Sameness-difference judgments and the discrimination of obliques in the rat[1]

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With conspicuous stimulus displays lining the walls of a Y maze, rats learned an oblique discrimination with relative ease and a sameness-difference judgment of obliques with moderate difficulty. It appears that difficulty in learning a conventional oblique discrimination is attributable to attention or memory rather than perceptual limitations.

Learning to discriminate between mirror image obliques proves easy for the pigeon (Mello, 1965), cat (Sutherland, 1963) and rabbit (Hof, 1966), harder for the goldfish (Mackintosh & Sutherland, 1963), extremely difficult for young children (Rudel & Teuber, 1963), and impossible for the octopus (Sutherland, 1960). Lashley (1938) reported very little learning by rats required to jump to one or other oblique, and even this could have been due to configurational cues (Sutherland, 1961).

Before such findings are incorporated into theories of shape discrimination (Sutherland, 1957; Dodwell, 1957; Deutsch, 1960), it is necessary to exclude limiting factors other than perceptual ones. Were Ss attending to the appropriate stimulus dimensions and able to recode and retain relevant information efficiently from trial to trial?

Young children respond differentially to orientation long before they succeed with such stimuli in standard discrimination learning situations (Hunton, 1955). They are not incapable of a perceptual analysis by orientation, but rather ignore it as a relevant dimension. As regards recoding for memory storage, this is an ill-explored variable in animals.

The present work investigates the rat's ability to discriminate obliques. Attention is directed to the relevant stimulus dimension by an extensive and conspicuous display. Memory load is eased by training rats to make sameness-difference judgments, which do not depend on detailed recall of the distinctive properties of the positive stimulus from trial to trial.

EXPERIMENT 1

Apparatus

A covered Y maze of 18 in. sides and 7 in. end was used. Stimulus displays on cards were inserted along vertical grooves so as to line the far walls of the limbs of the Y (as in the T-maze used by Vowles (1965) with ants). For sameness-difference judgments stimulus cards also lined the near walls. The ends of the limbs were unlined. The displays were: (1) homogeneous black and homogeneous white surfaces, and (2) alternating black and white striations of equal thickness (1 in.) at 45° inclination.

Procedure

Following institution of a food deprivation schedule 38 female hooded rats aged 3 months were run for food reward by the correction method for 10 trials each day to a criterion of nine correct trials out of 10, or a maximum of 300. Four experimental conditions were used:

(1) Black-white discrimination (N = 5). The far sides of the two limbs of the Y maze were lined, one with the black and one with the white stimulus card, randomized for position. Animals were rewarded for choice of white (N = 3) or black (N = 2).

(2) Oblique discrimination (N = 9). The far sides of the limb of the Y were lined by a stimulus display in which *all* striations were parallel, sloping up and towards one or other side. Animals were rewarded for running in the direction of the upper (N = 5) or lower ends (N = 4) of the striations.

(3) Black-white sameness-difference judgment (N = 16). At each trial, one limb was lined on both lateral walls *either* by white or by black cards. The other was lined on one side by black, on the other by white. The positions of the "same" and of the "different" display were randomized. Animals were rewarded for choice of "same" (N = 8) or "different" (N = 8).

(4) Oblique sameness-difference judgment (N = 12). At each trial, the walls of one limb were lined by striations in the same direction, those of the other limb by striations in opposite directions. Direction of slope of the "same" as well as of the "different" display was randomized, as were their positions. Animals were rewarded for choice of "same" or "different."

Results

(1) Black-white discrimination, N = 5, all reached criterion (mean trials 64).

(2) Oblique discrimination, N = 9, all but one reached criterion (mean trials 102.5).

(3) Black-white sameness-difference judgment, N = 16, 10 (62.5%) reached criterion (mean trials 159).

(4) Oblique sameness-difference judgment, N = 12, 9 (75%) reached criterion (mean trials 143).

EXPERIMENT 2

Four rats who had reached criterion on the oblique sameness-difference judgment were given reversal training.

Results

Mean number of trials for original learning was 97.5. Mean number of trials for reversal learning was 100.

EXPERIMENT 3

Cue reduction was secured by the progressive centripetal shortening of the stimulus display, for two pairs of rats who had reached criterion in groups (1) and (2) respectively, and two sets of four rats, who had reached criterion in groups (3) and (4) respectively. On the seventh day (70 trials) the display consisted solely of single 1 in. thick vertical or oblique strips just within the entrance to the limb of the Y.

Results

All animals maintained criterial performance throughout the process of cue reduction.

DISCUSSION

Discrimination learning for obliques did not prove unduly difficult under the conditions of Experiment 1. Configurational cues seem ruled out by the results of Experiment 3. The relative ease of learning was perhaps due to the greater attention attracting property of the multiple display compared to Lashley's (1938) single stimuli; or the present (successive) presentation may have been more readily recodable for memorization than Lashley's simultaneous situation. At any rate, the results show that discrimination between mirror image 45° obliques is well within the rat's perceptual repertoire; the difficulty experienced in the earlier experiment appears not to have been perceptual in origin, and conclusions drawn as to limitations in the rat's ability to discriminate obliques are not tenable.

A majority of rats mastered each of the sameness-difference judgment situations, in spite of Lashley's (1938) earlier failure in this respect using the jumping stand. It took longer to learn this than the simple discrimination; reversal training of the sameness-difference judgments of obliques (Experiment 2) took as many trials as original learning. Again the use of obliques as stimuli presented no serious obstacle; if anything it proved easier to reach criterion on the basis of a sameness-difference judgment of obliques than of black and white surfaces. The perceptual aspect of the tasks appears not to have seriously limited performance. As before, success may have been due to the attention compelling nature of the display, or the relative ease in retaining the "same" or "different" concept, with no need to recall the direction of orientation of positive and negative obliques on the previous trial.

"Sameness-difference" stimulus displays were unusual in incorporating two elements, one on each wall, requiring separate glances, so as to minimize configurational cues. The maintained accurate performance during cue reduction (Experiment 3) further rules out use of extraneous cues.

Like oddity, sameness-difference judgment minimizes memory load when the stimuli are difficult to recode. Oddity learning is impossible (Lashley, 1938) or at least very difficult (Wodinsky & Bitterman, 1953) for rats. Sameness-difference judgments may prove to be more easily acquired, and if they transfer consistently from problem to problem, as with oddity in monkeys (Young & Harlow, 1943) and perhaps rats (Koronakos & Arnold, 1957), the method may have application to psychophysical studies of visual perception in the rat.

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Note

1. I am grateful to Dr. Brendon McGonigle for helpful discussion.