Concept learning with one relevant dimension in the squirrel monkey¹

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Sixteen squirrel monkeys learned four discriminations in a procedure patterned on human concept learning (CL). Each discrimination involved one relevant and three irrelevant dimensions. A backward learning curve of pre-criterion trials was stationary, in agreement with some models of human CL. But unexpectedly, a forward learning curve within the criterion run appeared to be incremental

Students of human concept learning (CL), e.g., Bourne (1966) have mentioned the value of a comparative psychology of CL. Studies of other primates would be of particular relevance. Previous studies of primate CL (e.g., Andrew & Harlow, 1948) have used procedures such as sequences of 6-trial object discriminations. But in the typical human CL study, Ss is given a different stimulus on each trial, and the whole array is specified by known relevant and irrelevant dimensions. The present study is an initial demonstration of CL in a convenient primate using procedures similar to those in human studies.

Method

Ss were 16 female squirrel monkeys maintained at 90% ad lib weight.

The apparatus was a manually-operated WGTA with two Kluver-type pull-in carts replacing the single tray. In action, the carts were placed 7 in. apart, 14 in. from the animals, and the cord from each cart was tied to a ring just outside the bars of S's compartment. A movable stimulus block covered the reward cup on each cart.

Stimuli were mounted on the face of a 2 x 2 in. wood block, and represented all 81 combinations of size (large, medium, small); shape (triangle, circle, square); color of background (green, yellow, blue); and pattern within the figure (a cross, vertical stripes, crosshatching).

In each discrimination problem, Ss were presented with a choice between two stimuli on each of 36 trials per day, in a non-correction procedure. Positive and negative stimuli were randomly paired, and correct side was randomized with a restriction of three consecutive placements on the right or left cart. A criterion of 15 out of 18 consecutive correct responses was used.

Ss learned four discriminations in a series of non-reversal shifts. In each case there was one relevant and three irrelevant dimensions. The first problem also served as a shaping task, in which the choices were made successively more complex by the addition of irrelevant dimensions. The positive cues in the four problems were Small, Circle, Stripes, and Green. A Latin square ensured that problems were encountered in different orders.

Results and Discussion

The four successive problems were learned in an average of 75.6, 146.9, 143.2, and 131.7 trials to criterion. The first problem appears to be learned more rapidly only because data were not recorded until shaping had been completed. There was no reliable improvement over the four problems. Nor were there reliable differences among the four relevant dimensions. Mean trials to criterion were: Small = 135.6; Circle = 129.6; Stripes = 142.5; Green = 89.7. In a specific comparison, Green did not differ from the other dimensions. These general results for the Latin square analysis of variance were not unexpected, since the stimulus dimensions had been chosen to be relatively comparable, and since this species is not noted for rapid learning-to-learn (Harlow, 1959; Miles, 1957).

How do these data compare with those from human studies using similar procedures? Some recent models of human CL (e.g., Bower & Trabasso, 1964) predict one-trial learning of simple, one-relevant-dimension concepts of the kind used here. The principal indication of this is a flat, "stationary" backward learning curve prior to the last error before criterion. Such a curve appears in the left-hand portion of Fig. 1, based on data from the last three problems for all 16 Ss, potentially 48 scores per trial. (The shaping involved in the first problem makes it non-comparable.) A non-stationary analysis (Suppes & Ginsberg, 1963) yields a Chi square of only 5.36 ($df=9$; $p>.80$), indicating that the curve is indeed stationary rather than incremental. Subject loss is modest: there are 44 scores per trial in Block -1, 43 in -4, 41 in -8, and 35 in -10.

The right-hand portion of the graph shows blocks of four trials within the criterion, plus the final two

Fig. 1. Proportion of correct responses in blocks of four trials.

trials. In all cases there are 48 scores per trial. The increase in the first four blocks is significant ($\chi^2 = 11.29$, $df = 3$, $p < .02$). This unexpected result resembles data presented by Suppes & Ginsberg (1963) for the final portions of Vincentized backward learning curves when criteria of perfect performance are imposed on human Ss. These authors, as well as Restle (1964), propose a model which predicts a multi-stage process when more than one cue must be conditioned. In these problems, though, a single cue would suffice. One interpretation is that following the initial rapid improvement (adoption of the correct "hypothesis"?) Ss garner a higher proportion of reinforcement which allows a rapid incremental phase (confirmation?).

However, the present data have been examined not as a typical backward learning curve, but as an "inside out" curve with both backward and forward components. While this was necessary because of the less-than-perfect criterion, it has unique statistical properties. In particular, the criterion run portion, as any forward learning curve, may appear incremental by averaging individual step functions which occur on different trials.

Further comparative work will explore some of these

problems, and will also apply these techniques to more complex concept tasks.

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Note

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