

THE ROLE OF GENERALIZATION DECREMENT IN FAILURES TO
DEMONSTRATE CONDITIONED REINFORCEMENT: TEMPORAL FACTORS

by

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Those stimuli which increase the strength of the responses they follow are ordinarily designated reinforcers. Traditionally, two types of reinforcers have been distinguished. Primary reinforcers (S^R s) are stimuli which have reinforcing properties at the beginning of an experiment and can be expected to hold these properties throughout the experiment. Conditioned or secondary reinforcers (S^F s) are stimuli which do not have reinforcing properties at the beginning of an experiment, but acquire these properties during it.

A satisfactory description of conditions by which stimuli acquire and maintain conditioned reinforcing properties is necessary for an adequate theory of behavior and behavior change. That these conditions have not yet been adequately specified is evidenced by the lack of apparent agreement among the results of various experiments. There seems to be general agreement, however, that stimuli become conditioned reinforcers by preceding other reinforcers. The present paper will describe three procedures which have been used to study the variables affecting the conditioned reinforcing value of stimuli. The problems with the extinction test, and with chaining procedures will be described briefly. Then problems with the new response procedure, which is used here, will be specified. Only a few experiments representative of each procedure will be covered.

Note that we are not concerned here with Pavlovian higher order conditioning, in which response-independent procedures are employed throughout. The present concern is with those procedures which measure the effect of antecedent training on the tendency for S^F to increase or maintain the strength of the response it follows. That is, the concern is with a reinforcer in the sense of a reward and not in the sense of an unconditioned stimulus.

With the extinction test for conditioned reinforcement, response strength above baseline is first produced by repeatedly following responses with primary reward. A neutral stimulus acquires conditioned reinforcing properties when it is presented between the response and S^R on acquisition trials, or in separate pairings with S^R . The primary reward is then omitted, and the rate of response is measured when responses are followed only by S^R . Greater resistance to extinction when S^R is contingent on a response than for a control without S^R is usually attributed to the conditioned reinforcing effect of S^R .

One of the earlier experiments with this technique was Bugelski's (1938). He trained hungry rats to press a bar for food. Each food delivery was preceded by an audible click. The rats were then divided into two groups for extinction. Bar presses of the control group had no effect, while bar presses of the experimental group produced the click but no food. The experimental group made significantly more responses in extinction than the control group. Bugelski inferred that the click served as a sub-goal or conditioned reinforcer in extinction.

Later experimenters noted that Bugelski's results were open to other interpretations. Wyckoff, Sidowski, and Chambliss (1958) suggested that the click might serve as a positive discriminative stimulus, rather than a conditioned reinforcer. Experiment II of Wyckoff et. al. was a test of this hypothesis. Here rats were trained and divided into two groups for an extinction test. These two groups differed only in the temporal relationship between a barpress and a buzz which had preceded water presentations. In the experimental group, a rat received the buzz following each barpress. Each rat in the control group was yoked to a rat in the experimental group. Each time the experimental rat pressed the bar, it's

control counterpart received the buzz, provided that the latter had not pressed the bar in the preceding ten sec. The two groups did not differ significantly in mean rate of responding during extinction. Thus, no secondary reinforcing effect of the buzzer was demonstrated.

There are two major problems with the extinction test of conditioned reinforcement. First, during the course of the extinction test the conditioned reinforcing value of S^R may extinguish quite rapidly. Thus the extinction test may not be sensitive to the conditioned reinforcing value of the S^R established during training. The test is sensitive, however, to variables which effect the similarity of testing and training trials. Variables like partial reinforcement (of both response and of S^R) can exert a great deal of influence on the test.

Chaining procedures are another way to study conditioned reinforcement. In chaining procedures, one or more stimuli precede the primary reward. Transition to successive stimuli and access to the primary reward are each contingent on a response. Kelleher and Gollub (1962) lauded the chaining procedure as a means of testing the conditioned reinforcing effects of S^R without removing it from the training sequence.

Following the final link in the chain with primary reward, however, introduces additional problems. First, it may be difficult to determine whether a reinforcing effect is attributable to the conditioned reinforcing stimuli or a direct incremental effect of the primary reward which follows. Second, when the increasing proximity to a reward influences the operant level of responses used in the chain, increases in rate due to the strength of S^R are confounded with increases in operant level associated with proximity

to primary reward, i.e. to stimulus-reinforcer effects. Staddon and Simmelhag (1971) demonstrated that the peck, commonly studied in chaining, is particularly sensitive to changes in food proximity and probability. In their experiment, an observer recorded the behaviors of food deprived pigeons under three schedules of access to food. Of particular interest here is the behavior of birds under the Fixed Time (FT) 12 sec. schedule. (Staddon and Simmelhag called this Fixed Interval 12 sec. although the more common designation of the response-independent schedule is FT.) Here, the probability of a peck (to the food hopper wall) increased as the time of food delivery approached, independent of any differential reinforcement for pecking. Thus there may be strong response-independent effects during the chaining procedures which would introduce a confound.

In addition, generalization of response tendencies complicates the interpretation of the results when the response preceding primary reward is the same as the response preceding the earlier links. To the extent that environmental conditions preceding the primary reward and the conditions preceding earlier links are similar, response tendencies will generalize from the former to the latter.

Finally, there is the acquisition of a new response measure of conditioned reinforcement. This procedure involves separate training and testing trials. On the training trials, S^r is repeatedly followed by primary reward. On test trials, S^r is made contingent on a response, and the measure of conditioned reinforcement is the increase in the strength of the response. Because S^R never follows S^r on test trials, it is possible to rule out direct reinforcing effects of S^R .

The results of many experiments using the new response technique do not appear to lead to clear cut conclusions. The results of Wyckoff, Sidowski, and Chambliss's Experiment II, for example, indicate no conditioned reinforcing effect of a stimulus previously paired with primary reward. In this experiment, thirsty rats were first presented several times with a buzzer which was immediately followed by water. The rats were then divided into two groups. Rats in the experimental group received the buzzer for each barpress. Rats in the control group received the buzzer on an FT 1 min. schedule provided they had not pressed the bar in the preceding ten sec. Response rates in the experimental group were no different from those in the control group. However, in an experiment by Saltzman (1949) rats acquired a choice response as rapidly when it was followed by a conditioned reinforcement as when it was followed by a primary reward.

In the new response procedure the secondary reinforcing effect must generalize from training to test trials. Although the environmental conditions during S^r are identical on training and on test, the contexts of the respective presentations may differ. As an example, consider training trials and test trials presented in separate phases. Here, training stimuli and test stimuli might be discriminable because they are temporally discrete and reinforcing properties gained in the former may not generalize to the latter.

Consider a pair of experiments by Saltzman (1949). The experiments included four groups which differed with respect to training, however we will be concerned here only with the two groups receiving continuous reinforcement (CRF) training. Phase I training trials took place in a runway. For Group 1 and Group C, each of 5 daily trials led to a goal

box consistently baited with food. The goal box was the same brightness on all trials for a given subject (either black or white). Phase II test trials took place in a single choice maze. For Group 1, one goal box of the maze was black and one was white. Rats obtained no food on test trials. For Group C, both goal boxes were the brightness not used in training trials and one of the boxes was consistently baited with food. Fifteen test trials were run. Group C selected the rewarded arm significantly more than half the time. Group 1, however, did not select the arm leading to the color previously rewarded significantly above chance.

In Saltzman's second experiment, rats in the experimental groups received a food reinforced runway trial after each test trial. This procedure might increase the choice of S^R in Group 1 in two ways. First, including food trials in the test block increases its similarity to the training block in which food was present after each of the trials. Second, the interspersed food trials might recondition the conditioned reinforcing effect of the goal box cues as they extinguish over test trials. Indeed, in Experiment II, Group 1 chose S^R significantly more than half of the time.

In Saltzman's experiments discussed here, the physical context of presentation of S^R differed on training and on test trials also (i.e., training takes place in a runway, and testing in a single choice maze). It is not unreasonable to assume that this facilitates a discrimination between training and test trials and as a consequence reduces generalization of effects from the former to the latter.

There is one way in which training trials and test trials necessarily differ with the new response procedure. Test presentations of S^R are

always preceded by a response and usually by a stimulus controlling the response. On the other hand, training trials are preceded by the inter-trial interval (ITI) conditions. Here, at the time of termination of S^r the two types of trials might be discriminated on the basis of the short-term memories (STM) of different antecedent conditions. The S^r -in-context can be expected to acquire differential reinforcing value or attractiveness on the two types of trials to the extent that the memory of the preceding conditions remains a salient cue until S^r termination.

A body of research has developed on the STM of pigeons. Several experiments indicate that the duration of the memory for such events as brief colored key stimuli and peck responses may not last longer than a few seconds (Shimp, 1976, Roberts and Grant, 1974). If applied to the preceding analysis of the discrimination of conditions on the two types of trials, the STM results imply that for S^r s of longer duration, the reinforcing value acquired would generalize between S^r - S^R trials and R - S^r trials. Figure 1 describes the general nature of the relationship assumed between duration of stimuli and discriminability of conditions just before trial termination. If S^r is sufficiently long conditions may not be discriminably different on the R - S^r and S^r - S^R trials at the time of S^r termination. Therefore there should be a substantial amount of generalization between S^r - S^R trials and R - S^r trials and the latter trials should have a strong reinforcing effect. However, if S^r is very brief, the conditions would be expected to be discriminable on the two types of trials. To the extent that the two contexts are discriminated, any reinforcing value which generalized from S^r - S^R trials should extinguish rapidly.

The present experiment is designed to determine whether the duration of a stimulus used in the acquisition of a new response procedure has the expected effect. Food deprived pigeons were assigned to four groups which were treated identically except for the duration of the red and green stimuli used as S^r . The stimuli were of 30, 10, 3, and 1 sec. duration for Groups 30, 10, 3, and 1 respectively. All birds were exposed to a series of response-independent trials in which the two stimuli on the key differentially predicted food (e.g., the probability of food following red was .9 and the probability of food following green was .1). In a later phase, there were also choice trials in which two white keys served as the choice stimuli. Red followed a peck to one key and green followed a peck to the other key. One might expect, if there is 100% generalization between stimuli on response-independent and choice trials, that red would be the stronger conditioned reinforcer and therefore would come to be selected more often on the choice trials. If, on the other hand, red following choice is so different from red on the response-independent trials that there is no generalization between them, red and green would be chosen equally often. The context of the stimuli on response-independent and choice trials differ only in the STM of their antecedents and could be discriminated only by the short-term memory cues. On the assumption that short-term memories for the antecedent stimuli only last between 3 to 30 sec., differential predictions can be made for the four groups. Groups 1 and 3 would be expected to discriminate between the choice red and the response-independent red and choose red only half the time. Group 30 would be expected not to discriminate between the two and therefore to choose red on the choice trials more than half of the time. The results for Group 10 depend

on the duration of the STM. If after 10 sec. the STM for antecedent conditions provide effective differential cues, the results will resemble those for Group 3. If the STM for the antecedent dark key and pecks to white key do not persist for 10 sec., the results for Group 10 will resemble those for Group 30.

Method

Subjects: Data are presented for the sixteen pigeons completing the experiment. All of these experimentally naive birds were obtained locally. Additional birds began the experiment, but did not complete it due to equipment problems. There was no indication that these latter birds performance differed in any way from those completing the experiment.

Apparatus: All sessions for Groups 30, 10, and 3 were conducted in two standard Grason-Stadler two key pigeon chambers located in sound attenuating housings. Group 1 received keypeck training, however, in a single key box. This group was switched to the two key boxes after keypeck training. Inner dimensions of the single key box were: length - 35.0 cm., width - 32.5 cm., and height - 30.5 cm. The keys in the box were 21.0 cm. from the floor of the chamber. The 3 watt houselight was located in the ceiling of the chamber, behind a piece of translucent plastic. In all other important respects the single key box was like the two key boxes. The inner dimensions of the two key chambers were: length - 32.6 cm., width - 32.0 cm., and height - 30.7 cm. The keys, slightly recessed in a panel perpendicular to the door of the chamber, were translucent and were transilluminated by IEE stimulus projectors. The keys were 25.0 cm. from the floor of the chamber and 5.8 cm. apart, center to center. When lit, pressure on the key with a force of .06 N registered as a peck and produced a feedback click. An opening providing access to the food hopper was located beneath and between the two keys. The Grason-Stadler hopper was filled with a 50-50 mixture of wheat and milo. When presented, the hopper was illuminated by a 1.1 watt bulb. A 3 watt houselight was mounted on a panel opposite the keys at a height of 19.2 cm. It was covered by an upside-down styrofoam cup. The

houselight was off when the hopper was accessible and at session termination, and was on at all other times. A ventilation fan and a speaker transmitting white noise (each located behind the intelligence panel) served to mask extraneous sounds. Events were programmed by electro-mechanical equipment located in an adjoining room.

Procedure: The birds were maintained at 75% of free feeding weight and individually housed in a room with constant illumination. They had free access to water in their home cages. During preliminary training, each bird was trained to eat promptly from the magazine whenever it was presented.

Groups 30, 10, 3, and 1 received the colored key stimuli for 30, 10, 3, and 1 sec. respectively throughout all phases of the experiment. Group 1 was run after the other 3 groups, and differences in it's treatment will be noted where appropriate. Before Phase I training began, birds were un-systematically assigned to Groups 30, 10, and 3. Birds for Group 1 were selected from the pigeon colony in an unsystematic fashion and there is no reason to believe that they differed from birds in the other groups in any relevant way.

On the day following completion of magazine habituation, Phase I training began. Each daily session of Phase I consisted of 40 single key presentations of a stimulus, each separated by a dark key inter-trial interval (ITI) of 120 sec. Red and green stimuli were presented equally often. The stimuli were presented in a pseudo-random order, with red and green appearing equally often on each side. Half of the birds in each group received food following the red stimulus nine of the ten times it appeared on each response key, and following the green stimulus only one

of the ten times it appeared on each key. These proportions were reversed for the remaining birds in each group. Phase I training continued for each bird in Groups 30, 10, and 3 until it met an overall rate criterion of 9.6 pecks per min.

Two birds in Group 1 (#5 and #6) did not begin pecking when exposed to the Phase I training for 7 and 3 days respectively. For this reason, all 4 birds in Group 1 were given two days of keypeck training. This training took place in the single key chamber. The key was continuously illuminated and a pattern of horizontal lines on a white ground was projected onto the key. Initial hand-shaping was followed by 15 min. of continuous reinforcement of keypecking. Day 2 consisted of 15 min. of CRF. All birds in Group 1 were then run on the Phase I procedure for two days.

Phase II began immediately at completion of Phase I. In Phase II sessions, there were 40 response-independent trials as in Phase I but 10 pairs of response-dependent trials were randomly interspersed. The procedure for the response-dependent trials is represented in Fig. 2. Each pair consisted of a choice trial followed by a forced trial with a dark key ITI intervening. Choice trials were initiated by white illumination of both keys. When a key was pecked, it changed to the appropriate color (e.g., red if on the left and green if on the right) for the appropriate duration (1, 3, 10, or 30 sec.), and the other key went dark. On these trials, food followed both red and green half the time. A forced trial followed each choice trial by 120 sec. Each forced trial was initiated by white illumination of the key which had not been pecked on the preceding choice. The first forced trial peck changed the key to the color appropriate

for that side. Food was presented on a forced trial only if food had been presented on the preceding choice trial. The key color followed most often by food and the color which appeared on the right were fully counter-balanced across subjects within groups.

Phase II training continued until the bird met the criterion of choice of the .9 stimulus on 19 of the 20 choice trials on two successive days, or until 15 days of Phase II training had been completed.

Phase III training began on the session following completion of Phase II. In Phase III each bird received a color side pairing on choice trials opposite to the one in Phase II, i.e. if red followed a peck to the right in Phase II, green followed a peck to the right in Phase III. The determinants for termination of Phase III were the same as those for Phase II.

Results

The birds in Groups 30, 10, and 3 required from one to five days to reach the criterion of 9.6 pecks per min. in Phase I. The median number of days required was two. No systematic differences were observed among the three groups. Phase I training for Group 1 has been described in the Method section of this paper.

Percent choice of .9 will hereforward designate the percent of the choice trials on which the stimulus followed by food on 90% of the response-independent trials was selected. Fig. 3 shows the mean daily percent choice of .9 for each group in Phases II and III. Each bird which was reversed before the 15 day limit was assigned 100% choice of .9 for all subsequent sessions. This was not expected to differentially influence the results for the groups unless they completed training at different rates, as hypothesized. Note that the curves for Groups 10 and 30 rose to between 80 and 100% in both phases, while the curves for Groups 1 and 3 never stayed above 70% for two consecutive sessions. Fig. 4 shows the percent choice of .9 as a function of days for individual pigeons. In Groups 10 and 30 combined, 5 of 8 birds met the choice criterion in both phases within 15 days. The remaining 3 birds met the criterion in only one of the phases. In Groups 1 and 3 combined, no birds met the criterion in both phases, and 3 did not meet the criterion in either phase. Table 1 shows the number of birds in the two duration categories (Groups 1 and 3 v.s. Groups 10 and 30) which met the criterion in both phases or in one or fewer of the phases. The durations were compared on the number in each category meeting both criteria v.s. the number meeting no more than one of the criteria. A Fisher's exact test indicated an effect of duration

significant at $p < .025$. Thus Groups 10 and 30 met criterion in both phases significantly more often than Groups 1 and 3.

Since Group 1 received pretraining which differed from that given the other 3 groups, the following analyses were performed first using only the 3 longer durations (Groups 3, 10, and 30), which were treated identically except for the value of the independent variable. For the first analysis Phases II and III were combined, to minimize the effects of side preference on the test measures. All of the significance tests performed on the percent choice of .9 data use only data from the last 10 days of Phases II and III. The 10 day figure was chosen arbitrarily to minimize the confounding effects of relearning the color-side pairing after reversal. To produce the combined score the mean percent choice of .9 (over the last 10 days of the phase) was averaged over Phases II and III for each bird. When Phases were combined, the Kruskal-Wallis one-way variance analysis indicated a significant main effect ($p < .02$). This effect was also apparent when Phase II was analysed separately ($p < .05$), but not for Phase III alone ($.05 < p < .10$). An analysis including all 4 groups produced a similar pattern of results. There was a significant effect for Phases II and III when combined ($p < .02$), however this effect was significant only in Phase II ($p < .05$) when the phases were analysed separately. (For Phase III $.10 < p < .20$).

Fig. 5 shows the mean peck rate during .9 and .1 over days beginning with the first Phase II session for Groups 30, 10, and 3. (The rates in Group 1 were so low as to be negligible.) Note that, since the birds in a group completed the phases at different rates, the points in Fig. 5 are not all based on data for 4 birds.

Two major trends are apparent in the rate data of Fig. 5. First, the mean rates in Groups 10 and 3 are higher than the overall rates in Group 30. This is consistent with data on rates of autopecking collected by Perkins, Beavers, Hancock, Hemmendinger, Hemmendinger, and Ricci (1975), and Terrace, Gibbon, Farrell, and Baldock (1975). The former experimenters found that rates of autopecking were lower to long duration stimuli than they were to short duration stimuli. Terrace et. al. found that groups of birds in which the ITI was long acquired an autopeck response faster and attained a higher asymptotic rate than groups of birds which had a short ITI. In the present experiment, in Group 30 the mean rate to the .9 stimulus increased initially but dropped off as training progressed. Appendix A contains plots of the mean pecks per sec. for individual birds in the four groups. Notice that the decrease in mean rate to .9 over sessions in Group 30 is largely due to the influence of two birds (#J21 and #Q8). Notice also that birds in Group 30 approached asymptotic rate to the .1 stimulus somewhat more slowly than they approached asymptotic rate to the .9 stimulus.

The late peak of the peck rate to the .1 stimulus in Group 30 might be interpreted as indicating that the .1 stimulus had not attained its maximal secondary reinforcing value by the beginning of the choice trials. This fact might contribute to the increased choice of .9 in Group 30. This cannot account entirely for the present results, however, since each bird in Group 30 reached asymptotic rate to the .1 stimulus before Phase III began.

Discussion

The present results indicate that long duration stimuli (10 and 30 sec.) demonstrate greater conditioned reinforcing effects than short duration stimuli (1 and 3 sec.). This result was predicted on the basis of assumptions about processes which might effect the generalization of attractiveness from training to testing trials. That is, with the shorter duration stimuli, the different antecedents of training and test trials could, through 'retention in memory' provide differential cues throughout the stimulus. With the longer duration stimuli, however, there is less probability that the differential cues provided by STM of antecedents will persist until stimulus offset and trial consequences take effect.

Several experiments indicate that the probability that antecedent conditions will control responding is a decreasing function of time since exposure to those conditions (e.g. Roberts, 1972, Shimp, 1976). The parameters of this function are influenced by the procedures used and the nature of the antecedent conditions. Experiments using the delayed matching to sample (DMTS) procedure typically report performance at chance levels at delays longer than 5 sec. (e.g., Roberts, 1972, Shimp, 1976). However, using the advance procedure, Honig (1974) found performance nearly undiminished at retention intervals up to 20 sec. In addition, experiments by Roberts and Grant (1974) and Shimp (1976) indicate that the accuracy of delayed matching to sample is a function of presentation duration of the sample. That is, as the exposure time of the antecedent stimulus becomes longer, the probability that it will be correctly matched increases.

Although there are experiments in which antecedent stimuli have provided the basis for differential responding at delays up to 20 sec., there are reasons to believe that the conditions of the present experiment would make the differential cues short lived. The two white keys which served as choice stimuli were generally of short duration. Most subjects faced the key panel at all times, and pecked one of the white keys immediately at onset, introducing the appropriate colored stimulus on that key. In addition, the dark keys, which preceded the response-independent trials, were of low salience. Therefore, neither the dark nor the white keys are likely to have provided differential cues for as much as 30 sec.

The choice response, a peck to the left or the right key, also preceded the S^R on choice trials. The data from Shimp's 1976 experiment indicated that the memory for stimuli and responses was relatively brief, less than 6 sec. In addition, pecking to the S^R itself might interfere with the memory for the antecedent choice response and associated stimuli.

Finally, there was little or no incentive for discriminating response-independent from choice trials. Choice did not influence the probability that food followed a particular trial. If incentive is a factor in 'remembering', then the memory for antecedent conditions in the present experiment would have been short-lived.

In summary, results of memory experiments are quite consistent with the explanation given for the present results.

The present results have important implications for research on conditioned reinforcement. Earlier reviewers of experiments on conditioned reinforcement (Meyers, 1958, Longstreth, 1971, Schuster, 1969) found the phenomenon to be inadequately demonstrated. These reviewers apparently

assumed, however, that conditioned reinforcing effects would generalize completely from training trials (where S^R is followed by S^R) to test trials (where S^R is not followed by S^R). Their approach runs into problems with this assumption. The fault is not with the concept of conditioned reinforcement, but rather with the failure to consider organismic processes in its acquisition and demonstration.

It is difficult to evaluate the effect that discrimination of training from test trials may have had on results of past experiments. Many published reports give only summary scores, such as means or medians over the total $R-S^R$ trials. An experiment by Armus and Garlich (1961) does, however, report data over trials or days, allowing an estimation of the effects of extinction. In the Armus and Garlich experiment two groups were studied. In one group (Group CRF), a light-sound compound stimulus (S^R) was always followed by food on training trials. In another group (Group FR5), food followed S^R on an FR 5 schedule. The conditioned reinforcing value of S^R was tested in a two bar apparatus. Bars retracted for 6 sec. upon each press. Presses to one of the bars produced S^R on a CRF schedule. The percent of presses to the S^R -bar was used as a measure of the conditioned reinforcing effect of S^R . Group CRF never chose the S^R -bar significantly more than chance over the 15 blocks of 10 trials each. Group FR5, however, showed a peak choice on Block 11 of over 70%, which dropped off to 50% by Block 15. One might speculate that the conditioned reinforcing value of the CRF stimulus extinguished so rapidly that its reinforcing effect never showed up in the test. The conditioned reinforcing effect of the FR 5 stimulus, however, is clearly demonstrated and drops off after about 130 trials.

Any approach treating the S^r as though identical on training and on test trials could only have predicted the present results by assuming that long duration stimuli either acquire greater conditioned reinforcing properties or they acquire these properties faster than the shorter duration stimuli. Results of experiments on delay of reward, however, lead toward the opposite conclusion. A short delay preceding reward is generally chosen over a longer delay when the absolute amount of reward is held constant (e.g., Schneider, 1972). If this preference is transmitted to the delay stimulus, a stimulus associated with a short delay to reward would become a stronger conditioned reinforcer than a stimulus associated with a longer delay. A factor of this sort may have operated in this experiment. Recall that in Phase II, Group 10 reached asymptote in mean choice of .9 long before Group 30. In fact, Group 10 reached the maximum mean choice of .9 within 4 days of the start of Phase II. In Phase III however, Groups 10 and 30 approached asymptote at more similar rates. This reduction in rate of acquisition for Group 10 might reflect the cumulative effect of discrimination of training from test trials.

These results have implications which reach farther, even, than research on conditioned reinforcement. This experiment indicates that those theories or models which always treat the experimental situation as though consisting of a set of component stimuli have limited usefulness. The present results touch on issues which reach further, even, than conditioned reinforcement. These results could not have been predicted nor can they be accounted for by a schema which deals only with simple component stimuli. When specified in terms of environmental events, S^r is identical on training and on test trials. Thus a strict component view would predict 100% generalization between the two types of trials. One might account for the behavior

of birds in groups 1 and 3, however, in terms of formation of a conditional discrimination. That is, when the colored key stimuli are differentially associated with food they are preceded by the ITI conditions, but when each are followed by food equally often they are preceded by the white choice stimuli and a peck. The birds in Groups 1 and 3 behave as though a discrimination of this sort has been learned. Any theory postulating simple component stimuli with no interaction between the components (eg. Rescorla and Wagner, 1972) could not account for this result.

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Figure 1 - The proposed relationship between the duration of a stimulus and the discriminability of the STM cues for antecedent conditions.

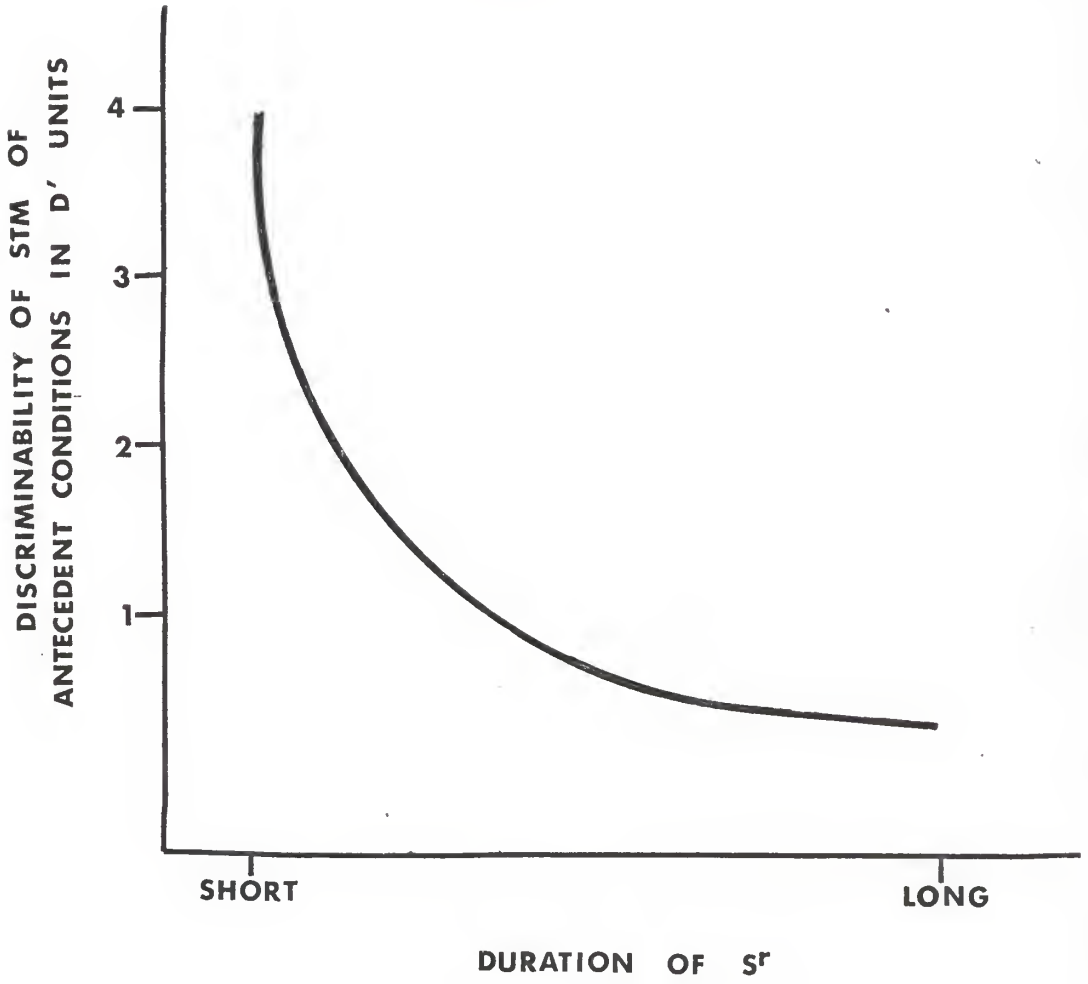


Figure 2 - The sequence of events for the response-dependent trials of Phases II and III. Half of the birds received the illustrated color-side pairing on choice trials (i.e., red appeared on the left) in Phase II and half of them received the reverse pairing (i.e., green appeared on the left).

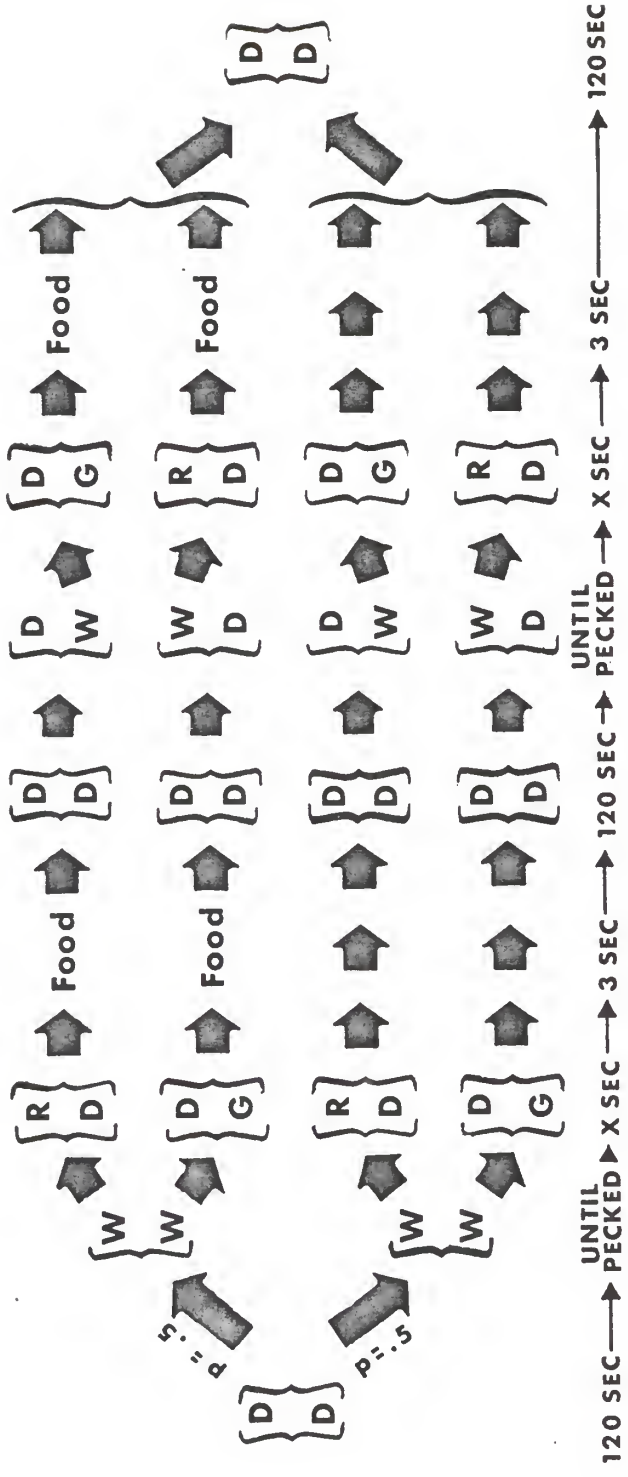


Figure 3 - Mean percent choice of .9 over the
15 days of Phases II and III for Groups 30, 10,
3, and 1.

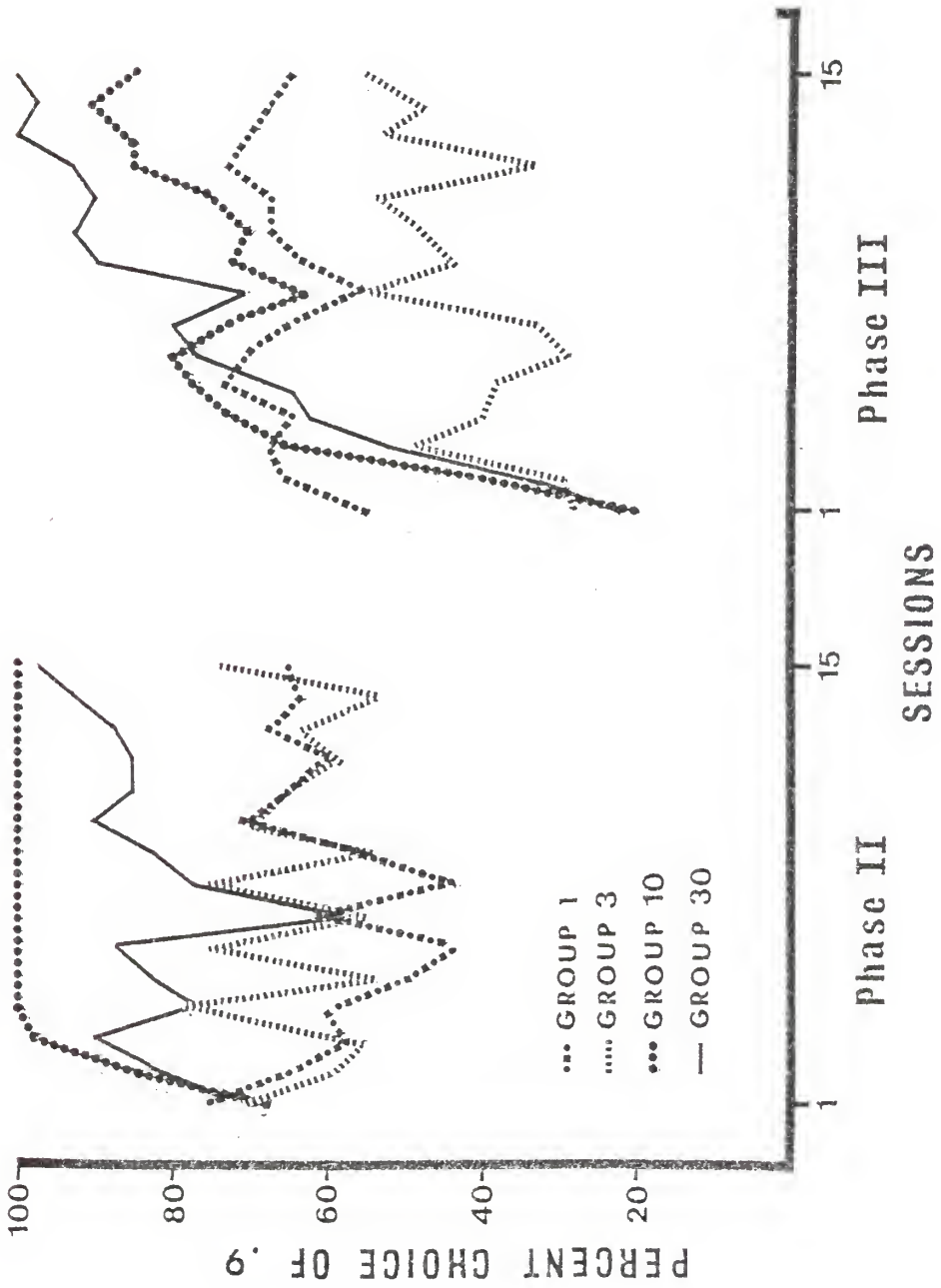
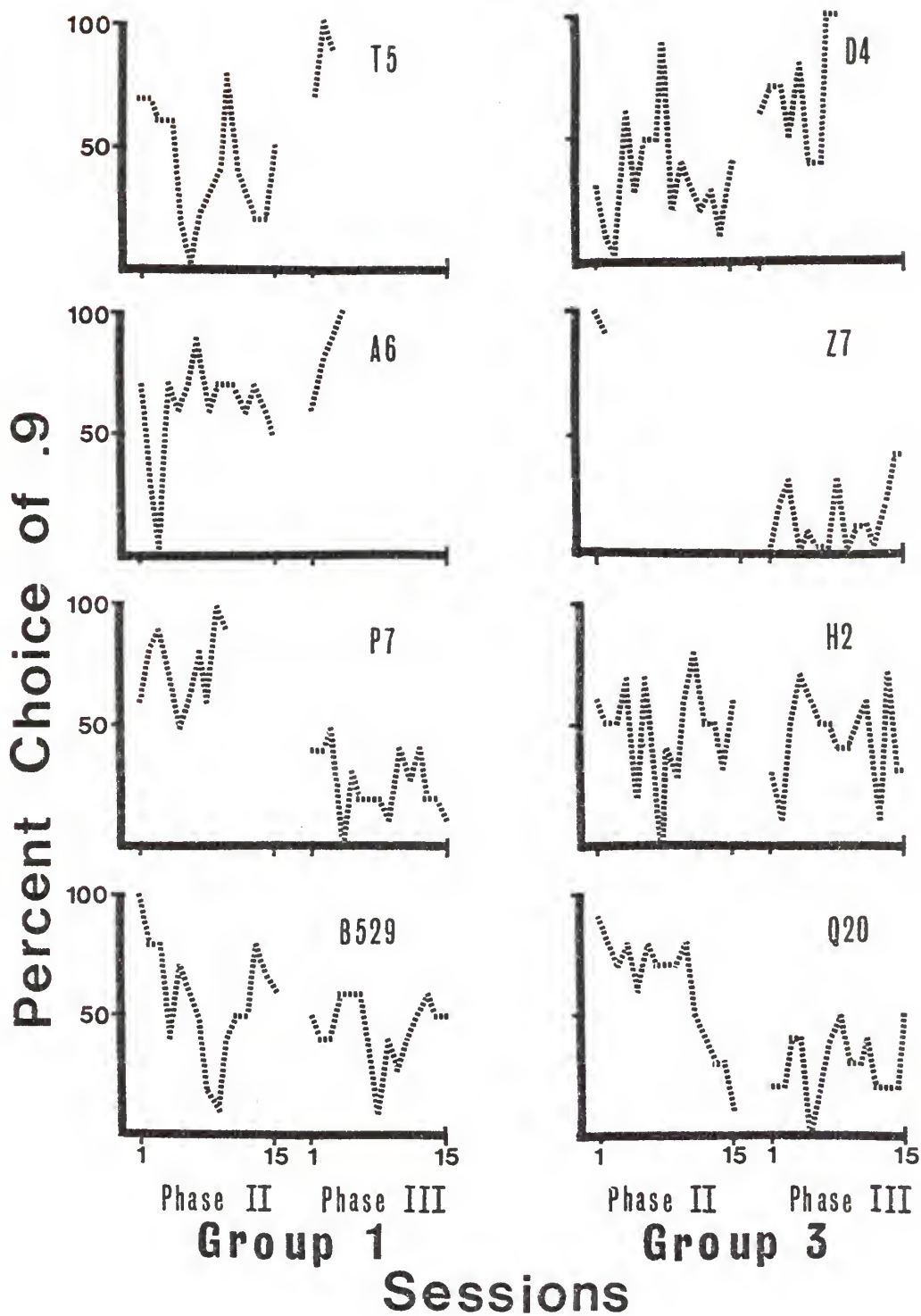


Figure 4 - The percent choice of .9 in Phases II and III for individual birds.



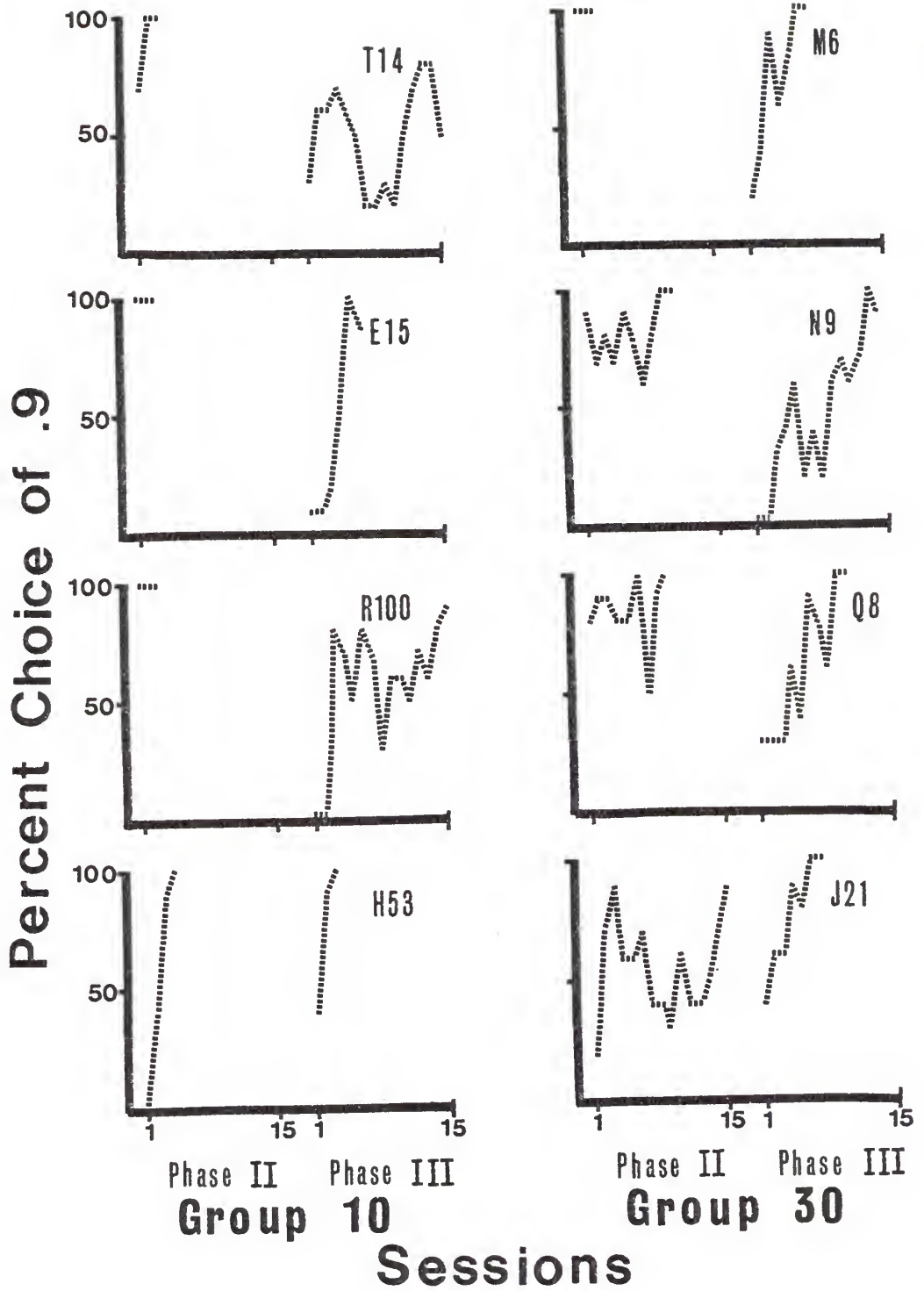


Figure 5 - The mean peck rate over days for Groups 30, 10 and 3 for response-independent and response-dependent trials separately. Consecutive days are plotted irrespective of phase. Points on curves to the right of arrows are based on data for three birds.

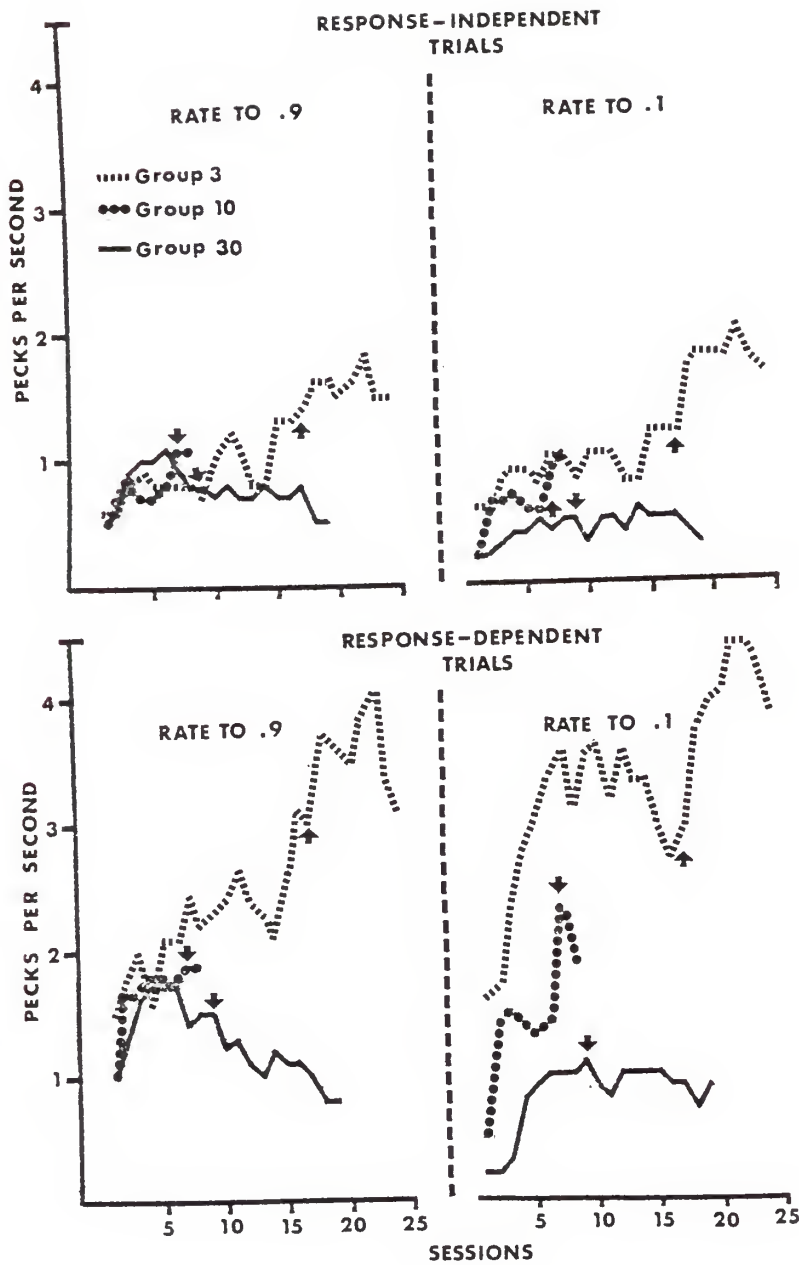
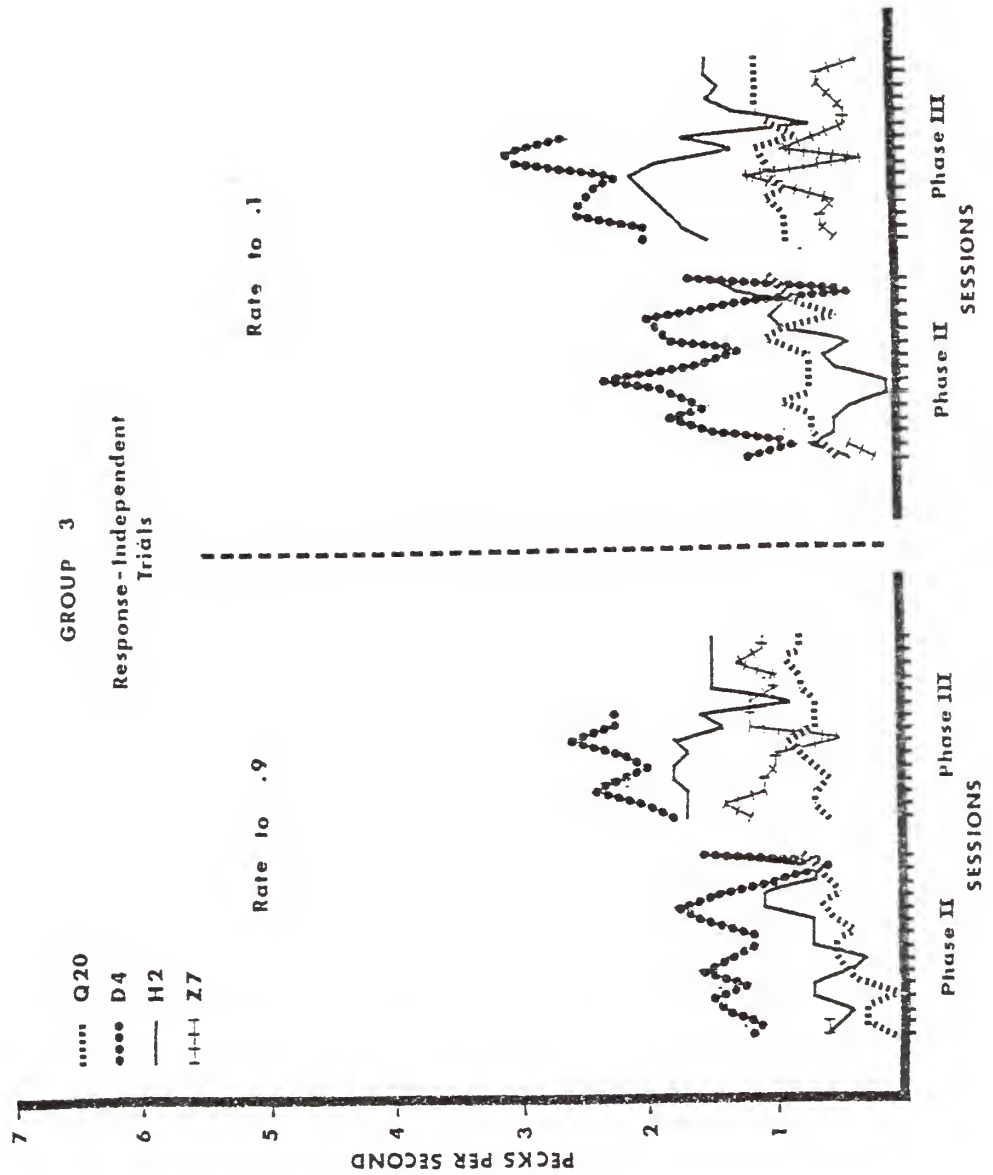


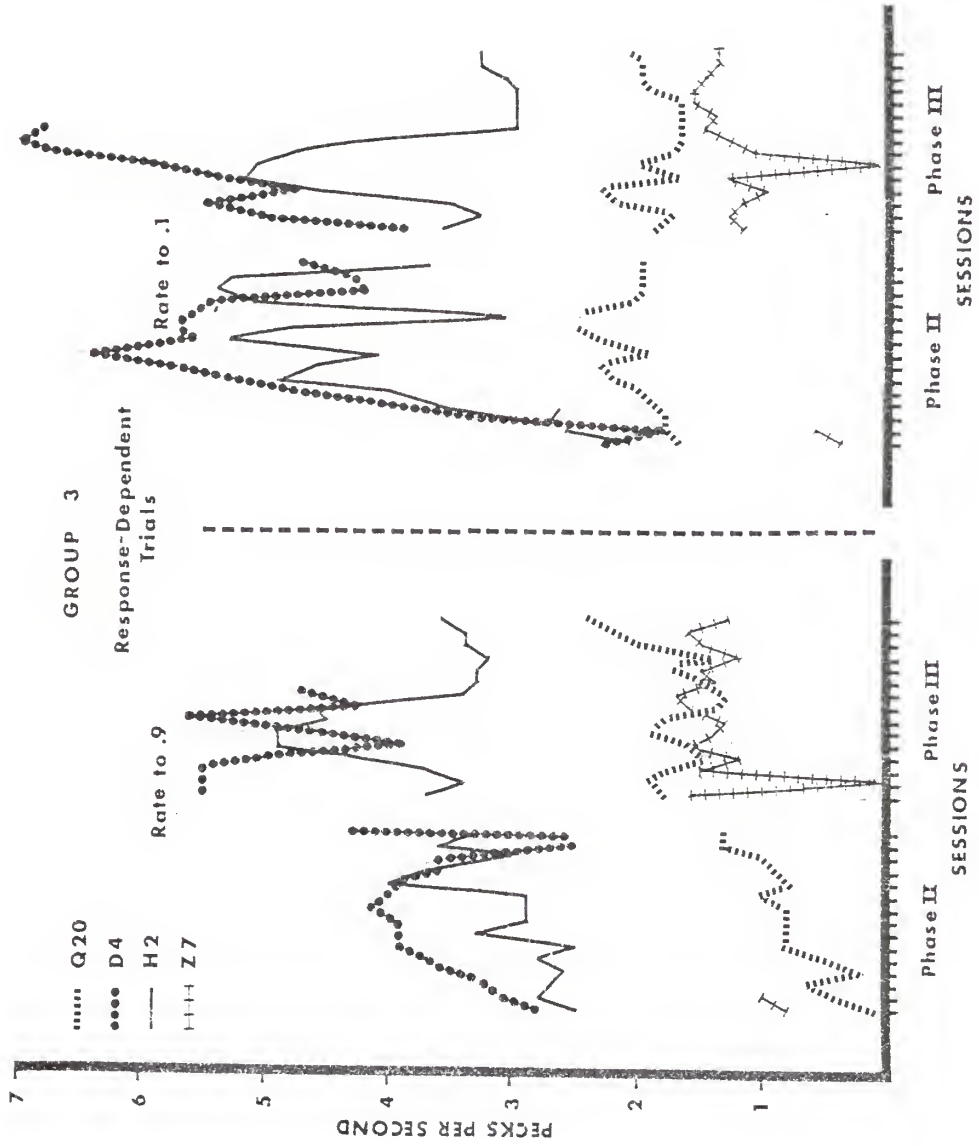
Table 1 - The number of birds in Groups 1 and 3 and in Groups 10 and 30 meeting both or meeting one and fewer of the two phase criteria.

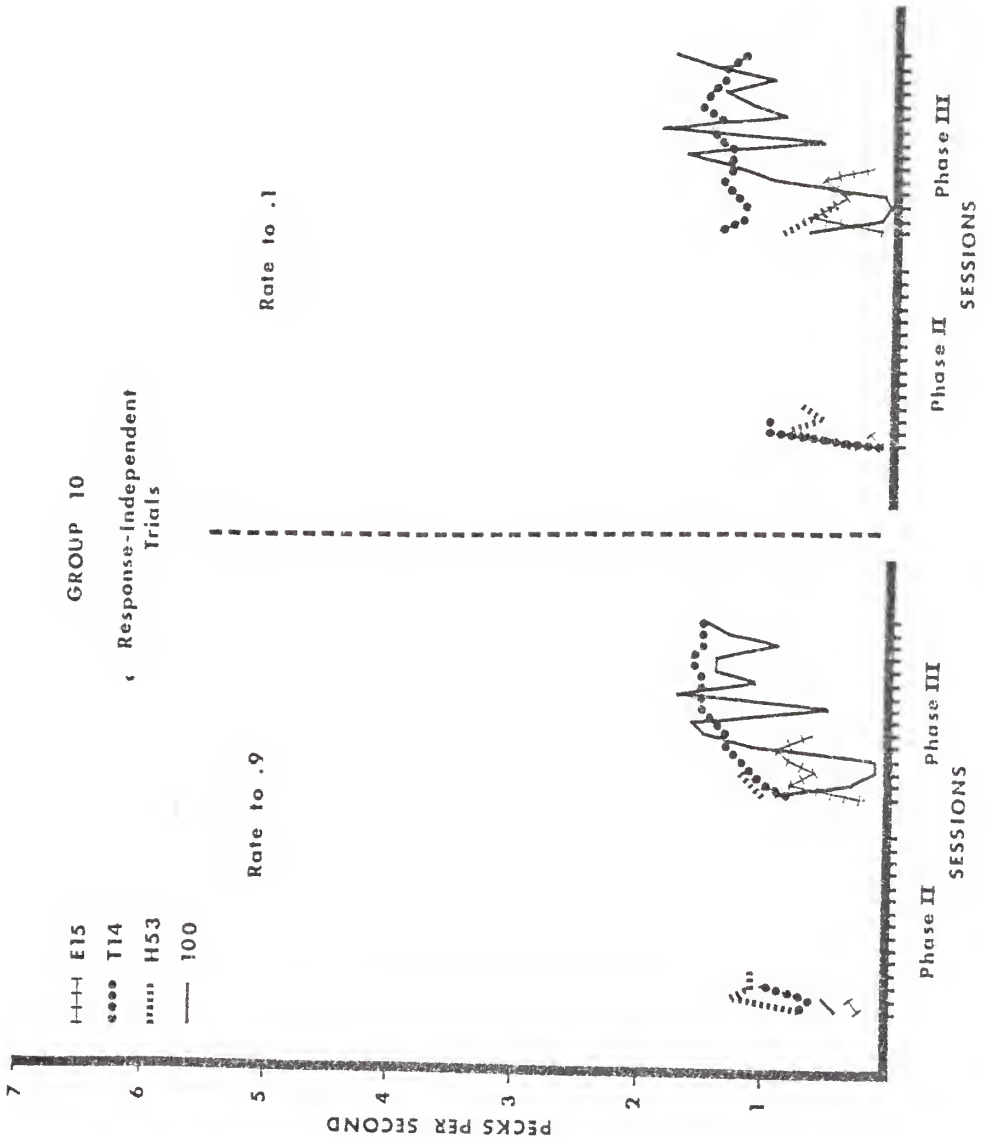
	Both	One or Fewer
Groups 1 and 3	0	8
Groups 10 and 30	5	3

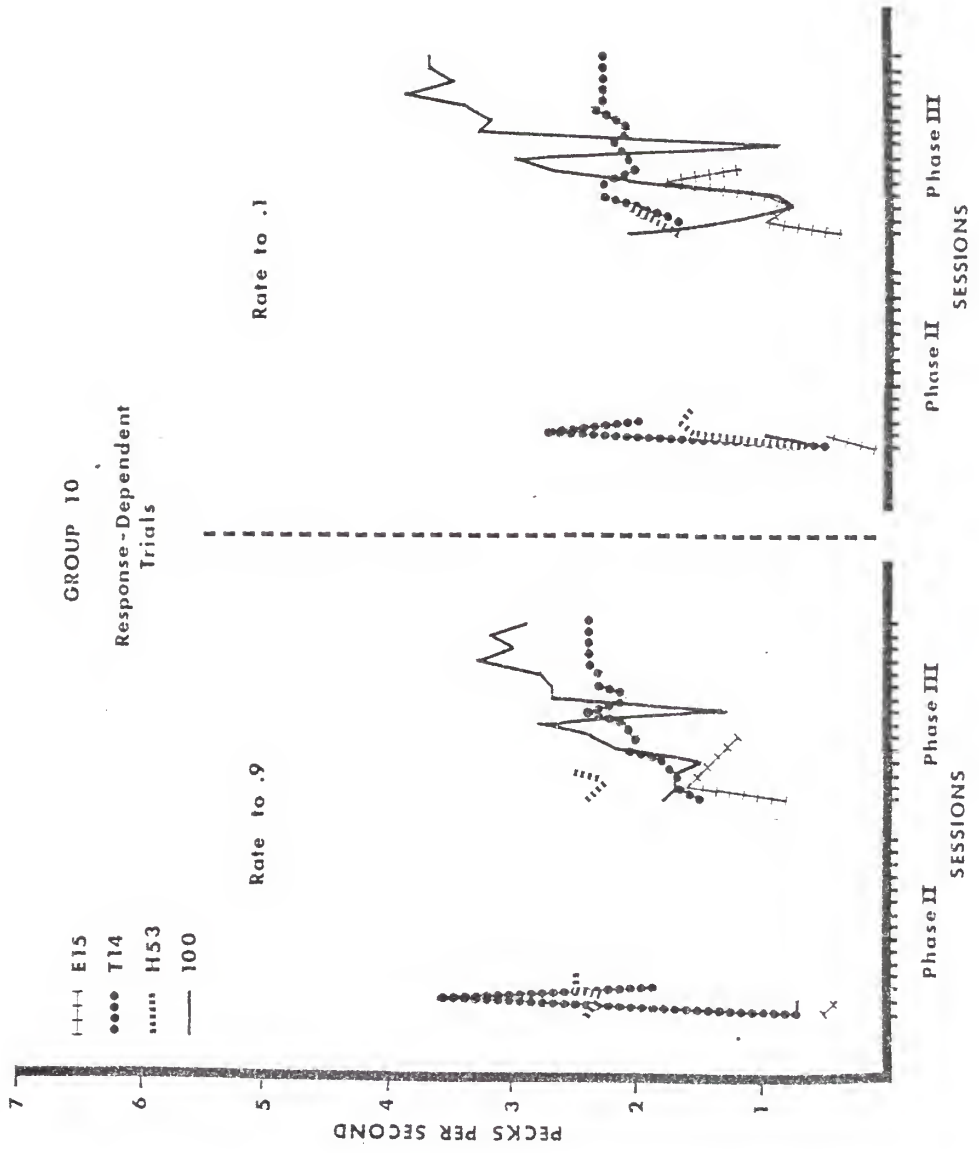
APPENDIX A:

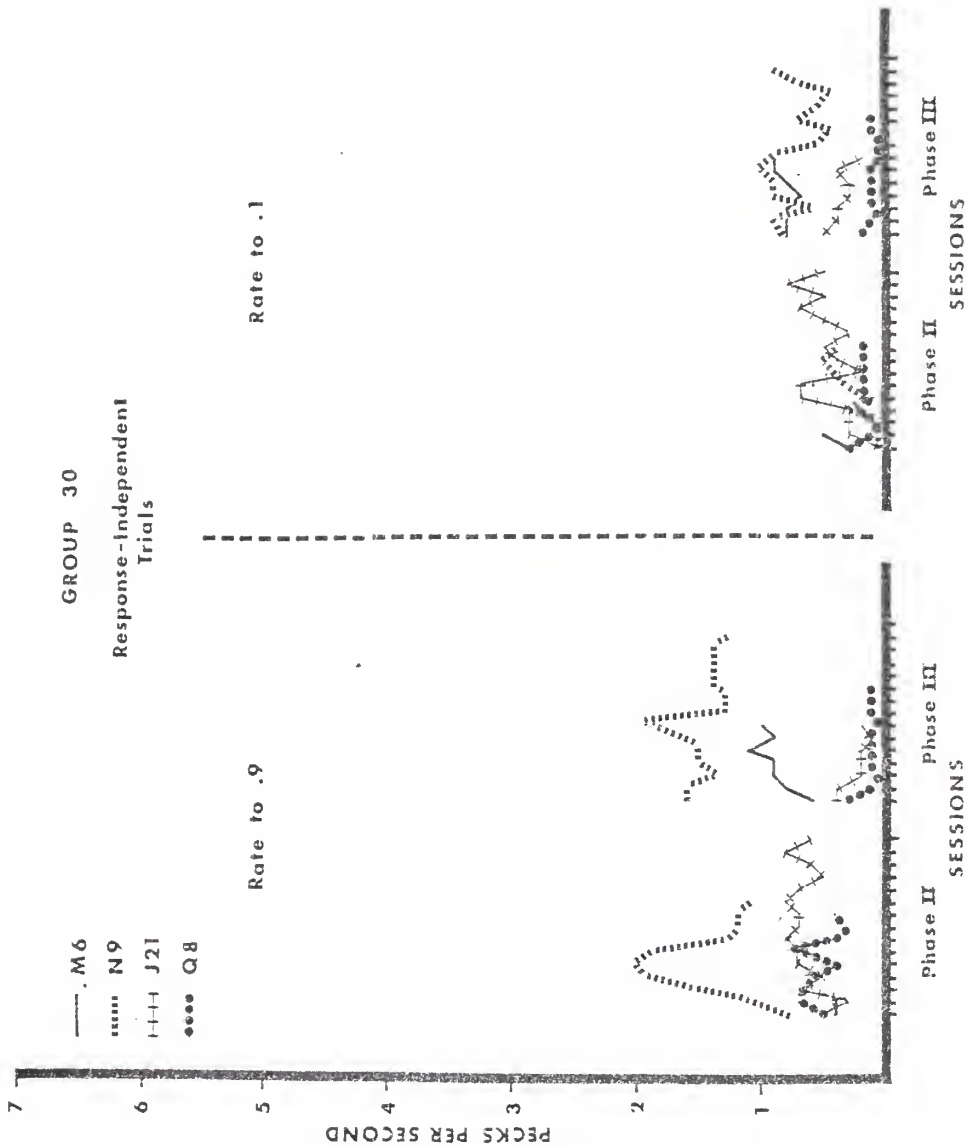
Response rates for individual birds in Groups 3, 10, and 30 for response-independent and response-dependent trials separately.

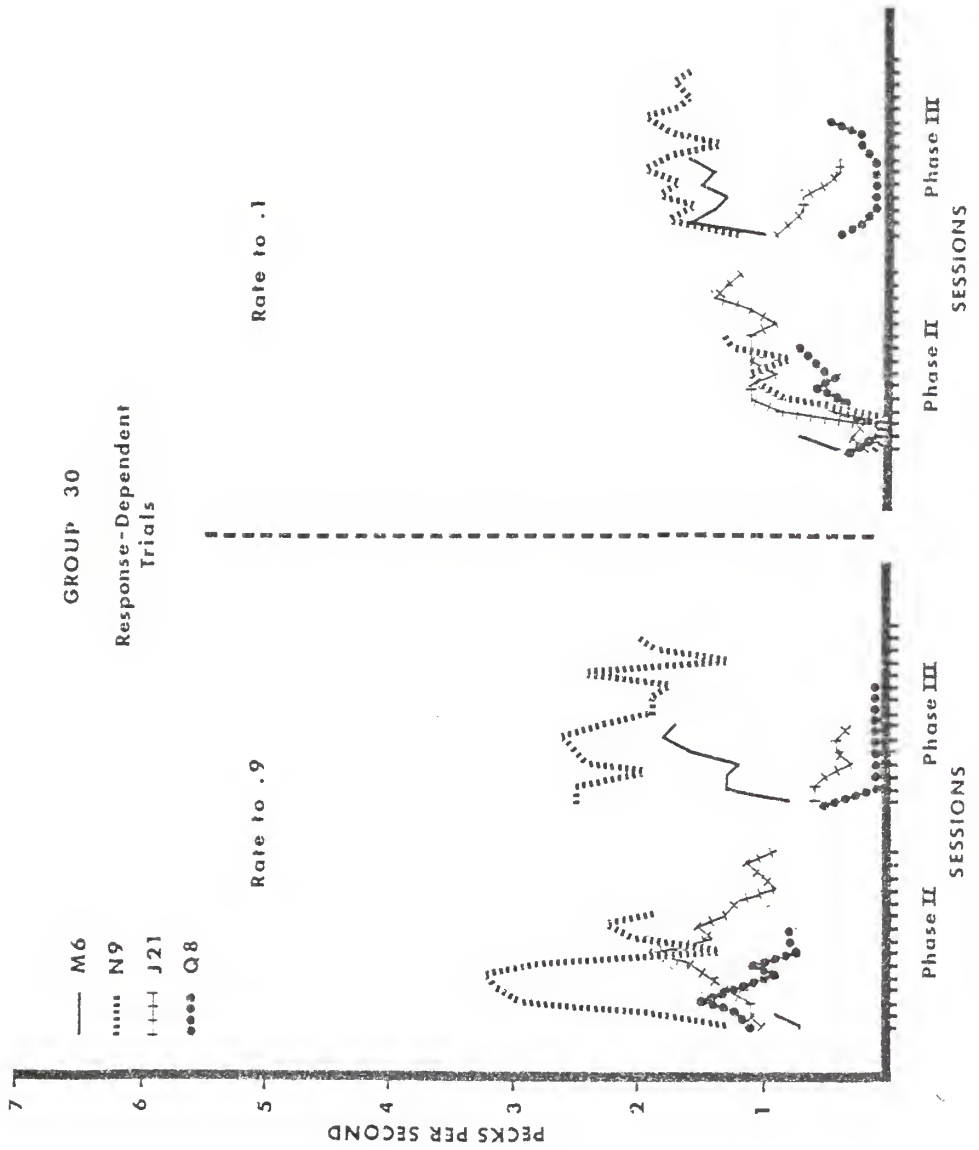












THE ROLE OF GENERALIZATION DECREMENT IN FAILURES TO
DEMONSTRATE CONDITIONED REINFORCEMENT: TEMPORAL FACTORS

by

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Experiments often fail to show that stimuli (S^R s) which have preceded primary rewards strengthen new responses. If conditioned reinforcing properties are acquired by the total set of prevailing cues rather than component stimuli, the absence of sec. reinforcing effects may be explained by a generalization decrement or discrimination between conditions which include S^R on S^R -reward and those which include S^R on response- S^R trials. Since the two types of trials have different antecedents this might result from a difference in short-term memory (STM) cues. An experiment was designed to test the implication of this view that when environmental conditions are identical on both kinds of trials, pigeons will acquire new responses followed by S^R better as S^R duration is increased from 1 to 30 sec.

Twelve naive pigeons served as subjects. The red and green stimuli used as S^R were of 30, 10, 3, and 1 sec. duration for the four experimental groups. The 1 Sec. Group was added after the other groups had completed training. Its treatment necessarily differed somewhat from theirs. In Phase I, birds received response-independent trials in which red and green keylights were differential predictors of food (e.g., food followed red with a probability of .9, and green with a probability of .1). In Phase II, choice-forced trial pairs were interspersed among the response-independent trials. Choice trials were signalled by white illumination of the two keys. A peck to one key produced the red stimulus, and a peck to the other produced the green stimulus. On the forced trial, only the key not previously chosen was available. Food followed choice and forced trials with a probability of .5. In Phase III, the color-side pairing on choice trials was reversed.

The stimulus which was the better predictor of food on response-independent trials was chosen above chance by Groups 30 and 10, but not by Groups 3 and 1. Kruskal Wallis nonparametric analysis of variance showed that Group 30 and 10 chose the .9 stimulus significantly more often than did Groups 3 and 1 ($p < .05$).

These results indicate that conditioned reinforcing effects are acquired by a total set of cues (including STM's) present on S^r -reward trials and not by component stimuli irrespective of context.