Process of component and pattern learning[1]

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The process of discrimination among stimuli on the basis of cue patterns or their partially relevant subsets was traced by independent tests spread over the course of learning. While the cue subsets seemed most important during early trials, the full patterns rapidly started dominating as discrimination accuracy on the basis of common subsets actually decreased.

In order to answer some questions raised by mathematical learning theorists, the present experiment traced component and pattern conditioning by the use of tests at various learning stages. The stimuli involved both common cues and common patterns of cues, and perfect discriminations could be made only by the use of highest order patterning.

Unfortunately, the full array of learning blocks that had been planned at the outset could not be completed. The design of the experiment necessitated the use of very large numbers of Ss and the subject-supply during the year of running was exhausted before completion of all conditions. At the end of the year, the apparatus was dismantled because of a change in the affiliation of the principal investigator.

Method

The learning and test stimuli may be seen in Fig. 1. The responses associated with the learning stimuli, by paired-associates with anticipation, were VOP, GAK, FUH, TEF, CYQ, ZIR, QAR, and BYM.

The Ss were run in threesomes and forced to respond at each choice point. That is, during learning, all three Ss had to respond to each stimulus before its syllable appeared in association with it. Then, the stimulus-response pair remained in view until all Ss who had responded incorrectly to the stimulus alone corrected their responses. The intertrial interval was 2.2 sec.

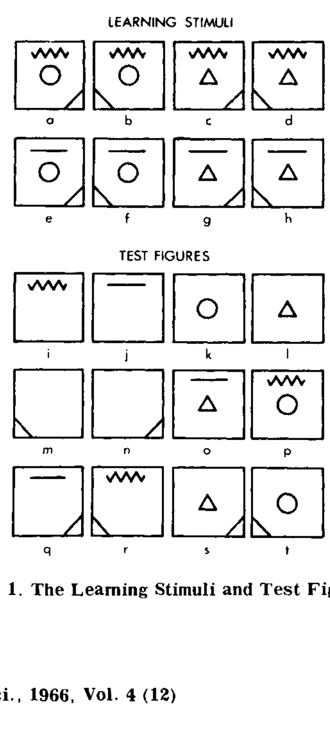

Fig. 1. The Learning Stimuli and Test Figures.

On test trials, the figures designated i to t in Fig. 1 remained in view without associated responses until all Ss responded.

Learning for one set of Ss consisted of a single block of learning trials (all eight learning stimuli in Fig. 1) and their paired syllables; a single test trial followed. No further tests nor learning trials were given to these Ss because of the desirability of avoiding the potentialities for contamination of learning set by the test. For convenience of reference, the Ss shall be considered in groups as follows: Group Ii was shown figure i as the test, Group Ij was shown j, and so forth through Group It. All test figures occurred an equal number of times over the groups.

For other Ss, precisely two learning blocks were followed by a single test and nothing else. Again, there were Groups IIi, IIj, etc. and all test figures occurred equally frequently. In addition, since paired-associate trials were structurally identical to test trials during the interval preceding occurrence of the responses, the first trial of the second block could be regarded as a test in the same way as the tests for Groups Ii, Ij, etc. The test figure was then a stimulus of full cues. To allow for this source of data, all learning stimuli occurred first an equal number of times during the second block. Using a similar coding, Group Ia contains those Ss who received two (or more) learning blocks and who were shown a as the first stimulus during their second block.

Similarly, some Ss were run for exactly three learning blocks and others for exactly four blocks. A single test trial followed learning in each case. None were run for more than four blocks for the reasons given earlier, although the original intention was to run groups for more and more blocks until a criterion was met.

Twenty-four threesomes were run for each of the fixed block lengths (1 to 4). The number 24 is a multiple of 12 (the number of test figures) and 8 (the number of learning stimuli), and allowed equal occurrences among test figures after each learning block as well as among the learning stimuli in their role as test figures. Thus, Groups Ii, Ij, IIi, etc. contained six Ss each, Groups Ia to Ih - 27 each, Groups IIa to IIh - 18 each, and Groups IIIa to IIIh - 9 each.

Results and Discussion

For convenience of reference, the differentiating stimuli in figures i to n (Fig. 1) shall be referred to as components, the stimulus arrays in figures o to t

Table 1. Relative Frequencies of Appropriate Responses

	Learning Block Preceding Test											
Test Figures	1			2			3			4		
	Chance Expect.		Obt.	Chance Expect.		Obt.	Chance Expect.		Obt.	Chance Expect.		Obt.
i-n(Components)	.500		.611	.500		.750	.500		.722	.500		.639
	Chance Expect.	Using Comp.	Obt.	Chance Expect.	Using Comp.	Obt.	Chance Expect.	Using Comp.	Obt.	Chance Expect.	Using Comp.	Obt.
o-t(Intermediate Patterns)	.250	.306	.528	.250	.375	.528	.250	.361	.417	.250	.320	.472
	Chance Expect.	Using Comp. & Inter. Patt.	Obt.	Chance Expect.	Using Comp. & Inter. Patt.	Obt.	Chance Expect.	Using Comp. & Inter. Patt.	Obt.			
a-h(Full Patterns)	.125	.208	.204	.125	.226	.271	.125	.211	.278			

as intermediate patterns, and the arrays in the learning stimuli (a to h) as full patterns. Table 1 contains a summary of proportions of appropriate responses to the various test figures. In addition to the obtained proportion, both the proportion expected if responding were purely random and that expected if the cues used in response determination were a proper subset of the array actually available are shown.

The case of proportions based on fewer cues than the array available will be illustrated by a, for which the proper subsets consist of both components and intermediate patterns. Assuming equal likelihood of sampling component or intermediate pattern, the estimated probability of an appropriate response to a as a test following Block 1 is $.5(.611/4) + .5(.528/2) = .208$, where the .5 multipliers represent probabilities of component and pattern selection, the numerators the relative frequencies of appropriate responding to component or pattern, and the denominators the number of appropriate responses for the particular cue configuration, only one of which is appropriate to the full pattern of a.

The data in Table 1 would seem to indicate that components and intermediate patterns account for nearly all the initial learning, but that full pattern learning begins to show itself rather rapidly. Note that the relative frequency of appropriate responses to full patterns after Block 1 is completely accounted for by assuming only use of components and intermediate patterns. But, the tests on figures a-h following subsequent blocks show increasing tendencies to respond appropriately at a rate higher than could be expected by the use of anything less than full patterns. (The relative frequencies for full patterns as tests correspond, as expected, with the obtained proportions of correct anticipations to all learning stimuli over Blocks 1 to 4 which are, respectively, .156, .215, .269, and .340.) And, concomitantly, starting with Block 2, the proportions of appropriate responses to i-n and o-t decrease regularly over the remaining blocks with only one exception.

The results of Binder & Feldman (1960) may be used to estimate the probabilities of appropriate responding to components and intermediate patterns after a criterion is reached in identifying full patterns. Their Group I-E run involved eight learning stimuli identical to those of the present experiment. Learning was again paired-associates by anticipation, but fixed anticipatory periods were used and tests were given only after a criterion of two consecutive perfectly anticipated blocks was reached. The obtained proportions of appropriate responses were .943 to components and .829 to intermediate patterns.

The proportions of appropriate responses to components and intermediate patterns shown in Table 1 do not seem headed anywhere near those magnitudes, even though the learning of full patterns shows regular increments. There would seem two principal contenders to account for the patterning of results. First, except for the results of preliminary exploration of stimuli, components and intermediate patterns are not learned until the full patterns are adequately learned—perhaps later learning involves a closer examination of stimulus characteristics and the association of responses to cue subsets. And second, identification of appropriate responses to components and intermediate patterns is mediated by prior identification of full cue response. That is, when, for example, a test like t is shown, the S fills in missing details and responds accordingly. This second hypothesis implies a less direct association between responses and components or intermediate patterns in general, although it could certainly allow for some associations to subsets which are as immediate as those to full patterns.

Reference

Binder, A., & Feldman, S. E. The effects of experimentally controlled experience upon recognition responses. *Psychol. Monogr.*, 1960, 74, No. 9 (Whole No. 496).

Note

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