Classical discrimination conditioning and reversal in the albino rabbit

ARTHUR L. YEHLE, LIONEL E. SPAULDING, and HSIU-YING LAI
Memphis State University, Memphis, Tenn. 38111

Eight albino rabbits were trained in a classical discrimination conditioning task measuring heart-rate and nictitating-membrane responses. Following 10 days of acquisition, reversal training was carried out for 10 days. The nictitating-membrane response indicated a successful discrimination reversal within 3 days, while the heart-rate response never showed discrimination reversal during the entire period.

A number of recent studies of cardiac conditioning have shown a similarity between heart-rate (HR) responding and striate-muscle responding during acquisition. For example, Miller (1969) and DiCara (1970) have operantly conditioned visceral and glandular responses and have shown that learning in the autonomic nervous system (ANS) appears to follow the same rules as the instrumental learning of skeletal responses in the peripheral nervous system (PNS). Obrist (1968) has shown "cardiac changes in human Ss during classical aversive conditioning are coincidental in the modification of somatic motor activity." In addition, Obrist views "cardiac and somatic-motor events as different aspects of the same response process."

Nevertheless, as other studies have demonstrated (Schneiderman, Vandercar, Yehle, Manning, Golden, & Schneiderman, 1969; Yehle, 1968a; Parrish, 1967; de Toledo & Black, 1966), the HR response differs considerably in speed of acquisition, habituation, and discrimination. These latter studies suggest that more than one learning process may be occurring simultaneously within a single organism during conditioning.

The present study, examining discrimination reversal during classical aversive conditioning of the rabbit, lends further support to a multiple process theory.

METHOD

The Ss were eight male New Zealand albino rabbits, approximately 14 weeks old, and weighing between 5 and 5½ lbs. Each S was caged individually and had free access to food and water.

During training the Ss were restrained in a Plexiglas box that was placed in a ventilated sound-attenuated chamber. The nictitating-membrane (NM) response was recorded by using a loop suture through the NM attached to a strain gauge. (For details, see Yehle, 1968b.) Two stainless steel safety pins were inserted into the skin of each S to record the HR.

The CSs were tones of either 700 Hz or 1,900 Hz presented to the S through a 6-in. speaker located 4 in. above the S's head. The US was an ac electric shock of .3-sec duration administered through two stainless steel hooks that held the S's right eyelid open. The CS duration was 1 sec, and the offset of the CS was coincident with the offset of the US. The intertrial interval was 69 sec.

The US intensity varied in the following manner: In one condition, the US intensity was gradually raised over a period of 1-8 days from 2 mA to 3, 8.5, 14, or 19.5 mA, and was maintained at that level throughout the remainder of the study, with one S per different intensity. In the second condition, the four remaining Ss were initially administered 3, 8.5, 14, or 19.5 mA and were maintained at that level throughout the study.

Conditioning consisted of 1 day of adaptation, 10 days of classical discrimination training, and 10 days of reversal training. During each daily session of initial discrimination training, the Ss received 24 trials with the CS+ (1,900 Hz) and 24 trials with the CS– (700 Hz) randomly presented, but with no more than two similar trials in succession. Following the 10 days of discrimination training, the CS contingencies were reversed (CS+ at 700 Hz and CS– at 1,900 Hz), and the Ss were run for 10 days under these reversed conditions. Trials 11 and 12, 23 and 24, 35 and 36, and 47 and 48 were designated as test trials (no US) and used to assess HR responding to the CS+ and the CS– by measuring the distance between 10 successive heart beats prior to CS onset and comparing this with the measurement of 10 successive heart beats immediately following CS onset. A percent change from baseline was then calculated and used as a measure of HR conditioned responses. The NM responding was measured on every trial and a 2-mm pen deflection with a latency of less than .7 sec was used as a criterion for a conditioned NM response.

RESULTS

Although the present study was initially designed to investigate US intensity effects, the variability among Ss, coupled with the use of only one S per cell, indicated no systematic effects of differing condition or shock level. Therefore, the resultant HR and NM responses for all eight Ss were combined and averaged.

The HR response shown in Fig. 1 indicates that a discrimination was made on the first day of training and continued throughout the following 9 days. A decrease in HR responding due to habituation, usually observed in rabbit HR conditioning of this type, can also be seen

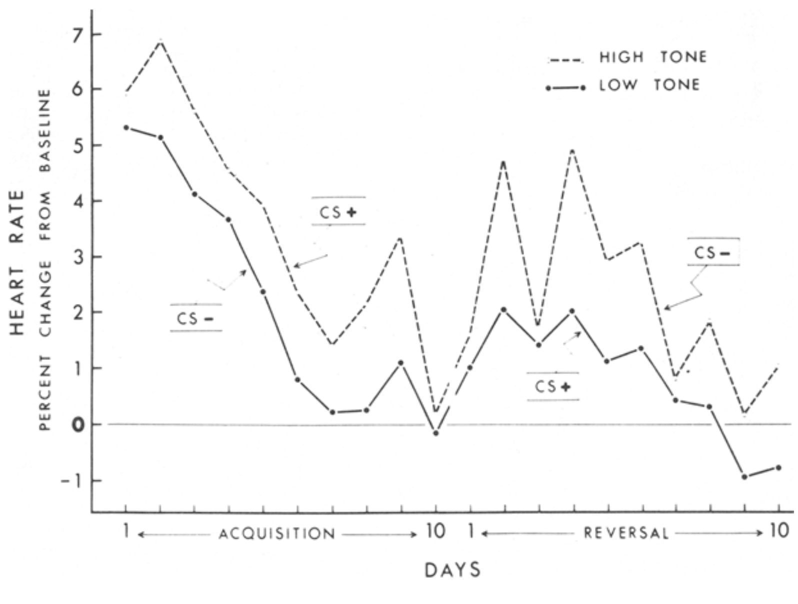
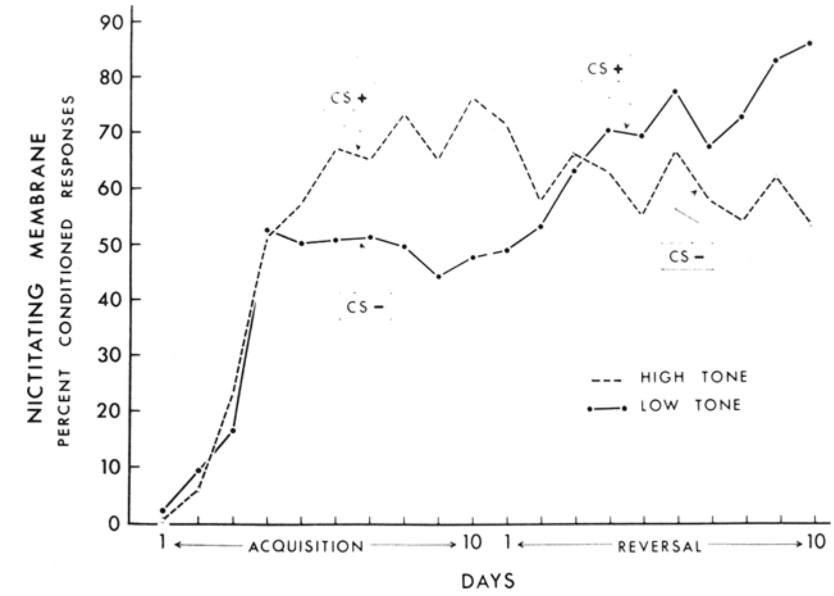


Fig. 1. Mean heart rate response (n = 8) to high- and low-frequency tones during acquisition and discrimination reversal.

Fig. 2. Percent nictitating membrane responses to high- and low-frequency tones during acquisition and discrimination reversal.



during the first 10 days of training.

Upon initiation of discrimination reversal (DR), a temporary increase in overall HR responding can be noted, but responding to the high frequency tone continues throughout the 10-day reversal period to be greater than that to the low frequency tone, even though the US pairing has been reversed.

The NM responding portrayed in Fig. 2 shows a gradual acquisition and a clearcut discrimination starting with the fifth day of training and continuing throughout the remaining 5 days. After 3 days of DR, however, the NM responding, unlike the HR response, shows a reversal that improves for the remainder of the reversal training.

DISCUSSION

In previous studies, several factors have been shown to affect DR and successive DR. Among them are species differences (Bitterman, 1965; Gossette, 1968), motivation and incentive (Gossette, 1969), number of negative stimuli (Schaeffer & Shadro, 1968), irrelevant cues and overtraining (Marsh & Johnson, 1968), and amount of position responding (Sperling & Yoder, 1969). The present study measuring two different responses simultaneously demonstrates that DR may be dependent on the response system measured and that this in turn may reflect differing learning processes.

Most personality theories stress the importance of early emotional training and the difficulty of changing emotional responses developed during childhood. The HR response, dependent mainly on the ANS, may be considered a type of emotional response. Its inability to effect a DR in this study suggests a parallel with early human emotional development and argues against the similarity of PNS and ANS conditioning.

REFERENCES

BITTERMAN, M. E. The evolution of intelligence. Scientific American, 1965, 212, 92-100.

de TOLEDO, L., & BLACK, A. H. Heart rate: Changes during conditioned suppression in rats. Science, 1966, 152, 1404-1406.

DiCARA, L. V. Learning in the autonomic nervous system. Scientific American, 1970, 222, 30-39.

GOSSETTE, R. L. Examination of retention decrement explanation of comparative successive discrimination reversal learning by birds and mammals. Perceptual & Motor Skills, 1968, 27, 1147-1152.

GOSSETTE, R. L. Role of motivational and incentive levels in the control of successive discrimination reversal (SDR) performance in comparative analysis. Perceptual & Motor Skills, 1969, 28, 283-292.

MARSH, G., & JOHNSON, R. The effect of irrelevant cues and overtraining on discrimination reversal in the pigeon. Psychonomic Science, 1968, 12, 321-322.

MILLER, N. E. Learning of visceral and glandular responses. Science, 1969, 163, 434-445.

OBRIST, P. A. Heart rate and somatic-motor coupling during classical aversive conditioning in humans. Journal of Experimental Psychology, 1968, 77, 180-193.

PARRISH, J. Classical discrimination of heart rate and bar press suppression in the rat. Psychonomic Science, 1967, 9, 267-268.

SCHAEFFER, B. H., & SHANDRO, N. Discrimination acquisition and reversal in the rat as a function of number of negative stimuli. Journal of Comparative & Physiological Psychology, 1969, 69, 201-206.

SCHNEIDERMAN, N., VANDERCAR, D. H., YEHLE, A. L., MANNING, A., GOLDEN, T., & SCHNEIDERMAN, E. Vagal compensatory adjustment: Relationship to heart rate classical conditioning in rabbits. Journal of Comparative & Physiological Psychology, 1969, 68, 175-183.

SPERLING, S. E., & YODER, S. G. Amount of position responding in discrimination reversal and speed of reversal. Journal of Experimental Psychology, 1969, 79, 573-574.

YEHLE, A. L. Divergences among rabbit response systems during three-tone classical discrimination conditioning. Journal of Experimental Psychology, 1968a, 77, 468-473.

YEHLE, A. L. A method for transducing nictitating membrane and breathing rate responses in the rabbit. Journal of the Experimental Analysis of Behavior, 1968b, 11, 207-208.