The extradimensional transfer session was administered some time after the intradimensional transfer. This time period varied from 4 days to 87 days for the four animals. The procedure for the extradimensional transfer was as follows: The monkeys were again stabilized on the red, green, and blue simultaneous matching paradigm until they attained a criterion of three consecutive sessions of 95% or better matching performance. The length of time between the intra- and extradimensional tasks did not seem to affect the number of days required to reach criterion, since the animal with the longest time interval required three sessions to reach criterion, as did the animal with the shortest interval. During the session following the attainment of criterion, the blue stimulus was again replaced, this time with a white triangle having ¾-in. sides.

RESULTS AND DISCUSSION

As Fig. 1 shows, all monkeys immediately transferred matching to the yellow stimulus, but during the first session of extradimensional transfer, the monkeys responded to the colored stimulus whenever the triangle appeared as a CO. Two monkeys began to match the triangle during the second session of extradimensional transfer, while neither of the other monkeys responded to the triangle even once during the two sessions of extradimensional transfer. Although we can offer no immediate explanation, it is of interest to note that the monkeys that began to respond to the triangle during the second session had a longer time period between testing on the intradimensional and extradimensional transfer tasks. During both extra- and intradimensional transfer, all monkeys continued to match correctly in those trials in which the red and the green stimuli were ST.

These findings contrast with Cumming and Berryman's observations upon transfer of matching by pigeons. In an almost identical intradimensional transfer situation, the pigeons reverted to a position habit on trials in which the novel yellow stimulus was the ST, and this performance was interpreted as indicating that previous training had not resulted in the formation of a matching concept. However, the monkeys apparently did form at least a rudimentary matching concept, since matching was transferred 100% to the novel intradimensional stimulus. Nevertheless, the failure of the same monkeys to transfer matching to the novel extradimensional stimulus suggests that monkeys may not transfer their matching performance across certain stimulus dimensions.

REFERENCES

CUMMING, W. W., & BERRYMAN, R. Some data on matching behavior in the pigeon. Journal of the Experimental Analysis of Behavior, 1961, 4, 281-284.

NOTES

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2. Animals used in this study were handled in accordance with the "Guide for Laboratory Animal Facilities and Care" prepared by the National Academy of Sciences, National Research Council, and in accordance with the Secretary of Agriculture Standards in "Laboratory Animal Welfare."

3. Requests for reprints should be sent to William J. Jackson, 6571st Aeromedical Research Laboratory, Holloman AFB, N. Mex.

The effects of stimuli associated with shock onset or termination on restraint-induced gastric lesions[1]

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Rats under physical restraint were presented a CS that was previously paired with either shock onset or electric shock termination, or at random intervals before and after shock onset (control). The group exposed to the CS previously paired with shock onset had significantly more gastric lesions than did the other two groups, which did not differ. These results support the findings of studies which measured an instrumental response in showing that the effects of a CS associated with shock onset were different from the effects of a CS previously paired with shock termination.

Estes & Skinner (1941) demonstrated that a CS that had been previously paired with shock onset would function as a negative reinforcer. Mowrer (1956) proposed that a CS presented after shock onset, and immediately prior to the termination of electric shock, would have a different effect on behavior and would function as a positive reinforcer. The differential reinforcing effects of a CS once paired with shock onset as opposed to a CS paired with shock termination have been demonstrated in studies of barpressing (Mowrer & Aiken, 1954), activity (Davitz, 1955), and stimulus preference (Goodson & Brownstein, 1955).

The frequency of gastric lesions has been employed as a dependent variable in studies involving conflict (Sawrey & Weisz, 1956), Sidman avoidance conditioning (Brady, Porter, Conrad, & Mason, 1958), and physical restraint (Rossi, Bonfils, Lieffogh, & Lambling, 1956). Sawrey & Sawrey (1964) performed an experiment that combined the presentation of a CS having negatively reinforcing properties with physical restraint, and used frequency of gastric lesions as the dependent variable. These investigators found a higher frequency of gastric lesions when the CS paired with onset of electric shock was later presented to rats under physical restraint than when a backward-conditioned CS (control) was presented during restraint. Sawrey & Sawrey (1964) suggested that since restraint-induced gastric lesions occur in response to changes in autonomic functioning, then frequency of lesions may be an indirect measure of autonomic conditioning in response to the presentation of a CS with negatively reinforcing properties. It was further suggested that frequency of gastric lesions may be a more direct measure of the effects of the negative reinforcing properties of this CS than the measurements used in an instrumental conditioning situation.

The present study was designed to compare the effects of the CS associated with shock onset and the effects of a CS associated with shock termination on restraint-induced gastric lesions. If it is correct that frequency of lesions is a good measure of the strength of the negative reinforcing properties of a CS, then there should be a difference in the frequency of lesions between Ss presented this type of CS and Ss presented a CS previously paired with shock termination. This difference, if found, would parallel the findings of studies that reported a behavioral difference in the presence of these two CSs.

SUBJECTS

Thirty-six male Long-Evans rats, 70-100 days of age at the beginning of the experiment, were assigned randomly to three groups of equal size. All Ss were deprived of food and water for 23 h prior to conditioning and were maintained on a 23-h deprivation schedule throughout conditioning. Upon completion of conditioning trials, Ss were allowed food

and water for 24 h, following which Ss were again subjected to 23-h food and water deprivation immediately prior to restraint.

APPARATUS

Conditioning and restraint were carried out in three white 6 x 9 x 12 in. chambers that were located inside a sound-shielded compartment consisting of a 2 x 2 x 6 ft refrigerator shell. The floor of each conditioning chamber consisted of 1/8-in.-diam brass rods spaced 7/8 in. apart. The UCS for all groups was a 10-sec presentation of a 150-V ac electric shock delivered through a 150,000-ohm resistor in series with S. The CS for all groups was the simultaneous presentation of two 100-W light bulbs and a 6.3-V buzzer, all of 3 sec duration. Restraint was accomplished by means of 2 x 4 x 9 in. cages constructed of ½-in. hardware cloth, through which 1/8-in.-diam brass rods were inserted to further immobolize S.

PROCEDURE

The three groups differed only in the contingency of the 3-sec CS and 10-sec UCS. Group 1 (CS paired with shock onset) was exposed to a pairing in which the CS terminated simultaneously with the onset of the UCS. For Group 2 (CS paired with shock termination), the CS was presented 7 sec after the onset of the UCS and both stimuli terminated simultaneously. An interval of 4 min duration between CS presentations was imposed on Groups 1 and 2. Any consistent temporal relationship between the CS and UCS was negated for Group 3 (control) by presenting the CS at 4-min intervals and presenting the UCS randomly (Rescorla, 1967). Eighty presentations of the CS and of the UCS were administered to each S in blocks of 16 trials per day for 5 consecutive days.

Forty-seven hours after the completion of conditioning, Ss were restrained and suspended in a horizontal position approximately 12 in. from the floor of the sound-shielded compartment. The CS was presented every 4 min during the 48-h period of restraint. Following restraint, all Ss were sacrificed and autopsied. Lesions were identified and counted in accordance with the procedure described in Sawrey, Conger, & Turrell (1956).

RESULTS

Two Ss in Group 1 died during restraint, and data on these Ss were lost due to tissue decomposition. The median number of lesions in Group 1, Group 2, and Group 3 were 2.0, 0.5, and 1.0, respectively. The median test (Siegel, 1956) was used for an overall test of significance on all three groups and also for paired comparisons of each group with every other group. The overall test on the three groups was significant ($\chi^2 = 8.80$, $df = 2$, $p < 0.05$). Significance was obtained in the paired comparisons of Group 1 and Group 2 ($\chi^2 = 4.58$, $df = 1$, $p < 0.05$) and of Group 1 and Group 3 ($\chi^2 = 4.58$, $df = 1$, $p < 0.05$). The comparison of Group 2 and Group 3 was not significant ($\chi^2 = 0.22$, $df = 1$, $p > 0.05$).

DISCUSSION

Results of the present study were in agreement with the findings of Sawrey & Sawrey (1964), in that a CS previously paired with shock onset and then presented during restraint resulted in a greater number of gastric lesions than did a control CS. In the present study, lesion frequency did appear to be a measure that differentiated between the effects of the CS presented at shock onset and the effects of the CS paired with shock termination. The findings of the present study, using frequency of gastric lesions as a measure, supported the results of experiments using an instrumental response (Davitz, 1955; Goodson & Brownstein, 1955; Mowrer & Aiken, 1954) in that the CS previously paired with shock onset had a different effect on the dependent variable than the CS once paired with shock termination. If, as Sawrey & Sawrey (1964) suggested, lesion frequency was an indirect measure of autonomic conditioning, then it may also be concluded that there was a difference in degree of autonomic response to the CS previously paired with shock onset than to the CS once paired with shock termination.

REFERENCES

BRADY, J. V., PORTER, R. W., CONRAD, D. G., & MASON, J. W. Avoidance behavior and the development of gastroduodenal ulcers. Journal of the Experimental Analysis of Behavior, 1958, 1, 69-72.

DAVITZ, J. R. Reinforcement of fear at the beginning and at the end of shock. Journal of Comparative & Physiological Psychology, 1955, 48, 152-155.

ESTES, W. K., & SKINNER, B. F. Some quantitative properties of anxiety. Journal of Experimental Psychology, 1941, 29, 390-400.

GOODSON, F. E., & BROWNSTEIN, A. Secondary reinforcing and motivating properties of stimuli contiguous with shock onset and termination. Journal of Comparative & Physiological Psychology, 1955, 48, 381-386.

MOWRER, O. H. Two-factor learning theory reconsidered, with special reference to secondary reinforcement and the concept of habit. Psychological Review, 1956, 63, 114-128.

MOWRER, O. H., & AIKEN, E. G. Contiguity vs drive reduction in conditioned fear: Temporal variations in conditioned and unconditioned stimulus. American Journal of Psychology, 1954, 67, 26-38.

RESCORLA, R. A. Predictability and number of pairings in Pavlovian fear conditioning. Psychonomic Science, 1967, 4, 383-384.

ROSSI, G., BONFILS, S., LIEFFOGH, F., & LAMBLING, A. Technique nouvelle pour produire des ulcérations gastriques chez le rat blanc: L'ulcerè de constrainte. Comptes Rendus des Seances de la Société de Biologie et des ses Filiales, 1956, 150, 2124-2126.

SAWREY, W. L., CONGER, J. J., & TURRELL, E. S. An experimental investigation of the role of psychological factors in the production of gastric ulcers in rats. Journal of Comparative & Physiological Psychology, 1956, 49, 457-461.

SAWREY, W. L., & SAWREY, J. M. Conditioned fear and restraint in ulceration. Journal of Comparative & Physiological Psychology, 1964, 57, 150-151.

SAWREY, W. L., & WEISZ, J. D. An experimental method of producing gastric ulcers. Journal of Comparative & Physiological Psychology, 1956, 49, 269-270.

SIEGEL, S. *Nonparametric statistics for the behavioral sciences.* New York: McGraw-Hill, 1956.

NOTE

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