

Undergraduate Psychology Research Methods Journal

Volume 1 | Issue 5

Article 2

5-2007

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Recommended Citation

Thomson, Meghan and Stamps, Wendy (2007) "Memory Recall: Cued or Free," *Undergraduate Psychology Research Methods Journal*: Vol. 1 : Iss. 5 , Article 2.

Available at: https://digitalcommons.lindenwood.edu/psych_journals/vol1/iss5/2

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Memory Recall: Cued or Free

Meghan Thomson and Wendy Stamps

Cues may be helpful to aid a person in memory recall. Two experiments were conducted in order to test the hypothesis that recall is enhanced with the presentation of cues. In Experiment 1, the recall performances for the same forty-eight participants were compared under cued and free recall conditions. A paired t-test was performed on the participants who received both cued and free recall questions. In Experiment 2, thirteen participants were given either cued only or free only questions to recall. An independent t-test was performed on the participants who received only cued recall questions or only free recall questions. There was a statistically significant finding that cues do help in recall compared to no cues being provided.

Bringing forth stored information can be a very difficult process. When taking a test, what allows people to recall information that they have studied? Also, can the memories be influenced or slightly manipulated by other thoughts? Different external factors can influence memories (Loftus, 1975). Therefore, people cannot fully trust memories due to the external factors that may have shaped those memories. Details seem to aid in the recall of stored information. Also known as cues, keywords can bring the desired information to surface more easily.

People are better able to remember things that they just read or that have just occurred than those facts less recently discovered (Marsh & Ahn, 2006). This is known as the recency effect. A study was performed based on similar and dissimilar cues in which subjects were

given either similar or dissimilar cues at input and output. Some subjects were allowed to recall the information immediately while others had to complete a task for thirty minutes before recalling the information. The results showed that if cues were similar at input and output, recall was more effective than if cues were dissimilar. In regards to the thirty minute interval, subjects were better able to recall information when they could do so immediately instead of having to wait thirty minutes (Wohl & Izawa, 1980). Also, if people have knowledge of the subject from previous learning, the memory is more stable and more easily recalled. As discovered in a study of older adults and their medications, another key factor is if the information is pertinent to their life, as the relevance can provide cues to remember (Insel, Morrow, Brewer, & Figueredo, 2006).

According to some models, cues must be the same at the input and output phase of recalling information. The encoding specificity principle states that for something to be remembered at recall, the same cue must be given both at the initial encounter of the information and the recalling of the information (Epstein & Dupree, 1977). Following the same view, Tzeng, Alva, and Lee (1979) found that it is easier for subjects to remember the meaning of a sentence if the cognitive surroundings are the same at input and output. This is an example of state dependent learning. A person must be in the same state of mind and environment surrounding at input and output to recall information.

In the Epstein and Dupree (1997) study, the principle of encoding specificity was proved wrong because participants created their own system of categorizing words if they were uncategorized at input. Their study can be explained by the generation-recognition model of retrieval; cues don't have to be present at input because subjects can create their

own cues. At recall, cues are helpful in remembering the information because of the cues generated by subjects themselves at input.

Opposing the idea that cues aid in memory recall, in one study, free recall held the best retention rate compared to cued recall and recognition. The fewer amount of cues provided on the final test resulted in better recall than the previous test with more cues (Carpenter & DeLosh, 2006). Some people prefer essays to multiple choice questions because of the lack of expression of their knowledge found in fixed alternative testing.

Another asset to recalling information is the use of imagery. If one can picture the information, it is easier to recall. Also, if the information is concrete, making it more distinct, the knowledge is more easily recalled (Paivio, Kahn, & Begg, 2000). By the use of imagery, one can connect a mental picture to the information being retained, making it more real to the person.

Memory has a special place in the brain. In the prefrontal areas, encoding and retrieval take place. If the frontal lobe is damaged, people can have trouble with free recall, cued recall and recognition memory (Hashimoto, Maruishi, Sawada, & Toshina, 2005). This can lead to difficulties with both long- and short-term memories.

The hypothesis of this study was that people would be able to recall more information when cues are provided. We tested participants to see if there was a difference in recalling information when given cues as opposed to when not. Two experiments were conducted to test our hypothesis.

*Experiment 1***Method***Participants*

For the first experiment, 48 participants were recruited from the Human Subject Pool at Lindenwood University. There were 17 men and 31 women who participated in our study. These participants were recruited from the general education courses in psychology, anthropology, and sociology. For their participation in the experiment, the participants received extra credit toward their course grade. Demographic information for participants from both experiments was as follows: the age of the participants ranged from 17 to 25. The mean of the ages of all sixty-one participants was 19.77 with a standard deviation of 1.717. There was a wide variety of participants from different countries including the United States, Spain, Brazil, Venezuela, Kenya, India, Mexico, Russia, Germany, Japan, Nepal, Ukraine, Bosnia, and Ecuador.

Materials

The experiment was conducted in a designated room in the Psychology Laboratory in Young Hall in Room 105. A total of four chairs and a table were provided. A stopwatch was kept handy to time the participants' responses to the questions. Pens were available for the participant to use to reply to the forms provided by the researchers. Two different stories were provided for the participant to read (see Appendices A1&B1). The stories were extracted from GRE basic reading comprehension practice tests (2007) from the World Wide Web. The related questions were not standardized but created by the experimenters from the information from the stories. Questions included cued recall, such as providing cues to help the participant to recall the information from memory and free recall format, not providing

any cues or hints to aid the participant in recalling the information (see Appendices A2, A3, B2, & B3). Examples of cued recall for the Ferdinand Magellan story would be: What famous Portuguese explorer led the first expedition to sail around the world? An example of free recall would be: Who led the first expedition to sail around the world? The questionnaire was provided at the end of the study for the participants to fill out (see Appendix C). Some of the questions that were asked in the questionnaire were about what type of recall, cued or free, the participant preferred on tests and whether or not the participants' native language was English for this could affect the results of the study. Participants were also asked about the difficulty of the stories to read and comprehend. The informed consent form was given to participants at the beginning of the study to obtain consent to perform the experiment. A feedback letter was given to the participants for their own records to explain the reasoning behind the study and to debrief them of any further questions.

Procedure

First, we recruited participants from the Human Subject Pool at Lindenwood University. Next, the participant came into the Psychology Lab and sat down at the designated table where one of the researchers was sitting. The researcher handed the participant two informed consent forms, one for his or her records and one for our records. Both consent forms were signed by both the participant and researcher. Then, the participant was given a participant receipt form to fill out with all of his or her information to receive extra credit toward his or her class. The receipt form was to be taken to the Human Subject Pool office located in Young Hall, room 407 after the experiment. Before the experiment started, the participant was assigned an ID number and group number unbeknownst to the

participant. The reasoning behind doing this was to provide anonymity for the responses to the questions. A group number was assigned to the participant to provide counterbalancing between the different stories and questions and the experimenters kept track of which participants received which method of recall with which story. The participant ID number and group number were counterbalanced by means of a Latin Square Design to keep anonymity between the participants.

Participants received both a cued recall and a free recall question format to answer from the two different stories that were provided. The participant was handed an instruction form to read. If the participant had any questions about the experiment, he or she was instructed to ask them before the experiment started. The researcher handed the participant a story to read. The orders of the stories were counterbalanced between participants. The participant was instructed to read the first story only once and then let the researcher know when he or she was finished. Once he or she was finished reading the story, the researcher took away the story and handed the participant a list of questions, free or cued recall, to answer in five minutes. The order of free or cued recall questions were counterbalanced between participants. The researcher timed the participant for five minutes and after the participant was finished, the researcher took the question list away and asked the participant to count aloud to 100 by fours. The participant was asked to do this to prevent information from the first story to interfere with the next story he/she was about to be read, which is known as practice effect.

After the participant had finished counting to 100 by fours, the researcher handed the participant the other story and was told to once again to read the story only once and let the researcher know when he or she was finished reading. Once the participant let the researcher

know that he or she was finished reading the story once, the researcher took the story away and handed the participant another list of questions, counterbalanced from the time before. The researcher gave the participant for five minutes to complete the questions to the best of his or her knowledge. After the participant was finished answering the second set of questions, he or she was then given a questionnaire to fill out about memory recall. Once the participant finished filling out the questionnaire, the researcher provided him or her with the feedback form to read and ask any questions that he or she might have about the experiment, while debriefing the participant. The participant was made aware of the researchers' contact information if he or she wished to know the results of the study after it was conducted.

A within-subjects design for their experiment in an attempt to show which method of recall, free or cued, was more effective in remembering information. The researchers wanted the same person to provide information for both methods to have a better idea of which method helps in the recall of information.

Results

A paired t-test was performed on participants' responses to cued recall and free recall. The results of the paired t-test revealed a significant finding that participants' responses to cues ($M= 3.54$) was more effective in recalling information than responses to questions with no cues provided ($M= 2.58$), $t(23) = 3.154$, $p < .05$.

Experiment 2

In addition, the researchers wanted to see if the story order made a difference in participants' responses, so a second experiment was conducted using a between-subjects design. In the between-subjects design, thirteen participants were either given only cued recall questions to answer for both stories, or free recall questions to answer for both stories.

The reasoning behind conducting two separate experiments was to find out if participants were better able to remember more information from the stories provided with or without cues. The first experiment had both cued and free recall questions. The second experiment consisted of participants receiving either only cued recall questions or only free recall questions to answer about the two stories.

Method

Participants

For the second experiment, thirteen additional participants were recruited from the Human Subject Pool at Lindenwood University. There were five men and eight women who participated in our study. These participants were also recruited from the general education courses in psychology, anthropology, and sociology just like in experiment 1. For their participation in the experiment, the participants received extra credit toward their course grade. The age of the participants ranged from 18 to 24.

Materials

The experiment was conducted in a designated room in the Psychology Laboratory in Young Hall in Room 105. A total of four chairs and a table were provided. A stopwatch was kept handy to time the participants' responses to the questions. Pens were available for the participants to use to reply to the forms provided by the researchers. Two different stories, the same stories that were used in experiment one, were provided for the participant to read (see Appendices A1&B1). The stories were extracted from GRE basic reading comprehension practice tests (2007) from the World Wide Web. The related questions were not standardized but created by the experimenters from the information from the stories. The questions, which were also used in experiment one, included either cued recall, such as

providing cues to help the participant to recall the information from memory or free recall format, not providing any cues or hints to aid the participant in recalling the information (see Appendices A2 & B2 or A3 & B3). Examples of cued recall for the Ferdinand Magellan story would be: What famous Portuguese explorer led the first expedition to sail around the world? An example of free recall would be: Who led the first expedition to sail around the world? The same questionnaire from experimtn one was provided at the end of the study for the participants to fill out (see Appendix C). Some of the questions that were asked in the questionnaire were about what type of recall, cued or free, the participant preferred on tests; whether or not the participant's native language was English because this could make a difference in the results of the study. Participants were also asked about the difficulty of the stories to read and comprehend. The informed consent form was given to participants at the beginning of the study to obtain consent to perform the experiment. A feedback letter was given to the participants for their own records to explain the reasoning behind the study and to debrief them of any further questions.

Procedure

Experiment two used the same procedure as in experiment one except that the participants received either free recall questions or cued recall questions. The participant filled out an informed consent form and participant receipt. The participant was given instructions to know what was expected of them for the experiment. After the participant confirmed that he or she understood what to do for the experiment, the researcher handed the participant a story to read over once. Once the participant finished reading over the first story only once, he or she turned in the copy of the story, and then given either a free or cued question format, the order of which was counterbalanced, to complete. The participant was

given five minutes to answer the questions, then asked to count aloud to 100 by fours. Next, the participant was given the second story. Once the participant finished reading over the second story only once, he or she let the researcher know and then handed in the story and received the second set of questions, either free or cued, but the same format as the set of questions for the first story. After the participant finished answering the questions during the five minute time lime, he or she was then asked to fill out a questionnaire. After filling out the questionnaire, participants were then debriefed of the experiment with the feedback letter and were informed of the researchers' contact information.

Results

A between-subjects design was used for experiment 2 in order to determine if participants were better able to answer cued recall questions or free recall questions. We tested different participants to see if they would recall more information if they were only given cues to answer the questions or if they were not given any cues to answer the questions. An independent t-test was conducted, and a statistically significant result was found, $t(35) = 2.665$, $p < .05$. Participants that were given only the cued recall format were more likely to recall the information from the story. The mean of the cued only recall task was 6.83 with a standard deviation of 2.15. The mean of the free only recall task was 4.74 with a standard deviation of 2.60.

In order to discover if the stories we used to test participants were similar in difficulty level, we performed a paired samples t-test on the Ferdinand Magellan and Marie Curie stories, based on the participants' responses to the question of difficulty on the questionnaire. We found that the stories were similar in difficulty level both with a mean of 2.93. The paired t-test resulted in a significant two-tailed test between the stories, $t(60) = 0.00$, $p > .05$.

This t-test shows that the stories were similar in difficulty level. The researchers also wanted to determine if the order of the stories in which the participants' received made a difference in recall. In order to prevent order effects, we counterbalanced the order of the stories between participants. Furthermore, we wanted to make sure that the story order did not create a confounding variable in our experiment. The results of the two-tailed paired t-test showed that the order of the stories had no effect on the recall of information for participants, $t(60) = -1.793, p > .05$.

General Discussion

The results of our experiment support our hypothesis that people will recall more information when provided with cues than when they are not provided with cues. In experiment 1, we tested to see if participants recalled more information from the two stories when they were given cues over when they were not given cues. We counterbalanced the stories and the recall format (cued or free recall questions). The results of our first experiment coincide with our hypothesis that cues do help in the recall of information. We then wanted to see if the stories that we used were similar in difficulty level. We wanted to find out if the Ferdinand Magellan story and the Marie Curie story were the same in regards to the participants' ability to comprehend and understand the information presented. We found that the stories were almost identical in difficulty level.

Furthermore, we wanted to determine if the order in which the stories were given to participants had an effect on recall. We found that the order of the stories did not have an effect on the recall of information. We controlled for a possible confounding variable of order effects by counterbalancing the stories in which the participants received them. We

controlled for the possible confound of difficulty level of stories by testing to see if the stories were similar in complexity.

In order to confirm the strength of our hypothesis, we performed an additional experiment to see if participants that were provided with cues had more of an advantage of recalling information than participants who were not giving any cues at all. The second experiment consisted of an additional set of participants who were either given only cues to recall information from both stories or were not given any cues at recall. The experiment showed that people who were provided with cues only, recalled a greater amount of information than those who were not given any cues to recall information from the stories provided.

In regards to our experiments, we should have taken into account those who do not like history because both stories were historical accounts of Ferdinand Magellan and Marie Curie. However, the stories were taken from a standardized source, practice GRE tests. We should have possibly found stories that were more generalized to our participant population, although we would always have the problem of someone not liking a particular subject. Also, a participant from Spain was more at an advantage of recalling information about the Ferdinand Magellan story because of familiarity with it because it is part of the country's history. In addition, some people enjoy history (Ferdinand Magellan) over science (Marie Curie). However, as stated earlier, our results show that there was no difference in the story relationship of which one was easier than the other. They were both similar in difficulty.

In our second experiment, we may not have had a representative sample of the population because we didn't acquire as many participants as is required for this between-subjects design. Our goal was to recruit twenty-four participants to create a representative

sample but only thirteen showed up for the experiment. The lack of participants may have had an effect on the results of the second experiment even though significance was found for cued only recall.

In our results, we performed two t-tests: a paired t-test for the first experiment and an independent t-test for the second experiment. The paired t-test for the within-subjects design showed significance for the cued recall task and the independent t-test for the between-subjects design showed significance that when participants only received cues for recall, they were more effective in remembering information. Counterbalancing was performed to counteract order effects and practice effects.

The reasoning behind the two experiments were to find out if participants were better able to recall information from the stories if they were given both free or cued questions to answer or if recall was similar to experiment one in which participants were given either free or cued questions.

Moreover, the significance of our findings can be beneficial to others because people can use cues to help recall more information for exams, presentations, memory tasks, and remembering important information. Cues can make it easier for people to recall information when others are relying on that information to be relayed.

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Appendix A1

Story #1

In the 16th century, an age of great marine and terrestrial exploration, Ferdinand Magellan led the first expedition to sail around the world. As a young Portuguese noble, he served the king of Portugal, but he became involved in the quagmire of political intrigue at court and lost the king's favor. After he was dismissed from service to the king of Portugal, he offered to serve the future Emperor Charles V of Spain.

A papal decree of 1493 had assigned all land in the New World west of 50 degrees W longitude to Spain and all the land east of that line to Portugal. Magellan offered to prove that the East Indies fell under Spanish authority. On September 20, 1519, Magellan set sail from Spain with five ships. More than a year later, one of these ships was exploring the topography of South America in search of a water route across the continent. This ship sank, but the remaining four ships searched along the southern peninsula of South America. Finally, they found the passage they sought near a latitude of 50 degrees S. Magellan named this passage the Strait of All Saints, but today we know it as the Strait of Magellan.

One ship deserted while in this passage and returned to Spain, so fewer sailors were privileged to gaze at that first panorama of the Pacific Ocean. Those who remained crossed the meridian we now call the International Date Line in the early spring of 1521 after 98 days on the Pacific Ocean. During those long days at sea, many of Magellan's men died of starvation and disease.

Later Magellan became involved in an insular conflict in the Philippines and was killed in a tribal battle. Only 1 ship and 17 sailors under the command of the Basque navigator Elcano survived to complete the westward journey to Spain and thus prove once and for all that the world is round, with no precipice at the edge.

Source: www.testprepreview.com/modules/reading1.htm

Appendix B1

Story #2

Marie Curie was one of the most accomplished scientists in history. Together with her husband, Pierre, she discovered radium, an element widely used for treating cancer, and studied uranium and other radioactive substances. Pierre and Marie's amicable collaboration later helped to unlock the secrets of the atom.

Marie was born in 1867 in Warsaw, Poland, where her father was a professor of physics. At the early age, she displayed a brilliant mind and a blithe personality. Her great exuberance for learning prompted her to continue with her studies after high school. She became disgruntled, however, when she learned that the university in Warsaw was closed to women. Determined to receive a higher education, she defiantly left Poland and in 1891 entered the Sorbonne, a French university, where she earned her master's degree and doctorate in physics.

Marie was fortunate to have studied at the Sorbonne with some of the greatest scientists of her day, one of whom was Pierre Curie. Marie and Pierre were married in 1895 and spent many productive years working together in the physics laboratory. A short time after they discovered radium, Pierre was killed by a horse-drawn wagon in 1906. Marie was stunned by this horrible misfortune and endured heartbreaking anguish. Despondently she recalled their close relationship and the joy that they had shared in scientific research. The fact that she had two young daughters to raise by herself greatly increased her distress.

Curie's feeling of desolation finally began to fade when she was asked to succeed her husband as a physics professor at the Sorbonne. She was the first woman to be given a professorship at the world-famous university. In 1911, she received the Nobel Prize in chemistry for isolating radium. Although Marie Curie eventually suffered a fatal illness from her long exposure to radium, she never became disillusioned about her work. Regardless of the consequences, she had dedicated herself to science and to revealing the mysteries of the physical world.

Source: www.testprepreview.com/modules/reading1.htm

Appendix A2

Story #1 Free Recall Questions

1. Who led the 1st expedition to sail around the world?
2. Who did he serve in Spain?
3. What did this explorer name the discovery that he found?
4. Where was this first explorer killed?
5. What did the explorers' prove to be wrong?

Appendix A3

Story #1 Cued Recall Questions

1. What famous Portuguese explorer led the 1st expedition to sail around the world?
2. This famous explorer served what Spanish emperor?
3. What was the name of the strait that this explorer found?
4. What Southeast Asian country was this explorer killed at?
5. What famous false belief about the world did these explorers' prove to be wrong?

Appendix B2

Story #2 Free Recall Questions

1. What did Marie Curie and her husband, Pierre, discover?
2. What is this element used for?
3. What kind of a job did Marie's father have?
4. Where did Marie receive her education?
5. When did Marie receive the Nobel Prize?

Appendix B3

Story #2 Cued Recall Questions

1. What radioactive element did Marie and her husband, Pierre, discover?
2. What type of disease is this element used for today?
3. A man of great knowledge and wisdom and a willingness to help others learn, what kind of profession did Marie's father have?
4. What French university did Marie attend?
5. In the beginning of the 20th century, Marie received the Nobel Prize. What year did she receive this award?

Appendix C

Memory Recall Questionnaire

Participant ID # (to be randomly assigned by experimenter): _____

Group Letter (to be randomly assigned by experimenter): _____

1. Age:
2. Gender:
3. Country of Origin:
4. Major:
5. Are you a native English speaker?
6. Do you think that you will be able to apply the use of cues to your studying habits and test taking skills?
7. On tests, do you prefer short answer questions or multiple choice and true or false questions?
8. Were both stories about the same in regard to their level of difficulty to read?
9. Were both stories about the same in regard to their level of difficulty to comprehend (in other words, did you understand the material presented in the story?)