On Long-Term Memory Deficits: A Clinical Procedure
Designed to Stimulate Memory Recall
in an Aphasic Patient

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Introduction. The role of memory in information processing has received
abundant interest (Collins and Quillian, 1969, 1972; Sternberg, 1969, 1975;
Lindsay and Norman, 1972; Collins and Loftus, 1975, Craik and Lockhart,
1972). In many cases, the essential roles played by the short-term
memory (STM) and long-term memory (LTM) systems in the perceptual and
associative processes of information storage have been given special
interest. It has been suggested that LTM is stored in terms of semantics
while STM appears to be stored in terms of the acoustic or articulatory
properties of the material (Craik and Lockhart, 1972). In this way, the
STM system acts as a hold for process organization before the information
is transferred to LTM where it will then be more readily retrievable. The
presumption of a semantically-organized LTM storage system is currently
accepted (Collins and Quillian, 1969; Tzeng, 1972; Collins and Loftus, 1975)
but distinctions in availability and accessibility of this information for
retrieval have been raised (Allen, 1969; Birnbaum and Eichner, 1971). In
studies of free-recall learning, it has been found that recall can be
augmented by providing subjects with appropriate cues (Allen, 1969; Birnbaum
and Eichner, 1971). This evidence suggests that an item may be stored
(available) but not retreivable (accessible) and that in free recall situations,
some significant number of the unrecalled items represent inaccessible traces
of those items rather than unavailable ones (Allen, 1969). Cueing techniques,
therefore, represent potential devices for increasing retrieval of available
items which previously were not accessible. Other strategies, such as re-
hearsal and delay, were found to have differential effects on recall. The
amount of rehearsal activity an item receives appears to be unimportant for
LTM registration. Rather, it is the conditions which are set up during the
delay period for rehearsal which contribute significantly to recall perfor-
mance (Frase, 1973; Roenker, 1974).
    Many factors have been mentioned as facilitating LTM recall. Among
these are increased phonological stress of stimuli (Nichols and Jeter, 1973),
input clustering (Frase, 1973; Puff, 1974), concreteness of stimulus items
(Wortman and Sparling, 1974), intention to learn (Frase, 1973) and block
organization of stimulus lists (Puff, 1974). Internal manipulations of
cue conditions have also yielded optimal situations in which maximum benefit
is derived from specific types of cues delivered (Allen, 1969). Unrecalled
words from a stimulus word list (Allen, 1969) and superordinate relational
items (Puff, 1974) have been shown to be two such types of cues which effect-
ively aid recall. Method of stimulus presentation also provides a signi-
ficant variable in promoting recall of word lists. Optimal levels of sub-
jective organization must be established prior to cueing and may be achieved
by providing a long, well structured list coupled with several study trials
(Allen, 1969; Birnbaum and Eichner, 1971).

The anatomical basis for memory functions has been investigated and generally determined to be located in the left posterior temporo-parietal area for both short-term and long-term memory systems (Fedio and VanBuren, 1974). Recent studies have been directed toward better understanding of the effects of damage to this cortical area upon memory processes. Brooks (1975) has found that, in patients with severe head injury, the memory deficit was in the LTM stage of processing. His discussion of "intrusion errors" relates directly to the availability-accessibility distinction raised previously whereby items from previous lists were recalled incorrectly. The low frequency of such errors in this population suggested that the main defect lay in storage rather than retrieval. Warrington (1975) proposed that LTM is hierarchically organized into a perceptual classification system, composed of knowledge of attributes and associations of objects, and a semantic classification system, composed of broad category information. This hierarchical organization of systems allows for differential impairment which result in such disturbances as visual object agnosia. She, like Brooks, suggests that the deficit is not merely in the retrieval of semantic information but that the storage systems are damaged.

The purpose of the present investigation was to conceive a therapeutic technique for long-term memory disorders which would be constructed utilizing optimal conditions supported by empirical evidence and also be eclectic in nature. This effort represents a case study from which the results may contribute to further designs of rehabilitation programs for this large group of patients.

Case Selection. The patient is a 48 year old female who began having body aches while at work on February 4, 1977. Several hours later she began having acute difficulty talking, marked by slurred and confused speech. Disorientation and loss of awareness followed. Upon admission to the hospital, she received a neurological work-up including a brain scan, EEG, skull x-ray, and spinal tap. Results of brain scan revealed no definite abnormality. Initial EEG findings revealed abnormal activity consistent with diffuse encephalopathy. Spinal tap revealed encephalitis and she was begun on antibiotics. Arteriograms showed no evidence of aneurysm or mass effect. Results of subsequent EEG findings on April 26, 1977 revealed activity to be within normal limits. There was no focal change or evidence of diffuse encephalopathy. A computerized tomography (CT) scan was performed on November 8, 1977. Areas of decreased density in both temporal regions, especially on the left, compatible with focal areas of atrophy were found.

Initial Speech and Language Evaluation. Administration of the Porch Index of Communicative Ability (PICA) (Porch, 1967) at approximately nine months post onset revealed overall performance to be at the 89th percentile. Subsequent testing performed at approximately eleven months post onset showed an increase in overall performance to the 91st percentile. The patient reported that the main difficulties at the time of the second evaluation were memory deficits and reading comprehension. Presentation of auditory verbal digit span for assessment of short-term memory processing revealed essentially normal capacity with a span of seven digits. The patient was then enrolled in a therapy program.

Quasi-Experimental Design. At the initiation of therapy, a clinical experiment was begun which consisted of comparing the effectiveness of two types of cueing techniques, one utilizing superordinate relational items and the other utilizing unrecalled list words, that were designed to aid free recall of randomized serial word lists. An equivalent time-samples design (Campbell and Stanley, 1963) was used to compare the cueing techniques with each other over alternating periods of time. Treatment was begun on January 23, 1978. There were four treatment periods altogether that extended over twenty therapy sessions which terminated on April 7, 1978.

Baseline Testing. Two substests from the Wechsler Memory Scale (Wechsler, 1945), logical memory and associate learning, were selected for baseline testing as a quantitative index of long-term memory functions. These measures were administered once a week for the duration of the treatment period which lasted ten weeks. Other initial measures which were adminis-tered included the Token Test (DeRenzi and Vignolo, 1962), the Raven Standard Progressive Matrices (Raven, 1958) and the Boston Diagnostic Aphasia Examination (Goodglass and Kaplan, 1972). Based upon formal and informal measurements of assessment, a problem list was enumerated with regard to the patient's total communicative ability. Table 1 shows this list.

Table 1. Patient's Problem List With Regard To Total Communicative Ability.

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1. Moderate to severe long-term memory difficulties
2. Mild anomic condition
3. Moderate deficit in reading written material
4. Difficulty with auditory comprehension of complex material
5. Depressed emotional state concerning communicative difficulties
6. Limited self-correction

Procedure. In order to improve recall, ten serial word lists consisting of twenty-five concrete nouns in five semantic categories were constructed. The list words were controlled for high frequency of occurrence and ordered for block organization, while the categories were chosen from the fifty-six categories for which Battig and Montague (1969) developed category norms. Words were printed individually on 3 x 5" index cards and presented with a consistent rate of one item every three seconds in randomized order to counter any effects of learning. The clinician named each item during presentation in order to provide simultaneous auditory and visual stimula-tion. To increase the effects of intentional recall, the patient was told before the procedure was begun each time that she would be required to re-call as many of the stimulus items as possible following presentation of the word list. The patient was then presented with three study trials followed by a test trial where she was asked to recall as many words as she could. These responses were recorded and assigned a scaled value of five, if the item was recalled immediately, or four, if a delay intervened between re-call of the last immediate item and the item being considered. Another study trial was then presented followed by a test trial composed of two

phases. In phase one, the patient was asked to recall as many words as possible during a sixty second time span; during phase two, the patient was given one of the two cueing techniques under study every fifteen seconds until all categories had been exhausted. These responses received a scaled score of three if they were recalled during phase one of the test trial or a scaled score of two if they represented a cued response. A final study trial was then employed, followed by a short filler task designed to decrease recency effects of recall. The patient then attempted to recall all the list words presented. Those words left unrecalled were stimulated by phonetic cues to aid memory, and received a scaled value of one if recalled following this procedure. Table 2 represents the multi-dimensional scoring scale used to score these responses.

Table 2. Multidimensional Scoring Scale

5 - Immediate recall
4 - Recall with delay
3 - Recall following fourth study trial
2 - Recall by cueing procedure
1 - Phonemic cue
0 - Fail

Results and Discussion. Before discussion of the overall results of the procedure can be undertaken with respect to long-term memory functions, it is imperative to direct the reader's attention to the behavioral variability which was evidenced throughout the implementation of the program and its probable deleterious effect upon the efficacy of therapy. It is apparent that when uncontrollable environmental events complicate the treatment program, the effects of treatment may be somewhat limited or less effective (Hersen and Barlow, 1976). In the present case, the patient's severe depression seemed to be a source of great variability throughout the treatment program and was evidenced graphically by the inconsistency of results from one session to the next as measured by the treatment task. Since this variability was presumably due to life circumstances and not an intrinsic factor, I will speculate that withdrawal of this variable from the treatment situation would have resulted in an improved treatment environment and therefore, more effective treatment results. Even in the presence of this behavioral variable, however, some positive observations were made from the treatment results.

The patient's overall scaled score, which was the most sensitive indicator of changes in discrete behaviors, e.g., delays, cues, and needs for additional information, showed an increase from 24% to 64% correct recall of serial list words following adjustments after the initial session for stimulus list construction. Stimulus lists for the initial session were constructed using categories which induced guessing, e.g., colors, so that once the semantic relationship between the words was realized, a rote recitation of all the members of the category was given. This served to inflate the initial score so that subsequent lists contained members of categories which were more open in nature and not as susceptible to guessing. The patient therefore did show improvement in her ability to retrieve

information from long-term storage following treatment. Figure 1 displays these results and represents the previously mentioned variability between sessions.
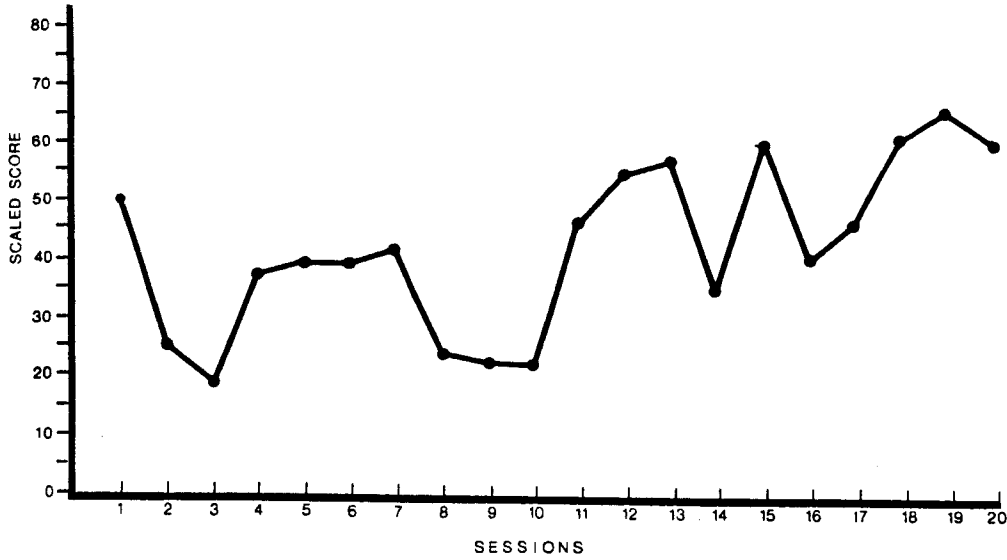

Figure 1. Changes in scaled score over sessions.

In addition to the patient's scaled scores, improvement was indicated by an increase in the total percentage of words recalled during the treatment program. With adjustments as described following the initial session, the patient improved from 72% to 90% recall of the total number of words presented in the treatment task (Fig. 2) Again, significant variability was demonstrated
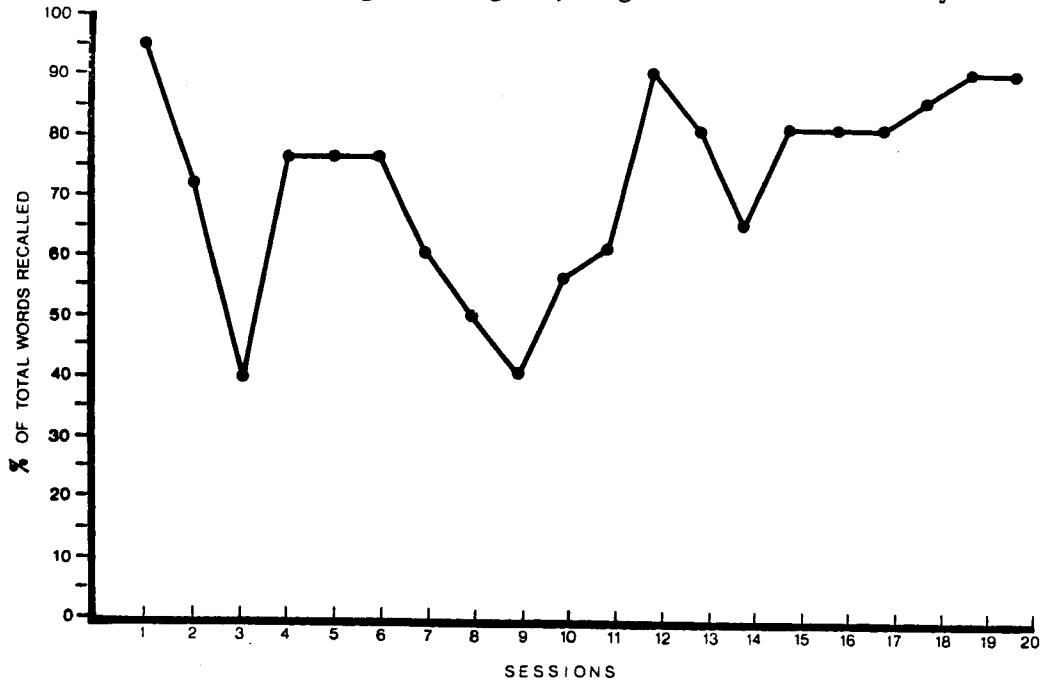

Figure 2. Percent of total words recalled over sessions.

by these results, which ranged from 40% recall at the third session to 90% recall by the twelfth session followed by further subsequent regression and improvement. These results are more evidence to substantiate the notion that there was improvement in long-term memory recall which was subject to antecedent environmental events.

Generalization of these improved skills to other measures of long-term memory function was not demonstrated, and in fact, an overall regression of long-term memory abilities in the presence of treatment was observed. Initial baseline measurements revealed 30% recall on the logical memory task and 10% recall on the task of associate learning. These measurements were not realized again for either task throughout the course of treatment.
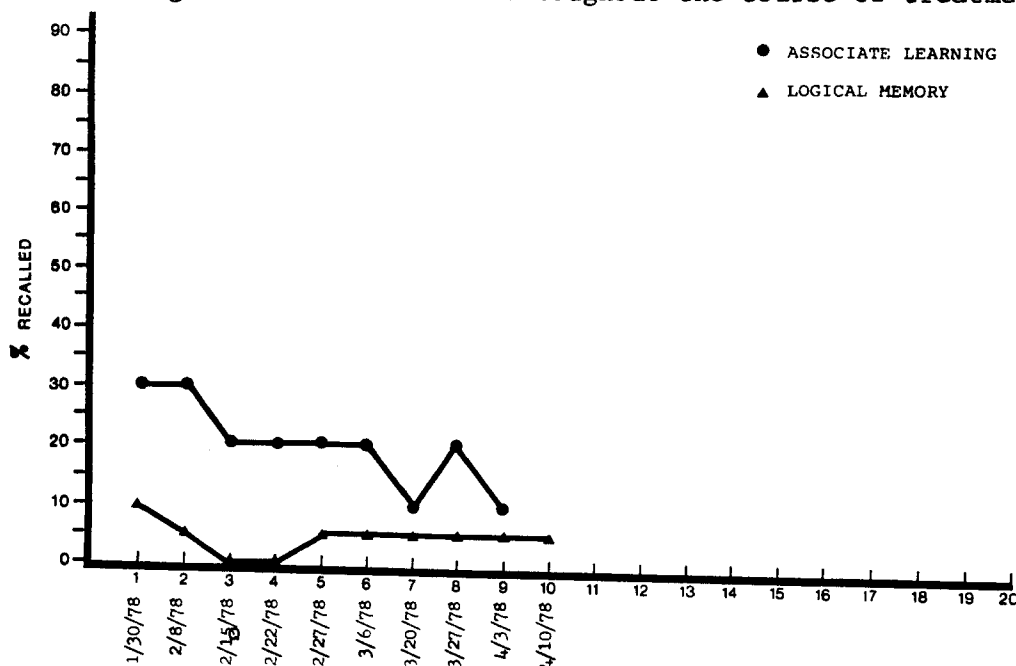

Figure 3. Associate learning and logical memory scores

Although these results seem paradoxical, it is not unlikely for such regression to occur in the presence of treatment when uncontrollable but observable events in thepatient's environment are imposed upon the treatment program (Hersen and Barlow, 1976). In this case, the source of the regression was the patient's severe depression.

With respect to the clinical experiment, which involved the comparison of the two cueing techniques, no clinically significant differences were observed in the percentage of list words which were recalled when cues of either type were delivered (Figure 4). While the alternating periods of time for the two conditions were of unequal spans, especially during the reinitiation of the second experimental condition due to the patient's withdrawal from the program prematurely, it was not evident that recall improved more dramatically during condition A, that of the superordinate relational items, or condition B, the unrecalled list word cueing procedure. The greatest evidence for the more facilitating procedure came from the overt statements of the patient himself while she was trying to recall the stimulus items. In most instances, regardless of cueing procedure, the patient would verbally recall the semantic
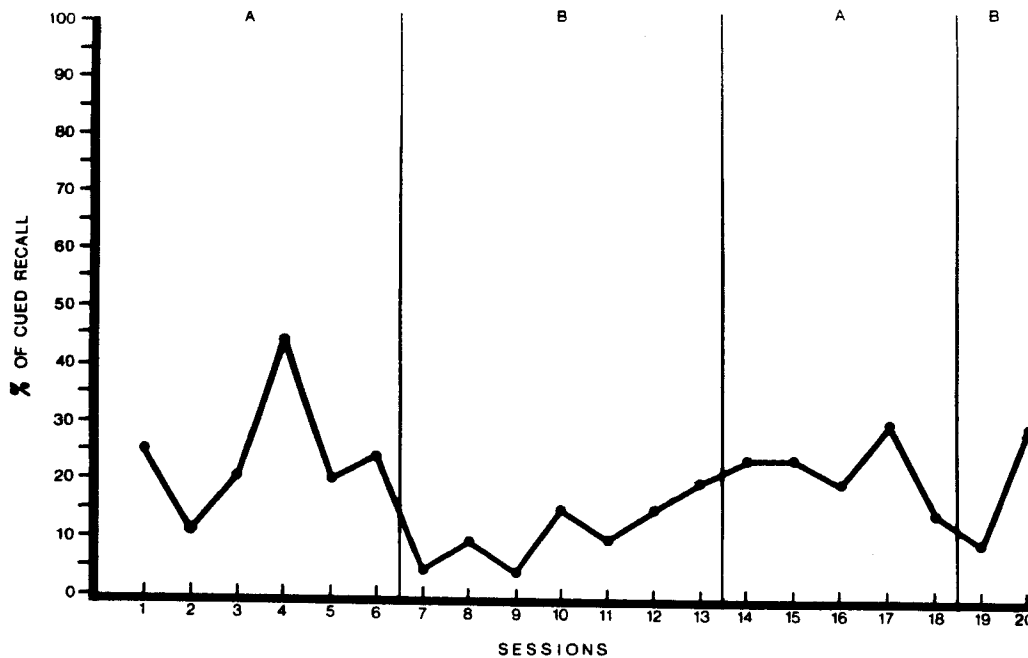
Figure 4. Effects of cues on recall.

categories within which the list words were blocked and then proceed to recall as many of the stimulus items as possible. This would seem to indicate that the patient's own subjective organization of the presented material was accomplished by clustering the items according to semantic relationships and that improvement of recall might better be achieved in this case by delivery of cues which corresponded most closely to the patient's own method of organization of material. Inasmuch as traditional cueing techniques have relied to a great extent on semantic cues, it seems proper that we continue in this direction. However, in some cases, unrecalled list words may also be a cueing method worthy of consideration if it can be demonstrated that this method resembles the patient's subjective organization techniques more closely than a semantic approach.

The main concern in constructing a therapeutic technique is whether or not the procedure is valid, that is, does it tap the skills for which it was intended? The strongest evidence that this procedure was an exercise in long-term memory was found in the high number of "intrusion errors" which were present in the patient's responses following presentation of the stimulus lists. Stimulus items which were presented during previous sessions were consistently observed in the patient's responses during subsequent treatment sessions. These errors suggested that in the present case, the main difficulty lay not in storage of the list items, but rather in the accessibility of the items when responding to the recall task. An inverse relationship, then, was noted from that which Brooks (1975) observed in patients suffering memory deficits from severe head trauma. Perhaps a qualitative difference in terms of type of long-term memory deficit is suggested by these findings when memory loss is consequent to different etiologies, such as viral encephalitis, in the present case.

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A final point needs to be mentioned. While most patients complaining of memory deficits are referring to losses of experiential memory rather than memory for serial recall, it is not my intention to state that these two kinds of loss are equivalent in nature. While storage of events might deal with familiar notions of syntax, Collins and Loftus (1975) have suggested that the search for memory of concepts and words involve very similar kinds of structures. Inasmuch as it would be considered an insurmountable task to treat a patient for memory of a lifetime of experiences, it seems possible to stimulate the same processes of recall by memory for serial word lists as that required for experiential memory. This has been the purpose for the construction of this therapeutic technique. If the procedure is viewed as a basis for further development of treatment tasks for memory deficits, then a positive step in aphasia rehabilitation has been accomplished.

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DISCUSSION

Q. Did this patient virtually seem to make a change across sections on the Boston Exam, as in her ability to recall category names like animal names?

A. As I told you, she left the program before the end of treatment, so I did not get a chance to complete any post-measures so that we could make a comparison with post-intervention results.

Q. What was your basis again for saying that you were in fact testing long-term memory—was it the fact that there were intrusion errors?

A. Yes.

Q. Were the intrusion errors observed within any one specific session?

A. We saw them throughout the treatment program.

Q. Would it have improved your design if you began your session first with a test of whether or not she could recall any of the words she had studied the session before so that you wern't dealing with intrusion errors coming from short-term memory as well?

A. That was our original intention. We were seeing her three times a week on Monday, Wednesday, and Friday and wanted to test her one day for what we had presented her during the previous session. What we found was that she could not recall things five minutes later. Therefore, to even consider her trying to recall something from two days earlier would have been an impossible task.

Q. I'm interested in knowing what the time difference was between EEG's, the normal and the abnormal.

A. The initial EEG was done approximately two months post-onset, and the subsequent test was done almost three months later.

Q. Do you think that maybe we might be able to use EEG's as possible predictors of something going on that you'd have to get them early enough to see if there's an abnormal pattern?

A. Yes. I feel that any technique which would contribute to early identification would be beneficial to the patient and our treatment programs, and if EEG's are one source of doing this, then they should be examined closely.

Q. Perhaps the memory disorders were not related to the organicity but to the psychiatric status, and if it were so, would that affect your treatment hypothesis?

A. Yes. On the days when she would appear to be feeling best, she would show her best performances. Other days, the treatment would consist of counseling her for her depression.

Q. My point is that I don't think a psychiatrist would treat a memory disorder in that way—perhaps we should look at other ways to treat memory disorders if they are indeed a psychiatric memory disorder.

A. In this particular case, the disorder had an organic basis which was being complicated by psychiatric factors.