Second-eye reversal acquisition as a function of overlearning and level of illumination¹

FRANCES J. TEMPLE² and CHARLES L. SHERIDAN,
University of Missouri and Veteran's Administration Hospital,
Kansas City, Mo. 64110

Four groups of albino rats were given varying degrees of training on a monocular pattern discrimination, then were reversal trained with the opposite eye. Second-eye training took longer than had first-eye training, and degree of original training had no significant effect. In a second experiment, two groups of albino rats were given monocular and second-eye reversal training under either 1 or 25 ft-c of illumination. At either level of illumination, second-eye acquisition took longer than acquisition of the first problem.

There have been several reports showing that rodents readily acquire and retain an original and reversal discrimination mediated by opposite eyes, even when other measures of interocular interaction indicate the presence of substantial transfer across the midline (Sheridan, 1965; Levinson & Sheridan, 1966a, b; Besley, 1967). However, rates of acquiring the second-eye reversal have varied across experiments. Sometimes the reversal is learned more quickly than was the original discrimination (Sheridan, 1965; Levinson & Sheridan, 1966b) and other times either first and second eye rates do not differ (Levinson & Sheridan, 1966b), or the reversal is learned a good deal more slowly (Besley, 1967).

It was the purpose of the experiments reported here to determine the relationship between first- and second-eye acquisition over a wide range of conditions by measuring the influence of two variables, overlearning and level of illumination, on rate of acquiring a second-eye reversal in albino rats. The overlearning variable was of interest because it can influence reversal acquisition under the usual bilateral training conditions (Reid, 1966), and level of illumination was selected for study because leakage of visual input into the occluded eye with the concomitant bilateral representation of the original discrimination might impair "second-eye" reversal acquisition.

EXPERIMENT 1

Subjects

The Ss were 16 male albino rats of the Sprague-Dawley strain.

Apparatus

The apparatus, a modified Thompson-Bryant box (Thompson & Bryant, 1955), utilized shock motivation and consisted of a startbox, runway, choice-point with two alternative cue doors, and a goalbox. Motivational shock in the startbox and choice areas was a pulsed ($\frac{1}{2}$ sec on; $\frac{1}{2}$ sec off) current of about 250 mW supplied by a Lehigh-Valley Electronics sine-wave shocker, Model 1311. A door between the startbox and runway closed a microswitch mounted on the side of the box. When the door was lifted out, the switch was tripped and a tone came on for 10 sec before shock was presented in the startbox. Twenty seconds after the start of the trial, the shock came on and continued to pulse in the runway until the trial was terminated by the animal running into the goalbox. In front of each goalbox entryway there was a grid extending approximately 4 in. into the runway. This grid was continuously electrified in front of the incorrect door and that door was locked. Any contact with the grid in front of the incorrect door was counted as an error. Detection of such contact was facilitated by a neon lamp which brightened when current flowed through the grid.

Procedure

Subjects were pretrained to gain access to the goalbox by knocking over gray stimulus cards which blocked the entryways. The day after pretraining, Ss were randomly divided into four equal groups: Group 0, which received monocular discrimination training until a criterion of 18 correct responses in 20 consecutive trials was reached, after which the reverse discrimination was given via the opposite eye until the same criterion was reached; Group 50 which was trained to criterion and given 50 overtraining trials; Group 100 which was given 100 overtraining trials after meeting criterion; and Group 150 with 150 overtraining trials before second-eye reversal. One-half of each group started with the left eye, the other half with the right eye covered with an opaque contact occluder. Discriminanda were $\frac{1}{2}$ -in. alternating black and white horizontal stripes vs similar vertically oriented stripes. Horizontal was the correct cue for all groups and its position was determined across trials by a Gellerman series (Gellerman, 1933). Ss were run 25 trials per day until criterion was met, or until 300 trials were completed.

Results

One animal failed to reach criterion on the first eye within 300 trials and was terminated at that point. Data from the remaining Ss are given in Table 1, which shows each group's median trials to criterion for original-eye/original-problem learning and for the second-eye reversal. Twelve Ss took more trials for reversal learning, two took fewer trials, and one took the same number of trials for original and reversal learning. This difference is statistically significant (two-tailed sign test, $p < .02$). It was clear from inspection of the individual scores that all groups overlapped heavily, and that overtraining had no significant effect on second-eye reversal acquisition.

Table 1
Means and Standard Deviations of First and Second Eye Trials to
Criterion Scores at Each of Four Levels of Training

Group	0		50		100		150	
Eye	M	SD	M	SD	M	SD	M	SD
1	167.7	21.6	122.3	31.1	165.0	86.3	115.0	19.5
2	200.0	62.6	158.5	9.1	196.0	53.5	179.8	42.7

Discussion

In general, second-eye reversal occurred more slowly than original acquisition. In only two Ss did learning occur more quickly on the second than on the first eye. It appears that the influence of any potentially facilitatory factors stemming from first eye acquisition, such as the "general" component described by Levinson & Sheridan (1966b), is outweighed by intrusion of the specific solution to the original problem. Furthermore, this relationship between the two influences holds over a wide range of training levels. Ss in most of the preceding interocular reversal studies have been given training on the original eye to an 18/20 followed by either a second 18/20 criterion or a 10/10 criterion. Since the second criterion is commonly reached in a median of 0 trials, the number of training trials following acquisition of the 18/20 criterion is about 20 for most Ss. Hence, the present levels of overtraining easily encompass those of earlier studies. Since, in spite of this, facilitation occurred at none of the levels of overtraining, a second variable which might influence second-eye acquisition was investigated in the next experiment.

Table 2
Means and Standard Deviations of First and Second Eye Trials to
Criterion at 1 and 25 ft-c

Group	1 ft-c		25 ft-c	
	M	SD	M	SD
Eye 1	106.4	33.7	102.3	18.3
2	198.9	56.0	138.9	41.0

EXPERIMENT 2

Level of illumination was varied, since it is known that albino rats can, under some conditions, make visual discriminations on the basis of light which leaks around contact occluders (Chorover & Chase, 1968; Sheridan & ShROUT, 1965). A high level of illumination was used in Experiment 1 (25 ft-c measured at the level of the cue doors), and it might be that leakage around the occluders at this level was enough to provide a basis for binocular discrimination of both the original and the reversal task. This may have impeded reversal acquisition.

Subjects

Sixteen male albino Sprague-Dawley rats were used as Ss.

Apparatus

The apparatus was the same one used in Experiment 1, but a lighting apparatus consisting of a 20 x 13 x 6 in. box containing a bank of six rows of five 15-W lights with a translucent Plexiglas diffusion screen was mounted over the runway just in front of the cue doors. The number of lighted bulbs could be varied to provide either 25 ft-c or 1 ft-c of incident light at the cue doors. A squirrel-cage blower was mounted on the side of the light apparatus.

Procedure

Half of the 16 rats were chosen randomly for training at the 1 ft-c level and the other half for training at 25 ft-c. Pretraining took place as in Experiment 1, then half of the Ss in each group were occluded on the right eye and half on the left eye, and discrimination training was begun. The horizontal-vertical discrimination of Experiment 1 was used, half of the Ss in each group being given horizontal and the other half vertical as the correct cue. Each S was run to an 18/20 criterion or until 300 trials had elapsed. They were then given overlearning trials till an additional 18/20 criterion had been met. Finally, the occluder was switched to the opposite eye and the animal was run to criterion on the second eye reversal problem, or until 300 trials had been given.

Results

One S in the 1-ft-c group was dropped due to E error. Trials-to-criterion data for the remaining Ss are summarized in Table 2. At either level of illumination, second-eye acquisition took longer than acquisition of the first problem. For first- vs

second-eye trials to criterion at 1 ft-c, $t = 3.59$, $df = 6$, $p < .05$ (all ps two-tailed), and at 25 ft-c, $t = 2.48$, $df = 7$, $p < .05$. The expected improvement in second-eye performance at the lower level of illumination clearly did not occur. On the contrary, the mean number of trials to reversal criterion at 25 ft-c was smaller than at 1 ft-c, though this difference was not significant. Only two Ss learned the reversal faster than the original problem, and one of them was at 1 ft-c and the other at 25 ft-c.

Discussion

It seems clear that, although the albino rats readily retain an original monocular discrimination despite the intervention of reversal training with the opposite eye, the facilitated second-eye learning sometimes observed by Sheridan (1965) and Sheridan & Levinson (1966) is of very limited generality. Though we have not been able to isolate the variables which determine whether such facilitation will or will not occur, we have shown that retarded rather than facilitated second-eye acquisition is typical over a substantial range of experimental conditions. In order to isolate the critical variables in question, it will presumably be necessary to repeat the earlier experiments under conditions virtually identical to the original ones.

REFERENCES

- BESLEY, S. Conflicting discriminations in the albino rat. Unpublished M.A. thesis, University of Missouri at Kansas City, 1967.
- CHOROVER, S., & CHASE, R. Persistence of visual pattern discrimination in binocularly-occluded albino rats. *Journal of Comparative & Physiological Psychology*, 1968, 65, 238-245.
- GELLMAN, L. W. Chance orders of alternating stimuli in visual discrimination experiments. *Journal of Genetic Psychology*, 1933, 42, 206-208.
- LEVINSON, D. M., & SHERIDAN, C. L. Retention in guinea pigs of monocular pattern discriminations during reversal acquisition with the opposite eye. *Psychonomic Science*, 1967a, 7, 239-240.
- LEVINSON, D. M., & SHERIDAN, C. L. Acquisition and retention of monocular discrimination in rats as a function of relevant (reversal) or irrelevant opposite eye training. *Psychonomic Science*, 1967b, 8, 475-476.
- REID, L. The development of noncontinuity behavior through continuity learning. *Journal of Experimental Psychology*, 1953, 46, 107-112.
- SHERIDAN, C. L. Interocular interaction of conflicting discrimination habits in the albino rat: A preliminary report. *Psychonomic Science*, 1965, 3, 303-304.
- SHERIDAN, C. L., & SHROUT, L. L. Interocular transfer in the rat: The role of the occlusion process. *Psychonomic Science*, 1965, 2, 173-174.
- THOMPSON, R., & BRYANT, H. Memory as affected by activity of the relevant receptors. *Psychological Reports*, 1955, 1, 393-490.

NOTES

1. Supported in part by Veterans Administration 8200 funds and in part by Grant USPH NBO 7445-03 to Charles L. Sheridan.
2. Now at the University of Kansas.