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MEMORY SPAN AND SELF-DIRECTION IN SERIAL LEARNING OF NAMES.

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THIS STUDY SOUGHT TO DETERMINE WHETHER SERIAL LEARNING EFFICIENCY DEPENDS ON THE RELATIONSHIP BETWEEN PART SIZE AND THE EMPIRICALLY DETERMINED MEMORY SPAN OF THE LEARNERS. ISSUES EXPLORED WERE THE TRADE-OFF BETWEEN REHEARSABILITY AND EFFORT IN OPTIMIZING THIS RELATIONSHIP, AND FEASIBILITY OF A FLEXIBLE PART SIZE. A MEASURE OF MEMORY SPAN WAS COMPUTED, AND THEN 65 GRADE 6 STUDENTS WERE RANDOMLY ASSIGNED TO 3 TREATMENT GROUPS, 2 VARYING PART SIZE AND 1 A SELF-DIRECTED (COMPLETE FREEDOM IN METHOD OF STUDY) GROUP. A LIST OF LAST NAMES OF THE FIRST 30 U.S. PRESIDENTS WERE PRESENTED IN WHOLE OR IN PART ON 6 TRIALS. SCORES AT 3 MEMORY SPAN LEVELS SHOW A GREATER EFFECTIVENESS OF A PART SIZE SUBSTANTIALLY LARGER THAN MEMORY SPAN, SUGGESTING THAT EFFORT INDUCED BY STRETCHING THE LEARNER'S MEMORY SPAN MAY BE MORE IMPORTANT THAN GUARANTEE OF IMMEDIATE REHEARSAL. BUT OTHER DATA PRESENTED CONTRADICT THIS AND SUGGEST AN ALTERNATE, UNKNOWN EXPLANATION. (LH)

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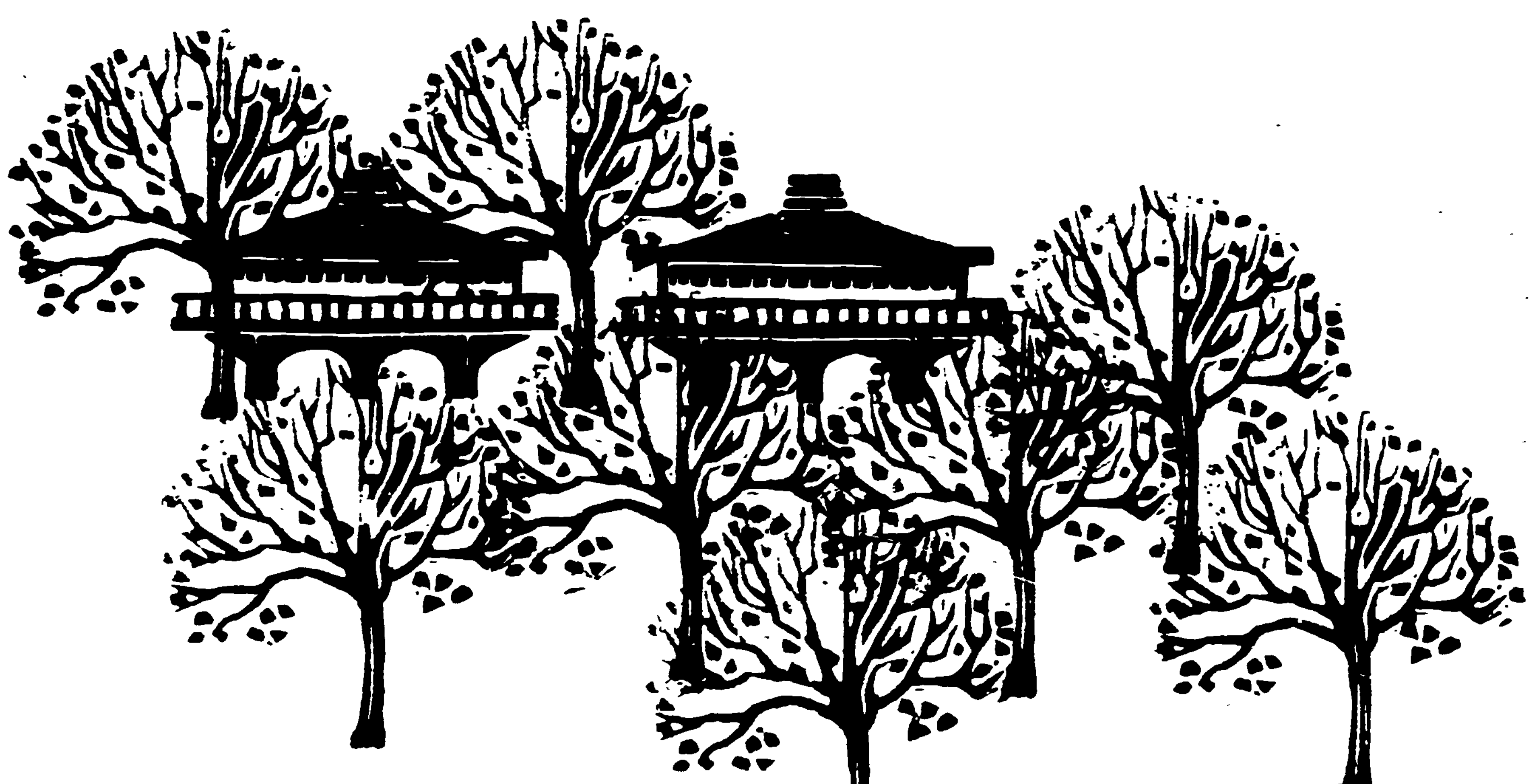

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Introduction

This report summarizes an experiment investigating the effects of instructor-determined and student-determined part size in the learning of a serial task. The serial task was chosen to represent that category of school learning referred to elsewhere (Campbell, 1963a) as ordered specifics, in which specific things such as names, places, or objects must be remembered and associated in a fixed order.

It has been shown that as the length of a serial list increases, the "part" method of learning becomes more efficient and the "whole" method less efficient (Margolius and Sheffield, 1961; Orbison, 1944). However, the choice of step-size, or length of the part, has been a neglected area of investigation. Recent experimentation on serial tasks, both motor and verbal, has shown the relevance of the learner's memory span to manner and rate of learning (Jensen, 1963; Waugh, 1962; Whitmore, 1963). The present study was designed to determine whether learning efficiency depends on the relationship between part size and the empirically determined memory span of the learners.

Since recitation and rehearsal are effective techniques in learning by memorization, and the learner can only rehearse as much as he can remember, keeping the part size of the material to be remembered within the immediate memory span of the learner would seem desirable. On the other hand, presenting a part size in excess of the learner's memory span might induce greater effort and thereby more efficient learning. The tradeoff between rehearsability and effort in determining the optimal relation of part size to memory span was the first issue explored in the present study. An additional feature of the study was the provision, in one treatment, for continuous learner control over part size. The memory span of a given learner is bound to vary as a function of his familiarity with the stimuli, the distractions of the moment, and other factors. If there is an optimal relation between memory span and part size, learning efficiency should be enhanced by varying part size according to such fluctuations in memory span. If the learner were free to adjust part size on the basis of momentary changes in memory span, or any other relevant basis, he might learn more efficiently than with a fixed part size. This was the second issue explored in this study.

Summaries of the other exploratory studies on self-directed learning conducted under this grant, as well as the rationale for self-direction and self-evaluation in general, can be found in the final project report (Campbell, 1963b).

Method

Subjects

The 65 students in two sixth-grade classes at a public elementary school served as subjects (Ss). The two classes had been grouped on the basis of reading ability by the school. One class was composed of average and slow students while the other class was composed of average and superior students.

Evaluation of Memory Spans

For purposes of initial memory span evaluation all Ss were seated in a dimly lit auditorium. The experimenter (E) presented general information about the experiment and assurance that teachers would not view the results. The Ss were asked to help E by following instructions and trying as hard as they could to use their memories in order for E to find out how memory works. The memory materials for all Ss were individual surnames projected on a screen at the front of the auditorium. Names were drawn randomly from phone and reference books, except that very unusual or difficult names were excluded.

The individual names were automatically projected at four second intervals, in a sequence of from two to seven names. Sequences were presented in ascending series (two to seven names) and descending series (seven to two names) alternately. After each sequence Ss were asked to write down in their answer pads as many of the names as they could remember. Five seconds of writing time was allowed for each name in the sequence just viewed, and no name was viewed more than once. Four series (two ascending, two descending) were shown and from this data an index of memory span was computed for each S as follows: Maximum memory span on a given series was defined as the longest sequence for which all names were correctly recalled (spelling ignored). The mean maximum memory span for the four series was used as the index of memory span in the experiment proper.

Experimental Learning Task and Procedures

The serial learning task was to memorize the last names of the first 30 presidents of the United States. The names were presented one at a time in chronological order, the entire list of 30 names being presented on each trial. Six trials were given to all Ss. On the fifth and sixth trials all 30 names were presented before the Ss tried to write them down. On each of the first four trials, however, the list was shown in parts, and the written rehearsal of a given part occurred immediately after the part was presented. Viewing and writing times were the same as those used in the memory span evaluation. That is, each name was viewed for four seconds and the time allotted for written rehearsal was five seconds per name. (E.g., Ss just shown a sequence of three names had 15 seconds to write them down.) Training time of about 35 minutes was constant for all groups, regardless of part size.

Ss were randomly assigned to one of three experimental groups which differed only as to the way in which the 30-name list was divided into parts for the first four trials through the list. The groups did not significantly differ with respect to mean memory span. All groups were given a brief general orientation and then treated as follows:

Group 1 (n = 25). On the first trial (one complete presentation of all 30 names) the part size for this group was three names, which approximately equaled the mean memory span (2.73) of all Ss on the pretest. After each sequence of three names, Ss were asked to recall or rehearse the names by writing them in an answer pad provided. The second trial again presented the ten three-name parts. For the third and fourth trials the part size was doubled to six names. The increased part size was intended to approximate the increase in memory span for these particular names due to learning on previous trials.

Group 2 (n = 25). The part size used in trials 1 and 2 was five names, which was about twice the mean memory span of the Ss in this group. On the third and fourth trials the part size was doubled to ten names per part.

Group 3 (n = 11). This was the self-directed group. Each S in the group was run individually and in addition to a general explanation, was given the following instructions:

I am going to show you the names in order, and you will watch them on the screen. When you think you can't remember any more, turn away from the screen and start writing in your writing pad. I will keep showing names until you turn away from the screen. Then I will turn off the projector, and you will have five seconds for each name you tried to remember, to write the names down. When your time is up I'll say "turn page" and you will turn the page and watch the screen for some more names. Remember, the number of names in any one group is up to you. If you try a small group and get them all, you might want to try a larger group the next time, or if you tried a large group and didn't feel right, you could choose a smaller group the next time. You might even pick a comfortable number and vary each group choice around that number. We will go through the list four times in this manner, and then we will show you the whole list twice and ask you to try and remember it each time.

For all three groups the fifth and sixth trials were "whole" presentations in which all 30 names were viewed before written rehearsal. Number of names recalled on the sixth trial was taken as the criterion of amount learned.

Results

Table 1 shows the part size and the number of names correctly recalled by each group on each trial. The mean part sizes for Group 3 do not include the last part attempt made by Ss in which part size was restricted by the end of the list.

Table 1

Part Size and Mean Number of Names Correct for Each Trial and Treatment Group

	Group 1		Group 2		Group 3	
Trial	Part Size	Names Recalled	Part Size	Names Recalled	Mean Part Size	Names Recalled
1	(3)	22.56	(5)	18.28	(4.2)	17.18
2	(3)	24.48	(5)	22.92	(3.9)	21.55
3	(6)	20.52	(10)	18.76	(4.0)	22.36
4	(6)	20.44	(10)	18.16	(4.1)	22.73
5	(30)	12.36	(30)	14.44	(30)	14.36
6	(30)	12.56	(30)	15.84	(30)	15.27

Trial 6 scores were subjected to an analysis of covariance, and the group means were adjusted on this basis to control for individual differences in memory span. A t-test of the difference between adjusted means for Groups 1 and 2 indicated that the part size substantially longer than the Ss' memory span was more effective ($p \leq .05$) than the part size approximately equaling memory span. The difference between Groups 1 and 3 was not significant. Pearson r's were computed correlating memory span with sixth trial score. The correlations were .50, .39, and .71 for Groups 1, 2, and 3 respectively.

The entire sample was divided into three memory span levels (medium being a memory span of $2.73 \pm 1\sigma$ where $\sigma = .45$) and mean trial 6 scores computed for each treatment-level combination, as shown in Table 2. An analysis of variance of these data yielded a nonsignificant interaction between treatment and memory span level. (The interaction effect was computed directly rather than as a residual, in order to minimize the effect of disproportionate Ns.)

Table 2*

Mean Number of Correct Names Recalled on Sixth Trial for Each Memory Span Level and Treatment Group

Memory Span	Group 1		Group 2		Group 3			
	n	$\bar{x}$	n	$\bar{x}$	n	$\bar{x}$	n	$\bar{x}$
Low	10	10.0	9	13.1	3	10.7	22	11.4
Medium	8	14.9	9	17.6	5	16.4	22	16.3
High	7	13.6	7	17.1	3	18.0	17	15.8
Total	25	12.6	25	15.8	11	15.3	61	14.4

* Estimated standard deviation within cells is 5.41, or 5.17 if the variance attributable to individual differences in memory span is taken out.

Examination of graphs comparing the trial-by-trial performance of Ss having the highest memory spans in the sample with that of Ss having the lowest memory spans revealed no evidence of differential performance due to memory span ability level through trials.

Discussion

The greater effectiveness of a part size substantially larger than memory span suggests that effort induced by stretching the learner's memory span may be more important than ensuring that the names viewed are rehearsed immediately. However, the superiority of the larger fixed part size over the smaller fixed part size was of about the same magnitude at all three memory span levels. This means the results could also be explained by the ratio of part size to list length, or by some other characteristic of the task unrelated to memory span of the learners.

Two interesting anomalies should be noted about the data shown in Tables 1 and 2. First, there seemed to be no improvement in number of names recalled between trials 3 and 4. These trials were at the same part size and the increase expected and found between the first two trials and between the last two trials was not evidenced at this stage of learning. Second, learners with high memory spans learned no more, possibly slightly less, than learners with medium memory spans, even though both groups clearly learned more than the low memory span Ss.

The mean part size chosen by Group 3 on the first two trials was midway between the two fixed part sizes, and their final mean criterion score correspondingly fell between Group 1 and 2 means. However, interpretation in terms of initial part size is complicated by the fact that self-determined part size showed no increase in mean number of names attempted as the list was viewed through four trials. These Ss appeared to choose a personal part size (not obviously correlated with memory span) on the first few attempts and then did not deviate much from it during the four free-choice trials.

If further experimentation should confirm the effectiveness of a part size substantially larger than the learner's memory span, self-determination of part size might be made more effective if the learner were persuaded to increase average part size from trial to trial as learning progressed, always viewing slightly more material than he could easily remember.

Summary

Two issues explored in this study of serial part learning were the efficiency of using (a) a fixed part size at or above the learners memory span and (b) S's own judgment of optimal part size dependent on Ss extimation of momentary memory span.

The larger fixed part size group performed significantly better than the smaller fixed part size group. The self-determined part size group learned nearly as well as the larger fixed part size group. No interaction between treatment and pretested memory span was noted.

The greater effectiveness of a part size substantially larger than memory span can be interpreted to mean that eliciting greater effort from the learner may be more important than ensuring overt rehearsal. Self-determination of part size might be made more effective by instructions to the learner to increase the part size attempted o· each trial.

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