A "split-alley" technique for equating brightness in a visual discrimination task¹

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Hooded rats were run on a visual discrimination to two stimulus alleys equated for brightness by splitting each alley down the middle and having black in the left half and white in the right half as one discriminandum and the reverse as the other discriminandum. Discrimination learning in this "split-alley" situation was just as rapid as in the usual black-white one. Furthermore, the lack of any differences between position groups indicated that the use of this technique would eliminate the need to control for absolute effects of brightness.

Discrimination studies and within-S partial reinforcement studies using rats running in a straight-away have often employed different brightnesses as discriminanda. In the usual experiment, one brightness (e.g., black) is correlated with nonreinforcement (or partial reinforcement) and the other brightness (white) with continuous reinforcement for one group, while a second group has these brightness-reinforcement relations reversed as a check on absolute brightness effects.

From a statistical point of view, these brightness controls are necessary to unconfound brightness and reinforcement. The brightness controls are also made necessary by the fact that rats prefer dim areas over bright ones in the absence of any external, drive-related reinforcement (Johnson, 1964; Johnson, 1965).

Recently, however, there have been suggestions that even simple counterbalancing for brightness is not sufficient since not only significant brightness main effects but also brightness by reinforcement interactions have been interfering with the interpretation of data. For example, Amsel (1964) has reported that in within-S partial reinforcement studies where the same animal runs to two brightnesses, one associated with partial reinforcement and the other with continuous, differences in performance to the two stimuli are absolutely greater when white is the partial stimulus. These differences appear largely to be due to faster running to the partial (white) stimulus. Since there seems little, if any, difference in speed when white or black is the stimulus associated with continuous reward, a brightness by reinforcement interaction appears responsible for the differences in performance between the brightness control groups.

Additional support for this finding comes from a series of experiments reported by Amsel, Rashotte, & MacKinnon (1966). These experiments illustrate the reliability of the Amsel (1964) finding by showing that when brightness and brightness by reinforcement effects are significant, they always favor superior performance to white-partial, thus making it impossible to attribute

a given result to either brightness, reinforcement, or both.

The present experiment reports a technique for manipulating brightness pattern as a cue in visual-discrimination, runway training while holding absolute level of brightness equal from one discriminandum to the other.

Method

The apparatus consisted of a pair of runways each of which could be aligned with a common entry box-start box unit. In order for these two alleys to be of equal brightness and still serve as discriminanda, a metal insert painted half black and half white along the mid line of the floor was positioned in each runway. These 1/32-in. thick inserts, when in place in the runways, covered the floor and walls such that half the floor and its adjacent wall was one brightness (e.g., black) while the other half and its adjacent wall was the other (white). All guillotine doors and food cups were modified in the same manner to provide this "split-alley" effect. In one alley, looking from the start box to the goal box, black was on the left and white on the right, while in the other alley, white was on the left and black on the right. Presumably then, any discrimination should be formed on the basis of the position of these colors.

The entire apparatus was constructed of 3/4-in. pine, and was covered throughout with 1/4-in. Plexiglas, hinged to allow access to the runways. The runways were 3-3/4 in. high and 2-7/8 in. wide. The entry box (EB) dimensions were 11 in. x 3 in. x 3-3/4 in., and the start box (SB) dimensions were 10-1/2 in. x 2 in. x 3-3/4 in. Both were painted flat grey. EB was separated from SB by a grey, metal, guillotine-type door. A clear 1/4-in. Plexiglas door separated SB from the runway portion of the apparatus.

Five performance measures were taken over five 1-ft. segments by means of timers activated by a photoelectric system. The first (start) measure was provided when S traversed the first foot of the runway. A second photobeam located 24 in. from SB, when interrupted, provided the Run I measure, and so on, until the interruption of a beam located 3 in. from the end of the alley provided the goal (fifth) measure. A small metal food cup extending the width of the alley and with a lip to conceal the presence of a food pellet was suspended on the end wall of the runway 3 in. beyond the last photobeam and 2-1/4 in. from the alley floor.

Metal retrace doors, corresponding in color to the walls and floors of the runways, confined S to the food cup area. The length of the goal segment was 12 in.

The apparatus was illuminated by two 15-watt bulbs suspended in milk-glass globes approximately 96 in. above the runways.

The Ss were six hooded rats (three males and three females) approximately 90 days old at the beginning of discrimination training. For 14 days prior to the start of training Ss were maintained on an 11 gm/23 hr. feeding schedule. They were maintained on 11 gm (including the pellets received as reinforcement) throughout the experiment. For two days before training, Ss were placed in the carrying cages, brought into the experimental room and allowed to sit for 1/2 hr. On these two days, four Noyes pellets were included in the 11 gm ration given to the Ss in their home cages. Water was always available in the home cages.

The Ss were run four trials a day, two to S+ and two to S-. A 15-min. intertrial interval was observed. Reward on positive trials was one 500-mg Noyes pellet. On nonreward trials, S was removed from the goal box after approximately 45 sec. Order of running Ss was randomized each day. The following orders of reinforcement were employed once each in any four-day block: ++--, +-+-, -+++,

Fig. 1. Discrimination data and extinction data for five measures in the split alley.

- + - +. All orders were used on each day and each S received a different sequence of orders over each four-day block.

For half the Ss, black-on-the-left-white-on-the-right was positive and white-on-the-left-black-on-the-right negative (BW + WB -), while for the other half these relationships were reversed (WB + BW -).

All Ss received 62 days of discrimination training followed by 10 days of extinction with the only difference in extinction being the omission of reinforcement to the positive stimulus.

Results and Discussion

Since there were no differences in any of the measures between Ss having BW + WB - and those having WB + BW - in either acquisition or extinction, the data for both groups were combined and are presented as Fig. 1.

It is evident that discrimination is apparent on or slightly after the tenth day of training in each of the five measures. This suggests that the BW + WB - discrimination is no more difficult than the usual B + W - discrimination; data collected by Henderson (1966) in the same apparatus using B and W stimuli also show discrimination at about the tenth day of training. Although the discrimination, once established, persists throughout training, there is some suggestion that performance to S- recovers in the latter stages, a finding not uncommon in successive discrimination experiments (e.g., Amsel & Ward, 1965).

In extinction, speed to both stimuli showed a significant decline over days in all measures ($p < .01$ in each case), and no Day by Reinforcement interaction was significant, indicating that the course of extinction (except for absolute level) is the same for S+ and S-. However, the extinction curves start at such different levels that this apparent lack of difference in extinction slope cannot be taken too seriously. What is interesting

is the suggestion of an initial positive acceleration in the S+ extinction curves, a phenomenon uncharacteristic of extinction following continuous reinforcement.

It seems clear, then, that rats can learn to discriminate differentially positioned black and white stimuli in an alley as easily as they can discriminate black from white. This technique has obvious usefulness in other within-S experiments since it eliminates the complication of absolute brightness effects. It is conceivable, also, that the technique may be useful in dealing with problems in other areas. An example we think of comes from the study of interocular transfer where rats could perhaps be run using the "split-alley" in conjunction with a nasal blinker. With such a procedure, Ss could be trained in one alley (BW) under conditions where each eye sees only one stimulus as S runs, and tested for transfer in the other alley (WB).

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