Memory in concept identification¹

Tom Trabasso, UNIVERSITY OF CALIFORNIA, LOS ANGELES
Gordon Bower, STANFORD UNIVERSITY

Abstract

Recent quantitative theories of concept identification assume a limited memory during learning. To test this assumption, Ss recalled the stimulus dimensions and the correct responses on each stimulus card in 12 six-card problems. The expected recency effect was obtained but a larger, unexpected primacy effect was also observed. On those problems which were solved, the joint recall of the relevant dimension and the correct response to the cards was above chance. On unsolved problems, the recall of the relevant dimension was independent of the recall of its classification. Average recall on all problems was only slightly above the chance level. These results, with the exception of the primacy effect, support the limited memory assumption.

Problem

Hunt (1962) discussed the role of memory in concept learning and, in particular, pointed out that recent mathematical models of concept identification (Restle, 1962; Bower & Trabasso, 1963) are, in effect, "no memory" models. These theories view S as sampling hypotheses randomly and *with replacement* each time S makes an error, so that no memory for past hypotheses rejected or previously presented concept examples is assumed. This characterization is not entirely accurate since the models do assume that S can remember his current working hypothesis and whether it has been correct for the past several trials. In tests of these models, the assumption of a limited memory appeared plausible since the tasks involved complex stimulus patterns (from five to seven bits of information per pattern) and the patterns were shown only one at a time. Since direct evidence of recall for stimuli and the correct responses in concept identification was lacking, the present study was conducted to assess the recall of stimulus dimensions and their classification within a simulated concept identification task.

Method

The Ss were 53 students from the introductory psychology course at Stanford University and they were tested in groups of three to five Ss each.

Subjects received (a) a complete description of the stimulus materials (b) instructions on the recall procedure (c) information on the nature of the classification to be learned (e. g. red in Category A and green in Category B, if color were the relevant dimension) and (d) a practice problem involving recall of two stimulus patterns. After these preliminaries, Ss received 12 six-trial concept identification problems, where each trial consisted of E announcing a trial number (one, . . . , six), and presenting a stimulus pattern on a card along with its correct classification. After the sixth

card of each set, S was asked to state what he thought was the classification rule for that set, and then he was asked to recall, one by one, the six stimuli and their assigned classifications. The stimulus materials consisted of drawings of geometric stimuli on white 3 x 5 in file cards. There were six binary dimensions, consisting of shapes (triangles or squares) which varied independently in color (red or green), number (one or two), size (large or small), position (right or left) and orientation (upright or tilted). Each pattern, when presented by E, was classified as either in Category A or Category B, according to a rule which S was instructed to learn. Each problem was constructed so that the six trials eliminated all but one dimension as the relevant one. Each dimension was relevant in two of the 12 problems. To begin a problem, E announced the trial number, then displayed the stimulus pattern and its category for 5 sec. After six patterns were thus successively shown, a S had 10 sec. to write his solution. Then, E announced a card number (one to six) and the S had 15 sec. to recall all the stimulus dimensions and the correct category for that card of the set. Recall was performed by S circling an appropriate written description of each dimension (e. g. Color: Red or Green?) and the card's category (A or B) on a prepared data sheet. The order of recall of the six cards was counter-balanced in a Latin-square design, so that each presentation trial occurred in each recall position about equally often. When S omitted circling a value for a stimulus dimension or for the correct response, he was assigned a score of 1/2 an error on that attribute (chance guessing level was 1/2 with two alternative values).

Results and Discussion

Table 1 summarizes the effects on recall of presentation order and recall order. These data are aver-

Table 1. Probability of Recall for Dimensions and Classification as a Function of Presentation (P) and Recall (R) Order. Chance guessing level is .50.

		Order					
		<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>
Dimensions: (3,816)*	P	.66	.56	.51	.52	.54	.60
	R	.58	.56	.58	.56	.57	.55
Classifications: (636)*	P	.61	.55	.52	.51	.52	.62
	R	.61	.58	.56	.54	.57	.56

*Observations per pattern

aged across Ss' problems, and the six attributes of the stimuli. A typical serial position curve of retention resulted from presentation order, whereas the recall order showed only a slight recency effect. Since a S is theoretically able to remember his "working hypothesis" at the conclusion of a problem, these recency effects are consistent with the models. However, the somewhat larger primacy effect is not presently accounted for in these theories. The result suggests that, in attempting solution, a S might try to remember the details of the first pattern, and then test dimensions of succeeding patterns against this first pattern as a part of his general hypothesis-testing approach. This primacy effect may help explain why an appreciable proportion of Ss solve these problems with very few errors (e. g., Bower & Trabasso, 1963). However, the general outcome was that Ss' recall was extremely poor. The average probability of correctly recalling a stimulus dimension was only .567. If S remembered only one of the six attributes present in each pattern, his average recall score would be .583. Thus, on the average, Ss apparently recall less than one bit out of six bits of information in each pattern, even though recall received more emphasis in this situation than it does in the conventional concept identification experiment.

Since Ss need not remember all the information contained in the patterns in order to solve a problem, selective attention and recall would be expected. The Ss' protocols were subdivided into solved and unsolved problems, and the data are summarized in Table 2.

The serial position effect of presentation order is apparent in these data. On solved problems, recall of the relevant dimension is superior; on unsolved problems, recall of the dimension stated by Ss as the solution is slightly superior. The largest difference in the recall in these comparisons occurred for the sixth card. This result reflects selective focusing by Ss for specific dimensions, and is consistent with the assumption that

Table 2. Probability of Recall for Dimensions on Solved and Unsolved Problems

Problems	Presentation Order					
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>
Solved:						
Relevant Dimensions	.71	.59	.53	.57	.58	.65
(346)*						
Irrelevant Dimensions	.68	.56	.52	.52	.55	.59
(1730)*						
Unsolved:						
Stated Dimensions	.66	.55	.49	.55	.54	.64
(244)*						
All Others	.65	.55	.49	.51	.53	.60
(1496)*						

*Observations

Table 3. Probability of Joint Recall for Relevant Dimension and Category

Problems	Presentation Order					
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>
Solved:	.61	.51	.40	.46	.45	.55
(346)*						
Unsolved: Observed	.35	.28	.23	.25	.26	.34
(290)*						
Predicted	.35	.27	.25	.26	.27	.33

*Observations

Ss remember the information contained in their current working hypothesis.

To solve, a S must know both the stimulus dimension and its category (e. g. red-A and green-B, if color were relevant). Table 3 summarizes this joint recall.

On solved problems, the joint recall is above the chance level of 1/4 and higher than that on the unsolved problems. This result probably reflects the S's application of his final hypothesis during recall (i. e., making recall of a dimension and its category consistent). It may be noted that the entries in the first row of Table 3 are approximately 85% of the corresponding entries in the first row of Table 2. This might indicate that S first recalls the relevant attribute, and then assigns his category "recall" about 85% consistent with his hypothesis and his recall of the relevant attribute.

On the unsolved problems, if memory is limited, one might expect that the recall of the relevant dimension to be independent of its classification. To test this, the separate probability of recall of the relevant dimension was multiplied by the probability of recall of the category on the unsolved problems. These predictions, for each serial position, are presented in Table 3 and are remarkably close to the observed data. This result indicates that if a S has not solved the problem, his recall of the relevant dimension and its classification are independent of one another.

References

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Note

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