

Variations in Delayed Recall Performance
of Aphasic and Normal Adults

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One method of assessing the relationship between recall and memory has been by observing free recall of subjects' responses to serial word lists. In studying the capacity and retention characteristics of both short term memory (STM) and long term memory (LTM), via serial word list recall performance, Peterson and Peterson (1959) demonstrated that LTM storage and retention is massive while STM decays rapidly if rehearsal strategies are not implemented. These writers concluded that the central properties of STM were small capacity and short life and demonstrated that as the rate of the words presented was decreased, performance on the initial portion of the word lists (LTM) improved while performance on final items (STM) did not. Similar results were obtained by Madigan and McCabe (1971), Rundus and Atkinson (1970), Postman and Phillips (1965) and Murdock (1962).

While the manipulation of input appears to be one of the most active areas of research in aphasia, few investigations have been concerned with the effects of serial position upon either recall or memory following brain injury. Locke (1978) showed five aphasic patients three pictures and then turned them over. The subjects were then shown a target picture and required to turn the matching picture up. Initial (primacy) items were recalled with more accuracy than middle items when initial items were nameable. The results of this study suggested that rehearsal is important in recall and memory within the brain-injured population.

Goodglass, Gleason and Hyde (1970); Heilman, Scholes and Watson (1976) and Cermak and Moreines (1976) suggested that inability to rehearse probably represents ineffective verbal coding and is a factor in the impaired memory performance of aphasic adults. Cermak and Moreines (1976) studied verbal retention deficits in five different groups and demonstrated that aphasic subjects showed considerable improvement when the rate of stimulus presentation was slowed from two to three seconds while other (nonaphasic) groups maintained their same level of performance. Rothi (1979) demonstrated that fluent aphasic adults could not recall a consonant trigram following an 18-second distractor task, while nonfluent aphasic subjects' performance appeared to be unaffected. Riege, Metter and Hansen (1980) demonstrated that aphasic patients' memory for words was impaired across distractor-filled intervals. They also demonstrated that aphasic subjects retained initial and final words, even when a large number of words was placed between a target and the probe.

These investigations with aphasic subjects describe information processing by aphasic adults, but fail to describe the linguistic attributes of the stimuli and their effects on recall performance. The investigations reported suggest that various input factors (e.g., stimulus interval duration, stimulus familiarity, and rehearsal ability) affect memory for aphasic and normal subjects. It appears reasonable to assume that different linguistic categories carrying different semantic and syntactic loads might also affect recall ability. Loverso and Craft (1982) demonstrated with ten aphasic and ten normal

adults that the recency-primacy effect within a serial position experiment for words was negated by loading the middle of a list with words from a different linguistic category. These authors failed, however, to control for the effect of changing stimuli (proactive interference). This interference effect could account for the changes in recall performance found on a serial position curve based on nonspecific changes within a word list. Data remain sparse concerning serial position and performance based on variations in linguistic categories for the aphasic population.

The purpose of this investigation was to study the relationship between differing linguistic structures (nouns and verbs) and recall as reflected in the serial position curve when rehearsal was made possible. Specifically, the following question was asked. What are the effects of differing linguistic stimulus characteristics on the serial position curve derived from the delayed recall performance of both aphasic and normal subjects?

METHOD

Subjects. Subjects were ten left-brain-damaged (aphasic) and ten normal adults. All subjects in the aphasic group (who were judged by a speech pathologist to be aphasic) met the following criteria. Each subject was at or above the 50th percentile on the Porch Index of Communicative Ability (Porch, 1967); each subject had left brain damage following neurologic diagnosis of left CVA confirmed by three of the following four procedures: abnormal angiogram, abnormal motor signs, abnormal CAT scan, and/or abnormal brain scan. Any subject who exhibited evidence of right hemisphere brain damage was excluded from the study. Each aphasic subject showed audiometric thresholds which were no greater than 30 dB (ANSI 1969) for the octave frequencies between 250-4000 Hz. Additionally, aphasic subjects demonstrated sufficient understanding and ability to perform the experimental task, as measured by 100% accuracy on pretrial testing. All subjects included in the normal group met the following criteria. Each subject was at or above the 92nd percentile on the PICA. Each showed hearing levels comparable to the experimental group. Each had sufficient ability to perform the task. (100% accuracy on pretrial testing.) None had a history of neurologic impairment.

Procedures. All procedures were carried out in a quiet distraction-free environment. Pretrial testing required each subject to repeat 3 nouns and 3 verbs following 20-second delay. These pretrial stimuli were presented with a 2-second delay between words. While it was not possible to rule out the possibility of naming deficits, all subjects studied were able to perform adequately on the pretrial testing, suggesting that they had the capability to perform the experimental task. All aphasic and nonaphasic subjects studied were able to perform the pretrial task with complete accuracy.

After meeting pretrial criterion, all subjects performed the experimental task. Four experimental lists of words were presented. (1) One list of twelve nouns. (2) One list of twelve verbs. (3) One list of six nouns followed by six verbs. (4) One list of six verbs followed by six nouns. The order of words in each list was randomly determined. The order of list presentation (noun, verb, noun-verb, verb-noun) also was randomized for each subject. Only words of similar frequency of occurrence appeared in each list, as determined by the Thorndike and Lorge (1944) Word Lists, 400-A and 400-B.

The experimenters presented the word lists to each subject in the manner previously described. The experimenters said each list (noun, verb, noun-verb, verb-noun) at a rate of one word every two seconds. Following the presentation of each list, the subject was asked to repeat as many words as possible.

However, no subject was allowed to respond until 20 seconds had elapsed following presentation of the last word in each list. All subjects' responses were audiotaped.

RESULTS

The results were statistically analyzed with an analysis of variance with repeated measures (Winer, 1971). Table 1 summarizes these results.

Table 1. Summary of Analysis of Variance.

Source of Variation	SS	df	MS	F
Group	16.27	1	16.27	26.67*
List Type	.13	3	.05	.32
List Type by Group	.08	3	.03	.21
Serial Position	16.88	3	1.53	6.65*
Serial Position by Group	2.73	3	.24	1.08
List Type by Serial Position	14.15	9	.42	2.20*
List Type by Serial Position by Group	4.95	9	.15	.77

* Significant at $p < .01$

The results were summarized for position by collapsing the serial positions for words 1-3, 4-6, 7-9, 10-12. Statistically significant ($p < .01$) differences existed between the normal and aphasic groups (Factor A). Significant ($p < .01$) differences were also noted for the main effect of serial position (Factor C) as well as for the interaction of list type by serial position (Factor B X C). No other statistically significant ($p < .05$) differences were found. Because interactive effects are hierarchical, the interaction between list type and serial position (Factor B X C) is the finding of note. For purposes of clarity, the results for each list type (nouns, verbs, noun-verbs and verb-nouns) are plotted in Figure 1 for the four serial positions (1-3, 4-6, 7-9, 10-12).

The differences between the normal and aphasic groups (Factor A) are plotted separately for each list type. For the noun only condition, both groups demonstrated best recall for the initial three and final three word positions. The presence of a recency-primacy effect was evident in this condition for both groups (Figure 1A) as best recall was noted for initial and final stimuli. However, the recency effect for normal subjects was demonstrated with the final three items of this list, while the brain-damaged group showed a recency effect for the final six words in this list. This upward trend in delayed recall for the brain damaged group emerged from a sharp performance dropoff between positions one through three (43%) and four through six (10%). In the verb only condition (Figure 1B) the normal group demonstrated best recall for the initial three items, suggesting a strong primacy effect. These data indicate that normal performance (which began with highest recall for the initial three items) started a downward pattern

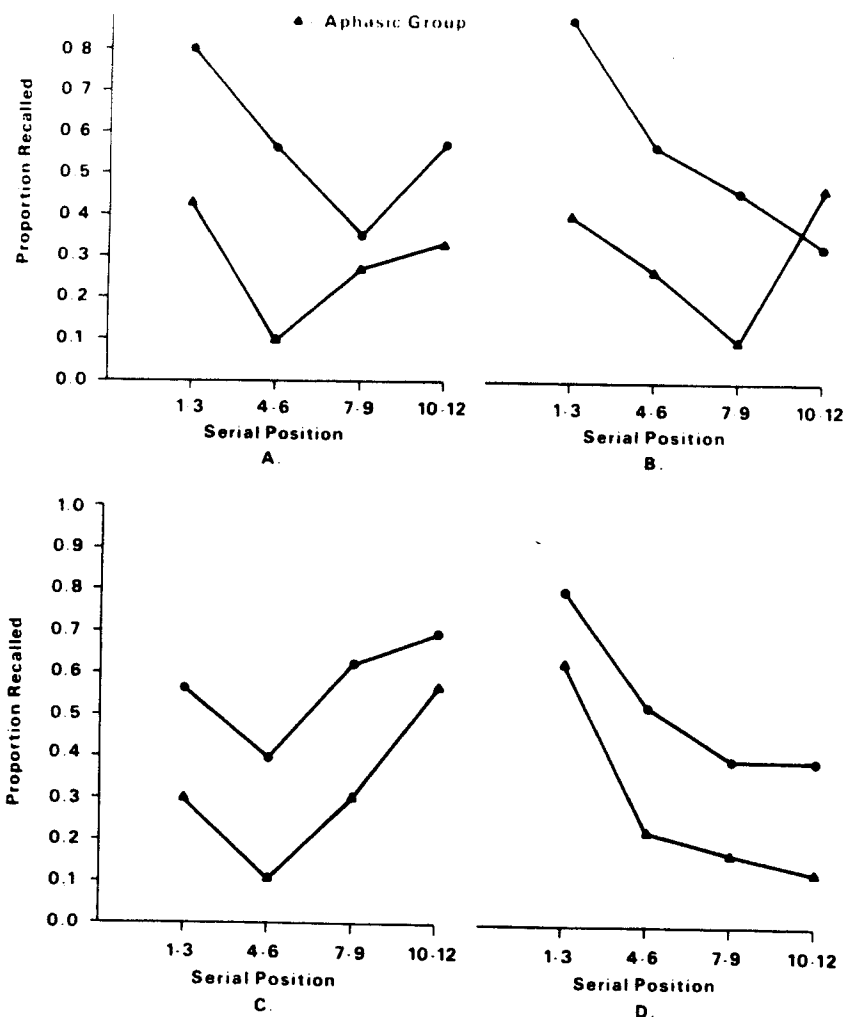


Figure 1. Proportion of words recalled by position and list type. A: Nouns. B: Verbs. C: Nouns plus verbs. D: Verbs plus nouns. Data are collapsed across serial positions so that positions 1,2,3 - 4,5,6 - 7,8,9 - 10,11,12 are represented together.

resulting in the absence of a recency effect. In contrast, the pathologic group demonstrated highest recall for the final three items in this condition. A recency-primacy pattern emerged, however, as seen by the relatively low performance for the middle six positions (4-6 = 27%, 7-9 = 10%) when compared with the initial three (40%) and the final three (47%) positions. When six nouns preceded six verbs, the groups again demonstrated different levels, but similar patterns of performance (Figure 1C). For the final six items (verbs) both groups demonstrated better recall than in any other condition for those word positions. What appeared to be an extremely strong recency effect was seen for the normal and the pathologic group in this condition, as the first six items were disproportionately lower than the final six. When verbs preceded nouns (Figure 1D) best recall was seen for the initial six versus final six positions indicating a strong primacy effect and the absence of a recency effect for both groups. The normal group (which began with 80% recall frequency for the first three items) flattened out to 40% for the final six items. The pathologic group showed best recall (63%) for the first three items and poorest recall for the final three items (13%) with relatively low recall for the middle six items.

CONCLUSIONS

The findings of this investigation demonstrated that imposing a 20-second delay on free recall of aphasic subjects resulted in poorer performance overall

than was seen for a normal control group. This finding corroborates previous research which indicated that aphasic patients demonstrate a reduction of overall recall and memory (Albert, 1976). This finding was true across serial position and list type with the exception of the final three items in the verb only condition. Delayed recall performance of aphasic subjects for those final three verb only items revealed a 14% better recall proportion than for normal subjects.

The interaction between linguistic type (noun, verb, noun-verb and verb-noun) and serial position demonstrated the effect of each of these variables on the other. All subjects, regardless of group, demonstrated a primacy effect -- initial position recall performance was always higher than middle position. When only verbs were presented or when verbs followed nouns, recall was facilitated (recency effect) for aphasic subjects as demonstrated by their increased performance on final serial positions. This recency effect was not exhibited by the normal subjects for the verb condition alone but was true for the noun plus verb condition. It appears that for aphasic patients inclusion of verbs, either singly or following nouns, enhances recall for the most recent materials heard. Possible differences in recall strategy between normal and aphasic subjects may exist for verbs in that primacy-recency strategies were used by the aphasic subjects, while only a primacy strategy appeared to be used by the normal subjects. It is interesting to note that the recall of verbs by aphasic subjects in the recency position was superior to that exhibited by normal subjects.

These data indicate that the verb, whether in initial or final positions, facilitated recall performance. This finding is in contradiction to a proactive interference effect which might be specific to changes in the linguistic class (verb-noun) of the stimuli presented in those two conditions. Keppel and Underwood (1962) and Wickens (1972) suggested that the Peterson and Peterson (1958) paradigm may be subject to proactive interference. Wickens demonstrated that changes in recall performance could be explained by changes in stimulus attributes in a word list to be recalled. Wickens' research indicated that while sensitivity to semantic attributes is high, sensitivity to syntactic characteristics is relatively low. If proactive interference, based upon changes from noun to verb and verb to noun was an issue in the present study, one might expect similar patterns of change to be noted in the mixed-word-list conditions. In fact, the opposite occurred. An upward trend in recall performance was seen on linguistic attributes rather than on serial position (1 through 6 versus 7 through 12).

Meunier, Stanners and Meunier (1971) concluded, as did Crowder and Morton (1969) that rehearsal disproportionately increases recall of early list items and not final list items. The results of the present study did not support this finding. These data suggest that memory is affected by linguistic features of the stimuli, combined with serial position. If rehearsal was a strategy implemented by the subjects in this experiment, future research may focus on the ease with which rehearsing can be accomplished with different categories of words, rather than on the specific position of the word within the list.

In summary, it appears that aphasic and normal subjects' delayed recall performance is affected by the linguistic attributes of words and their serial position. Aphasic patients demonstrated poorer recall for initial, middle and final items, compared with normals (with the exception of the final 3 items in the verb only condition). Verbs in the initial position (primacy) and final positions (recency) were recalled with more frequency than were nouns for both groups studied.

REFERENCES

- Albert, M.L. Short term memory and aphasia. Brain and Language, 3, 28-33, 1976.
- Cermak, L.S. and Moreines, J. Verbal retention deficits in aphasic and amnesic patients. Brain and Language, 3, 16-27, 1976.
- Crowder, R. and Morton, J. Precategorical acoustic storage (PAS). Perception and Psychophysics, 5, 365-373, 1969.
- Goodglass, H., Gleason, J.B. and Hyde, M.R. Some dimensions of auditory language comprehension in aphasia. Journal of Speech and Hearing Research, 13, 595-606, 1970.
- Heilman, K.M., Scholes, R. and Watson, R.J. Defects of immediate memory in Broca's and conduction aphasia. Brain and Language, 3, 201-208, 1976.
- Keppel, G. and Underwood, B.J. Proactive inhibition in short-term retention of single items. Journal of Verbal Learning and Verbal Behavior, 1, 153-161, 1962.
- Locke, J.L. and Dick, J.W. Retrieval failure, rehearsal deficiency and short term memory loss in aphasic adults. Brain and Language, 5, 227-235, 1978.
- Lovero, F.L. and Craft, R.B. Memory performance as a function of stimulus input characteristics for both aphasic and normal adults. In R.H. Brookshire (Ed.), Clinical Aphasiology: Conference Proceedings, 1982. Minneapolis, MN: BRK Publishers, 1982.
- Madigan, S.A. and McCabe, L. Perfect recall and total forgetting: A problem for models of short-term memory. Journal of Verbal Learning and Verbal Behavior, 10, 101-106, 1971.
- Meunier, G., Stanners, R. and Meunier, J. Pronounceability, rehearsal time, and the primacy effect of free recall. Journal of Experimental Psychology, 88, 123-127, 1971.
- Murdock, B.B., Jr. The serial effect of free recall. Journal of Experimental Psychology, 64, 482-488, 1962.
- Peterson, L.R. and Peterson, M. Short term retention of individual items. Journal of Experimental Psychology, 58, 193-198, 1959.
- Porch, B.E. Porch Index of Communicative Ability. Palo Alto, CA: Consulting Psychologists Press, 1967.
- Postman, L. and Phillips, L.W. Short-term temporal changes in free recall. Quarterly Journal of Experimental Psychology, 17, 132-138, 1965.
- Riege, W.H., Metter, E.J. and Hanson, W.R. Verbal and non-verbal recognition memory in aphasic and non-aphasic stroke patients. Brain and Language, 10, 60-70, 1980.
- Rothi, L. Retention of verbal information by aphasic individuals. Presented at the International Neuropsychological Society, New York, New York, 1979.
- Rundus, C. and Atkinson, R.C. Rehearsal processes in free recall: A procedure for direct observation. Journal of Verbal Learning and Verbal Behavior, 9, 99-105, 1970.
- Thorndike, E.L. and Lorge, I. Teachers Word Book of 30,000 Words. New York: Teachers College, Bureau of Publications, Columbia University, 1944.
- Winer, B.J. Statistical Principles in Experimental Design, Second edition. New York: McGraw-Hill, 1971.
- Wickens, D.D. Characteristics of word encoding. In A.W. Melton and E. Martin (Eds.), Coding Processes in Human Memory. Washington, D.C.: Winston and Sons, 1972.

DISCUSSION

Q: In your discussion you talked about primacy and recency strategies. I am wondering if that's an appropriate choice of words. The word strategy

implies, I think, planfulness and some sort of organization or conscious behavior. Usually primacy and recency are talked about as effects without any strategic implications. Are you suggesting that such strategies do exist and are engaged in by aphasic people?

A: I saw more strategy implementation by normal subjects than aphasic subjects in this investigation.

Q: What did you see that led you to call them strategies?

A: For example, some would begin counting on their fingers to monitor number of recalled items, while others separated the mixed word groups into two lists as indicated by a gestural confirmation of two types of information within a list.

Q: I don't want to make this to sound like a value judgment, but the question is, is this a scholarly theoretic paper or a scholarly clinical paper?

A: Well, its nice to have a paper with both theoretical and clinical value and I feel that this paper has both. The clinical value of this paper addresses specifically the manner and type of stimuli we choose for treating aphasic people. This paper also supports our previous work with verbs which alludes to verb as core or verb as central node in designing treatment programs. I think this has many implications for the clinical setting. Its theoretical value is obvious.

Q: Can you tell us something about these patients' rehearsal strategies and what rehearsal strategies they went through?

A: I don't really know what each patient's rehearsal strategies were. What we do know is that each patient was able to repeat either nouns or verbs as measured by pretrial testing. So, what their rehearsal abilities were or if they implemented rehearsal strategies is a question which I don't know the answer to. Again, what we do know is that we provided the necessary time to implement any type of strategy they wanted to before recall was required.

Q: Did individual serial position curves look like the mean curves?

A: I think the collapsed data are representative of the individual curves. There was some variation in those data, but again the group curves reflect, in general, individual performance for both groups studied.

Q: I think this paper has a tremendous amount of clinical value. I think to go a step beyond and look at some of those strategies would be interesting. It would be beneficial to know if rehearsal does in fact help.

A: I agree.

Q: Did you control for word frequency and match the lists?

A: Yes, we did as stated earlier.

Q: Since you got both qualitative and quantitative differences between groups I think these data deserve some follow-up.

A: I agree.

Q: Have you thought about looking at strategies and facilitation of performance?

A: Yes we have. However, the present study is looking at only delayed recall and the issue of choosing verbs over nouns for the treatment environment for

aphasic people. I think as clinicians we are always searching for strategies that might facilitate either input or output processing. The present investigation begins laying some groundwork, in terms of methodology, for looking at just that issue.