Smell Ya Later: The Impact of Working Memory Capacity on Odor-Based Context-Dependent Learning

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Alexis Arvanitis graduated from Adrian College in Adrian, Michigan in May 2024 with a bachelor's degree in psychology and a minor in political science. As an undergraduate, Alexis was a member and vice president of Psi Chi—the National Honor Society for Psychology—as well as a member of many other academic honor societies. Her research interests are primarily rooted in cognitive psychology, with an emphasis on memory and applied psychology. Alexis studied abroad at Oxford University in Oxford, England, researching industrial/organizational psychology. Her senior thesis, entitled *Smell Ya Later: The Impact of Working Memory Capacity on Odor-Based Context-Dependent Learning* has been presented at local and regional conferences, including the Adrian College Ribbons of Excellence Day conference and the Midwestern Psychological Association annual meeting in Chicago, Illinois. Alexis plans to continue to study psychology at the graduate level and pursue a master's degree and an education specialist degree in school psychology.

Abstract

Odor, a known memory cue, provides significant context for the encoding specificity principle (Hertz, 1997; Sorokowska, et al., 2022). The encoding specificity principle, or context-dependent memory, is the idea that things are better recalled in the same environment as in which they are learned. Working memory capacity refers to the individualized storage capacity of short-term memory (Rosen & Engle, 1997). Individuals with low working memory capacity retain less information than individuals with high working memory capacity because they are more easily distracted by external stimuli (Conway et al., 2001). The present study aimed to examine the effectiveness of odor-based context-dependent learning for individuals with high and low working memory capacities. Thirty undergraduate students completed an autobiographical memory task in one of four match/mismatch odor/no-odor conditions. It was expected that individuals with high working memory capacity would recall more words than those with low working memory capacity and that those in matched conditions would recall more words than those in mismatched conditions. Results found no significant main effects for condition and no significant interaction between condition and working memory capacity, but a trend of mean differences did support the hypothesis. There was a significant main effect for working memory capacity, with high working memory individuals recalling significantly more words than low working memory individuals. Implications of this study show that context-dependent learning, including odor as a context, can be beneficial for memory. Further research is needed to know if odor specifically acts as a distraction for low working memory capacity individuals.

Keywords*:* working memory capacity, context-dependent learning, autobiographical memory, OSPAN, memory

Context-dependent memory has been studied for several decades (Godden & Baddeley, 1975; Herz, 1997a). As examined by Godden and Baddeley (1975), context-dependent memory, or the encoding specificity principle, is a phenomenon in which individuals better recall information in the same environment as in which they learned it. Additional research has found that the encoding specificity principle is not exclusive to the physical environment and can be seen in contexts such as odor (odor-based context-dependent memory), where one recalls something better when certain distinct odors are present at both encoding and recall (Eich, et al., 1994; Herz, 1997a; Sorokowska, et al., 2022). Working memory capacity is the maximum amount of information an individual can store in their short-term memory at one time (Rosen & Engle, 1997). It has a limited capacity and is used mostly for cognitive functions including problem solving and learning. Working memory is essentially the short-term store where we keep information for immediate, day-to-day use. Having low working memory capacity can create difficulty in concentration and memory/recall abilities (Conway et al., 2001). The current study aimed to examine if working memory capacity has a moderating effect on odor-based context-dependent learning. Knowing the effectiveness of odor-based context-dependent learning for high and low working memory capacity individuals allows the potential for people to use the odor-based context to later increase recall performance.

Context-Dependent Memory

Godden and Baddeley (1975) conducted some of the most widely cited research on context-dependent memory. In a classic study, Godden and Baddeley set up a match-mismatch experiment in which participants were presented with information (words) both underwater and on land and had to recall them in matching or opposite conditions. Results found that participants who learned and recalled words in the same environment had the best recall overall. This created the basis for the encoding specificity principle – the idea that information is best recalled in the same environment in which it is learned. This research on the encoding specificity principle shows that context-dependent learning is a major factor in the recollection of semantic information.

The encoding specificity principle is not restricted to the physical environment, as odor has been used to create a unique environment (Hertz, 1997ab). Hertz (1997ab) conducted two experiments in which both contextually appropriate and distinct odors were presented, along with Eich's autobiographical event generation procedure (Eich et al., 1994), which was used as an encoding task (Herz 1997a). Forty-eight hours later, in a recall session, participants who had been presented with a contextually distinct odor such as peppermint or osmanthus showed higher word recollection than participants in the contextually appropriate odor condition (Herz 1997a). The odors helped to create the environment in which words were encoded in, and the distinct scents may have been encoded along with the words presented.

It is important to ensure that participants understand and recognize the distinctiveness of the odor. Herz (1997a) found distinct odors result in better memory recall (more words recalled) than indistinct, or contextually expected odors. Distinct odors were identified as unexpected in the environment. Indistinct, or expected odors, like floral or common cleaning scents such as citrus or pine are not as effective as memory cues. This is likely due to the expected scents being dismissed as part of the background, while distinct scents are observed as unique while learning the information presented.

To ensure that participants identify an odor as distinct, they may name the odor and identify how intense it is—forcing them to pay attention to it. Both Rubin et al. (1984) and Chu and Downes (2002) involved the name of the odor in their odor-based context-dependent memory research. Distel and Hudson, (2001) found that when participants were required to name an odor before rating how intense it is, they found it as more intense than if they did not have to name it initially. Naming the odor and acknowledging the intensity ensures that participants noticed the odor and that it did not get dismissed as part of the background of the setting. Acknowledging the odor helps to ensure it is encoded along with the words presented in memory tasks.

Context-dependent memory is applicable to many areas other than physical space – odor and mood included. Eich et al., (1994) examined mood-dependent memory for autobiographical events. The researchers conducted three experiments examining if mood created better or worse memory of neutral nouns encoded with autobiographical events. As a tool for this research, Eich's autobiographical event generation procedure was created. The procedure involves presenting neutral nouns and instructing participants to recall events in their lives that are positive, negative, or neutral. Fifteen neutral nouns were presented one at a time to participants. Participants were asked to describe specific memories of or related to these words that occurred at least one month ago. The event generation procedure is a simple and effective way to administer a list of words for participants to encode for a future memory test. Eich's (1994) autobiographical event generation procedure for studying context-dependent memory inspired the procedure for the present study. Research found that when the mood at recall matched the mood at generation, events were better remembered as opposed to when the mood was mismatched, further proving how versatile the encoding specificity principle is.

Odor can be used to improve memory of both declarative and nondeclarative memories (Sorokowska et al., 2022). Declarative memories, such as list learning, are recalled using a different part of the brain than episodic memories. This suggests that it is not just the autobiographical tool that is encoding, but that the odor plays an important role as well. Declarative memories are recalled with one part of the brain, while odor is processed with another part and recalled along with words. Much evidence suggests that odor is a significant cue for memory and that it can play a role in context-dependent memory or state-dependent learning as a specificity principle.

Working Memory

Our working memory is what we use on a day-to-day basis to complete functions such as decision making, problem solving, and general immediate use. When learning information for immediate recall, it is stored in the working memory. Working memory capacity is the limit of how much information individuals can store in their short-term memory at one given time (Rosen & Engle, 1997). Individuals have different working memory capacities. Individuals with lower working memory capacity are commonly thought of as easily distracted and comprehend less of what is being presented to them. Many individual differences can lead to decreased working memory capacity. Factors such as neurodivergence, like ADHD, a deficit known for its symptoms of distractibility and lack of concentration, is frequently associated with low working memory capacity, and is known to relate to memory errors (Roberts et al., 2023).

Sanchez and Wiley (2006) separated participants via a median split by giving them two different tests to sort them into high and low working memory capacity groups. Similar to the OSPAN from Turner and Engle (1986), they had tests including mathematical equations, word recollection, and reading comprehension activities. Results were scored by averaging the correct responses for each individual (Sanchez & Wiley, 2006). Participants then read a study and had to write an argumentative essay and answer questions in response to the text. Some participants were presented photos within the text, while others were not. Results showed that individuals with high working memory capacity had better recollection of things from the text when they were presented with photos (seductive details), and individuals with low working memory capacity had the lowest recollection when presented with those seductive details (Sanchez & Wiley, 2006). This suggests that the photos were a distractor to the individuals with lower working memory capacity, causing them to have lower recall overall.

In addition to stronger comprehension, individuals with higher working memory capacity can retain more information than individuals with lower working memory capacity (Rosen & Engle, 1997). Participants were asked to generate names of a topic, such as animals. Results found that individuals with higher working memory capacity were able to retrieve more animal names faster than individuals with lower working memory capacity (Rosen & Engle, 1997). Additionally, results show that when presented with a confounding task, such as counting digits while recalling names, high working memory capacity individuals were able to recall significantly more than low working memory capacity individuals (Rosen & Engle, 1997). This suggests that working memory capacity plays a role in the amount of information one can learn and further supports the idea that those with low working memory capacity are more easily distracted.

Conway et al. (2001) applied working memory capacity to the classic cocktail party phenomenon. The cocktail party phenomenon is the idea that the brain will filter out external stimuli to focus on one specific stimulus, usually an auditory stimulus. Conway et al. (2001) repeated the cocktail party phenomenon and categorized participants by high or low working memory capacity. They found that when presented with a random message along with distractions, more low working memory capacity individuals heard their name than high working memory individuals. Hearing their name and being pulled away from the current conversation is a distraction from the task at hand.

Evidence that low working memory capacity individuals are more easily distracted supports the idea that working memory capacity may play a role to the extent that odor functions as a memory cue (Conway et al., 2001; Roberts et al., 2023). Past research has shown that many factors may be a distraction for individuals with low working memory capacity (Sanchez & Wiley, 2006; Rosen & Engle, 1997; Conway et al., 2001). Rather than improve memory, it may distract them as it is another thing to focus on other than the material presented. Additionally, previous research suggests having the same odor in encoding and retrieval increases memory, so it brings the question that the absence of this would cause an additional disadvantage for individuals with low working memory capacity (Herz, 1997a; Chu & Downes, 2002; Rubin et al., 1984).

Purpose of the Present Study

Context-dependent memory has been found to be quite versatile and applicable to things other than the physical environment. Odor specifically can create a sufficient context for the encoding specificity principle. Distinct odors, such as peppermint, help increase memory performance as compared to indistinct odors (Herz, 1997a). Individuals with low working memory capacity are more distractible than individuals with high working memory capacity individuals (Conway, et al., 2001). Low working memory capacity individuals are not able to hold as many things in their short-term memory and have a harder time with list recall (Rosen & Engle, 1997).

A correlation between odor-based context-dependent memory and working memory capacity has not yet been examined. It is unclear if there is a difference in how odor acts as a memory cue for high and low working memory capacity individuals. It is unknown if odor-based context-dependent memory is a beneficial memory tool for individuals with low working memory capacity, or if it acts as a distractor, like photos or name-calling do (Sanchez & Wiley, 2006; Conway et al., 2001). If odor-based context-dependent memory reduces recall accuracy in individuals with low working memory capacity, that could be a precaution those individuals take when studying and attempting to have high recall/success by avoiding strong odors. Similarly, if odor-based context-dependent learning improves memory performance, distinct scents could be presented in schools to help increase test performance.

The goal of the current study was to examine if working memory capacity moderates the effects of odor-based content dependent memory. The study examines how odor affects memory for individuals with high and low working memory capacity. Participants experienced one of four conditions, a match or mismatch of odor presence during encoding and retrieval. Participants were first presented with either a distinct odor or no odor at all and then were directed through Eich's autobiographical event generation procedure (Eich et al., 1994). A retrieval session occurred approximately 48 hours after the initial encoding session, in which participants attempted to recall all the words that they were able to from the previously presented word list. The number of words recalled were compared for individuals in different odor conditions and separated by the individual difference of high and low working memory capacity. Working memory capacity served as a quasi-independent variable, with participants sorted into high and low working memory groups. Number of words recalled was a dependent variable and results were expected to vary based on the conditions in the experiment. The connection between working memory capacity and the effectiveness of odor as a memory cue for individuals with both high and low working memory capacities was examined.

It was expected that more words would be recalled in matched conditions where odor is present at both encoding and retrieval. It was expected that participants who had odor present would have higher rates of recall than those in mismatch conditions or with no odor. It is also expected that high working memory capacity individuals would recall more words than individuals with low working memory capacity.

Method

Participants

30 Adrian College undergraduate students enrolled in General Psychology were recruited using SONA, an online research participation system. Participants received course credit for their participation in the study. Participants were required to confirm their working sense of smell before registering for the study. Any participants who did not sign the informed consent or indicated sensitivity/allergy to or inability to smell odor were dismissed. Participants were 80% white/Caucasian, 53% female, and had a mean age of 18.43 years.

Materials

Odor

A 100% pure peppermint oil odor was presented to some participants via an essential oil diffuser. Six drops of peppermint oil were placed in the diffuser with 200 ml of water. The diffuser was placed on a shelf in the corner of the room. The diffuser was run for at least 15 minutes prior to the participant entering the room and left running for the duration of the trial. No-odor conditions did not have any odor present via the diffuser.

Memory Encoding Task

A variation of Eich's Autobiographical Event Generation Procedure (Eich et al., 1994) was used to provide participants with an encoding tool during the first session. Participants were orally provided with a list of 15 neutral nouns (ex. plane, table, pencil) and asked to provide autobiographical memories regarding those items. Autobiographical memory was solely an encoding tool and was not measured or analyzed in any way (see Appendix A).

Operation Span Task (OSPAN)

Working memory capacity was measured using an automated Operation Span task (OSPAN). The automated OSPAN task is a computer test that presented questions of math equations followed by letters. Immediately following presentation, participants were tested on their memory of the letters in sequential order. The OSPAN task measured comprehension and memory ability, which is akin to working memory capacity. OSPAN scores were calculated via the sum of all correctly remembered letters. High scores represented high working memory capacity and low scores represented low working memory capacity. The OSPAN task was completed via an Automated OSPAN task on Inquisit Web. Participants were separated by high and low working memory capacity via a median split by their scores on the automated OSPAN test (Unsworth et al., 2005). The highest 50% of scores represented high working memory capacity and the lowest 50% of scores represented low working memory capacity.

Room Environment Questionnaire

Participants evaluated the testing space using a variation of Herz's (1997b) Room Environment Questionnaire. This questionnaire asked participants to evaluate the lighting, appearance, odor, etc. of the space. The questionnaire was edited to examine the office space with minimal furniture and decoration. The questionnaire was not analyzed but was used to ensure that they notice the odor in the room if present (see Appendix B). Any participants in the odor condition who did not recognize an odor present at both encoding and retrieval were not analyzed.

Procedure

Prior to entering the testing space, all participants read and signed an informed consent (see Appendix C). Participants were brought into the testing room, with either odor or no odor present. Conditions were randomly assigned to participants based on date and time they signed up for the experiment. Conditions included odor/odor, no odor/no odor, odor/no odor, and no odor/odor, at encoding/retrieval, respectively. Participants were given approximately two minutes to observe their surroundings and then were presented with a variation of Herz's Room Environment Questionnaire fitted to the testing space (Herz, 1997b).

Each session took place in a carpeted office-type room. The room contained fluorescent lighting, bookcases, and a table/desk set up with a chair for the participant. Odor conditions included an essential oil diffuser with 200 ml of water and six drops of 100% pure peppermint oil. Room conditions, aside from odor presence, were consistent throughout the experiment.

Participants were then presented with a list of 15 neutral nouns, following Eich's Autobiographical Event Generation Procedure (Eich et al., 1994). Participants were asked to provide a verbal description of an autobiographical event for each word. They were asked to describe an event that was a specific occurrence rather than an everyday event and to describe a memory that occurred at least one month ago. The experimenter stated a word and asked the participant to provide a one-to-two-sentence response describing a specific personal experience. No time limit was implemented, but each session lasted approximately ten to fifteen minutes. After the participant responded to all the words, they were thanked for their time and dismissed until the second session.

Participants returned for a second session approximately 48 hours after the initial session. They returned to the room with or without odor presence depending on the assigned condition. They filled out the variated Room Environment Questionnaire (Herz, 1997b) and were given two minutes to observe their surroundings once again. Participants were then asked to verbally recall as many of the words as possible from the initial 15 presented to them two days prior via free recall. The number of words recalled was recorded and later assessed for accuracy.

Participants were then tested for working memory capacity via the automated OSPAN task (Unsworth et al., 2005). The researcher gave the participant a laptop to complete the task on, with all directions for the task provided on the screen. The automated OSPAN task lasted approximately 20–25 minutes in length per participant. Following the OSPAN task, participants responded to several short demographic questions such as age, gender, year in school, and race (see Appendix D). Following these questions, participants were thanked and dismissed as well as awarded course credit for their time.

Results

Table 1 contains the means and standard deviations for words recalled as a function of matched conditions and working memory capacity. A 2 (Condition: matched vs mismatched) x 2 (Working Memory Capacity: high vs low) factorial ANOVA was conducted to examine if there is a difference in effectiveness of odor-based context-dependent memory for individuals with high and low working memory capacity. No significant results were found for the interaction between match condition and working memory capacity $F(1, 26) = .06, p > .05$, $\eta_p^2 = .002$. There were also no significant results regarding match conditions, $F(1, 26) = .37, p > .05$, $\eta_p^2 = .014$, however, there is a pattern of mean differences supporting the hypothesis that individuals in matched conditions would recall more words ($M = 3.80$, $SD = 1.90$) than individuals in mismatched conditions ($M = 2.93$, $SD = 1.53$). The analysis revealed a significant main effect for working memory capacity, $F(1, 22) = 15.92$, $p < .01$, $\eta_p^2 = .42$, supporting the hypothesis that individuals with high working memory capacity would recall more words than individuals with low working memory capacity. Figure 1 displays the mean number of words recalled in each condition.

Discussion

Limitations and Future Directions

The goal of the current study was to examine if there was a difference in effectiveness of odor-based context-dependent memory for individuals with high and low working memory capacity. Prior research on the topic focused on each construct individually, finding that when information is learned and recalled in the same condition as opposed to different conditions, recall performance is higher (Godden and Baddeley, 1975). Godden and Baddeley (1975) provided the basis for the encoding specificity principle by having divers learn word lists on and off land and recall them in matched or mismatched environments and found recall rates to be higher in matched conditions.

Other past research found that distinct odors lead to better recall than indistinct odors, due to the scent being encoded along with the information (Herz 1997a). Additionally, it has been found that naming the odor is important in encoding it for later recall. Naming the odor ensures that the participant notices it and can encode it along with the information presented (Rubin et al., 2984; Chu & Downes, 2002).

Those with low working memory capacity are generally known to have lowered memory abilities. Fewer words or topics can be spontaneously recalled, causing memory difficulties (Rosen & Engle, 1997). An extension of the well-known cocktail party phenomenon found that not only do individuals with low working memory capacity have lower recall abilities, but that they are also more distractible (Conway et al., 2001). This may explain their lack of ability to retain larger amounts of information.

The current study tested the effectiveness of odor-based context-dependent memory by using a variation of Eich's Autobiographical Event Generation Procedure (Eich, et al., 1994). Participants were sorted into high and low working memory capacity via a median split of OSPAN scores from an automated OSPAN task. The study found no significant effect for match/mismatch conditions, but a trend of means did support the hypothesis that those in matched conditions would recall more words than those in mismatched conditions (see Figure 1). There was a significant main effect for working memory capacity, supporting the hypothesis that those with high working memory capacity would recall more words than those with low working memory capacity. These significant results and mean differences are consistent with prior research on working memory capacity and context-dependent memory. Although some results were not statistically significant, the trend of means supports the prior research on the topic.

In the experiment, two different office spaces were used for the odor and no-odor conditions. Time constraints for the experiment did not allow ample time to air out one room after odor conditions, so a second space was necessary. It is possible that the change in space rather than the odor caused the difference in effectiveness. Due to the change in space, it is difficult to know how effective odor itself was as a context, as compared to physical space. To truly test odor-based context-dependent learning, ideally the same space would be used for both conditions. Efforts were made to make environments as similar as possible, keeping both rooms bare, however, this still may have affected results. Future research should use the exact same environment for odor and no-odor conditions, aside from odor presence. A longer data collection period may be needed to ensure proper time to allow odor to dissipate. In the current study, data was collected over a three-week period.

The OSPAN task was incredibly long, and some participants may have stopped paying attention and not tried as hard. OSPAN scores collected were unusually low and did not provide a full representation of possible scores. This could have caused individuals to be sorted into the wrong condition, causing results to be superficially large for working memory capacity. It is not expected that primarily low OSPAN scores changed the results, due to a superficial high and low category being created via a median split. The categories created within the context of the experiment to ensure participants from the limited sample pool would fall in to both categories. Re-testing with truly high and low working memory capacity individuals on either end of the scale rather than superficially creating high and low working memory capacity groups may have created more significant results. A remote OSPAN task, with literature, may have been more engaging for participants and could be considered in the future.

Possible explanation for the insignificant results is a limited number of participants. There were only 30 participants in the study, with seven to eight participants per condition. Due to a lack of time and resources for the experiment, more participants were not able to be recruited. If the study were to be repeated, increasing the sample size may result in more significant results. The mean trends supported the results, but with such a small number of participants, the data may have unproportionally affected the magnitude of the results. A low sample size is not ideal, and is a reflection of limited eligible subjects and time restraints. Participants were all introductory psychology students at a small, private college, leading to a limited number of potential and actual subjects for the experiment.

Studying only matched conditions would allow the researchers to further investigate the effect of odor for low working memory capacity individuals. Odor may act as a distractor like other things in the environment and cause low scores. The current study investigated odor with context-dependent learning, so it is not possible to examine if odor itself created a distraction. Further research is needed in this area to determine how much of a distraction or aid odor is for individuals with low working memory.

Future research is needed to understand the real-world implications of the odor outside of clinical settings. Although insignificant, the mean trends in this study supported the idea that odor is a memory aid for information learned in an autobiographical memory task. The information was semantic, coded through episodic memories. If odor is found to be effective in increasing memory ability, particularly for people with low working memory capacity, it could be used in school and work settings to help increase performance. Odor could be used in classrooms to help students perform better in school. In professional settings, increased recall ability could be helpful for ease of tasks along with productivity. Another future study could examine if odor aids in increasing productivity.

Conclusion

Results were not significant for match/mismatch conditions. This was surprising and goes against what previous research has found. In general, mean trends supported the hypothesis participants in odor conditions would recall more words than participants in no-odor conditions, and that high working memory individuals in odor conditions would recall the most words, as compared to low working memory capacity individuals in non-odor conditions. Overall, although not all results were significant, this study finds that distinct odor such as peppermint is an effective memory cue.

It is expected that future research would support the mean differences seen in the study, providing the effectiveness of context-dependent memory. A small sample size is the most likely explanation for the lack of significant results. Having a larger sample size would increase the strength of the results and prevent outliers from affecting the data.

Future research is needed to see exactly how odor affects individuals with high and low working memory capacity and if it acts as a distraction or aid for low working memory capacity individuals. Should future research find odor to be a beneficial memory tool, it could be used to increase recall performance in school or work settings. Distinct odors could be a memory tool for individuals in real world and be useful for students trying to perform better on tests or employees trying to have better recall in the workplace. The current study, despite not having significant results, has opened the door to more questions about odor and context dependent memory. Results of future studies could help individuals in their everyday lives and become a useful tool for memory struggles.

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Table 1

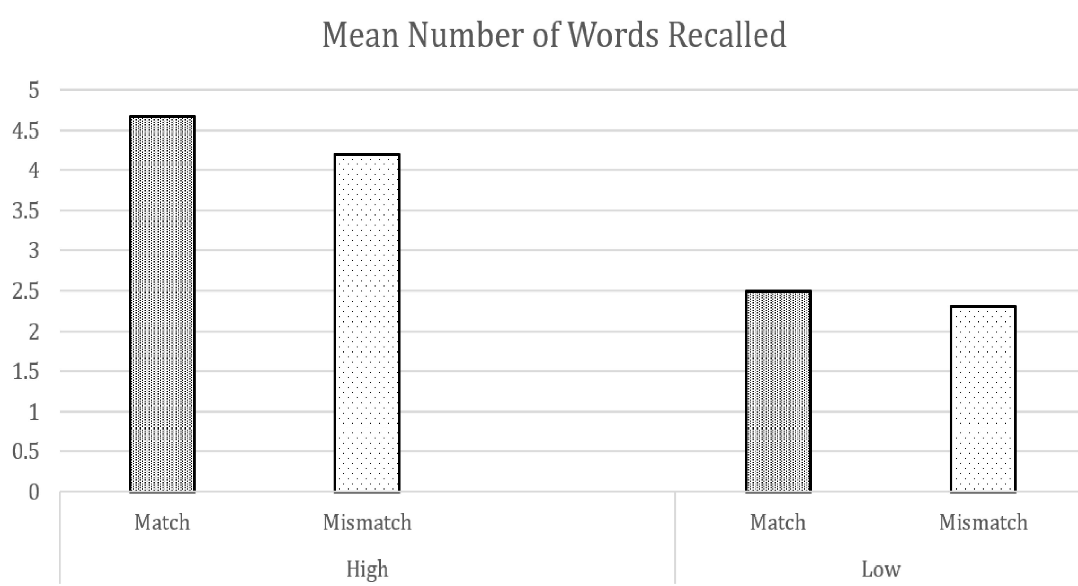
Mean Number of Words Recalled

	Working Memory Capacity		
	High	Low	Overall
Condition			
Matched	4.67 (1.50)	2.50 (1.76)	3.80 (1.90)
Mismatched	4.20 (.45)	2.30 (1.50)	2.93 (1.53)

Note: Standard deviations are in parenthesis

Figure 1

Mean Number of Words Recalled Per Condition



Appendix A

Autobiographical Memory Task

1. Table
2. Pencil
3. Plane
4. Desk
5. Sofa
6. Fork
7. Television
8. Car
9. Shirt
10. Cucumber
11. Shoe
12. Pillow
13. Sky
14. Cup
15. Broom

Appendix B

Room Environment Questionnaire

Please take several minutes to observe the room we are in, and then answer the questions below.

If you have any questions, please ask the investigator.

Would you consider the room to be brightly or dimly lit?

Do you notice any odor present in the room? If so, please describe.

How would you describe the room's appearance? Generally, what type of room are we in?

What furniture do you see present in the room?

Are you comfortable in the environment?

Appendix C

Consent to Participate in Research Study

Title of Study: Memories of Items in Life

Investigators: Dr. Janet Pietrowski (jpietrowski@adrian.edu), Dr. Stacey Todaro (stodaro@adrian.edu), Alexis Arvanitis (aarvanitis24@adrian.edu)

Procedures: The purpose of this study is to examine memory via events about everyday items in life. You will be presented with a list of 15 nouns and asked to provide a memory of your experience with the item. You will then perform a brief reading and mathematical task, and later return for recall of the nouns. This study will take place over two sessions, each lasting approximately 20–30 minutes in length. Your responses will remain confidential; however, the combined responses of all participants may be presented as part of a paper or oral presentation.

Risks and Benefits: This is a minimal risk study. Other than the credit you might receive from your psychology class, you may also email or call the investigators to request printed matter explaining your role in the study. This will include a description of the hypotheses and final analysis of the data. If you choose not to participate, your instructor has other options for you to obtain credit.

Costs/Compensation: There is no cost to you beyond the time and effort required to complete the procedures described above. You will receive credit in your class for participation, but you can discontinue participation at any time. You can consult with your professor regarding an alternative assignment.

Right to Refuse or Withdraw: You may refuse to participate. You may change your mind about being in the study and quit after the study has started without affecting your grade. Questions: If you have any questions, please feel free to email the investigators.

Consent: By moving forward with this survey, you indicated that you have agreed to volunteer as a research subject, that you are 18 years of age or older, and that you read and understand the information provided above. You may request a copy of this informed consent.

Participant Name (print) ____________________

____________________________ ________________________

Date Signature of Participant

____________________________ ________________________

Date Signature of Investigator

Appendix D

Demographic Questionnaire

Basic Demographics

1. Gender (please circle one)
    a. Male
    b. Female
    c. Other (please specify)
    d. Prefer not to answer

2. Age

3. What is your ethnic background? (Circle all that apply)
    a. American Indian/Alaskan Native
    b. Asian/Pacific Islander
    c. Black/African American
    d. Hispanic/Latino
    e. White/Caucasian
    f. Other (please specify)
    g. Prefer not to answer

4. Class Year (please circle one):
    a. Freshman
    b. Sophomore
    c. Junior
    d. Senior

5. Major