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*STIMULUS GENERALIZATION AND INHIBITORY CONTROL
THE STIMULUS GENERALIZATION OF PUNISHMENT¹*

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A series of studies has been carried out with the aim of obtaining stimulus generalization gradients of the effects of punishment. In the first of these (Honig and Slivka, 1964), three pigeons were trained to respond with equal rates to a "baseline" of spectral stimulus values ranging from 490 to 610 mu. When responses to 550 mu were punished while all values were presented and equally reinforced, gradients of response decrement around the punished value were obtained. After punishment was discontinued, baseline responding was reattained and the gradients disappeared. Due to the intermixing of the punished value with safe stimuli, the gradients must be interpreted as discrimination rather than "pure" generalization gradients.

A second study was carried out in the same

way, except that punishment was introduced on 550 mu without the presentation of the safe baseline stimuli. When all stimuli were then presented after punishment was discontinued, no gradient of response decrement was observed. A further effort was made to "sensitize" the Ss to the spectral dimension by training them on a spectral stimulus discrimination based on reinforcement and extinction previous to the introduction of punishment in the manner of the second study. This procedure also failed to produce decremental gradients based on punishment. It appears, therefore, that the opportunity for the discrimination of safe stimuli from punished values is necessary for generalization gradients around the punished stimulus to develop.

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MODIFICATION OF "NON-ADJUSTIVE" HUMAN OPERANT BEHAVIOR UNDER AVERSIVE CONTROL

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In one study, two groups of Ss were conditioned under a three-ply multiple avoidance, avoidance-escape, and escape schedule with PLPs (point-loss periods) as the aversive stimulus. Group I was conditioned under no-cost (no-point loss response) and Group II under a one-point cost (loss of one point per response). Following stabilization of performances under the three-ply multiple schedule, a six-ply multiple schedule was put into effect by introducing a period of either a one-point cost (Group I) or no-cost (Group II), during the latter half of each component of the three-ply multiple schedule.

Excessive unreinforced responding characterized Group I's performance under no-cost on all aversive contingencies. Cost reduced such excessive responding. Performances obtained from Group II suggest that it may be more difficult to produce excessive unreinforced no-cost responding following a prior

history of low rates of responding under cost.

In a second study, excessive escape responding of Ss in Group I and Group II under avoidance-escape contingencies was modified (*i.e.*, escape responding was shifted to avoidance responding) by increasing the total amount of points lost during the PLP (*i.e.*, by increasing the escape penalty). The conditioning sequence of no-cost and cost did not appear to be an important factor in such modifications.

A third study dealt with the modification of excessive responding during extinction following avoidance conditioning. Fairly rapid response cessation was effected by increasing the cost of responding. Individuals differed in terms of the magnitude of response cost required for avoidance extinction. Such differences in response cost magnitude provided a measure of resistance to extinction.

PUNISHMENT AND "RECOVERY?"¹

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Procedures in which rats are concurrently reinforced with liquid food on variable-interval schedules and punished with 0.5-sec shocks delivered through the response lever and a grid floor were explored. In contrast to some previously reported studies involving pigeons and other methods of punishment administration, the results show that punishing shock contingent upon each response has a stable, suppressing effect upon behavior. The functional relationship between punishment

intensity in ma (I) and response rate (R) can be described by an exponential equation of the form:

$$R_I = R_o e^{-5.16I}$$

where R_I = punished rate, and R_o = unpunished rate. This relationship appears to be invariant with respect to level of deprivation.

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SEQUENTIAL EFFECTS IN A MULTIPLE SCHEDULE INVOLVING DOUBLE ALTERNATION OF A PAIR OF TWO-LINK CHAINS¹

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Squirrel monkeys were trained on Chain FI 2 FR 10 and Chain FI 2 VI 1. The second link of each chain lasted for 1 min at each presentation, and responding in the second link was reinforced with food pellets. Responding in the first link was reinforced only by the onset of the stimuli marking the second link.

After training on a schedule where the two chains appeared in simple alternation: Ch FI 2 FR 10 Ch FI 2 VI 1 . . . the monkeys were shifted to a double alternation sequence of the chains: Ch FI 2 FR 10 Ch FI 2 FR 10 Ch FI 2 VI 1 Ch FI 2 VI 1 . . . and finally to a quadruple alternation sequence: Ch FI 2 FR 10 Ch FI 2 FR 10 Ch FI 2 FR 10 Ch FI 2 FR 10 Ch FI 2 VI 1 Ch FI 2 VI 1 Ch FI 2 VI 1 Ch FI 2 VI 1 . . .

Performances in the various links were qualitatively similar to those observed in other

species reinforced on the same schedules. In addition, a sequential effect was observed: Fixed-interval performances in the first links of the chains were a joint function of the preceding and succeeding second-link contingencies. FI response rates were higher following a VI food reinforcement period, but lower in chains terminating in VI reinforcement. The relation between response rates in the first link and contingencies in the succeeding second link accords with known principles of conditioned reinforcement. The relation between response rates in the first link and reinforcement contingencies in the preceding second link resembles in some respects Reynolds' behavioral contrast phenomena, and may depend on emotional factors.

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NEGATIVE REINFORCEMENT OF NON-AGGRESSIVE BEHAVIOR

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It has been reported that rats can be conditioned to fight by reinforcing with shock termination all responses approximating attack. More recent studies have shown, however, that simply presenting an aversive unconditioned stimulus will produce fighting between various paired animals and that such fighting occurs prior to any specific conditioning. Such findings suggest that fighting supposedly conditioned through the removal of shock would have taken place even if no shock termination

had occurred. The present experiment studied whether or not paired animals could be conditioned not to fight by reinforcing non-fighting responses with a period of shock removal. It was found that fighting responses to shock tends to persist in spite of negative reinforcement for other behavior. The frequency of shock-induced fights lowered significantly only when the reinforcement of shock termination was made contingent upon a specific non-aggressive response.

SOME MULTIPLE SCHEDULE EFFECTS IN RETARDED ADOLESCENTS

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Some retarded Ss were shown how to press a lever to receive frequent reinforcement on FR or crfDRL before being placed on a mult FR 15 (50) crfDRL 5 sec (10 sec) schedule. When control was obtained, each component was successively extinguished and reconditioned.

These instructed Ss did not behave discriminably different from others who had been instructed only to "press the bar and get lots of candy (pennies)."

The most common pattern of acquisition consisted of three stages: (1) rate was consistent with instructions and/or the first schedule in

the alternating sequence; (2) rates alternated in response to nonreinforcement as if on a mixed schedule; (3) S^D control was obtained. A second pattern included: (1) "incorrect" S^D control, as if crfDRL *ext* had been programmed; (2) "correct" S^D control with virtually no schedule interaction.

Usually, extinction and recovery of one component did not affect performance during the other. However, the rate still being reinforced was emitted in S^A prior to cessation of responding. The course of extinction was influenced by the rate of responding which continued to produce reinforcement in the situation.

AVOIDANCE OF TIME-OUT FROM TWO VI SCHEDULES OF POSITIVE REINFORCEMENT

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An ongoing rate of key-pecking behavior was maintained in two pigeons by a VI schedule of food reinforcement. To avoid the onset of a 5-min time-out period from the VI schedule, a response was required on a second key according to a concurrent avoidance schedule. Each response on the avoidance key delayed the onset of the TO by 60 sec and successive presentations of the TO occurred every 30 sec when there was no response on the avoidance key. TO avoidance behavior was first established and maintained with a VI 9 food reinforcement schedule. Avoidance behavior occurred at an overall rate of about 2.5 responses per min. When the food schedule was changed from a VI 9 to a VI 1, avoidance

responding decreased over a number of sessions and became almost nonexistent. The food key schedule was changed back to a VI 9 and avoidance behavior returned, reaching its former baseline values. The VI 1 was again placed in effect and again the avoidance rates fell to zero. Following a replication series, ending with the VI 1 schedule in effect and no avoidance behavior, responding on the VI key was allowed to undergo extinction. Avoidance responding returned as extinction continued, suggesting that the lack of occurrence of avoidance behavior during the programming of the VI 1 schedule may have been due to the effects of that schedule's relatively high reinforcement frequency.

A METHOD FOR THE DETERMINATION OF PSYCHOPHYSICAL FUNCTIONS IN THE RAT

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In a two-lever chamber, rats could produce an increment in overall illumination, ΔI , by responding on bar A on a conjunctive FI 20 sec VR4 schedule. The first response on bar B in the presence of ΔI terminated ΔI and produced water reinforcement. If no bar B response occurred, ΔI was terminated after 2 sec. Premature responses on bar B reset the VR on bar A to zero. The value of ΔI was varied at random from trial to trial, including catch trials on which ΔI was equal to zero and no reinforcement was available. It was found that the probability of response on bar B in ΔI was

an orderly increasing function of ΔI with a low response probability when ΔI was zero, similar to typical psychophysical functions. The form of this function was sensitive to the probability of reinforcement in ΔI . The relation of this situation to signal detection experiments was studied by using only one value of ΔI . It was found that the probabilities of response on bar B in the presence and absence of ΔI covaried according to a typical receiver operating characteristic curve when probability of reinforcement was varied.

A FIXED EFFORT SCHEDULE OF REINFORCEMENT¹

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Six rats were run for 20 sessions (30 reinforcements per session) on a Fixed Effort (FE) schedule of reinforcement. On such a schedule the effort of each response—defined as the time-integral of force of the response—cumulates with the effort of all preceding responses since the last reinforcement until the total effort meets a selected criterion. The animal receives reinforcement at the end of the response which met the criterion and the contingency resets. In the present study the FE criterion was 30 g-sec. The manipulandum was a silent strain gauge lever which sensed all responses of greater than 2.5 g peak force.

The schedule resulted in an increase of response rate and an increase in the duration of

post-reinforcement pauses over that maintained under CRF (in which each response greater than 2.5 g peak force produces reinforcement). The response frequency distributions along the dimensions of effort, peak force, and duration displayed strong bimodality. The first mode in all these distributions occurred at the recording threshold of the apparatus: 2.5 g for peak force, 0.1 sec for duration, and 1 g-sec for effort. The second mode of the peak force distributions occurred at 100 to 200 g and of the duration distributions at 1 to 2 sec. The shapes of the peak force and duration distributions for each animal were very similar. The second mode of the effort distributions occurred near 30 g-sec, suggesting some degree of response differentiation.

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SEQUENTIAL PROPERTIES OF SIDMAN-AVOIDANCE BEHAVIOR¹

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The purpose of this study was to test the assumption that IRTs during Sidman-avoidance are emitted according to a Poisson process (cf., Sidman, 1954),² i.e., (a) successive IRTs would be statistically independent, and (b) the conditional probability of an IRT between t and $t + \Delta t$, given that $\text{IRT} > t$, is a constant, p (cf. Kendall and Stuart, 1963).³

Three rats were trained extensively on Sidman-avoidance (RS=20 sec, escape contingency). In the data analysis, matrices were constructed to tabulate all possible transitions

from IRT j to IRT k , with an IRT class interval of 2 sec. These data indicated that during the warm-up period, irrespective of the value of the n^{th} IRT, the value of the $(n+1)^{\text{st}}$ IRT would be either a burst (0-2 sec IRT) or a shock (> 20 sec IRT). In the later parts of the session, however, strong trends were found: short IRTs were followed by longer IRTs, up to approximately $\text{IRT}=16$ sec. IRTs longer than this were likely to be followed by very short IRTs.

Other analyses revealed further sequential properties among successive IRTs. For example, the mean IRT was found to increase gradually over the first several post-shock responses. Further, the theoretical curve based on the assumption that conditional probability of an IRT is a constant, did not provide a very close fit to the data. These results indicate that, in general, successive IRTs are not independent, except perhaps during the warm-up period.

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