    Ninety-six subjects were assigned randomly to eight groups of 12 subjects. The
independent variables were (1) controlled association strength between groups of
words within a string (high association [HA] versus low association [LA]), (2) syntactic
structure (grammatical [G] versus ungrammatical [U] strings), and (3) instructions
(ordered learning and recall [O] versus free learning and recall [F]). Each subject
received four study-test trials on a 21-word string. On a measure of serial recall, the
HA condition was superior to the LA condition; the G condition was superior to the U
condition; and the O condition was superior to the F condition. Association and
grammatical structure interacted significantly, indicating that the effect of associative
strength was greater for G than for U strings. On a measure of total word recall
without regard for serial constraint, recall of HA words was superior to recall of LA
words; recall of words from G strings was superior to recall of words from U strings;
but the main effect of Instructions was not significant. There was significant
interaction between grammatical structure and learning-recall instructions (grammatical
structure facilitated O recall more than F recall). These results suggest that there are
limiting factors on the facilitating effects of grammatical structure and associative
strength on sentence recall. (Author/DO)

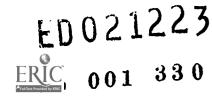# ASSOCIATION, SYNTAX, AND INSTRUCTIONS IN SENTENCE RECALL[1]

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96 subjects were assigned randomly to 8 groups of 12 subjects
in a 2 x 2 x 2 factorial design. The independent variables were
(a) controlled association strength between groups of words within
a string (high association--[HA] vs. low association--[LA]),
(b) syntactic structure (grammatical--[G] vs. ungrammatical--[U]
strings), and (c) instructions (ordered learning and recall--[O]
vs. free learning and recall--[F]). Each subject received 4 study-
test trials on a 21-word string. On a measure of serial recall,
the HA condition was superior to the LA condition; the G condition
was superior to the U condition; and the O condition was superior
to the F condition. Association and grammatical structure inter-
acted significantly, indicating that the effect of associative
strength was greater for G than for U strings. On a measure of total
word recall without regard for serial constraint, recall of HA
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are limiting factors on the facilitating effects of grammatical
structure and associative strength on sentence recall.

It can be hypothesized that the speaker of a natural language when faced
with the task of memorizing and later retrieving a sentence in that language,
has available a number of devices that are likely to facilitate the task.
The devices of interest here are primarily those (a) that increase the size
of the memory unit, and (b) that facilitate construction of the correct
response during retrieval.

For example, in the case of storage, (a) intonation contours act as
cues to phrase boundaries and thus should facilitate recoding of words into
phrase chunks, (b) identification of the overall syntactic structure of the
word sequence should permit him to recode the words into a single serially
organized syntactic chunk, (c) knowledge of rules of semantic interpretation
should permit him to assign a single meaning to the words in a phrase or in
the sentence as a whole, and (d) some word sequences are associatively inte-
grated, i.e., they represent sequences experienced in the past and, therefore,
do not require new learning.

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As for retrieval, in addition to the effects of the storage factors, (a) the speaker's recollection of the syntactic structure of the sentence together with the syntactic constraints exerted by items already recalled, should reduce the number of alternatives he has to select from to determine the form class of a word he is having difficulty remembering, and (b) his recollection of the meaning of the sentence, its associative structure, and the semantic and associative constraints exerted by items already recalled, should reduce the number of alternatives he has to select from within a form class in trying to construct a word he is having difficulty remembering.

Evidence for the independent operation of syntactic and associative factors in the recall of four-word strings comes from a study by the investigator (1966). Number of strings recalled (all words recalled correctly and in their original order) and total word recall was greater for grammatical strings (e.g., Strong lions roar fiercely) than for ungrammatical strings (e.g., Fiercely lions strong roar), and greater for strings of associatively related (free association norms) words than for low association sequences. The absence of interaction between association and syntax indicated that the recall of high association-ungrammatical materials was superior to the recall of low association-ungrammatical materials.

Thus, it appears that even when syntactic rules (and, of course, intonation contours and the rules on which the semantic interpretation of a whole sentence are based) were violated, the presence of associatively related items facilitated recall. It is reasonable to hypothesize, however, that this effect--at least in the case of recall of whole strings--is not likely to withstand the increased demands placed upon serial memory as the length of an ungrammatical string is increased. The present study was an attempt to evaluate this hypothesis in the case of 21-word strings within which were included groups of associatively related or associatively unrelated words. Further, the strings were grammatically or un-grammatically structured, and subjects were given either free learning-free recall instructions or ordered learning-ordered recall instructions. The inclusion of the instruction variable was for the purpose of determining to what extent the facilitating effect of syntactic structure is dependent upon the requirement that words be learned and recalled in order.

Method

Subjects and design. The subjects were 96 undergraduate students (volunteers) who were randomly assigned to 8 groups of 12 subjects each. The variables of

Association (high vs. low), Syntax (grammatical vs. ungrammatical) and Instruc-
tions (free vs. ordered learning and recall) were combined in a 2 x 2 x 2
factorial design. The subjects in each condition were tested in groups of 6.

Materials. To increase the generality of the results, two sentences with
similar syntactic structure were constructed for each level of association,
using the investigator's (1965b) associative sentence norms. The norms were
constructed by giving subjects sentence frames containing only the noun of the
form adjective-noun-verb-adverb. Their task was to associate an adjective, a
verb and an adverb to the noun in each sentence frame. High Association (HA)
strings were then constructed by selecting adjectives, verbs, and adverbs from
the top of the associative hierarchies, and Low Association (LA) sentences by
selecting items with comparable Thorndike-Lorge (1944) frequency and length
from the bottom of the associative hierarchies. Each of the 21-word strings
used in the present study contained within it either three HA sentences or
three LA sentences. For example, an HA string was the little baby cried loudly
while the old maid worked slowly and all the young children played happily with
their parents, and an LA string, the lovely baby fell angrily while the kind
maid washed calmly and all the poor children watched silently with their boats.
The noun at the end of the HA strings was a high-strength free associate of the
subject of the third underlying sentence (e.g., children-parents), while the
comparable item in the LA strings was a low-strength free associate (e.g.,
children-boats).

The grammatical (G) condition consisted of the HA and LA strings, while
the ungrammatical (U) condition consisted of the same strings with the words
arranged randomly, with the exception that the content words in the underlying
sentences occurred contiguously so as to facilitate scoring for serial recall
(e.g., loudly baby little cried).

The strings for the various conditions were printed in booklets, one to
a page. Each booklet consisted of four repetitions of a string, four blank
lined sheets for the written recall tests and filler sheets. The signals to
turn the pages and the recall signals were recorded on magnetic tape.

Procedure. All subjects received four study-test trials on one of the
experimental strings. Half of the subjects in each condition learned the first
string and half learned the second. The exposure interval was 10 sec., the
interval between the end of the study interval and the beginning of written
recall was 4 sec., the recall interval was 90 sec., and the intertrial interval

was 12 sec. All subjects were told that they would be exposed to a verbal

passage and that their task was to try to learn as many of the words in the

passage as possible. The subjects in the free learning--free recall (F) con-

dition were told to learn and recall the words in any order, while the subjects

in the ordered learning and recall (O) condition were instructed to learn and

recall the words in the order in which they appeared in the passage. All sub-

jects were urged to guess at items they could not remember. Detailed instruc-

tions in the use of booklets were administered, and the signals to turn pages

and to begin and end the recall tests were delivered to the subject by tape

recorder. The various conditions of the experiment were administered in

rotation.

Results

The measure of serial recall was the total number summed over the four

trials of underlying sentences recalled correctly. An underlying sentence

(e.g., <u>little baby cried loudly</u>; <u>loudly baby little cried</u>) was scored as

correct if all four content words were recalled correctly and in the order in

which they appeared in the original passage. With the exception of minor

spelling errors, scoring was for verbatim recall. Table 1 contains the means

for this measure for the various experimental groups. In general, it can be

seen that O recall was superior to F recall, HA was superior to LA and G was

superior to U.

Insert Table 1 about here

Although the distribution of scores in Group LAU-F was extremely skewed, it

was felt that there was nothing to be gained by transformation or by the use

of a non-parametric statistic (Edwards, 1960). Accordingly, a factorial

analysis of variance was carried out on the data for the serial recall measure.

The effect of Instructions was highly significant, F (1,88) = 33.37, p < .001,

as was the effect of Association, F (1,88) = 29.20, p < .001, and Grammar,

F (1,88) = 349.54, p < .001. The interaction between Association and Grammar

was significant, F (1,88) = 7.81, p < .01, which indicates that the effect of

Association was greater for G strings than for U strings, but none of the other

interactions was significant.

To determine the level of recall of individual items without regard for

serial constraints, the recall protocols were scored for the total number of

content words recalled correctly (summed over the four trials) without regard
for location on the recall sheets. The means for this measure can be found
in Table 2. Table 2 reveals that recall of HA words was superior to recall
of LA words, recall of words from G strings was superior to recall of words
from U strings, but that 0 recall was superior to F recall for words from G

Insert Table 2 about here

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strings while F recall was superior to 0 recall for words from U strings. The
effects of Association, F (1,88) = 31.99, p < .001, and Grammar, F (1,88) = 94.11,
p < .001, were found to be significant, but not the effect of Instructions. The
only interaction to reach significance was the interaction between Grammar and
Instructions, F (1,88) = 6.13, p < .025; the facilitating effect of grammatical
structure was greater for 0 recall than for F recall.

Discussion

The results of the present study are discussed below for each of the
separate independent variables.

Association. As anticipated, the facilitating effect of association on
serial recall in the case of long strings was greater for grammatical strings
than for ungrammatical strings. However, the effect of associative strength
was the same for grammatical and ungrammatical strings when recall was scored
without regard for serial constraints. Thus, it appears that subjects may
recall associatively related words better than associatively unrelated words
but have difficulty arranging them in proper order when the words appear in
long ungrammatical strings.

Grammar. The effect of grammatical structure on ordered and free recall
for the serial recall measure was striking. However, when recall is scored
without regard for serial constraints, the effectiveness of grammatical structure
is reduced if subjects are not required to learn and recall items in order.
These results suggest that it may be useful in verbal learning studies to dis-
tinguish between the effects of grammatical structure and the effects of the
requirement that the structure be used in learning and recall.

Instructions. Instructions appear to be an important variable in serial
recall regardless of level of association and grammatical structure. However,
it is clear from the results for total word recall that the effect of learning
and recall instructions is upon the serial organization of items in recall and
not upon the probability of recall of items. These last results are not

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consistent with the common observation that free recall is superior to ordered recall in the case of word lists. The reason for this discrepancy is not clear, however. One hypothesis to be tested is that it reflects the nature of the materials used.

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Footnote

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Table 1

Mean Number of Underlying Sentences Recalled Correctly

	Instructions	
	O	F
HAG	9.58	8.58
LAG	7.75	4.92
HAU	2.92	.83
LAU	1.92	.08

Table 2

Mean Number of Words Recalled Correctly

	Instructions	
	O	F
HAG	46.92	46.00
LAG	42.75	39.17
HAU	33.42	39.17
LAU	28.17	29.33