A stimulus generalization explanation of the serial position effect

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Abstract

Two experiments were run using either circles of different diameters or lines of different lengths as stimulus terms in PA learning. Those responses associated with the stimuli at the end positions of the stimulus dimensions of circle diameter and line length were learned first, producing the serial position effect. Analyses of intrusions supported a stimulus generalization explanation of the data. This explanation was extended to encompass the serial position effect in serial and PA learning.

Introduction

Recently, Murdock (1960) has proposed a "distinctiveness of stimuli" hypothesis to explain the serial position effect (SPE) in the learning of lists serially, and in paired associates (PA) tasks in which the stimulus terms vary along a single physical dimension. The basic idea of this hypothesis is that the less distinct a stimulus is, the easier will a S learn an association to it. By virtue of their order, stimuli at the end points of a dimension are more distinct than stimuli centrally located.

Although this hypothesis has intuitive appeal as well as predictive power, the critical feature of the hypothesis—the distinctiveness notion, has not been independently evaluated. Indeed, a more primitive idea—stimulus generalization, leads to the same predictions as the distinctiveness hypothesis, and is susceptible to independent evaluation. Our view is that it is because of greater or less stimulus generalization that stimuli become more or less distinctive. Hence, a very distinctive stimulus, e.g. one at the endpoint of a stimulus dimension, is a stimulus which suffers little interference due to stimulus generalization. Analysis of intrusion data should provide a test of the generalization hypothesis. Specifically, if it is through stimulus generalization that the SPE is produced, then intrusions from adjacent stimuli on a given dimension should be greater than expected by chance. Data from serial lists support this hypothesis (McGeoch & Irion, 1952; Murdock, 1960), but as far as we can determine, no intrusion data have been presented either in support of, or against the stimulus generalization hypothesis in PA tasks where the stimuli vary along a physical dimension.

With the above reasoning in view, the major objective of this paper is to provide intrusion data from two PA tasks utilizing different stimuli. In route to presenting this data, independent evidence will be provided supporting the position that in PA tasks, learning proceeds from the end points of a stimulus dimension, producing the SPE.

Method

Twenty undergraduates from the University of Cincinnati served as Ss in each of two experiments for a total of 40 Ss.

In Experiment 1, six circles of the following diameters served as the stimulus terms in PA learning: 1/8 in, 1/4 in, 1/2 in, 1 in, 2 in, and 4 in, forming a logarithmic progression. These diameters were selected with the intent of equalizing the perceptual distance between adjacent circles. The stimuli were drawn on 9 by 11 in cards, and randomized in five separate blocks of six with the provisions that no adjacent circles have the same diameter, and that the first circle presented to S be neither the largest nor the smallest circle in the series.

In Experiment 2, six lines drawn on 5 in by 8 in cards of the following lengths served as stimuli: 1/16 in, 1-3/16 in, 1-12/16 in, 2-6/16 in, 3-5/16 in, and 4-14/16 in. These values were extrapolated from line category scaling data presented by Galanter (1962, p. 143). In all other details, this experiment was identical to Experiment 1.

Thus, the scaling properties of the stimuli used in these experiments were different.

In both experiments, the Experimenter sat across the table from the S, and read instructions indicating that this was a PA experiment, involving the association of the letters A through F with the stimuli to be presented. The Experimenter held the cards and presented them one at a time. Following the S's response, the Experimenter stated the correct response to that stimulus. This procedure was continued until the S had given the correct association to 12 consecutive stimuli. Hence, the task was S-paced, with the intertrial interval being equal to the interstimulus interval. This procedure was adopted so that all errors would be intrusions.

Going from the smallest to the largest circle (Experiment 1) and from the shortest to the longest line (Experiment 2) correct responses were E, A, F, C, D, and B.

Results

In Table 1 mean number of errors to each stimulus is listed as a function of stimulus position on the dimension of circle diameter (Experiment 1) and line length (Experiment 2). The letters across the top of the table are the correct associations at each position on this dimension, with "E" being associated with the smallest circle (1/8 in diameter) and shortest line (11/16 in) and "B" the largest circle (4 in diameter) and longest line (4-14/16 in). In both experiments the error distribution is bow-shaped, with fewer errors made to the smallest and largest stimuli than to intermediate ones. Analyses of variance bore out this observation. For Experiment 1, $F=8.25$, $df=5/95$, $p<.01$; and for Experiment 2, $F=11.16$, $df=5/95$, $p<.01$. A Newman-Keuls test indicated that for Experiment 1 fewer errors were made to the smallest and largest circles than to the 1/2 in, 1 in, and 2 in circles (those associated with F, C, and D); and fewer errors to the 1/4 in circle than to the 1/2 in circle ($p<.05$). For Experiment 2, fewer errors were made to the shortest and longest lines than to the second, third and fourth shortest lines; and that more errors were made to the third shortest line than to the remaining lines ($p<.05$).

Table 1. Mean Number of Errors to Each Stimulus

	E	A	F	C	D	B
Experiment I	3.75	4.60	9.70	6.90	7.05	3.30
Experiment II	4.90	10.25	14.30	9.80	8.40	5.15

In Table 2 the median percentage of intrusions from adjacent stimuli to each stimulus are listed. These entries were computed by counting the number of intrusions (errors) made to each stimulus for each S; computing the percentage of intrusions from adjacent stimuli; and then taking the median percentage across all Ss. For the smallest circle and shortest line, then, adjacent intrusions are limited to "A" errors. For the next smallest circle and next shortest line, adjacent intrusions consist of both "E" and "F" errors, and so on for the rest of the stimuli. As can be seen, these percentages for every circle and every line exceed chance expectation, which is 40 for the four middle stimuli and 20 for the largest and smallest stimuli. This suggests that intrusions, in part, are determined by generalized interference.

The intrusion data were analyzed in two ways. First, the hypothesis was tested that Ss would not evidence more adjacent intrusions than expected by chance. This was determined by counting for each S the number of circles or lines for which the percentage of adjacent intrusions exceeded chance expectation. If this number was greater than the number of circles or lines for which the percentage of adjacent intrusions did not exceed chance expectation, it indicated that for that S adjacent intrusions were not random. This computation yielded the following results. In Experiment 1 19 Ss evidenced non-random adjacent intrusions, with one tie. Statistical analysis of this result was not deemed necessary. In Experiment 2, for 16 Ss adjacent intrusions exceeded chance expectation, 3 Ss were tied, and for 1 S adjacent intrusions were less than chance expectation. A sign test of this distribution was significant at the .01 level of confidence.

Discussion

The major findings in the present experiments were: Using either lines or circles which varied along the single dimension of length or diameter as the stimulus terms in PA learning, the SPE was produced with respect to the end points of these dimensions; for both lines and circles, adjacent intrusions occurred with a greater frequency than expected by chance. In fact observation of Table 2 indicates that for 9 of the 12 stimuli utilized, the majority of intrusions were from adjacent stimuli.

Table 2. Median Percentage of Adjacent Intrusions

	E	A	F	C	D	B
Experiment I	25	75	57	83	81	33
Experiment II	80	50	67	83	61	21

These results strongly support a stimulus generalization explanation of the SPE for stimuli varying along a physical dimension in PA learning. The stimulus generalization hypothesis can be extended to serial learning, and to PA learning where the stimuli vary along a conceptual dimension, e.g., the numbers 1 through 8, if it is assumed that positional cues are part of the effective stimulus (Ebenholtz, 1965). Thus, the positional cues associated with the n th position in a list are more similar to those cues associated with the $n-1$ and $n+1$ positions than to those cues associated with more remote positions. This produces more adjacent than remote intrusions which in turn produces the SPE. The latter comes about because the end points of the dimension suffer from adjacent intrusions from only one adjacent stimulus, and generalization from only one direction.

The data from these experiments also bear on the hypothesis of DeSota & Bosley (1962) that the response dimension is relevant in producing the SPE. Inspection of Table 1 indicates the inadequacy of this hypothesis in accounting for the present data. These authors would predict that learning would proceed from the stimuli associated with the letters A and F, which form the end points of the response dimension of the letters A through F. From Table 1 it can be seen that learning proceeded from the letters E and B which were associated with the end points of the stimulus dimension. In light of Ebenholtz's (1965) failure to find the SPE as a function of the response dimension made up of the numbers 1 through 8, it appears that this factor has, at most, a very weak role in producing the SPE.

References

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