures used in this study were public domain. The pictures were of 19 famous landmarks around the United States. Pictures of famous landmarks around

the United States were chosen because it was something that college students should have knowledge of. See Appendix D for the pictures chosen for the mnemonic device.

Qualtrics. This study was conducted online using Qualtrics survey software. There were 60 questions in the survey. The Qualtrics survey was set to randomly present the following conditions: method of loci using abstract words condition, method of loci using concrete words condition, musical mnemonic device using abstract words condition, musical mnemonic device using concrete words condition, rote memorization using abstract words condition, and rote memorization using concrete words condition.

Procedures

This study was submitted and approved by Central Washington University's Human Subjects Review Council. Participants were recruited through the Central Washington University's Department of Psychology's Sona system. Participants were instructed to complete the study individually (as instructed in the consent form). The participants read the consent form and agreed to the terms and conditions, which took approximately 5 min. The participants were then guided to the next page where they completed a background questionnaire regarding age, gender, ethnicity, and year in school. Participants received two points of extra credit for participation in the study. In total, the background questionnaire took approximately 10 min complete.

Next, the participants were randomly assigned to one of the six conditions: musical mnemonic device with concrete words, musical mnemonic device with abstract words, method of loci with concrete words, method of loci with abstract words, rote memorization with concrete words or rote memorization with abstract words. The rote memorization conditions served as the control conditions.

Musical mnemonic device conditions. If randomly assigned to one of the musical mnemonic device conditions (concrete or abstract word list), the participants were instructed to turn on speakers or wear headphones and keep speakers and headphones on for the remaining portion of the study. Next the participants took part in a sound check to ensure that the participants did have the volume turned on their speakers/headphones. If the participants correctly completed the first sound check correct, they moved on to the instructions for the musical mnemonic device memorization task. If the participants failed the sound check, then they moved to the second sound check. If the participants correctly completed the second check correct, they moved on to the instructions for the musical mnemonic device memorization task. If the participants failed the second check, then they moved to the third sound check. If the participants correctly completed the third sound check correct, they moved on to the instructions for the musical mnemonic device memorization task. If the participants failed third sound check, they were forwarded to the exit screen and thanked for participating in the study. The sound checks took approximately 1 to 2 min.

Assuming the participants successfully completed one of the three sound checks, the participants then read the instructions for the musical mnemonic device conditions. The instructions for the musical mnemonic device conditions did not differ for the concrete list of words or the abstract list of words. The only aspect that differed was whether the participants heard the concrete list of words to the song of "Twinkle Twinkle Little Star" or the abstract list of words to the song of a "Twinkle Twinkle Little Star." This took approximately 5 min. See Appendix E for the instructions for the musical mnemonic device conditions.

After clicking to the next page, the participants then participated in the learning period where they listened to a recording of singer singing the abstract list of 19 words or concrete list of 19 words in place of the words to "Twinkle Twinkle Little Star" for 5 min. The song was played at 72 beats per minute. The song was looped seven times. Research has found that melodies that are repeated lead to more items recalled than single exposure melodies (Wallace, 1994). The list of words appeared on the screen while the participants listened to the song. This portion took 5 min.

Immediate recall task for musical mnemonic device conditions. After 5 min, the participants were forced to move on to the next page where they recalled as many concrete or abstract words as possible using the vocables version of "Twinkle Twinkle Little Star." The participants were instructed to recall, in order, as best as they could. The participants were instructed to leave blank spaces if they knew they were skipping words. The participants typed the words in spaces provided for them. Some spelling errors were allowed. The participants had 5 min to recall the list with the same singer as before using the vocable version of the song "Twinkle Twinkle Little Star." This portion took 5 min.

Five minute delayed recall task for musical mnemonic device condition. After the 5 min immediate recall task was completed, the participants spent the next 5 min engaged in a distractor task. This distractor task consisted of answering math questions. The purpose of the distractor task was to provide a filler so the participants would be distracted from the previous recalled words. The distractor task lasted 5 min. See Appendix F for the math questions the participants completed. After the distractor task, the participants had another 5 min to recall the list of words with the vocable version of

"Twinkle Twinkle Little Star." Again, the participants typed the words in spaces provided for them. Some spelling errors were allowed. The participants were instructed to leave blank spaces if they knew they were skipping words.

After the participants completed the study or time ran out, they were debriefed, thanked for participating in the study, and instructed to exit the browser. These conditions (musical mnemonic device, abstract or concrete) took approximately 40 min to complete.

The method of loci conditions. If randomly assigned to one of the method of loci conditions (concrete or abstract word list), the participants read the instructions for the method of loci conditions presented on the screen. See Appendix G for the instructions for the method of loci conditions. The instructions for the method of loci conditions did not differ for the concrete list of words or the abstract list of words. The only aspect that differed was whether participants had a concrete list of words attached to pictures or an abstract list of words attached to pictures.

The words were listed on the screen with each of the landmarks. The landmarks followed an ordered path around the continental United States, starting with the Space Needle in Seattle and ending with Yellowstone National Park in Wyoming. The participants had 5 min to review the list associated with the famous United States landmarks. The pictures were displayed in a list format with either one concrete or abstract noun attached to one picture. The participants scrolled to see the pictures.

Immediate recall task for method of loci condition. After 5 min, the participants were forced to move on to the next page where they recalled as many concrete or abstract words as possible. The participants had 5 min to recall the list. The participants were instructed to recall in order as best as they could. Having the loci present was important

for the method of loci to work (Bower, 1970), therefore, during recall the pictures were available but the words were removed from each picture. The participants typed the words in the spaces provided for them just below each picture. Some spelling errors were allowed. Participants were instructed to leave spaces blank if they knew they were skipping words.

Five minute delayed recall task for method of loci condition. After the immediate recall task was completed, the participants spent the next 5 min engaged in a distractor task. This distractor task, described in the previous section, consisted of answering math questions. After the distractor task, the participants had another 5 min to recall the list using the method of loci they had been using previously. The pictures were presented when the participants tried to recall the words, but the words were taken off the pictures. The participants typed the words in the spaces provided for them just below each picture. Participants were instructed to leave spaces blank if they knew they were skipping words. Some spelling errors were allowed.

After the participants completed the study or time ran out, they were debriefed, thanked for participating in this study, and instructed to exit the browser. These conditions (method of loci, abstract or concrete) took approximately 40 min to complete.

The rote memorization conditions. The rote memorization conditions served as the control conditions. If randomly assigned to one of the rote memorization conditions (concrete or abstract word list), the participants read the instructions for the rote memorization conditions on the screen. See Appendix H for the instructions for the rote memorization conditions. The instructions for the rote memorization conditions did not differ between the concrete list of words or the abstract list of words. The only aspect

that differed was whether the participants had the concrete list of words or the abstract list of words.

The participants had 5 min to say the list of words out loud and in the order they were presented. The participants were told to repeat the list of words as many times as they could. This portion took 5 min.

Immediate recall task for the rote memorization condition. After 5 min, the participants were forced to move on to the next page where they recalled as many concrete or abstract words as possible. The participants typed the words in the spaces provided. Some spelling errors were allowed. Participants were instructed to leave space blank if they knew they were skipping words. The participants typed the words in the space provided for them. The participants had 5 min to recall the list.

Five minute delayed recall task for the rote memorization condition. After the immediate recall task was completed, the participants spent the next 5 min engaged in a distractor task. This distractor task, described in the musical mnemonic device section, consisted of answering math questions. After the distractor task, the participants had another 5 min to recall the list using the rote memorization strategy they had been using previously. The participants wrote the words in the spaces provided. Some spelling errors were allowed. Participants were instructed to leave spaces blank if they knew they were skipping words. Five minutes were allotted for this task.

After the participants completed the study or time ran out, they were debriefed, thanked for participating in this study, and instructed to exit out of browser. These conditions (rote memorization, abstract or concrete) took approximately 40 min to complete.

CHAPTER IV

RESULTS

One hundred participants participated in the study; data from 12 participants were excluded due to not finishing the immediate recall task or the 5 min delayed recall task. Data from one participant were excluded due to answering the questions incorrectly. Another participant was excluded because he/she was confused about the wording of the instructions and did not recall during the 5 min delayed recall task. Eighty-six participants fully completed the immediate and 5 min recall tasks. See Table 1 for a summary of the participant demographics.

Table 1

Summary of Participant Demographics

Gender	Age	Ethnicity	Year in School
Female = 76%	18-22 = 85%	Asian or Pacific Islander = 3%	Freshman = 21%
Male = 24%	23-27 = 3 %	Caucasian/White = 76%	Sophomore = 27%
Non-binary = 0%	28-32 = 2 %	Native American = 0%	Junior = 35%
	33-37 = 5%	Latino/Hispanic = 13%	Senior = 16%
	38+ = 5%	Black/African American = 3%	Graduate Student = 1%
		Puerto Rican = 1%	
		Other = 3%	

Note. Age is broken up into brackets of 5 years.

A Shapiro-Wilk Test was run to check for normality (*ps* > .004). Additionally, data were checked for homogeneity of variance. Levene's test showed that time 1 (immediate recall) (p = .135) and the time 2 (5 min recall) (p = .179) did not violate homogeneity of variance. Due to the online study format, there was no way to verify that the participants achieved independence. It was assumed the participants read the consent

form and noted they needed to take the test by themselves. Based on this, all of the assumptions for a mixed ANOVA were achieved.

Hypothesis 1

It was hypothesized that method of loci at time 1 (immediate recall) using concrete words would result in the most words recalled than any other method of memorization for concrete and abstract words at time 1 (immediate recall) and time 2 (5 min delay recall). The predicted interaction between Method, Word Type, and Time was non-significant, $F(2, 80)= .475$, $p = .624$.

Hypothesis 2

It was hypothesized that more concrete words would be recalled than abstract words at time 1 (immediate recall), followed by concrete words at time 2 (5 min delay recall). The predicted interaction between Word Type and Time was non-significant, $F(1, 80) = .909$, $p = .343$.

Hypothesis 3

It was hypothesized that the method of loci at time 1 (immediate recall) would result in the most words recalled, followed by the musical mnemonic devices at time 1 (immediate recall), rote memorization at time 1 (immediate recall), method of loci at time 2 (5 min delay recall), musical mnemonic devices at time 2 (5 min delay recall), and rote memorization at time 2 (5 min delay recall), respectively. The predicted interaction of Method and Time was non-significant, $F(2, 80) = 1.414$, $p = .249$.

Hypothesis 4

It was hypothesized that the method of loci using concrete words would result in more words recalled than those in the other methods of memorization using concrete and

abstract words. The predicted interaction of Method and Word Type was non-significant, $F(2, 80) = .288$, $p = .750$.

Hypothesis 5 and Hypothesis 6

It was predicted that overall, the method of loci would yield more words recalled, followed by musical mnemonic device and rote memorization. The main effect of Method was non-significant, $F(2, 80)= 2.830$, $p = .065$. The method of loci (M= 12.29, SD= 5.80) did not result in more words recalled compared to musical mnemonic device (M= 9.30, SD=5.66) or rote memorization (M = 11.59, SD=4.01). See Table 2 for Means and SDs of mnemonic devices.

Additionally, it was predicted that more concrete words than abstract words would be recalled. The main effect of Word Type was non-significant, $F(1, 80) = 1.110$, $p = .295$. The concreteness (M=11.61, SD = 5.46) or abstractness of the words (M= 10.50, SD = 5.21) did not influence the number of words recalled. See Table 3 for Means and SDs of word lists.

Hypothesis 7

It was predicted that more words would be recalled in the immediate recall task than in the 5 min delayed recall task. The main effect of Time was significant, $F(1, 80) = 14.840$, $p < .001$, $\eta_p^2 = .156$, *power* = .968. More words were recalled at time 1 (immediate recall) (M = 11.63, SD = 5.21) than at time 2 (5 min delay recall) (M = 10.48, SD= 5.47). See Table 4 for Means and SDs of Time. See Table 5 for a complete ANOVA table of findings.

Table 2

The Means and Standard Deviations for Method

Method	M	SD
MOL	12.29	5.80
MMD	9.30	5.66
ROTE	11.59	4.01

Note. MOL stands for method of loci, MMD stands for musical mnemonic devices, and ROTE stands for rote memorization. SD stands for standard deviations. M stands for means and represent the number of correct words out of 19 words and are averaged between time 1 (immediate recall) and time 2 (5 min delay recall).

Table 3

The Means and Standard Deviations for Word Type

Word	M	SD
CON	11.61	5.46
AB	10.50	5.21

Note. CON stands for the concrete words and AB stands for the abstract words. SD stands for standard deviations. M stands for means and represent the number of correct words out of 19 words and are averaged between time 1 (immediate recall) and time 2 (5 min delay recall).

Table 4

The Means and Standard Deviations for Time

Time	M	SD
IMM	11.63	5.21
5 MIN	10.48	5.47

Note. Imm stands for the immediate recall scores and 5 min stands for the 5 min delay recall scores. SD stands for standard deviations. M stands for means and are the number of correct words out of 19 words.

Table 5

Table of ANOVA Results

Source	*Type III SS*	*df*	*Mean Square*	*F*	*p*	*ηp2*	*Ob Power*
			Within-Subjects Summary				
Time	57.99	1	57.99	14.84	< .001	0.156	0.968
Time x Word	3.55	1	3.55	0.91	0.343	0.011	0.156
Time x Method	11.05	2	5.53	1.41	0.249	0.034	0.295
Time x Word x Metho	3.71	2	1.86	0.48	0.624	0.012	0.125
Error (Within)	312.66	80	3.91				
			Between-Subjects Summary				
Word	57.50	1	57.50	1.11	0.295	0.014	0.180
Method	293.12	2	146.56	2.83	0.065	0.066	0.541
Word x Method	29.86	2	14.93	0.29	0.75	0.007	0.094
Error (Between)	4143.04	80	51.79				

Note. df stands for degrees of freedom, η_p^2 stands for partial eta squared, and Ob Power stands for observed power.

CHAPTER V

DISCUSSION

The purpose of the current study was to further understand mnemonic devices and their effect on recalling abstract or concrete words at two time points, immediate and a 5 min delay. As reported, there were no statistically significant results found beyond the main effect of Time, but there were trends in the data. See Table 6 for a table of means for every condition. There were a number of factors that may have played a role in results found in this study, and these are explored below.

Table 6

Table of Means

Method	Word	Time	Means	SD	N
MMD	AB	IMM	9.07	5.09	14
MOL	AB	IMM	13.00	5.91	14
ROTE	AB	IMM	11.6	3.98	15
MMD	CON	IMM	10.2	5.97	15
MOL	CON	IMM	12.47	5.57	15
ROTE	CON	IMM	13.62	3.57	13
MMD	AB	5 MIN	8.36	5.57	14
MOL	AB	5 MIN	11.43	5.65	14
ROTE	AB	5 MIN	9.53	4.42	15
MMD	CON	5 MIN	9.47	6.21	15
MOL	CON	5 MIN	12.27	6.41	15
ROTE	CON	5 MIN	11.92	3.55	13

Note. IMM stands for the immediate recall scores and 5 MIN stands for the 5 min delay recall scores. CON stands for the concrete words and AB stands for the abstract words. MMD stands for musical mnemonic devices, MOL stands for method of loci, and ROTE stands for rote memorization M stands for means and represents the number of correct words out of 19 words. SD stands for standard deviations. N stands for the number of participants per condition.

As noted, there was a statistically significant main effect of Time. Specifically, the participants recalled more items at time 1 (immediate recall) than they did in at time 2

(5 min delay recall). This finding was supported by previous research (Carlson, Zimmer, & Glover, 1981; Carney & Levin, 2008; Roediger & Karpicke, 2006; Wheeler, Ewers, & Buonanno, 2003). A plausible reason why there was a main effect of Time was because the immediate recall task happened right after the learning period when the material was fresh on the participants' minds. During the 5 min delayed recall task however, the participants had just completed a distractor task of math questions, something completely different from the items being recalled. The distractor task may have inhibited the participant in recalling as many words for the 5 min delayed recall by "minimiz[ing] the participant's rehearsal of material and ensur[ing] that it [was] not currently stored in working memory" for the 5 min delayed recall task (VandenBos, 2015, p. 326). Previous research has shown that participants recall fewer items after a distractor task than before a distractor task (Roediger & Karpicke, 2006; Rowland & DeLosh, 2015).

Method of Loci

With respect to memorization Method, while differences were non-significant, a few notable trends emerged. It appeared that participants in the method of loci conditions recalled more words than for those participants in the musical mnemonic device conditions and rote memorization conditions (see Table 1). This trend has been seen in other literature on the method of loci, showing that it is plausible that the method of loci is an effective learning technique to recall words (Carlson, Kincaid, Lance, & Hodson, 1976; Legge et al., 2012; Qureshi et al., 2014).

Other research on mnemonic devices has suggested that the method of loci is an effective strategy when training is involved (Roediger, 1980). Roediger (1980) asked the participants to attend a training session, practice their mnemonic device, and then return

24 hours later to take the recall tests. It is reasonable to suggest that significant results were not found in the current study because the participants did not have an adequate amount of time to learn and rehearse the mnemonic device properly. According to McCabe, Osha, Roche, and Susser (2013), the method of loci was one of the mnemonic devices that undergraduate students were not familiar with in their study. It is possible that the lack of familiarity with the mnemonic device influenced the participants' ability to correctly use the device.

Previous research suggested that the method of loci may be more effective when the participants create their own loci because it adds a familiar element, making the method more meaningful to the participants (Bower, 1970; Massen et al., 2009; McCabe et al., 2013). The participants in the current study did not create their own loci; the researcher wanted to add as much control as possible to the study and thus created the loci for the participants. Not being familiar with the device, potentially needing more practice time to understand the method of loci, and not having the participants create their own loci offer a few suggestions as to why the results of this study did not mimic those found in the literature.

Musical Mnemonic Devices

While research has indicated that musical mnemonic devices are effective as memory aids (Ludke et al., 2013; VanVoorhis, 2002), other research has found that musical mnemonic devices are less efficient at recall than spoken word. For example, Peterson and Thaut (2007) conducted an EEG study using adults and tested to see whether participants in the singing version of Rey's Auditory Verbal Learning Test (AVLT) or a spoken version of the AVLT would promote the highest recall. The results

of the EEG showed that there were some differences in the frontal areas, which have been found to be related to learning. However, the results of the behavioral test (AVLT) showed that the participants in the singing version condition did worse on the AVLT than the participants in the spoken word condition. Peterson and Thaut (2007) suggested these results were found because of a modality issue between the learning period and the recall task. In their study, some of the participants heard a song, but were asked to recall the words by speaking instead of singing. Research has suggested that modality works best when it is the same between the learning period and recall period (e.g. singing learning period and a singing recall task).

Racette and Peretz (2007) conducted a study that explored the use of musical mnemonic devices by musicians and non-musicians. The learning and recall material used in the study was a song by a French-Canadian folksinger. The participants were assigned to one of three conditions: participants heard the song in the learning period and during recall they sang the song back, participants heard the song in the learning period and spoke the word back in recall, or participants heard the lyrics spoken in the learning period and spoke the words back during recall. The results showed that the participants in the singing conditions, regardless of being musicians or non-musicians, recalled less words than those in the spoken conditions. The researchers suggested that the music may have inhibited recall rather than aided in recall because the participants' attention was divided between the music and the lyrics. In the current study, there was a chance that the music may have divided the participants' attention as well and constrained the participants' ability to recall the word lists.

Research has also shown that while musical mnemonic devices may be helpful for some populations, specifically those with memory deficits, others may not benefit to the same degree. Simmons-Stern, Budson, and Ally (2010) conducted a study using healthy older adult participants and participants with Alzheimer's disease. The participants listened to 20 children's songs being sung and 20 children's songs being spoken. The participants were then given a list of 80 song lyrics and were asked to recognize which song lyrics were new or ones they heard previously. The results demonstrated that the participants who had Alzheimer's disease identified more children songs when singing was involved compared to when the songs were spoken. In the healthy adults, however, there were no differences between the singing and speaking at the recognition task. The current study's population consisted of healthy young adults, not cognitively impaired individuals, so perhaps this could explain why the participants in the musical mnemonic device conditions did not benefit from the technique for recall.

In the current study there was a trend that indicated the participants in the musical mnemonic device conditions recalled the least amount of words compared to the other conditions. See Table 1 for the means and standard deviations of the method utilized in the study. The data found in the current study might have differed from the statistically significant findings found in other research for a number of reasons. Contrary to Racette and Peretz (2007), Schellenberg and Weiss (2013) suggested that musical mnemonic devices may only be beneficial to musicians because musicians may pay closer attention to the music than non-musicians and thus may be better listeners. The researchers suggested that "music training may enhance the processing of temporal order for auditory stimuli . . . , which could mediate the link between training and verbal memory" (p. 521).

The current study did not specifically target musicians, but instead focused on the general college student; it is conceivable that this could have resulted in non-significant findings. Future research should investigate the difference between musicians and non-musicians in recall using musical mnemonic devices.

According to Brown and Craik (2000), the success of a musical mnemonic devices may be impacted by a number of things such as the instructions given and prior knowledge. Well written instructions that describe the mnemonic device could potentially aid in the participants' ability to use the mnemonic device efficiently. The researcher attempted to provide clear instructions for the musical mnemonic device conditions, but there was still a chance of miscommunication since the study was online and the participants could not ask the researcher for clarification. Regarding prior knowledge of these devices, some participants might have been more familiar with mnemonic devices than others, which may have aided them being able to recall more words than others. With the online nature of the study, these issues could not be controlled and could have played a role in the results.

As previously mentioned, the modality of the musical mnemonic device between the learning period and recall period may have played an important role in recall (Ferreri & Verga, 2016; Peterson & Thaut, 2007). For example, if the participants listened to a song during recall, they should have recalled the song by singing; this should have led to participants being able to learn and recall more words than they would if the modality between the learning and recall did not match (Ferreri & Verga, 2016). The current study did not have a consistent modality for the learning period and recall task. For the learning period, the participants listened to the song, but during recall they had a

writing/typing recall task. Future research studies should ensure that the modality between the learning period and recall task match.

Concrete vs Abstract Words

Previous research has demonstrated that concrete words were recalled more efficiently compared to abstract words (Belmore et al., 1982; Fliessbach, Weis, Klaver, Elger, Weber, 2006; Gullick et al., 2013). Although differences between recall of concrete and abstract words were non-significant, data in the current study suggested the participants in the concrete conditions recalled more words than the participants in the abstract conditions. See Table 2 for means and SDs of word lists. The dual code theory (Paivio, 1991) suggested that concrete words elicit both a verbal processing and an image processing when recalling the words; abstract words lack the image and solely rely on verbal processing. Based on the context-availability model (Schwanenflugel, 1991), concrete words should be easier to put into context than abstracts words because participants often substitute the abstract word with a concrete words. These two theories together may help explain how concrete words could be recalled more easily than abstract words. Legge et al. (2012) found a main effect of imageability, which suggested that high imageability words (like concrete words) were recalled at a higher rate than low imageability words (like abstract words). Additionally, the amount a person recalls depends on a number of factors that the researcher could not control such as motivation and attention span, which could potentially play a role in the lack of statistically significant findings (Baddeley, 2000b). Another feasible explanation as to why statistical findings may not have been found could have been due to a small sample size. The original estimation of sample size needed to achieve a power of .95 was calculated

inaccurately. The correct number of participants needed to achieve a power of .95 was 132 participants. The sample for this study was 86, which resulted in low statistical power for the interactions and main effects except for the main effect of time and likely contributed to the non-significant results.

Overall, the results of this study offered few definitive conclusions regarding the proposed hypotheses. Due to a small sample size, low statistical power, minimal training time for mnemonic devices, lack of modality between learning and recall, and other confounding variables, future research is necessary in order to investigate whether mnemonic devices lead to a higher recall than rote memorization as well as whether participants will recall more concrete words than abstract words.

Limitations

There were many limitations in this study. First, a question at the end of the first part of the study asking if the participants studied during the distractor task was inadvertently excluded. Without knowing this information, there was no way of knowing if the participants spent time practicing the mnemonic devices. If the participants had practiced the mnemonic device during the distractor task, it is likely to assume that the participants would have recalled more words on the 5 min delay task than the immediate recall task. Knowing this information as to whether the participants practiced the mnemonic device during the distractor task is important because it would allow the researcher to understand the recall scores more accurately. Although practice aids in the effectiveness of the mnemonic device, (Massen et al., 2009; Roediger, 1980) some research have also found no effects of practice (Calvert, 2001).

Second, the number of participants needed to run the mixed ANOVA and achieve power was 90 according to a sample size power calculator (Faul et al., 2007). This was not achieved, which could have influenced the lack of statistical findings. Third, while the online nature of study allowed for easier data collection, this made it impossible to control for individual participant variables such as motivation, distractions from environment, and confusion of instructions.

Fourth, this study used only one method, free recall, to measure whether the participants recalled the words using their mnemonic devices. Research has shown that there are a variety of tests that may be beneficial in measuring recall such as EEG, recognition recall tasks, Test of Memory and Learning – Second Edition (TOMAL-II), etc. (Ferreri & Verga, 2016; Ludke, et al., 2014). One method alone may not be sensitive enough to demonstrate that mnemonic devices do aid in recall.

Fifth, the song chosen for the musical mnemonic device conditions may have played a role in the lack of statistically significant findings. The researcher chose "Twinkle Twinkle Little Star" because it should be a song that everyone is familiar with. However, the song may have caused participants to recall adverse childhood experience and may have hindered the recall of the words. Perhaps future research should allow the participants to select from a list of three songs.

Future Studies

The lack of statistically significant findings presents new opportunities to further explore the use of the method of loci and musical mnemonic devices for recall of concrete and abstract words. It is reasonable that an increase in sample size would result in findings more consistent with the literature. The original estimation of sample size

needed to achieve a power of .95 was calculated inaccurately. The correct sample size for a 3 (Method— musical mnemonic devices, method of loci, and rote memorization) x 2 (Word Type— concrete or abstract words) x 2 (Time— immediate recall or 5 min delay recall) mixed ANOVA design, where Method and Word Type were between subjects and Time was within subjects, is a sample size of 132 participants; this would allow for sufficient and normally distributed data (Faul et al., 2007).

In future research, the researcher would like to add a few questions that ask how difficult the participants thought the task was and if they understood the instructions. This would tell the researcher that the results found were due to the actual conditions or the administration of the study itself. Future studies would also like to add a question about whether the participants in the musical mnemonic device conditions listened or tried to sing along while recalling the word lists and whether the participants in the method of loci conditions used the cognitive map while recalling the words. This would help the researcher better understand the results.

The researcher would like to investigate the tempo of the musical mnemonic device conditions in future research as well. There is a gap in the literature about what tempo works best for musical mnemonic devices. The researcher opted to use 72 bpm because that is what Ludke et al. (2013) used on their research involving musical mnemonic devices and found significant results. However, 72 bmp is incredibly slow. The current researcher is afraid that with such a slow tempo, the tune of the song was lost in translation. For future studies, the researcher would like to investigate the effects of bpm on musical mnemonic devices and see what tempo works best for the mnemonic device.

Additionally, one of the fascinating things about the use of mnemonic devices is the influence they have on the ability to recall words in the same order they were learned (Calvert, 2001; Claussen & Thaut, 1997; Legge et al., 2012; Ludke et al., 2013; Roediger, 1980). However, item scoring does not capture this ability, which is what was utilized in this study. Item scoring counts an item as "correct" if the participant listed the correct word, regardless of order. For example, if the list of items the participants had to recall were "Harry," "Ron," "Hermione," "Voldemort," and "Draco" and the participant put "Hermione," "Voldemort," "Draco," "Ron," and "Harry," all items would be scored as correct even though they were in the incorrect order. Future studies investigating the use of mnemonic devices should incorporate the use of multiple scoring methods, such as relative order scoring and strict position order scoring, to see if the mnemonic devices promote a higher recall of information in the correct order compared to rote memorization. Also, research has shown that there are a variety of different tests ranging from behavioral tests (e.g. TOMAL-II) to EEG that may be beneficial in measuring recall besides a free recall task; future studies would like to look into these different avenues as well.

Finally, an important question regarding long term recall of information was not investigated due to the small sample size and high attrition rate. Research has shown that musical mnemonic devices could be an effective method for delayed recall (Calvert & Tart, 1993; Rainey & Larsen, 2002). Calvert & Tart (1993) used college students to test for long term recall of a School House Rock song about the Preamble. The participants were randomly assigned to one of four conditions: "singing with repetition, verbal with repetition, singing without repetition, and verbal without repetition" (p. 253). The

researchers used an immediate recall task and a 5-week later recall task. The results of the study demonstrated that the participants in the singing conditions recalled more words than the participants in the verbal conditions for both the immediate recall task and 5-week later recall task. Rainey and Larsen (2002) conducted a study using college students to test whether musical mnemonic devices were more efficient at recalling the Boston Braves and Cleveland Indians rosters from the 1948 World Series. The participants either learned the roster through speaking or singing the rosters to the song of "Pop Goes the Weasel." One week later, the participants recalled the information. The results demonstrated that the participants in the singing condition were able to remember the rosters more quickly than those in the speaking condition. Research has also suggested that the method of loci may be a beneficial way to recall information in a long-term memory task. Dalgleish, Navrady, Bird, Hill, Dunn, & Golden (2013) conducted a study on whether the method of loci was an effective way to recall self-affirming memories for people who were depressed. The study consisted of adult participants who were struggling with depression and consisted of two conditions: the method of loci condition where the participants connected 15 happy memories to 15 spatial locations along a familiar route, like the journey from work to the home, and the rehearsal condition where the participants rehearsed the 15 happy memories. Dalgleish et al. (2013) had an immediate recall task and a 1 week later recall task. The results demonstrated that the participants in the method of loci condition recalled more of the happier memories than the participants in the rehearsal condition for the 1 week later recall task. The researcher of this current study hypothesizes that musical mnemonic

device conditions will promote the highest recall of words than the method of loci conditions or the rote memorization conditions in a delayed recall task.

Conclusion

In conclusion, the current study focused on mnemonic devices and which method— musical mnemonic devices, the method of loci, or rote memorization— was better at recalling abstract words or concrete words. The results showed that the participants recalled more words in the immediate recall task than they did in the 5 min recall task. Future research should focus on collecting more participants in order to achieve power and assess long term recall via a 1 week later recall task. The findings of the current study add to the existing literature on mnemonic devices and concrete and abstract words.

REFERENCES

Aben, B., Stapert, S., & Blokland, A. (2012). About the distinction between working memory and short term memory. *Frontiers in Psychology*, *3*, 301. http://dx.doi.org/10.3389/fpsyg.2012.00301

Baddeley, A. (2000a). The episodic buffer: A new component of working memory? *Cognitive Sciences, 4*(11), 417-423.

Baddeley, A. (2000b). Short-term and working memory. In E. Tulving & F. I. M. Craik (Eds), *The Oxford handbook of memory* (pp. 77-92). New York: University Press.

Baddeley, A. (2003). Working memory: looking back and looking forward. *Nature Reviews| Neuroscience, 4*, 829-839.

Bellezza, F. S. (1981). Mnemonic devices: Classification, characteristics, and criteria. *Review of Educational Research, 51*(10), 247-275.

Bellezza, F. S. (1996). Mnemonic methods to enhance storage and retrieval. In E. L. Bjork & R. A. Bjork (Eds). *Memory: Handbook of perception and cognition*. San Diego: Academic Press.

Bellezza, F. S., & Reddy, B. G. (1978). Mnemonic devices and natural memory. *Bulletin of Psychonomic Society, 11*(5), 277-280.

Belmore, S. M., Yates, J. M., Bellack, D. R., Jones, S. N., & Rosenquist, S. E. (1982). Drawing inferences from concrete and abstract sentences. *Journal of Verbal Learning & Verbal Behavior*, *21*(3), 338-351. doi:10.1016/S00225371(82)906594

Bennett, S. (2009). Music may improve verbal memory-implications for children with down syndrome. *Down Syndrome: Research and Practice, 12*(3), 173-174.

Bower G. H. (1970). Analysis of a Mnemonic Device: Modern psychology uncovers the powerful components of an ancient system for improving memory. *American Scientist, 58*(5), 496-510.

Brown, S. C., & Craik, F. I. (2000). Encoding and retrieval of information. In E. Tulving & F. I. M. Craik (Eds.), *The oxford handbook of memory* (pp. 93-107). New York: Oxford University Press.

Brysbaert, M., Warriner, A. B., & Kuperman, V. (2014). Concreteness ratings for 40,000 generally known English word lemmas. *Behavior Research Methods, 46*, 904911. doi:10.3758/s13428-013-0403-5

Calvert, S. L. (2001). Impact of televised songs on children's and young adults' memory of educational content. *Media Psychology, 3*(4), 325-342. doi: 10.1207/S153278 5XMEP0304_02

Calvert, S. L., & Tart, M. (1993). Song versus verbal forms for very-long term, long term, and short-term verbatim recall. *Journal of Applied Developmental Psychology, 14*, 245-260.

Carlson, L., Zimmer, J. W., & Glover, J. A. (1981). First-letter mnemonics: DAM (don't aid memory). *The Journal of General Psychology, 104*, 287-292.

Carlson, R. F., Kincaid, P., Lance, S., & Hodgson, T. (1976). Spontaneous use of mnemonics and grade point average. *The Journal of Psychology, 92*, 117-122.

Carney, R. N., & Levin, J. R. (1991). Mnemonic techniques and art education: Get the picture. *College Student Journal, 25*(3), 318-324.

Carney, R. N., & Levin, J. R. (1994). Combining mnemonic strategies to remember who paintedwhat when. *Contemporary Educational Psychology, 19*(3), 323-339.

Carney, R. N., & Levin, J. R. (1998). Mnemonic strategies for adult learners. In M. C. Smith and T. Pourchot (Eds.), *Adult learning and development: Perspectives from educational psychology* (pp. 159-175). Mahwah, NJ: Erlbaum.

Carney, R. N., & Levin, J. R. (2008). Conquering mnemonophobia with help fro three practical measures of memory and application. *Teaching of Psychology, 35*, 176 183. doi: 10.1080/00986280802186151

Caskey, H. R. (2016a). Abstract word list recorded to the tune of "Twinkle Twinkle Little Star" [by Ann Taylor (1806), Recorded by H. R. Caskey]. Ellensburg, WA.

Caskey, H. R. (2016b). Concrete word list recorded to the tune of "Twinkle Twinkle Little Star" [by Ann Taylor (1806), Recorded by H. R. Caskey]. Ellensburg, WA.

Caskey, H. R. (2016c). Vocables to the tune of "Twinkle Twinkle Little Star" [by Ann Taylor (1806), Recorded by H. R. Caskey]. Ellensburg, WA.

Chan, A. S., Ho, Y., & Cheung, M. (1998) Music training improves verbal memory. *Nature, 396,* 128.

Clark, J. M., & Paivio, A. (2004). Extensions of the Paivio, Yuille, & Madigan (1968) norms. *Behavior Research Methods, Instruments, & Computers, 36*(3), 371-383.

Claussen, D. W., & Thaut, M. H. (1997). Music as a mnemonic device for children with learning disabilities. *Canadian Journal of Music Therapy, 5*(1), 55-66.

Coltheart, M. (1981). The MRC psycholinguistic database. *The Quarterly Journal of Experimental Psychology, 33,* 497-505.

Connell, L., & Lynott, D. (2012). Strength of perceptual experience predicts word processing performance better than concreteness or imageability. *Cognition, 125*(3), 452-465. doi: 10.3758/BRM.41.2.558

Cowan, N. (2008). What are the differences between long-term, short-term, and working memory*? Prog. Brain Res. 169*, 323–338. doi:10.1016/S0079-6123(07)00020-9

Dalgleish, T., Navrady, L., Bird, E., Hill, E., Dunn, B. D., & Golden, A. (2013). Method-of-loci as a mnemonic device to facilitate access to self-affirming personal memories for individuals with depression. *Clinical Psychological Science 1*(2), 156-162. doi:10.1177/2167702612468111

Dellantonio, S., Mulatti, C., Pastore, L., & Job, R. (2014). Measuring inconsistencies can lead you forward: Imageability and the x-ception theory. *Frontiers in Psychology, 5*, 708.

Diamond A. (2013). Executive functions. *Annual Review of Psychology, 64,* 135–168. doi:10.1146/annurev-psych-113011-143750

Drewnowski, A., & Murdock, B. B. (1980). The role of auditory features in memory span for words. *Journal of Experimental Psychology: Human Learning and Memory, 6,* 319-332.

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, *39*, 175-191.

Ferreri L., & Verga, L. (2016). Benefits of music on verbal learning and memory: How and when does it work? *Music Perception, 34*(2), 167-182. doi:10.1525/MP.2-16.34.167

Fliessbach, K., Weis, S., Klaver, P., Elger, C. E., Weber, B. (2006). The effect of word concreteness on recognition memory. *Neuroimage, 32*(3), 1413-1421.

Gathercole, S. E., & Alloway, T. P. (2006). Practitioner review: Short-term and working memory impairments in neurodevelopmental disorders: Diagnosis and remedial support. *Journal of Child Psychology and Psychiatry 47*(1), 4 –15. doi:10.1111/j.1469-7610.2005.01446.x

Gullick, M. M., Mitra, P., & Coch, D. (2013). Imagining the truth and the moon: An electrophysiological study of abstract and concrete word processing. *Psychophysiology*, *50*(5), 431-440. doi:10.1111/psyp.12033

Heaton, P. (2009). Assessing musical skills in autistic children who are not savants. *Philosophical Transaction of the Royal Society B-Biological Sciences, 364*, 1443-1447.

Ho, Y., Cheung, M., & Chan, A. S. (2003). Music training improves verbal but not visual memory: Cross-sectional and longitudinal explorations in children. *Neuropsychology, 17*(3), 439-450.

Kilgour, A. E., Jakobson, L. S., & Cuddy, L. L. (2000). Music training and rate of presentation asmediators of text and song recall. *Memory & Cognition, 28*(5), 700-710.

Klee, H., & Eysenck, M. W. (1973). Comprehension of abstract and concrete sentences. *Journal of Verbal Learning & Verbal Behavior*, *12*(5), 522-529. doi:10.1016/S0022-5371(73)80032-5

Laing, G. K. (2010). An empirical test of mnemonic devices to improve learning in elementary accounting. *Journal of Education For Business*, *85*(6), 349-358. doi:10.1080/08832321003604946

Legge, E. L., Madan, C. R., Ng, E. T., & Caplan, J. B. (2012). Building a memory palace in minutes: Equivalent memory performance using virtual versus conventional environments with the method of loci. *Acta Psychologica, 141*, 380-390.

Ludke, K. M., Ferreira, F., & Overy, K. (2014). Singing can facilitate foreign language learning. *Memory & Cognition*, *42*(1), 41-52. doi:10.3758/s13421-013-0342-5

Lynott, D., & Connell, L. (2009). Modality exclusivity norms for 423 object properties. *Behavior Research Methods, 41*(2), 558-564. doi: 10.3758/BRM.41.2.558

Lynott, D., & Connell, L. (2013) Modality exclusivity norms for 400 nouns: The relationship between perceptual experience and surface word form. *Behavior Research Methods, 45,* 516-526.

Madan, C. R., Glaholt, M. G., & Caplan, J. B. (2010). The influence of item properties on association-memory. *Journal of Memory and Language, 63*, 46-63.

Maguire, E. A., Valentine, E. R., Wilding, J. M., & Kapur, N. (2003). Routes to remembering: the brains behind superior memory. *Nature Neuroscience, 6*(1), 90 95.

Massen, C., Vaterrodt-Plunnecke, B., Krings, L., & Hilbig, B. E. (2009). Effects of instruction on learners' ability to generate an effective pathway in the method of loci. *Memory, 17(*7), 724-731.

McCabe, J.A. (2011). Integrating mnemonics into psychology instruction. *Office of Teaching Resources in Psychology*, 1-32. Retrieved from: http://teachpsych.org/resources/Documents/otrp/resources/mccabe11.pdf

McCabe, J. A., Osha, K. L., Roche, J. A., & Susser, J. A. (2013). Psychology students' knowledge and use of mnemonics. Teaching of Psychology, 40(3), 183-192. doi: 10.1177/0098628313487460

McElhinney, M., & Annett J. M (1996). Pattern of efficacy of a musical mnemonic on recall of familiar words over several presentations. *Perceptual and Motor Skills, 82*(2), 395-400.

Miller, G. A. (1956). The magical number seven plus or minus two: Some limits on our capacity for processing information. *Psychological Review*, *63*, 81-97.

National center for voice and speech. (n.d.). Retrieved from: http://ncvs.org/ncvs/tutorials/voiceprod/tutorial/quality.html

Paivio, A. (1991). Dual coding theory: Retrospect and current status. *Canadian Journal of Psychology/Revue Canadienne De Psychologie*, *45*(3), 255-287. doi:10.1037/h0084295

Paivio, A., Yuille, J. C., & Madigan, S. A. (1968). Concreteness, imagery and meaningfulness values for 925 nouns. *Journal of Experimental Psychology, 76*(1, Pt. 2), 1-25.

Peterson, D. A., & Thaut, M. H. (2007). Music increases frontral EEG coherence during verbal learning. *Neuroscience Letters, 412*(3), 217-221.

Qureshi, A., Rizvi, F., Syed, A., Shahid, A., & Manzoor, H. (2014). The method of loci as a mnemonic device to facilitate learning in endocrinology to improve in student performance as measured by assessments. *Advances in Physiology Education, 38*, 140-144. doi: 10.1152/advan.00092.2013

Racette, A., & Peretz, I. (2007) Learning lyrics: To sing or not to sing? *Memory and Cognition*, *35,* 242-253. doi: 10.3758/BF03193445

Rainey, D. W. & Larsen, J. D. (2002). The effect of familiar melodies on initial learning and long-term memory for unconnected text. *Music Perception, 20*(2). 173-186.

Raz, A., Packard, M. G., Alexander, G. M., Buhle, J. T., Zhu, H., Yu, S., and Peterson, B. S. (2009). A slice of pi : An exploratory neuroimaging study of digit encoding and retrieval in a superior memorist. *Neurocase*, *15*(5), 361-372. doi: 10.1080/13554790902776896

Reilly, J., & Kean, J. (2006). Formal distinctiveness of high- and low- imageability nouns: Analyses and theoretical implications. *Cognitive Science, 31*, 157-168.

Roediger, H. L. (1980). The effectiveness of four mnemonics in ordering recall. *Journal of Experimental Psychology: Human Learning And Memory, 6*(5), 558-567.

Roediger, H. L., & Karpicke, J. D. (2006). Test-enhanced learning: Taking memory tests improve long-term retention. *Psychological Science, 17*(3), 249-255. Stable URL: http://www.jstor.org/stable/40064526

Rojo, N., Amengual, J., Juncadella, M., Rubio, F., Camara, E., Macro-Pallares, J., & Rodriguez-Fornells, A. (2011). Music-supported therapy induces plasticity in the sensorimotor cortex in chronic stroke: A single-case study using multimodal imaging (fMRI-TMS). *Brain Injury, 25,* 787-793.

Rosenheck, M. B., Levin, M. E., & Levin, J. R. (1989). Learning botany concepts mnemonically:Seeing the forest and the trees. *Journal of Educational Psychology, 81*(2), 196-203).

Rowland, C. A., & DeLosh, E. L. (2015). Mnemonic benefits of retrieval practice at short retention intervals. *Memory, 23*(3), 403-419, 10.1080/09658211.2014.889710.

Rubin, D. (1977). Very long-term memory for prose and verse. *Journal of Verbal Learning and Verbal Behavior*, *16*, 611-621.

Schellenberg, E. G., & Weiss, M. W. (2013). Music and cognitive abilities. In D. Deutsch (Ed.), *The psychology of music 3rd ed.* (pp. 499-550). Amsterdam: Elsevier.

Schwanenflugel, P. (1991). Why are abstract concepts hard to understand? In P. Schwanenflugel (ed.), *The psychology of word meanings* (pp. 223-250). New Jersey: Lawrence Erlbaum Associates.

Sharps, M. J., & Price-Sharps, J. L. (1996). Visual memory support: An effective mnemonic device for older adults. *The Gerontologist 26*(3), 706-708.

Simmons-Stern, N. R., Budson, A. E., & Ally, B. A. (2010). Music as a memory enhancer in patients with Alzheimer's disease. *Neuropsychologia, 48*(10), 3164-3167.

Slevc, L. R., & Miyake, A. (2006). Individual differences in second-language proficiency: Does music ability matter? *Psychological Science, 17*, 675-681.

Tulving, E., & Craik, F. I. M. (2000). The Oxford handbook of memory. Oxford: Oxford University Press.

Vandenbos, G. R. (Ed.) (2015). *APA dictionary of psychology*. Washington, DC: American Psychological Association.

VanVoorhis, C. (2002). Stat jingles: To sing or not to sing. *Teaching of Psychology, 29*, 3, 249- 250.

Vocable [Def. 1]. (n.d.). In *Merriam-Webster Online.* Retrieved May 5, 2017 from https://www.merriam-webster.com/dictionary/vocable

Wallace W.T. (1994). Memory for music: Effect of melody on recall of text. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 20*, 1471-1485. doi: 10.1037/0278-7393.20.6.1471

Wheeler, M. A., Ewers, M., & Buonanno (2003). Different rates of forgetting following study versus test trials. *Memory, 11*(6), 571-580. doi:0.1080/09658210244000414

Yalch, R. F. (1991). Memory in a jingle jungle: Music as a mnemonic device in communicating advertising slogans. *Journal of Applied Psychology, 76*(2), 268-275. doi:10.1037/0021-9010.762.268

Yates, F. A. (1966). *The art of memory.* Chicago: University of Chicago Press.

APPENDIXES

Appendix A

Consent Form

Please read the following information about this research study and click the "I accept" button at the bottom of your screen if you are interested in participating.

The following survey is part of a research study examining the effects mnemonic devices have on memory. This research study will add to the growing literature on memory in college students.

Anyone who has English as their first language, is 18 years or older, has no visual impairments (after correction), and no auditory impairments (after correction) can participate in this survey. You must complete this study alone and in a quiet room.

This portion of the web-based survey will take approximately 40 minutes to complete. By choosing to participate you will help expand the knowledge about how people use mnemonic devices to aid in memory recall. You will be randomly selected to be in 1 of 3 conditions.

Your decision to participate is strictly voluntary. There is a risk of experiencing mild anxiety, but nothing more than what you would experience in a college course. You are free to answer all, some or none of the questions on the survey. You may withdraw from participating at any time and to do so you simply close the Internet browser. Declining to participate will involve no penalty to you.

I am asking for you to provide your STUDENT email addresses and FIRST and LAST name, so I can send you a follow up memory study one week later. You will be provided extra credit for completing the first part of the study and will be rewarded more extra credit for completing the one week later portion of the study. The one week later portion of the study will take approximately 20 minutes to complete.

Once you have provided your email address and first and last name and have taken the second portion of the study, your data will be coded without identifiers. Because I am collecting your email address as well as first and last name, the data is not anonymous, but I will protect you by keeping the data on a password protected computer, locked office, and an encrypted flash drive. Data will be stored on a secure server and can only be accessed by the research team. Your data may be used in future studies conducted by the researcher.

Reasonable and appropriate safeguards have been used in the creation of the web-based survey to maximize the confidentiality and security of your responses; however, when

using information technology, it is never possible to guarantee complete privacy.

Individual results will not be available, but you may request the overall study results by emailing Sky Corby or Dr. Radeke. You can ask further questions about the research by contacting Sky Corby, graduate student at Central Washington University, at (405) 625-3700 or at corby.sky@gmail.com or Dr. Radeke, Associate Professor of Psychology at Central Washington University, at (509) 963-2367 or radekem@cwu.edu. You may also contact CWU Human Protections Administrator if you have questions about your rights as a participant or if you think you have not been treated fairly. HSRC office number is (509) 963-3115.

Please click “I accept” if you wish to participate or "I do not consent and wish to logout of this survey" to not participate. After clicking one of the two options, please press the red arrow to continue.

Appendix B

Background Questionnaire

Background Questionnaire

For the following items, please select the one response that is more descriptive of you or fill in the blank that is most appropriate. Please press the red arrow to continue.

Gender:

Male

Female

Non-binary answer

Background Questionnaire

For the following items, please select the one response that is most descriptive of you or fill in the blank that is most appropriate. Please press the red arrow to continue.

Age:

Background Questionnaire

For the following items, please select the one response that is most descriptive of you or fill in the blank that is most appropriate. Please press the red arrow to continue.

Ethnicity:

- Asian or Pacific Islander
- Asian Indian
- Black/African American (non-Hispanic)
- Caucasian/White
- Native American
- Latino/Hispanic
- Puerto Rican
- Other

Background Questionnaire

For the following items, please select the one response that is most descriptive of you or fill in the blank that is most appropriate. Please press the red arrow to continue.

Year in school:

- Freshman
- Sophomore
- Junior
- Senior
- Graduate Student

Background Questionnaire:

Please put down your **STUDENT** email address in the space below. I will be contacting you one week later to have you sign up to participate in a follow up study regarding memory. Your information will be stored on a password protected computer and in a locked file cabinet. You will receive extra credit for participating in this part of the study as well as additional extra credit for participating in the second portion of the study, which will be emailed to you one week later. Writing down your student email address will ensure that you are rewarded the extra credit for both parts. Please write your **STUDENT** email address in the space provided below. When you have finished, please click the red arrow to continue.

Background Questionnaire:

Please put down your **FIRST AND LAST NAME** in the space below. I will be contacting you one week later to have you sign up to participate in a follow up study regarding memory. Your information will be stored on a password protected computer and in a locked file cabinet. You will receive extra credit for participating in this part of the study as well as additional extra credit for participating in the second portion of the study, which will be emailed to you one week later. Writing down your first and last name will ensure that you are rewarded the extra credit for both parts. Please write your **FIRST AND LAST NAME** in the space provided below. When you have finished, please click the red arrow to continue.

Appendix C

Musical Mnemonic Devices

1) Sound Check #1 (Animal)
a. https://soundcloud.com/user-451542176/764452a

2) Sound Check #2 (Color)
a. https://soundcloud.com/user-451542176/1896343a

3) Sound Check #3 (Number)
a. https://soundcloud.com/user-451542176/8542264a

4) Concrete List
a. https://soundcloud.com/user-451542176/2385282831a

5) Abstract List
a. https://soundcloud.com/user-451542176/ab-1

6) Tune without words
a. https://soundcloud.com/user-451542176/lalala

Appendix D

Method of Loci-Pictures

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Appendix E

Instructions for Musical Mnemonic Device Conditions

You are about to take part in the musical mnemonic device aspect for this portion of the study. A musical mnemonic device connects the to be learned information with music. An example of a musical mnemonic device that everyone knows is the ABC alphabet song. The ABC alphabet song connects the ABCs with a tune. When later recalling the letters, having the familiar tune connected with the letters helps promote recall of the letters.

In this study, you will be memorizing a list of 19 words to the tune of Twinkle Twinkle Little Star. Before clicking in the next page, you **MUST** either turn on your speakers, turn up your speakers, or plug in headphones. You will have **5 minutes** to listen to the musical mnemonic device. Once you have turned up your speakers, turned on your speakers, or plugged in headphones, you may click "Continue" and press the red arrow to move to the next page to begin.

Appendix F

Math Questions

Instructions: Now you have 5 minutes to answer as many math questions as possible. **Please focus on answering the questions correctly.**

4 x 3 =	93 - 56 =	318 + 125 =	45 x 9 =	1263 + 531 =
5 - 4 =	81 + 69 =	30 x 8 =	754 - 164 =	1994 - 723 =
12 + 5 =	100 - 72 =	398 - 242 =	583 + 271 =	1326 + 278 =
2 x 4 =	19 x 4 =	234 + 317 =	427 + 619 =	2346 - 1576 =
5 + 17 =	125 - 117 =	345 + 213 =	48 x 14 =	67 x 25 =
16 + 20 =	143 + 129 =	31 x 11 =	742 + 235 =	2578 - 235 =
43 - 24 =	128 - 65 =	34 x 8 =	52 x 15 =	71 x 19 =
35 + 36 =	18 x 6 =	349 - 232 =	678 + 387 =	2352 - 845 =
12 x 4 =	191 - 188 =	456 - 235 =	814 - 349 =	76 x 24 =
35 - 23 =	145 + 55 =	421 + 72 =	59 x 21 =	2842 - 1698 =
24 + 54 =	207 + 135 =	478 - 45 =	891 - 175 =	2457 + 2362 =
43 + 28 =	211 - 169 =	491 + 167 =	872 + 261 =	4574 - 2362 =
15 x 15 =	21 X 6 =	37 x 15 =	56 x 22 =	84 x 34 =
65 - 51 =	234 -173 =	531 - 235 =	923 + 269 =	3781 + 2589 =
87 + 26 =	288 + 135 =	346 + 314 =	1062 - 584 =	5783 - 2351 =
34 + 67 =	26 x 4 =	643 - 162 =	63 x 18 =	88 x 46 =
17 x 18 =	306 - 210 =	41 x 13 =	1473 + 345 =	5991 - 3478 =
89 - 25 =	287 + 189 =	272 + 733 =	2322 - 893 =	99 x 39 =
57 + 65 =	357 - 84 =	523 + 136 =	1798 - 692 =	6321 - 3473 =
16 x 3 =	29 x 7 =	632 - 58 =	65 x 20 =	4521 + 2387

Appendix G

Instructions for the Method of Loci Conditions

You are about to take part in the method of loci aspect for this portion of the study. A method of loci uses visualization and connects one piece of information to one aspect of a familiar map or picture. You would then use said map/pictures to visualize and recall the words later. For example, say you are trying to recall grocery list of milk, eggs, and fish and you use your desk, computer, and lamp to remember said information. You connect the milk with the desk (by picturing milk spilled all over your desk), eggs with the computer (eggs being slammed into your computer), and fish with the lamp (by picturing a fish on top of your lamp). When you go to recall your grocery list later, you visualize your desk and remember that you need to buy milk. You visualize your computer and you remember that you need to buy eggs, and you visualize your lamp and remember that you need to buy fish.

In this study, you will be memorizing a list of 19 words to pictures of familiar landmarks around the continental United States (e.g. Statue of Liberty, Golden Gate Bridge, etc.) with 19 pictures in total. You will have **5 minutes** to memorize the words with the pictures and create those connections. If you have finished reading the instructions, you may click "Continue" and press the red arrow to move to the next page and begin.

Appendix H

Instructions for the Rote Memorization Conditions

You are about to take part in the rote memorization aspect for this portion of the study. For this, you will be saying the words out loud in the order as they appear. This is called rote memorization. You are to repeat this list of words until your time runs out.

In this study, you will be memorizing a list of 19 words in total. You will have **5 minutes** to memorize the words using rote memorization. If you have finished reading the instructions, you may click "Continue" and press the red arrow to move to the next page and begin.