ASSOCIATION WITH ORDINAL POSITION IN SERIAL ROTE-LEARNING

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IN ROTE-LEARNING A LIST OF NONSENSE SYLLABLES or other relatively homogeneous items the errors made before mastery are distributed according to the positions of the items in the series, forming the familiar negatively skewed bow-shaped serial-position curve. A number of theories have been proposed to account for this phenomenon referred to as the serial-position effect. (The major theories have been reviewed by McGeoch & Irion, 1952, pp. 125–34.)

One theory, which probably because of its common sense plausibility has apparently never been put to a direct test, was originally proposed by Woodworth and Poffenberger (1920, pp. 71–2). It persists in recent textbooks (Woodworth & Schlosberg, 1954, p. 711; McGeoch & Irion, 1952, p. 134). This theory holds that the learning of a serial list consists essentially of the formation of S-R bonds between each item and its ordinal position (or some symbolic equivalent thereof) in the series. The ordinal position of the item is the implicit stimulus for the response. It is as if the learner implicitly uses the ordinal numbers as a mnemonic device, as pegs, as it were, to which he can attach the items of the serial list. The comparative ease of learning the beginning and end items of the list is attributed to their ordinal positions being so definitely perceived, while the middle items are much more difficult to learn because their ordinal positions are not always clear to the learner. He tends to remain confused about the middle positions until he has first learned the ordinal positions of the other items successively adjacent to the first and last items of the list.

Probably the most clearly implied deduction we can make from this theory is that by constantly informing the learner of the ordinal position of each item in the series during the process of learning by serial anticipation we should facilitate the learning, reduce the number of errors made before attaining mastery, and decrease the relative difficulty of the middle items, thereby making the serial-position curve less sharply bowed.

The present experiment tested these predictions by constantly providing knowledge of the ordinal position of the items to be learned so that the subject could not be in doubt as to where he was in the list at any moment during its repeated presentations.

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Method

Subjects

Forty undergraduate students (30 women and 10 men) were recruited from an introductory course in educational psychology at the University of California.

Procedure

In order to minimize response learning, verbal associations, and intralist heterogeneity and to obtain a relatively pure form of serial learning, the serial list used in this experiment was made up, not of the usual nonsense syllables, but of nine coloured geometric forms: triangles (T), squares (S), and circles (C) coloured red (R), yellow (Y), and blue (B). Each shape appeared in the serial list once in each of the three colours. The Ss were informed of the rule that adjacent items in the series were never of the same shape or the same colour.

The stimuli were automatically projected from behind a ground-glass screen, 2 ft. square, at a 3-sec. rate with a 6-sec. intertrial interval. The stimuli were approximately 4 in. in size on the screen and the colours were vivid. The series was always preceded by a set of three dots which served as the signal for the S to anticipate the first item in the series. The order of the stimuli was constant throughout the experiment: . . . RT, BC, YT, RS, YC, BS, RC, BT, YS.

The Ss were tested individually. S sat directly in front of the screen at a distance of 10 ft. Before beginning the learning trials S knew all the items composing the series. All he had to learn was their serial order. The method of serial anticipation was used; S responded by saying "red triangle," "blue circle," etc. The S was instructed to guess when in doubt, so that there were relatively few failures to respond as compared with experiments using nonsense syllables. All Ss learned to a criterion of one perfect trial. The general procedure and instructions were exactly the same for the experimental and control groups.

Experimental group. Each of the nine stimuli presented to the experimental group had superimposed upon it the number of its ordinal position in the series. The Arabic numeral, printed in solid black, was almost as large as the geometric figure and appeared directly in the centre of the figure.

Control group. Each of the stimuli presented to the control group had superimposed upon it a capital letter printed in the same manner as the numerals in the experimental group. An alphabetic order of the letters was avoided, no vowels were used so that words would not be suggested, and none of the letters was the initial for any of the shapes or colours of the geometric figures. Thus, the letters could have offered little or no cue as to the ordinal position of the items in the series. The purpose of labelling the items with letters was to approximate the same degree of stimulus complexity as existed for the experimental group. The order of the letters was: K, G, D, L, Z, J, N, F, P.

Results

Figure 1 shows the serial-position curves of the experimental and control groups in terms of mean errors at each position. It can be seen that the curves are highly similar. In fact, contrary to prediction from the theory, the curve of the experimental group is slightly more bowed or peaked than that of the control group. To test statistically the difference between the shapes of the two curves an analysis of variance was per-

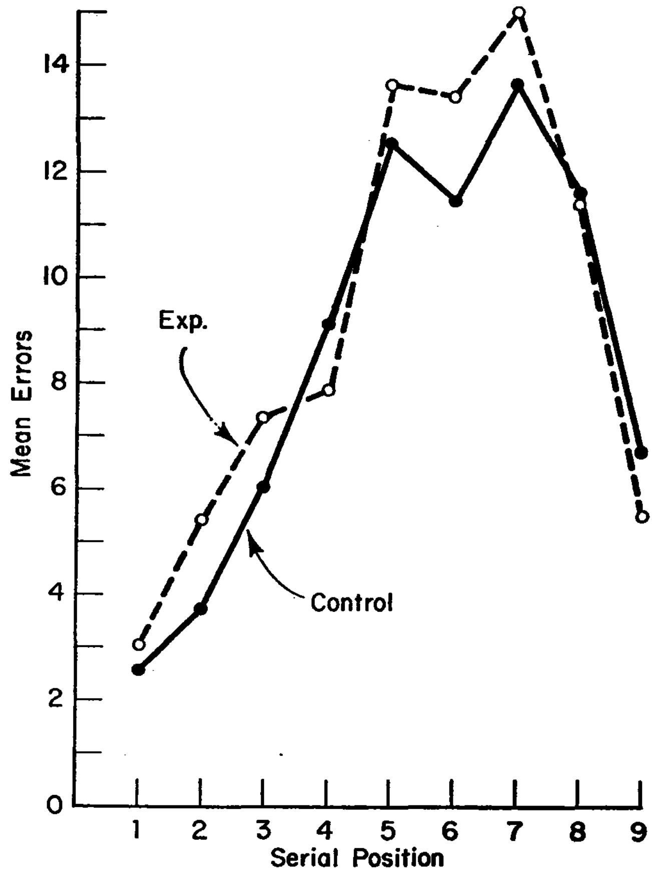

FIGURE 1. The serial-position curves of the experimental and control groups represented by the mean errors at each position in the series.

TABLE I

ANALYSIS OF VARIANCE OF ERRORS IN SERIAL LEARNING

Source	*df*	*MS*	*F*
Groups	1	19.60 (a)	0.31
[Subjects within Groups]	[38]	63.59 (b)	
Positions	8	672.56 (c)	40.20**
Groups × positions	8	14.57 (d)	0.87
Error	342	16.73 (e)	

**$p < .001$

formed on the errors. The analysis, shown in Table I, indicates that the groups do not differ significantly ($F < 1.00$) in mean number of errors and that the group × positions interaction, which tests the significance of the difference between the shapes of the two curves, also is not significant ($F < 1.00$). As would be expected, the differences between positions are highly significant.

Summary and Conclusions

An experiment was performed to test the hypothesis, originally stated by Woodworth and Poffenberger (1920), that a serial list is learned by associating each item in the series with its ordinal position and that the bowing of the serial-position curve is caused, at least in part, by the greater ambiguity of the ordinal positions of the items near the middle of the list.

The experimental group of 20 students learned a series of nine coloured geometric forms by the method of serial anticipation. Each stimulus was labelled with a numeral indicating its ordinal position in the series. The control group learned under exactly the same conditions except that the serial items were labelled with consonants arranged in a random order so as to afford no cues as to the ordinal position of the item.

Labelling the items with their ordinal positions did not significantly facilitate the learning of the series nor did it significantly alter the shape of the serial-position curve. The results do not substantiate the theory that the serial-position effect is caused by S's uncertainty about the ordinal position of the middle items in the series.

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