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THE EFFECT OF ELECTRIC SHOCK IN A GOAL REGION UPON VISUAL DISCRIMINATION LEARNING

By

SHIGERU SAITO (斎藤 繁)

(*Department of Psychology, Tohoku University, Sendai*)

The facilitating effect of the electric current shock for correct responses in a visual discrimination learning has been studied extensively by Muenzinger and others. A cognitive-perceptual principle and anxiety reduction hypothesis have been advanced to explain this paradoxical phenomenon.

To provide experimental tests of the facilitating effect of shocking correct responses during the earlier phase of discrimination learning, a control group and three experimental groups were trained in a white-gray discrimination under non-correction condition in a single-unit Y-typed maze.

Each experimental group was equally delivered the shock ranging from 50 m.a. to 150 m.a. during eleventh to twenty-fifth reinforcements and then after 25 reinforcements shock conditions were changed respectively to Shock-150 m.a., Shock-50 m.a. and Shock-0 conditions.

In terms of errors and trials the difference between Shock-50 group and Shock-150 group was not significant, and the difference between Shock-0 group and No-Shock group was significant. As compared with Non Shock group, all experimental groups showed a progressive improvement of learning in early stages of acquisition.

According to these results, the conditions, especially shock gradient, in early stages of acquisition were very important.

It has been shown by Muenzinger, K.F. and his co-workers (8) that moderate electric shock for correct selection after passing the choice point has an accelerating effect upon the visual discrimination learning in a corrective and a non-corrective situation. Muenzinger assumed that electric shock in discrimination learning has two function; (a) producing avoidance behavior, and (b) accelerating learning. If an animal is shocked when it makes a correct turn, this experience first tends to bring about an avoidance of shock. It is only after the tendency to avoid the shock has been somewhat overcome that the accelerating function of shock after the point of choice can manifest itself unhindered" (8, p. 117).

Wischner's result (15), however, was different from Muenzinger's, for he observed remarkable decline of error curve in later stages of learning process, but did not recognize the facilitating effect of shock for correct response in terms of errors and trials to reach the criterion of learning. These incompatible results might be due to the difference of terminology and experimental procedure as discussed by Takeuchi (10).

Takeuchi and Saito (12) examined the relationship between the intensity of electric shock and task difficulty and lend support to Muenzinger's arguments that the shock

* Now at the Child Guidance Clinic of Miyagi Perfecture, Sendai.

exerts a facilitating effect upon the learning, but they showed that there was no difference of the accelerating effect between medium shock (30～100 microamperes) and high shock (30～180 microamperes) in an easy and a difficult discrimination problem and the electric shock had more facilitating effect in the earlier stages of learning than in the later in the non-corrective situation.

Takeuchi and Saito (13) further examined these facts and demonstrated that the shock for correct selection could have no accelerating effect if the strength of electric current was increased in a sharp ascent in the early stages of learning, but after some initial shock-free reinforcements the sharply increased shock or the high shock was more effective than the gradually increased shock. Moreover, after 25 initial shock-free reinforcements the accelerating effect of shock was not produced in proportion to the shock intensity. These results were partially equal to Prince's result, in which among the Shock-0, Shock-15, and Shock-25 groups speed of acquisition was an increasing function of the number of initial shock-free trials, and the control group learned slower than the Shock-15 and Shock-25 group but faster than the Shock-0 group.

The present experiment was designed to examine further the above mentioned facts. It was supposed that if the difference of shock intensity after 25 reinfocements would not produce any different accelerating effects on the discrimination learning, it was possible to examine the facts by changing the shock intensity after 25 reinforcements, and that when animals received the shock just before consummation of reward in a goal region, the effect of shock might be more directly manifested than received in a choiced alley. Drew (1) had found that the shock administered just before consummation in a goal region facilitated visual discrimination learning as well as the shock administered in a choiced alley. But perceptual stimulus cues between in a goal and a choiced alley were unequivocal. If the goal stimulus cues and the discriminative cues were equivalent, the shock administered just before consummation in a goal area might have more facilitating effect on learning.

The learning task was white-gray discrimination. The wall of a goal area in which Ss were administered the shock and the discrimination card were painted in the same color. Therefore, the stimulus selection of animals at the point of choice would easily reflect the effect of goal shock. If the shock had negative effects, Ss would avoid corrective alley and then could not achieve the learning criterion. It was possible to confirm these facts by means of analysis of learning curves. Muenzinger (8) reported that the shocks of ranging from 100 m.a. to 150 m.a. were moderate intensity to provide facilitation of discrimination. Takeuchi and Saito (12, 13) showed that shock intensity, learning task, and other factors, for example, the time of administration of the shock or drive strength etc. interacted on one another.

The methodology of the present experimental study was devised by reference to those of Drew (1) and Muenzinger (8).

METHODS

Subjects: Ss were 27 albino rats, 24 males and 3 females, of Wister strain from the colony maintained at Tohoku University. They ranged between the weight of 140 grams and 244 grams, and age was aproximately 90 days at the beginning of the experiment.

Apparatus: The apparatus was s single Y-maze painted dull black with sides 26 cm high but the goals with the grid and discrimination cards were painted gray (negative clue) or white (positive clue).

The discriminanda were changed from side to side in randomizing the positional representation of the positive and negative cues. The shocking device delivered ten direct current impulses per second, which were of rectangular shape and whose amplitudes could be varied. The source of the direct current shock was a 80 vacuum tube with a plate voltage of 700v.

Procedure: Prior to training all Ss were given seven days of handling and of habituation to a 24 hr. feeding schedule. They were allowed to eat for about 40 min. with the food cups of their home cages.

Preliminary training: This covered a period of five days. Day 1 and Day 2 served as adjustment to the apparatus. All doors were removed, animals were introduced into the apparatus in pairs and were removed, animals were introduced and were allowed to explore freely for 30 min., and then Day 3 animals were introduced into the apparatus separately for 10 min. Day 4 and Day 5 were for training from choice point to the food compartment through the open choice alley. The animals received food in both goal boxes in each eight trials.

Regular training: Animal was placed in the starting box and allowed to proceed to the goal box. Ss had five reinforcements, that is, they had to run till to do five correct selections in a non-correction situation. After 25 reinforcements each shock group was equivalently regrouped. On and after the seventh day they were given ten reinforcements per day. Electric shock was administered from the eleventh reinforcement and then the shock intensity was gradually increased from 50 to 150 microampers in each five reinforcements and from 26th reinforcements the shock intensity was different in each shock group (see Table 1). The rats were motivated by a 23-hr. food deprivation. The reward found in the positive goal box throughout the experiment was a piece of 0.2 gm. cheese. The criterion of learning was two successive errorless daily sessions of ten runs each.

Table 1. Shock schedule in each exp. group.

Group \ Trial	1-10	11-15	16-20	21-25	26-
Shock-150 Croup	0	50	100	150	150 m.a.
Shock-50 Group	0	50	100	150	50
Shock-0 Group	0	50	100	150	0

Results

The performances of the control and three shock-right groups expressed in terms of the average number of errors and trials and the total learning period required to attain the criterion of learning for each groups are showed in Table 2.

In terms of trials before reaching the criterion Shock-150 group and Shock-0 group were almost equivalent scores and then reached most rapidly the criterion. Non-shock group needed twofold trials of these groups. The significane of the difference between groups for both measures is given in terms of U-values.

The differences between Shock-50 group and Shock-0 group are significant at more than .05 level of confidence. The Shock-150 group was significantly superior to the Shock-0 group for trails. No-shock group and other experimental groups are significant at .01 level.

In terms of errors the difference between Shock-50 group and Shock-0 group are significant at .05 level, but between Shock-150 group and Shock-0 group are small. ($U=38$, $0.1>P>0.05$)

Table 2. Errors and trials to reach the criterion of learning.

Measure / Group	Errors		Trials	
	Means	SD	Means	SD
NSG	41.33	9.04	151.17	25.82
S-0 G	29.29	5.62	99.57	10.82
S-50 G	21.57	4.71	69.14	16.26
S-150 G	21.43	6.02	69.73	19.13

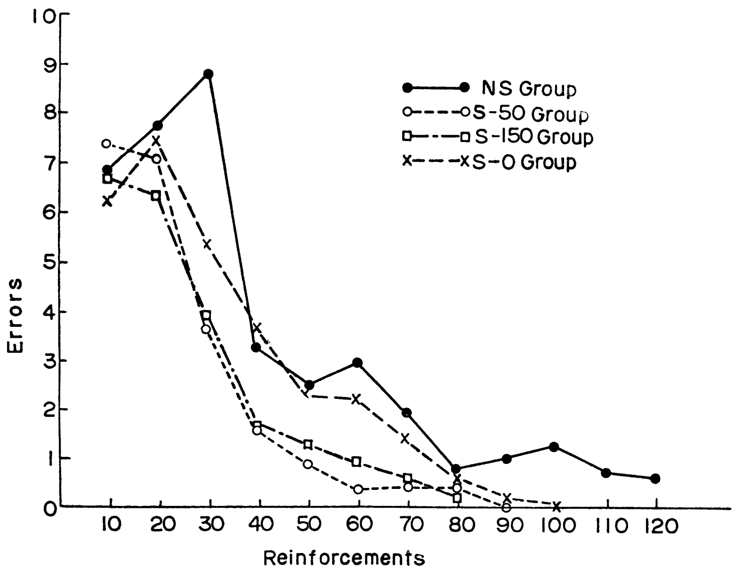

Fig. 2. Errors per ten reinforcements in each group.

Control group made significantly more errors than the experimental groups. The results are given graphically in Fig. 2 in the error curves for each group. These curves show even more strikingly the relative learning efficiency of the four groups.

The Shock-0 group was not discharged after 25 reinforcements and then it condition was changed to the same condition of the control group. Specially interesting however, is that there was the relatively rapid decrement in the latter part of the curve in the Shock-0 group. The No-shock group needed the average number of about 150 trials to reach the criterion and the error curve fell down gradually.

Discussion

From the results in the experiment, it is obvious that the shock for correct response has an accelerating effect, and these results confirmed the findings of Muenzinger, K.F., et al, Drew, G.C., Prince, A.I. Jr., and Takeuchi, T. et al. In a comparison of No-shock group vs. Shock-0 group a facilitating effect is apparent when the shock was administered only in the early stages of learning, and then in a comparison of Shock-50 group vs. Shock-150 group the shock near the threshold has an accelerating effect as well as the shock of the aproximately sixth of the threshold.

Muenzinger and Powloski postulated as follow; that shock after the point of choice whether for right or wrong turns in a visual discrimination box has an accelerating function in both situations, noncorrective as well as corrective, but in addition it also has an avoidance function which may under certain circumstances mask the accelerating effect. Shock after the point of choice makes the animal more sensitive to the cues to be discriminated, but it also creates a tendency in an animal to avoid the alley in which it has been shocked. If it should be possible torain an animal to adapt itself to the shock, and thus overcome the avoidance effect, it might then exhibit the acclerating effect more clearly (8, p. 123).

If the moderate shock (100~150 μA) at the optimal level had more facilitating effect, there could be demonstrated better learning performance in Shock-150 group. But the supposition could not be supported by the results in this experiment. Uunder this assumption, however, the quick fall of learning errors during earlier stages could not be accounted for.

Freeburne, C.M. suggested that the shock itself could serve as a cue to the correctness of the response, and so might come by way of different secondary reinforcement to bring about the faster learning shown in the shock groups. Hebb, D.O. explained the results of experiment by Muenzinger, K.F. and Drew, G.C. as follows;

> "In that one region, the pain stimulation now aroused organized cortical activity. This conclusion is meaningful for the observation of Muenzinger (1943) and Drew (1938) thnt giving a rate electric shock for the correct response (followed of course by food) increases the rate of learning. In Drew's experiments, when the food itself was electrified so that the rat got a shock with every bite, eating was voracious. In such a case, once the central effects of the pain stimulus have become organized, we must regard

the stimulus as essentially motivating; just as a blow of the whip may be motivating and energizing to a racehorse that appears already to be exerting himself to the utmost-a further stimulation that adds to the effectiveness of a pre-exsitent cerebral control of behavior" (4, p. 189-190).

According to the above discussions, the following conclusion can be drawn: when the shock at optimal level intensity was given prior to the rewarded responses, the function of emphasizer is superior to the avoidance tendency and strengthens the approach tendency and therefore has the facilitating effect of learning, and in the early stages of learning, shock intensity gradient was important as well as the number of initial shock free reinforcements. It would furthermore be desirable to investigate problems about the effect of shock on cognition, motor activity and motivation.

References

(1) Drew, G.C. The function of punishment in learning. *J. genet. Psychol.*, 1938, 52, 257–267.

(2) Freeburne, C.M. & Taylor, J.E. Discrimination learning with shock for right and wrong response in the same subjects. *J. comp. physiol. Psychol.*, 1952, 45, 264–268.

(3) Freeburne, C.M. & Schneider, M. Shock for right and wrong responses during learning and extinction in human subjects. *J. exp. Psychol.*, 1955 49, 181–186.

(4) Hebb, D.O. *The Organization of Behavior.* New York: John Wiley & Sons, Inc. 1949.

(5) Lohr, T.F. The effect of shock on the rats' choice of a path to food. *J. exp. Psychol.*, 1959, 58. 312–318.

(6) Mowrer, O.H. Learning theory and behavior. New York; John Wiley & Sons, Inc. 1960.

(7) Muenzinger, K.F. and Baxter, L.F. The effects of training to approach vs. to escape from electric shock upon subsequent discrimination learning. *J. comp. physiol. Psychol.*, 1957, 50, 252–257.

(8) Muenzinger, K.F., Brown, W.D., Crow, W.J. and Powloski, F.R. Motivation in Learning: XI. An analysis of electric shock for correct responses into its avoidance and accelerating components. *J. exp. Psychol.*, 1952, 43, 115–119.

(9) Prince, A.I. Jr. Effect of punishment on visual discrimination learning. *J. exp. Psychol.*, 1956, 52, 281–385.

(10) Takeuchi, T. The facilitating effect of electric shock on learning-especially concerning the effect of shock for correct choices. *Psychol. Papers to Commemorate the Anniversary of Dr. Y. Ohwaki's Professorship*, 1959, 214–231.

(11) Takeuchi, T. The effect of electric shock on bright and dark disscrimination learnig :VI. An analysis of the gradients of shock in preliminary training. *Abstracts of the reports at the 23th annual meeting of J.P.A.*, 1959, VI–35.

(12) Takeuchi, T. & Saito, S. The effect of electric shock on learning II-an analysis of the variously increased intensity of shock for correct responses in a black-white discrimination in the white rat. *Annu. Anim. Psychol.*, Tokyo, 1960, 10, 11–21.

(13) Takeuchi, T. & Saito, S. The effect of electric shock on learning: III. The optimum time of shock for correct responses in a white-black discrimination problem. *Memories of the Faculty of Education, Hirosaki University*, 1960, 6, 1–12.

(14) Tolman, E.C., Hall, C.S., & Bretnall, E.P. A disproof of the law of effect and a substitution of the law of emphasis motivation and disruption. *J. exp. Psychol.*, 1932, 15, 610–614.

(15) Wischner, G.J. The effect of punishment on discrimination learning in a non-correction situation. *J. exp. Psychol.*, 1947, 37, 271–284.

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