The measurement of "adopted chunks" in free recall learning¹

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Ss were given one learning trial on each of three lists presented in counterbalanced order. One of the lists contained items of the first order of approximation to English; another contained third order items; and the third consisted of text order items. After each trial Ss recalled as many items or parts of items as they could. The number of whole items remembered was a direct function of approximation to English. When "adopted chunks" were measured, there were no differences among lists in the number of chunks remembered. Between seven and eight chunks of information were recalled at all orders of approximation.

In most verbal learning studies, what Ss learn is usually expressed in terms of the number of "whole" items that they get correct. For the experimenter, it may be simple to measure whole items, but to imply that people learn verbal material only in terms of complete words, or complete nonsense syllables, or complete items of any kind is undoubtedly erroneous. There is probably some material that Ss learn in units the size of a word; but there is probably other material that Ss learn in units the size of two, three, or four words; and there is probably yet other material that Ss learn in units much smaller than whole items, the size of these units being perhaps only two or three letters. Related to the notion of a "subjective" response unit is Miller's (1956) concept of the "chunk." He believes that people tend to master verbal material in chunks of information organized as units. The number of these units that a person is able to receive, process, and remember, irrespective of the amount of information per unit, appears to be a constant and is limited to about seven, plus or minus two, chunks of information.

The major problem is how to measure these subjective units. Tulving & Patkau (1962) assume that S adopts some sequential organization from the input list. Thus, their "adopted chunk" is defined as any group of one or more items which occurs in S's recall in the same sequence as in the input list. They found that their Ss remembered approximately the same number of adopted chunks under all experimental conditions. While they were interested in how groups of words were formed into chunks, the aim of the present study was to determine whether Tulving and Patkau's method could be used to measure how groups of letters within words or items, as well as groups of items themselves, are organized into chunks. An adopted chunk was therefore re-defined as any group of one or more letters which occurred in S's recall in the same order

as in the original input list. Defining it in this way meant that chunks smaller in size than whole items would be measured, and yet two or more whole items which occurred in the same order in S's recall as in the input list would still be counted as only one chunk. An additional restriction was placed on one-letter "chunks" to eliminate the possibility of Ss' simply guessing single letters at random. To be counted as a chunk, a single letter had to be recorded in its correct intra-item serial position.

Method

Ss were 18 women taking an introductory course in psychology. Sixteen eight-letter sequences at each of the first, third, and text orders of approximation to English from another study (McNulty, 1965) were used as learning lists. Each S was given all three 16-item lists to learn. The order of presentation of the lists was counterbalanced over Ss, three Ss learning each of the six possible orders of presentation.

Only one learning trial was given on each list, with the 16 items being presented on a memory drum at the rate of 3 sec. per item. Three random orders of each list were constructed, with the three Ss in each of the six order of presentation groups learning different random orders of any list. After the learning trial on each list, S's task was to write down, in spaces provided on the record sheet, as many items as she could remember. Even if S could not remember an item in its entirety, she was instructed to write down as many letters in their correct positions in the item as she could. (The spaces for each item on the record sheet contained eight blanks, one for each of the eight letters in the item) Exactly 2 min. was allowed for recording responses, and, after a further 3 min. break during which S rested, the next list was presented. Detailed instructions regarding the task were given before the first learning trial was begun.

Results and Discussion

The mean number of whole items correctly recalled at each order of approximation is shown in Fig. 1. As one would expect, recall increased with approximation to English and this effect was highly significant statistically. An analysis of variance revealed no other significant effects. For example, the order in which the learning lists were presented had no effect upon recall scores.

Figure 1 also shows the mean number of adopted chunks recalled at each order of approximation. No significant differences due to approximation to English or any other variable were found in the number of

Fig. 1. Mean numbers of whole items and adopted chunks correctly recalled at each order of approximation to English.

chunks that were remembered. The number of chunks recalled appeared to be relatively invariant from one order of approximation to the next. It is interesting to note how closely the mean number of chunks at each order of approximation agrees with Miller's (1956) "magical number seven." At text order the number of chunks and words correctly recalled is about the same, indicating that after a single exposure of unrelated text order items a chunk of information corresponds roughly to a single word.

The size of an adopted chunk (in number of letters) did, of course, vary as a direct function of approximation to English. The fact that chunks vary in size should be no more surprising than the fact that words vary in size. Chunks are probably equivalent units of information to Ss and just as basic and unitary as words.

Undoubtedly, some "chance" chunking occurs. Data for "statistical" Ss were therefore generated. All of the letters comprising the items in a particular list were put into a box and letters were drawn at random to match the performance (in number of letters) of

actual Ss. The important consideration was not whether statistical Ss could "recall" as many chunks as actual Ss. Rather, the important point was whether or not chunks of the size of those observed in the recall of actual Ss could have been obtained by chance without their having been remembered from the input list. Thus, a statistical S was credited with a chunk only if it was at least as large in size as a chunk in the recall of the actual S. Amount of chance chunking was found to be negligible at all orders of approximation. In addition, the estimates are still probably too large because they did not take into account the facts that (1) Ss wrote down very few sequences of letters which were not in the input list while statistical Ss made a great many more "errors" than "correct" responses, and (2) nearly all of the chunks that actual Ss recalled were written down in the spaces on the record sheet corresponding to their actual positions in the learning items. (Details on how chance chunking was estimated may be obtained from the author upon request.)

With additional learning trials, the size of the chunks at each order of approximation would be expected to increase as Ss organize and learn the material. Nevertheless, the number of chunks correctly recalled on any trial should not change. At present, there is really no way to measure the number of chunks in later trials, although Tulving (1962) has developed a method to measure the organization that Ss impose upon unorganized material.

References

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