Serial Recall Memory
Effects of Distractors on Memory

Charles R. O'Neill

Oklahoma State University

Abstract

The multistore model for memory can predict Serial Recall Effects. Two free serial recall trials were tested with and without a distractor of 30 seconds to determine a relationship between distractor and memory recall. Distractor was found to cause large decrease in probability of correct recall from Short Term Memory while having no effect on recall from Long Term Memory. Implications and other experiments related to the success of this model are discussed. This experiment replicated and further tests Two Storage Mechanisms in Free Recall (Glanzer and Kunitz, 1966).

Note: This paper was a project for an introductory psychology class and is not peer reviewed. I wouldn't think there is much (if any) data traceability in this paper.

Charles O'Neill
18 Feb 2003

Serial Recall Memory: Effects of Distractors on Memory

Models of memory have been proposed throughout time in which each takes into consideration the technological and psychological advances in studying memory. Methods of testing memory can provide clues to the storage mechanisms of memory. This experiment attempts to test differences in word list recall abilities to determine a relationship between memory recall abilities and storage methods.

The multistore model of memory is based on having two separate memory areas, one short and one long term, each with different abilities. In this model, the short term memory (STM) can be considered a buffer of a finite volume with a finite storage time typically around 15 to 20 seconds. "We postulate a limited and constant capacity for the buffer. Items enter the buffer successively until it is filled, and then each succeeding entering item causes exactly one of the items currently in the buffer to be lost" (Phillips, 1967). The long term memory (LTM) consists of an near infinite buffer of near infinite storage time which is fed selected information from the short term memory. For this experiment, information is considered to be selected for LTM by an unknown mechanism that requires multiple accesses of the word in STM before the word is linked into LTM. "It is assumed that the information may enter LTS [Long Term Storage] only during the period in which the item resides in the buffer" (Phillips, 1967).

A direct result of the multistore model is the non-linearity of recall probabilities over time. Both LTM and STM can recall information with different probabilities depending on several factors, one of which is time since exposure. LTM recall probability is a decreasing concave function while STM is an increasing concave function. Because total recall probabilities with both STM and LTM working are the sum of the probabilities of a recall from LTM and a recall from STM, the Serial position effect function, the probability of a recall verses time since exposure, resembles a wide 'U'. The sharp increase of recall from LTM for an early time period is commonly called the Primacy Effect. The increase of recall from STM for the end time period is called the Recency Effect.

The Free Recall method of testing Primacy and Recency consists of presenting a list of words to a subject and then later recording the subjects' recalled list. Delayed recall differs from free recall in that after the last word is presented, the subjects are distracted for a time period before the subject is allowed to begin the list recall. This Distractor task exists to simply flush the STM of any list items. Serial Subtraction is an excellent distractor because the presence of an infinite series of integer numbers allows the STM to be totally overrun while allowing subjects with poor mental math skills the same distraction as those subjects with excellent skills.

This experiment is based on the hypothesized presence of two types of memory, Short and Long Term memory, and the relationship between the two. The hypothesis is that the mechanisms of memory in short and long term memory allow for differences in recall abilities between immediate and delayed recall when the recall conditions are varied.

As a direct consequence of the hypothesis, it is predicted that recall abilities will differ between the two trials, free and delayed. It is expected that the primacy effect will be strong on both trials because of the long term storage of the first few list items. Recency, which is expected to be present in the immediate recall trial, is expected to boost list recall for the last list items. However, the distractor in the delayed recall trial, thirty seconds of serial counting, will cause a decrease in recall of the last list items. As a result of the distractor and the subsequent absence of recency effects, it is predicted that the total number of correct recalled words will be greater in the immediate recall verses the delayed recall.

Method

Participants

For this experiment, twenty two (22) Oklahoma State University introductory psychology students were tested. The eighteen (18) females and four (4) males had a mean age of 18.7 years and a mean of 13.41 years of education. None of the subjects indicated prior memory training. This experiment was performed during an introductory psychology class, which was the incentive for the subjects to participate .

Procedure

The experiment consisted of two trials corresponding to the two conditions that were tested. Beforehand, two word lists of fourteen (14) words, given in the appendix, were composed with each list having a common theme. Before the trials, subjects were given a piece of paper sectioned off into 3 areas. The first area contained an identification form for recording name, age, gender, education level and previous memory training courses. The second and third areas were for recording each trials' recalled words.

For the first trial, the words from Condition 1, free recall, were presented at a rate of one word per five seconds with silence between the words. After all words and were presented and five seconds had elapsed, the subjects were instructed to recall the words presented by writing onto a sectioned off piece of paper.

For the second trial, words from Condition 2, delayed recall, were similarly presented at one word per five seconds with silence between the words. After the last word had been presented and five seconds of silence had elapsed, the subjects were instructed to count down (serial subtract) by 6's from 234. At the end of thirty seconds of serial subtraction, the subjects were instructed to recall the words presented onto the piece of paper.

The two trials were designed to be same except for the counting distractor used in the second trial. Due to the change of activities after the list between the first and second trial, the independent variable was the presence of a distractor of serial counting for 30 seconds. The dependent variable is the number of correct recalled words in the different areas of the list, specifically the primacy and recency areas. Both trials consisted of all subjects being tested at the same time and with the same word presenter. Subjects were spaced in several rows of 5 to 10 people spaced approximately 3 feet apart in a computer lab with non-blanked computer screens. No unusual or disrupting sounds occurred other than the computer coolant fans which ran throughout the experiment. Normal lighting levels were provided from florescent lamps.

Discussion

The results of the two trials indicate that there was a significant difference between delayed and immediate recall. The probability of a correct recall from the last three words of the immediate recall trial was nearly twice that of the delayed recall list. The predicted results and the experimental data gathered support the hypothesis that two type of memory exist and that a distractor task can influence the recall abilities. This result is consistent with Ashcraft (1989), "....the two portions of the serial position curve are indeed influenced by different factors".

The hypothesis proposed does account for the results obtained. Because of the noise in this experiment, it would be possible to attribute many other factors. However, this experiment only tests the applicability of the multistore model, which did conform to this experiment's data. This model may not account for all of the brain's memory processes; however, "One of the successes of an information-processing model that distinguishes between STM and LTM is that it can account for the serial position effect" (Reed, 1982).

The data set obtained contained interesting observations. In the first trial, 'Night' and 'Nightmare' were contained in the word list. The percentage of recall for 'Night' was 27%, while 'Nightmare' was 91%. Because these words were spaced 1 word away in the list, night may have indirectly supported nightmare by combining both records into one and subsequently not extracting 'night' when 'nightmare' was recalled. The other interesting fact is the length of words in the list. In the first trial, the mean length of words increased from the first half to the second half. The mean length of words in the second trial was larger in the first half. Assuming that the time between words was constant at 5 seconds, larger words would decrease time for brain to process the word before receiving a new word. As this was not the goal of this experiment, a more sophisticated and in depth statistical analysis would need to be done to check for any correlation between word length and recall abilities.

While the multistore model gave a good representation of the abilities of the subjects'

memory recall, it's apparent success makes the testing of other types of serial memory recall possible. Different distractors and methods of recalling the lists would determine if the multistore model still holds as a representation of memory storage for the human brain.

In this experiment, the length of the list was a constant at 14. Experiments with large lists would test the applicability of the multistore model with an increasing amount of recall data for the subjects. In a experiment of list length on STM, Phillips (1967) proposes "a limited and constant capacity for the buffer [STM]. Items enter the buffer successively until it is filled, and then each succeeding entering item causes exactly one of items currently in the buffer to be lost". He gives a model which finds the probability of a recall in the LTM plus the probability of the item still in the STM buffer. "It should be apparent that the model simultaneously fits the various serial position curves with remarkable accuracy" (Phillips, 1967).

Both trials for this experiment used a free recall, which means that the words could be recalled in any order. An experiment in ordered recall would allow a more rigorous check of multistore theories. Li and Lewandowsky (1995) report that "One consistent finding has been the trade-off between primacy and recency as a function of recall direction. When study participants are instructed to recall a list in a forward direction from beginning to end, the data data show extensive primacy and little recency. By contrast, when participants recall the list in a backward direction, primacy is minimal and recency tends to be much steeper." This could be partially derived from the multistore model; however, they also report "We have concluded that forward recall is primarily driven by.. associations formed at study, whereas backward recall relies at least partially on a visual-spatial representation of the input material." The multistore model does not give any indication of this sort of occurrence and would be an excellent further study into the applicability of the multistore model with varied recall methods.

The words used in this experiment are frequently used in the English language. Less used words may perhaps not fit this model for the reason of not being able to understand or

re-pronounce the word. Watkins and Watkins (1977) did a study of the differences between frequently and non-frequently used words, "High-frequency words are better recalled than low-frequency words at pre-recency positions, whereas there is no difference between the frequencies at recency positions. Moreover, this is true for both visual and auditory presentation...." Their report ends with "serial recall cannot be attributed entirely to secondary memory [LTM] or, in fact, to any simple unitary process."

For small lists, the multistore model accurately represents the expected recall function. The testing of multiple and simultaneous lists would test the limit of the STM's buffer size as well as test for any other memory type other than STM and LTM such as a 'scratchpad memory' that is separate from STM. "They [studies of stored sets] revealed that we do not have simultaneous and immediate access to all of the items currently in working memory. Instead, the serial comparison of items in working memory required switches between these items" (Garavan, 1998). Studies into the time of switching between these sets of data would give insight into the lower level processes of memory recall.

Appendix

Word Lists:

Condition (Trial) 1 Free Recall		**Condition (Trial) 2** 30_{sec} Delay	
	% Recall		% Recall
Dream	95	Frying Pan	86
Sleep	95	Blender	91
Pillow	91	Kitchen	86
Tired	77	Knife	91
Toss	95	Cookbook	45
Bed	91	Pantry	54
Snooze	91	Oven	77
REM	73	Sponge	54
Alarm	82	Dish	41
Blanket	73	Pot	73
Night	27	Mixer	82
Sandman	86	Stove	68
Nightmare	91	Toaster	36
Snore	82	Sink	41

References

Ashcraft, M. (1989). *Human Memory & Cognition*. Scott Foresman & Co., Boston.

Garavan, Hugh. (1998). Serial Attention within Working Memory. *Memory and Cognition*. Vol 26(2). 263-276.

Li, Shu-Chen, Lewandowsky, Stephan., (1995) Forward and Backward Recall: Different retrieval processes. *Journal of Experimental Psychology: Learning, Memory, & Cognition*. Vol 21(4). 837-847.

Phillips, James L., Shiffrin, Richard M., and Atkinson, Richard C. (1968). Effects of List Length on Short-Term Memory. *Journal of Verbal Learning & Verbal Behavior*, 6(3), 303-311.

Reed, Stephen K. (1982).*Cognition: Theory and Applications* (pp. 95-97). Monterey, CA: Brooks/Cole Publishing Company.

Watkins, Olga C., Watkins, Michael J. (1978). Serial Recall and the Modality Effect: Effects of Word Frequency. *Journal of Experimental Psychology: Human Learning & Memory*. Vol 3(6). 712-718.