Language and thinking: The interaction of amount of pretraining and relevance in the effect of naming on problem solving¹

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Abstract

Ss solved a "mental jigsaw puzzle" following 0, 2, 8, or 16 trials of pretraining either with names that were relevant to the problem, with irrelevant names, with nonselective names, or without names. Problem solving performance was an increasing monotonic function of amount of pretraining with relevant names, but first increased and then decreased with irrelevant names. Pretraining with nonselective names or without names had no reliable effects.

Problem

Saltz & Newman (1960) found that learning the names of the parts of a mechanical device to a low criterion facilitated subsequent assembly of the device, while learning the names to a high criterion hindered. They suggest that the reversal is an artifact due to response bias induced by prolonged training in the high criterion condition. However, Ranken (1963) obtained negative effects of naming on an analogous problem, and Ranken & Dowling (1965) have shown specifically that names which encode information irrelevant to problem solution are detrimental. De Rivera (1959) has suggested that the effects of small amounts of label learning are primarily perceptual, and that the labels themselves function as cues only when they are overlearned. This suggests the following alternative interpretation of Saltz and Newman's results: (1) Saltz and Newman's part names functioned as irrelevant labels, which did not encode the information required for problem solution. (2) At the high criterion, these irrelevant labels dominated S's representation of the stimuli, and hindered performance. (3) At the low criterion, performance was influenced by the perceptual effects of label learning, rather than by the labels as such. (4) The perceptual responses occurring in the early stages of label learning were relatively nonselective, i.e., encoded problem-relevant information as well as irrelevant information, and therefore facilitated problem solving even though the labels were irrelevant.

This reasoning leads to the following predictions: (1) Relevant labels will have a facilitating effect on problem solving which will increase monotonically with amount of pretraining, since both perceptual responses and labels encode problem-relevant information. (2) With irrelevant labels, small amounts of pretraining will facilitate problem solving (since the nonselective perceptual responses occurring early in pretraining

Fig. 1. Stimulus shapes, showing numerical labels used in the Named Selective condition and names used in the Named Nonselective condition. The shapes are ordered horizontally in the sequence in which they would be fitted together to solve the jigsaw problem.

encode some problem-relevant information), but large amounts will hinder (due to the dominance of the labels).

Method

The stimulus shapes are shown in Fig. 1. Three kinds of pretraining were used: Selective naming, using numerical labels which encoded only the top and bottom contours of the shapes; Nonselective naming, using words which were suggested by the shape as a whole; and Unnamed, in which Ss were instructed not to use words but were given equal exposure to the shapes. Within each naming condition, different groups of 10 undergraduates received 2, 8, or 16 pretraining trials following a demonstration trial. A control group ($N=10$) received no pretraining. Following pretraining, all Ss solved "mental jigsaw puzzles" in which the shapes had to be fitted together to form a vertical column or a horizontal row. The labels used in the Selective condition were relevant to the vertical problems, which required fitting together the top and bottom contours encoded in the labels, and irrelevant to the horizontal problems, thus constituting Relevant and Irrelevant conditions within the Selective naming condition.

The numerical labels consisted of two digits which encoded, respectively, the top and bottom contours, as follows: "1" = "left half points sharply up," "2" = "left half points slightly up," "3" = "right half points sharply up," etc. During pretraining the shapes, mounted on 2-1/2 by 3-1/2 in cards, were shown singly for 5 sec.

Fig. 2. Mean correct responses as a function of amount of pretraining. The data for Relevant and Irrelevant labels at a given level of pretraining come from the same Ss.

each, with 2 sec. between shapes. In the naming conditions, the label was supplied and its relation to the shape explained on the demonstration trial. Thereafter S attempted to give the name within the 5-sec. exposure interval, with correction. Ss in the Unnamed condition were instructed to study the shapes so they could recognize them later.

In the jigsaw problems, S was shown a shape for 1 sec., and instructed to indicate the order in which the shapes could be fitted together, jigsaw-puzzle style, starting with the given shape, to form a vertical column or a horizontal row. The remaining shapes were shown one at a time for 1 sec. each, with 3 sec. between shapes, until S chose a second shape to fit next to the starting shape. The process was then repeated with the six remaining shapes, S picking a third shape to fit next to the second one, and so on until all eight shapes had been used. Each S did two vertical problems, one working down and one up, and two horizontal problems, one to the right and one to the left. An error was scored for each instance in which two non-matching contours were juxtaposed in S's ordering of the shapes.

Results and Discussion

As shown in Fig. 2, performance following learning of relevant labels improved monotonically ($F(2,81) = 5.10$, $p < .01$) with amount of pretraining, as was predicted. Performance after learning irrelevant labels was not reliably different from that with relevant labels at 2 and 8 trials, but was reliably poorer at 16 trials ($F(1,81) = 19.37$, $p < .001$), and the interaction between amount of pretraining and relevance was reliable

($F(2,81) = 3.81$, $p < .05$). There were no consistent or reliable differences between horizontal and vertical problems in the Nonselective or Unnamed conditions. The similarity of the Relevant and Irrelevant curves up to 8 trials and the reversal in the Irrelevant curve at 16 trials accord with prediction. However, the predicted negative effect of large amounts of irrelevant name learning was not obtained, contrary to the findings of Ranken and Dowling. This divergence from prediction and from previous results suggests that 16 trials of pretraining were not enough to produce negative effects with the problem-solving task used here. This task was more concrete than that with which negative effects were obtained by Ranken and Dowling, and according to their results would therefore be expected to be less sensitive to the effects of labeling, positive or negative.

Pretraining had no reliable effect in either the Nonselective or the Unnamed conditions. The absence in the Nonselective condition of the positive effect found by Saltz and Newman, and replicated here with selective labels, seems to be due to the strong perceptual organization induced by the Nonselective names and the explanation of their appropriateness, which apparently makes it harder to deal with the shapes in terms of separate contours. The situation in regard to the proposed interpretation of Saltz and Newman's findings may be summarized as follows: The hypothesis that irrelevant names may facilitate or interfere depending on amount of training is supported by the present findings in conjunction with those of Ranken and Dowling. The assumption that nonselective names of the sort used by Saltz and Newman function like irrelevant names requires further testing, using names more nearly equivalent to theirs. More generally, the results demonstrate clearly that the effect of amount of pretraining depends on the relation of the names to the shapes and to the problem-solving task.

References

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Note

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