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A Study of "Habit Strength" in Relation to Clustering in
Free Association*

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In a systematic theory of verbal behavior, it must be recognized that verbal responses do not occur in isolation from one another. It is perfectly clear in everyday experience that words and thoughts follow one another in something other than a random way. There seem to be determinative factors that lead to regular order and relationships among thoughts and the like. But little is known concerning the dimensions which describe these regularities. This ignorance is especially pronounced when complex chains or series of responses are considered, as in the case when a series of unrestricted free associations is given by a subject to some stimulus. Apparent regularities can be seen in such sequences of responses, but little has been done to describe and evaluate these regularities or the factors that produce them.

Recently, Bousfield (1) has suggested a technique for the study of these processes. His procedure involves, essentially, the selection of words which have known relationships to one another and presenting them to a group of subjects in a scrambled order. The subjects are asked to recall the words after a single reading. The sequence of recalled words is then analyzed to determine whether clusters of related words appear in the free recalls. This technique seems to afford a simple and ingenious way to get at the variables which organize and regularize thoughts and other "mental" phenomena into patterns and regularities.

Bousfield has shown that clustering in free recall will occur among words that belong in the same category. For example, words that are names of occupations will tend to occur together in free recall, even though they were presented

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separately and mixed in with words from other categories when they were read to the subjects. Jenkins and Russell (2) have also studied a similar problem. They showed that clustering would occur when the words read included words given frequently as single responses to other words. They used stimulus words from the Kent-Rosanoff list and words given with high frequencies as responses to these stimulus words. Despite the random order in which these and other words were read, the subjects tended to restate, in free recall, the pairs from the Kent-Rosanoff list.

In interpreting his data Bousfield has suggested that two factors are responsible for the time or order of emergence of a particular word in free recall. One is habit strength. By this he implies that words exist in the vocabularies of persons in different degrees of availability for occurrence. Hearing a highly available word spoken (when the list is read) should easily raise its availability above a threshold for recall, whereas hearing a less available word spoken might not raise its availability enough for it to be recalled.

This factor would, to some extent, account for the fact that some words are recalled and that others are not. Further, if among all words whose availability is suprathreshold the one with the greatest availability is recalled first and so on, then the time and the order of recall of the words would also be affected by this factor of habit strength.

This explanation, however, would not account for clustering, because clusters of related words include words of variable habit strengths. Bousfield has postulated a second factor, relatedness increment, which, in interaction with habit strength, would produce clusters.

In Bousfield's study, habit strength was not investigated, since it was concerned with the demonstration of clustering on the basis of relatedness increment. The study by Jenkins and Russell presumably involved both factors, since habit strength is probably not separable from relatedness factors in the Kent-Rosanoff

pairs. It was the purpose of the present study to investigate the problem of habit strength as indirectly measured by Thorndike-Lorge frequency ratings.

Method

The method followed was essentially that described by Bousfield (1). Two separate studies were conducted. The first, to be referred to as Study A, was conducted with a 60 word list, composed of four groups of 15 words each. The four groups of words each represented a different frequency category from the Thorndike-Lorge general count (3). The order of the words was randomized, and the sixty word list was read once to a group of 56 male and female college students. Eight minutes were allowed for the recall which followed immediately. These words, grouped under the appropriate frequency categories, are presented in Table 1.

For three reasons, it was felt that the results obtained in Study A were not entirely satisfactory. The first of these reasons was that a number of the words began with or contained similar sounds, and clustering seemed to appear on the basis of sound similarity (clang). The second reason was that some of the infrequent words appeared to be odd or vivid, and this perhaps led to improved recall of them. The third reason was that the exact frequencies of words classified as 40 are not known and that the Thorndike-Lorge frequency intervals between the frequency categories and the range of frequencies within categories were unequal. Consequently, Study B was conducted.

Study B was conducted in the same way as Study A. Forty words were selected, grouped into four frequency categories of 10 words each, as shown in Table 2. (In both Study A and Study B, every effort was made to find the most meaningful relationships in the lists of words. The words were then randomized and read to a group of 15 male and female college students. A period of five minutes was given in Study A for the recall, a shorter period for Study B. In the recall trial, as the case in the Bousfield study, since the subject had ceased

responding prior to the expiration of the eight and five minute intervals.

The instructions for the two groups were identical and provided that the subjects mark their papers at one minute intervals on signal from the experimenter. These instructions were as follows :

I shall read you a list of words, and you are asked to recall as many of them as you can after I have completed the reading. You are to start writing the words as rapidly as possible when I say, "Go!" Write the words in a column at the left side of the paper that has been given to you. At intervals I shall say, "Draw a line." On hearing this signal please draw a short horizontal line under the last word you have written, and then continue with more words. In the event you have thought of no additional words since the last instruction, "Draw a line." you will draw another line just the same. Are there any questions?

The techniques for assessing clusters, suggested by Bousfield, were not used on these data, since clusters in his sense were not anticipated. The measures employed were the total number of words recalled per frequency group, and the number of words from each frequency group recalled in the first minute, the second minute, and so on. It was anticipated that if habit strength is related to recall, there should be a direct relationship between total number of words recalled and word frequency and that the words of higher frequency should be recalled especially often in the earlier part of the recall period.

Table 1

List of words read in Study A, classified by frequency category.

<u>AA</u>	<u>30-49</u>	<u>14-18</u>	<u>8-9</u>
able	abandon	absurd	absorption
back	bargain	banish	balcony
battle	barrel	bead	basic
came	candidate	camera	canto
century	champion	chariot	chaos
decide	deceive	decent	debtor
drink	drift	dreary	dressmaker
edge	echo	efficiency	edifice
enjoy	enormous	ending	engrave
father	fairy	famine	farthest
fresh	frequent	frail	freckle
father-	goose	grab	gallows
government	maiden	magistrate	gorge
machine	mirror	ninth	mainland
million			mince

Table 2

List of words used in Study B, classified by frequency category.

<u>47-48-49</u>	<u>37-38-39</u>	<u>27-28-29</u>	<u>17-18-19</u>
haste	dispose	widely	document
excite	draw	vapor	footstep
perceive	button	unit	fringe
snap	abandon	tremendous	guardian
wisdom	interrupt	stump	kneel
thunder	juice	sparkle	mound
constant	lawn	robber	rumor
neighborhood	tradition	replace	vigor
organize	verse	profession	wrist
slope	wherever	offend	bruise

Table 3

Total number of words correctly recalled in Study A, number recalled per minute (N of 38 56), and percent recalled of the possible recalls.

Frequency Rating	1st min.	2nd min.	3rd min.	4th min.	5th min.	6th min.	7th min.	8th min.	Total	%	Mean
AA	168	29	10	6	7	1	2	1	224	27	4.0
30-49 (39)*	105	21	13	7	3	7	2	2	160	19	2.9
14-18 (16)*	88	22	4	4	3	2	2	0	125	15	2.23
8-9 (8.4)*	103	15	8	6	5	1	0	1	139	17	2.48

* Average frequency counts for the words in these categories.

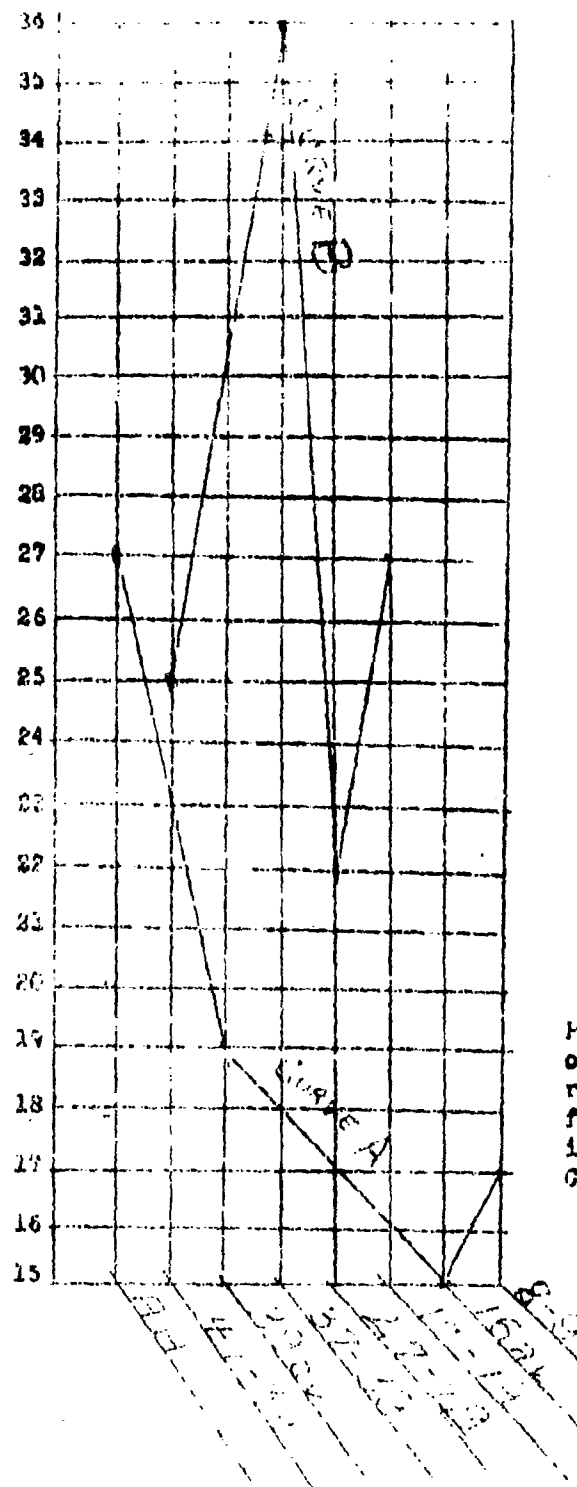
Table 4

Total number of words correctly recalled in Study B, number recalled per minute (N of 38 16), and percent recalled of the possible recalls.

Frequency Rating	1st min.	2nd min.	3rd min.	4th min.	5th min.	Total	%	Mean
47-49	33	5	0	2	1	41	25	2.56
37-39	50	4	1	3	0	58	36	3.6
27-29	32	2	1	0	0	35	22	2.1
17-19	38	4	1	0	0	43	27	2.7

Figure 2

% possible words



Results

The major results of the studies are shown in Tables 3 and 4 and in Figure 1. In Study A, there is a clear decline in the number of words recalled as a function of word frequency, with the exception of the difference between the number of words recalled in the last two frequencies. For the mean total number of words recalled, the only significant difference (t-ratio) is between the .05 and .01 levels and is that between the number of AA words recalled and the number of words recalled from the frequency group 14-18. In the first minute of recall, however, the differences between the mean number of AA words recalled and the number recalled from the other groups are all significant between the .05 level and the .01 level.

The results of Study A suggest a tendency for more of the higher frequency words than of the low frequency words to be recalled. This superiority seems to be maintained for the first minute of recall only. The number of words recalled in the subsequent recall intervals for the various frequency groups suggests very little but random variation.

The foregoing conclusion, tentative as it is because of the inversion in the number of words recalled for the last two frequency categories, is now supported by the results of Study B. Words with 47-49, 27-29 and 17-19 occurrences in a million are all recalled with about equal frequencies. The second most frequent category (37-39), however, shows a higher frequency of recalls. A combination of the two highest frequencies and a combination of the two lowest frequencies would give general support to the frequency-recall relationship (99 words recalled for the two high frequencies as compared to 78), but none of the relationships mentioned here is significant.

The results in Study B are further problematical, because the word list was designed to minimize certain deficiencies believed to characterize the list used in

in Study A. However, the use of a small number of rather highly selected subjects (graduate students in psychology) may account for the results of this particular investigation. Study B will be repeated in the future with a larger and less special group.

Discussion

Although the findings relevant to the main purpose of this study have been presented, certain other incidental results may be mentioned. One is that the percentage of the total possible words recalled was greater in Study B than in Study A. Over one-fourth (27.65%) of the 40 words read in Study B were recalled as against 19.26% in Study A. This was not true for words of the highest frequency, where the percentage of possible recalls was about equal for the two groups. It may be that the generally higher proportions of the lower frequency words recalled by the group in Study B is an indication of the influence of their highly selected character on the over-all results.

A second point that it seems appropriate to comment upon is the relatively small number of words recalled in these studies. In Study A the mean total number of words recalled (out of 60) was 11.53 and in Study B was 11.06 (out of 40). These means are about half the size of those reported by Bousfield (24.97 out of 60 words) and by Jenkins and Russell (24.54 and 23.59 out of 48 words). It is quite possible that the lower means reported here may be due to the lack of meaningful relationships among the words in the lists used in Studies A and B, whereas the semantic relationships in the Bousfield and Jenkins and Russell studies may have enhanced recall.

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