

AUTOSHAPING AND AUTOMAINTEANCE OF A KEY-PRESS RESPONSE IN SQUIRREL MONKEYS

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Following exposure for a minimum of 500 to 600 trials, three of four naive squirrel monkeys eventually pressed a response key, illumination of which always preceded delivery of a food pellet. Three other naive monkeys did not press the key when the pellets were delivered randomly with respect to key illumination. Despite some similarities to autoshaping using pigeons, the data indicate many points of difference when squirrel monkeys are used as subjects. Although key-food pairings were shown to be important in the acquisition of the key-press response, they were ineffective in maintaining the response when either a negative response-reinforcer dependency was introduced, or when there was no scheduled response-reinforcer dependency (fixed trial). Not all demonstrations of autoshaping can be considered to be under the control of those processes that are primarily responsible for the phenomena obtained in pigeons.

When response-independent food presentations follow brief periods of illumination of a disc, pigeons will reliably peck at the disc. Brown and Jenkins (1968) demonstrated that this phenomenon of autoshaping was dependent on "forward pairings" (*i.e.*, key illumination preceding food presentation). "Reverse pairings" (*i.e.*, food presentations preceding key illumination), constant key illumination, and dark key-food pairing procedures yielded minimal responding. The greater relative importance of the key-food, as opposed to the response-food, relationship in the maintenance of such pecking was demonstrated by Williams and Williams (1969). They showed that pecking was maintained despite a negative response-reinforcer contingency such that food was not presented if the pigeon pecked during the trial. Moreover, Gamzu and Williams (1971, 1973) have shown that when food is presented independently of responding, maintenance, as well as acquisition of pecking, is dependent on a differential association between key and food presentations. A non-

differential procedure in which food was presented randomly with respect to the illuminated key did not engender pecking and eliminated already established pecking.

It has been suggested that associative processes similar to those underlying classical conditioning play a major role in both acquisition and maintenance of autoshaped key pecking in the pigeon (Gamzu and Williams, 1973). Indeed, the topography of this response is similar to that of the consummatory response. This is strikingly so when one compares autoshaping in the pigeon using water as opposed to food (Jenkins, 1973; Jenkins and Moore, 1973; Moore, 1973). Furthermore, this similarity between the topographies of the autoshaped and consummatory responses has been observed in autoshaping with bobwhite quail (Gardner, 1969), fish (Squier, 1969), rats (Peterson, Ackil, Frommer, and Hearst, 1972), and dogs (Smith and Smith, 1971). On the other hand, there are reports of autoshaping in the rhesus monkey using food (Sidman and Fletcher, 1968) and the pigeon using shock (Rachlin, 1969), in which the topography of the autoshaped response differs from the consummatory response. Are all of these to be considered equivalent instances of the same phenomenon?

Except for the work done on pigeons, most autoshaping studies in other species simply demonstrate that a given response can be acquired. It is assumed that the stimulus-re-

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inforcer relationship is the major feature in the acquisition of these responses, primarily by analogy to the experiments with pigeons. However, the typical autoshaping procedure contains a response-reinforcer dependency, such that the performance of the response during the stimulus presentation results in immediate access to a reinforcer. Consequently, the mere demonstration of autoshaping of a response says nothing about the role of the stimulus-reinforcer relationship in the maintenance of that response and only indirectly hints at the role of that relationship in the acquisition stage.

The present study was designed to investigate the role of the stimulus-reinforcer relationship both in the acquisition and maintenance of autoshaped key pressing in a non-avian species. We chose to work with the squirrel monkey, since not only do monkeys exhibit a greater variability in the pattern of behavior leading to ingestion, but more importantly, we expected the topography of the key-press response to differ from that of the consummatory response. The latter point would then permit us to investigate the equivalency of different instances of autoshaping.

The first experiment was designed to see if autoshaping would occur and if so, whether stimulus-reinforcer pairings were necessary for the acquisition. This was accomplished by use of a control group that was exposed to a procedure in which there was no explicit stimulus-reinforcer association. In the second experiment, the role of the stimulus-reinforcer relationship in the maintenance of the autoshaped response was investigated.

EXPERIMENT I

METHOD

Subjects

Seven naive adult male squirrel monkeys (*Saimiri sciureus*), maintained at free-feeding weights, were approximately 22 hr food deprived at the beginning of each session. The monkeys were maintained exclusively on highly nutritional pellets manufactured at Hoffmann-La Roche according to the formula of Riddle, Rednick, Catania, and Tucker (1966). However, the formula was compacted into pellets of 120 mg weight. For four to six weeks before experimental treatment, the

pellets were gradually incorporated into the animals' diet in their home cages.

Apparatus

The experimental Plexiglas chamber was 22.9 by 25.4 by 27.9 cm. On one wall, a standard translucent Gerbrands pigeon key 2.9 cm in diameter was mounted and recessed 0.5 cm. During the trials, the key was illuminated by a 2.8-W, 28-V dc white light. On the lower left-hand corner of the same wall, a small wire mesh food cup extended into the chamber. The center of the food cup was 14 cm to the left of, and 12.7 cm below the center of the key. A small 1.1-W, 12-V dc white light, illuminated throughout the session, was positioned over the food cup. Delivery of 120-mg pellets was accompanied by a slight click of the feeder mechanism. A dimmed overhead 6-W, 28-V dc houselight mounted to the enclosing sound-attenuated chamber and low amplitude masking noise were on throughout the session.

Sessions were controlled by standard Behavioral Research Systems circuitry and monitored by closed-circuit television.

Procedure

All subjects were initially trained to approach the food cup whenever the feeder was operated; the key was continuously illuminated during this period of training.

Monkeys 269, 270, 287, and 300 (Group I) were subsequently exposed to the autoshaping procedure. This procedure consisted of pairings of illumination of the response key and presentation of food. A pellet was presented only after the key had been illuminated for a variable period of time. If during the trial a key press was made, the trial ended immediately with the delivery of a pellet. If the monkey failed to respond, the pellet was delivered at the end of the 10-sec trial. The subjects were exposed to this procedure until they were responding on 90% of the trials for four to seven consecutive days.

Monkeys 246, 273, and 289 (Group II) were exposed to the control procedure. In this procedure, pellets were delivered randomly in time, *i.e.*, the delivery of a pellet was equiprobable during each second of both the trial and intertrial intervals. However, if the animal pressed the key while it was illuminated, the trial was immediately terminated and a pellet delivered. The probability was adjusted so

that in the absence of any responding approximately 50 pellets would be delivered. If the monkey responded on each trial, it would receive at least 50 pellets during the trial intervals, while still receiving the pellets scheduled for the intertrial intervals. Thus, the density and absolute number of pellets delivered could increase as a consequence of key pressing. All three monkeys were exposed to 30 sessions of this procedure after they were reliably magazine trained. Subsequently, they received 30 sessions of the autoshaping procedure.

Subjects were studied five days a week. A session consisted of fifty 10-sec trials during which the key was illuminated. The mean intertrial interval was 40 sec with an approximately geometric distribution.

RESULTS

In three of the four monkeys in Group I, the key-press response was successfully autoshaped. The acquisition curves in Figure 1 show the per cent of the trials during which there was a response. Sustained key-pressing was obtained after 15 to 20 sessions. In all three cases there was a relatively large number of intertrial interval (ITI) responses at the beginning of acquisition, but stimulus control was evident once the monkeys were responding consistently.

This can be seen in Figure 2, in which responding during trial and intertrial intervals is shown separately. It should be noted that the ITI period was four times as long as the trial period and that there could be no more than 50 trial responses per day. Indeed, the relative rate of responding was much higher in the trial than in the ITI. Toward the end of the sessions shown in Figure 2, most of the ITI responses occurred immediately after the trial was terminated and were the result of double responses directed at the illuminated key.

The fourth monkey in Group I (270) was exposed to only 10 sessions of the autoshaping procedure and its key-press responding was then shaped by the method of successive approximations. This was the first monkey to be studied and we had expected rapid autoshaping on the basis of autoshaping experiments using pigeons (Brown and Jenkins, 1968) and rhesus monkeys (Sidman and Fletcher, 1968). A few responses were observed during the 10 sessions, and indeed the subsequent shaping was very rapid. These factors and the slow rate of acquisition by the other three subjects suggested that in this monkey too, the key-press response might have been autoshaped with more exposure to the procedure.

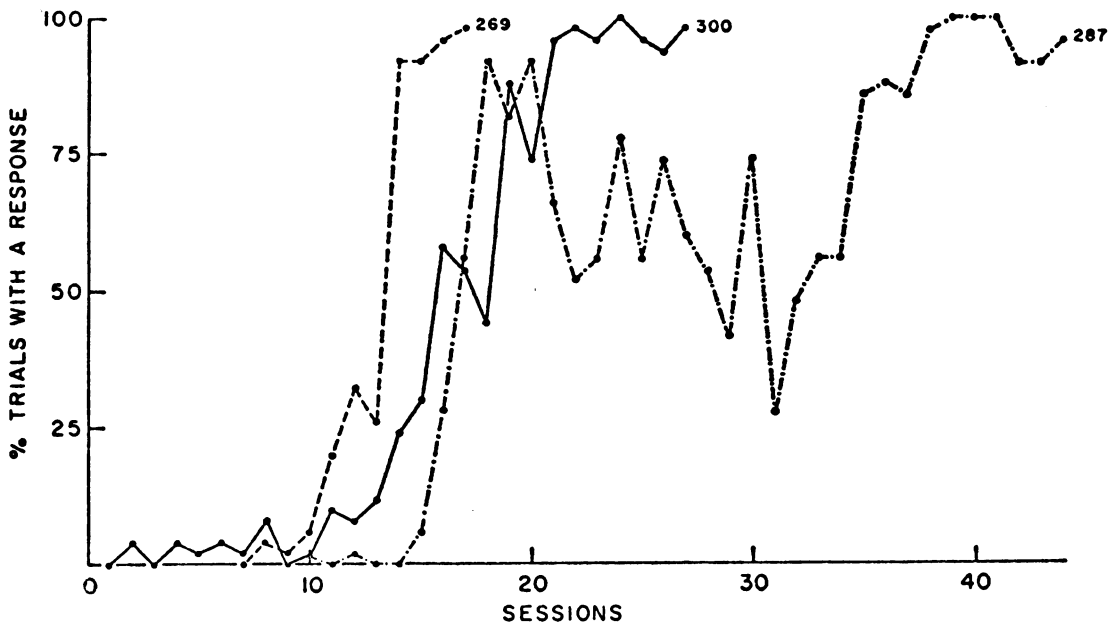


Fig. 1. Acquisition of key pressing by autoshaping in three squirrel monkeys. Per cent of daily trials to which there was a response.

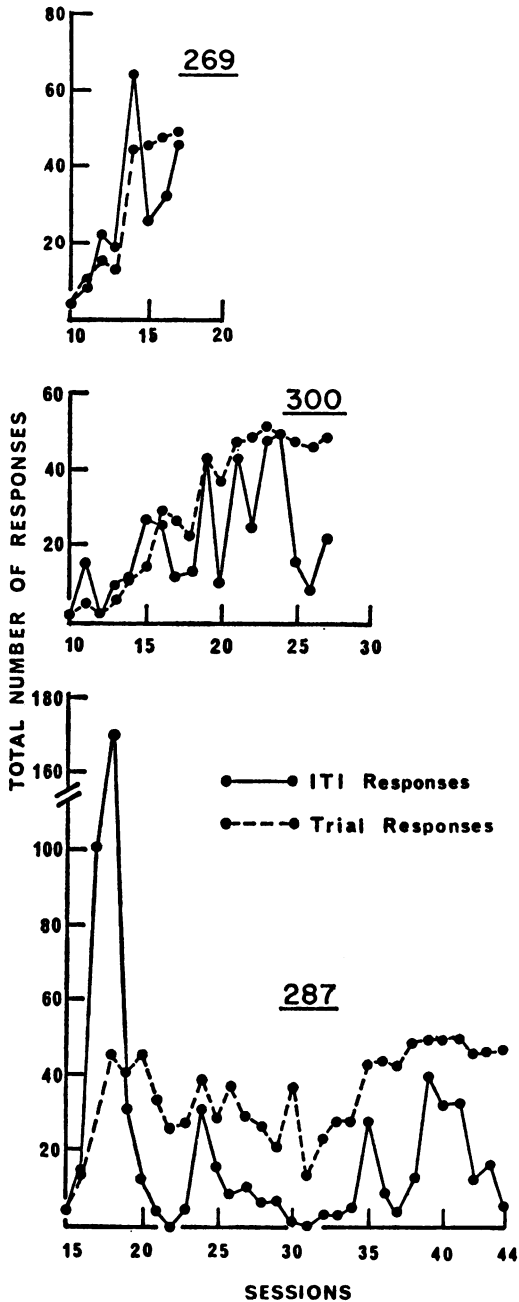


Fig. 2. Daily totals of intertrial responses (solid lines) and trial responses (dashed lines) in acquisition of key pressing by autoshaping. The maximum number of trial responses possible was 50, and the ITI period was four times as long as the trial period. Consequently, the relative rate of responding was much higher in the trial than in the ITI.

None of the monkeys exposed to the control procedure (Group II) showed any evidence of acquiring a key-press response in that condi-

tion. During 30 sessions of exposure to a random relationship between food presentation and key illumination they made a total of 32, 0, and 3 responses respectively, only 7, 0, and 1 of which were to the illuminated key. No monkey made more than one response to the illuminated key in any given session. On those occasions responses were, of course, immediately reinforced according to the response-reinforcer dependency; this was, however, insufficient to generate consistent responding. Furthermore, in none of the subjects was there any indication of acquisition of the key-press response when the autoshaping procedure was introduced. During 30 sessions they made 20, 0, and 0 key responses respectively.

Initial key responses were always made with palm facing down, and although the fingers were bent, the topography of this response was decidedly different from the hand movements involved in reaching for a pellet—scooping it up with the palm turning upward and bringing it to the mouth. Subsequently, some of the monkeys pressed the key with their noses.

DISCUSSION

These data represent an additional instance of an autoshaped response that differs in topography from the response to the reinforcer. Moreover, it is clear that a positive relationship between key illumination and food presentation was necessary for the acquisition of this response, since a random relationship between the illuminated key and food in the control group failed to engender key pressing.

The three monkeys (Group II) initially exposed to the control procedure gave no evidence of autoshaping of the key-press response. This indicated that stimulus-reinforcer pairings, while necessary for the autoshaping of this response, are not sufficient. The impairment of subsequent performance by random response-independent food presentations occurs in pigeons also (Gamzu and Williams, 1971, 1973) but without completely blocking it. The complete lack of responding in the autoshaping procedure after random reinforcement in squirrel monkeys is of a different order of magnitude and may parallel the phenomenon that results from initial exposure to randomly presented shocks (*cf.* Seligman and Maier, 1967).

There are at least three possible explanations of the lack of autoshaping in Group II. The first is similar to that offered by Seligman and Maier (1967), in that the monkeys somehow learned that nothing they could do would lead to food and this subsequently interfered with the acquisition of the key press. However, there are many problems to such an approach (Gamzu, Williams, and Schwartz, 1973). A second explanation is based on adventitious reinforcement of certain non-key-pressing responses during the control procedure. These responses would be maintained in the autoshaping procedure because pellets were delivered even if the key was not pressed. Moreover, the non-key-pressing behaviors could be expected to interfere with the development of key pressing. Finally, since the monkeys were exposed to 30 sessions during which key-illumination was not a discriminative stimulus, the key probably did not control their attention during subsequent autoshaping sessions. In general, the monkeys of Group II appeared quite passive in the experimental chamber. In both the control and the autoshaping procedures they would sit quietly with their heads down, occasionally looking up toward the wall containing the feeder and the key. These observations could be taken as evidence for any one of the above explanations, but do not offer enough evidence to distinguish among them.

EXPERIMENT 2

Once the monkeys in Group I were responding, each response to the illuminated key was immediately followed by reinforcement. Consequently, it was impossible to ascertain whether the stimulus-reinforcement contingency played a major role in maintaining the key-press response, even though it was necessary for acquisition of the response.

The second experiment was designed to investigate the role of the stimulus-reinforcer relationship in maintaining the autoshaped response. The most potent demonstration of the importance of stimulus-food pairings in maintaining the pigeon's key pecking was provided by Williams and Williams' (1969) demonstration of automaintenance despite a negative response-reinforcer contingency. Therefore, the four monkeys in Group I were exposed to a negative response-dependency procedure.

METHOD

The four subjects of Group I in Experiment 1 were used, with the same deprivation schedule, and the same apparatus employed in Experiment 1.

Procedure

The four different procedures are described below. In all procedures the distribution of the intertrial intervals was as in Experiment 1.

- (1) Autoshaping was as described in Experiment 1.
- (2) The "negative response-dependency procedure" arranged key-food pairings, but a key press during the trial terminated it immediately without reinforcement. If the monkey failed to respond, a pellet was delivered at the end of the 10-sec trial.
- (3) The "extinction procedure" was exactly like the autoshaping procedure except pellets were never delivered.
- (4) The "fixed-trial procedure" arranged key-food pairings with no response-reinforcer contingency; a pellet was delivered at the end of the 10-sec trial whether or not the animal responded.

Before exposure to any one of Procedures 2 to 4, the monkeys were required to have been responding on 90% of the trials on the autoshaping procedure for four to seven consecutive days. (Monkey 269 reached a criterion of only 80% on its second exposure to the autoshaping procedure). The other procedures were studied until responding was stable for three to four days.

At the onset of the experiment, all four monkeys had reached criterion on the autoshaping procedure in Experiment 1 and were all immediately exposed to the negative response-dependency procedure followed by re-exposure to autoshaping. Table 1 presents the order of all the procedures and the number of sessions of each procedure to which each individual subject was exposed.

RESULTS

Negative response-dependency. The introduction of the negative response-dependency resulted in rapid reduction of key pressing (Figure 3). Monkeys 269, 287, and 300 were pressing the illuminated key on only 25% of the trials after three sessions of the negative

Table 1

Order of procedure and number of sessions in parentheses for each subject: AS—autoshaping; Hshap—hand shaping; NRD—negative response-dependency; FT—fixed-trial; EXT—extinction (see text for further explanation of procedures).

269	300	287	270
AS (17)	AS (27)	AS (44)	AS (10) Hshap. (4) AS (2)
NRD (24)	NRD (12)	NRD (7)	NRD (25)
AS (37)	AS (14)	AS (24)	AS (8)
FT (33)	EXT (6) AS (7) FT (17)	FT (17)	EXT (25) AS (8) NRD (6) AS (8) FT (16)

response-dependency procedure, and key pressing was virtually eliminated after 5 to 10 sessions. The only evidence of automaintenance of key pressing in this procedure was during the first exposure received by Monkey 270, the monkey whose responding had been shaped by conventional techniques (successive approximations). However, it had ceased pressing the key after only six sessions of its second exposure to the negative response-dependency procedure, even though its rates of key pressing before both exposures to the procedure were identical.

Although key pressing was virtually eliminated by the negative response-reinforcer dependency, the monkeys were observed to be orienting to and occasionally approaching without contacting the key when it was illuminated.

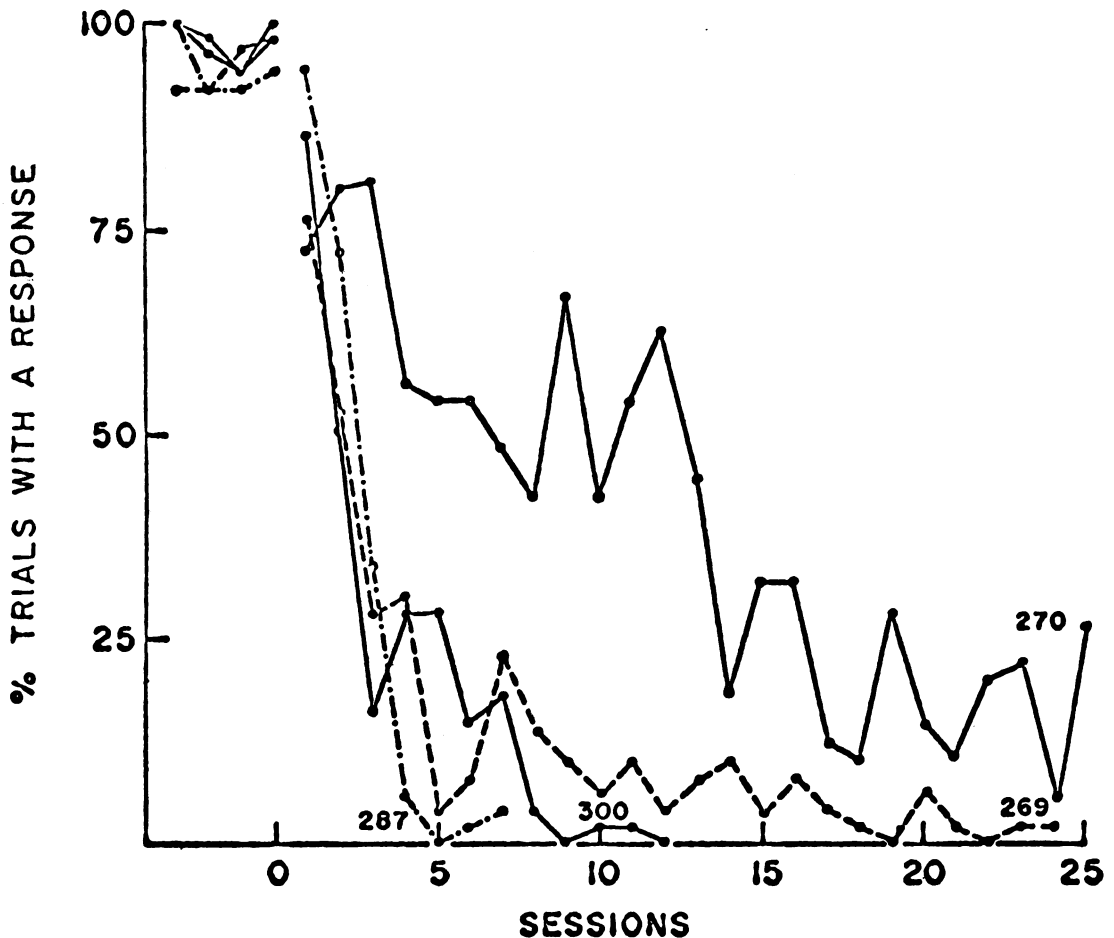


Fig. 3. Per cent of daily trials to which there was a response during the negative response-dependency procedure. The upper left-hand corner indicates responding during the preceding four autoshaping sessions.

Reacquisition in the autoshaping procedure after the negative response-dependency procedure was quite prolonged. Monkeys 269, 300, and 287 required 6, 7, and 14 autoshaping sessions respectively before they were reliably key pressing again. Monkey 270, which was still key-pressing during its first exposure to the negative response-dependency procedure, was pressing on most of the trials after only one session of the autoshaping procedure.

Extinction. The extinction procedure reduced key pressing by both monkeys (270 and 300) exposed to the procedure. The rate of decrease was similar to the rate of reduction of key pressing produced by the negative response-dependency procedure (Figure 4).

Monkey 300 ceased responding after three extinction sessions, and Monkey 270 was responding on only 20% of the trials after four extinction sessions.

Fixed trial. The removal of all response-reinforcer dependencies in this procedure reduced key pressing by all four monkeys. In this procedure, multiple responses during a trial were possible. In order to compare the results with those of the other procedures, the data are presented as trials on which at least one response was made (Figure 4). Monkey 270 and 300 were responding on only 10% of the trials after five sessions. The decline in responding for Monkeys 269 and 287 was not as marked. For Monkey 269, per cent of trials with a re-

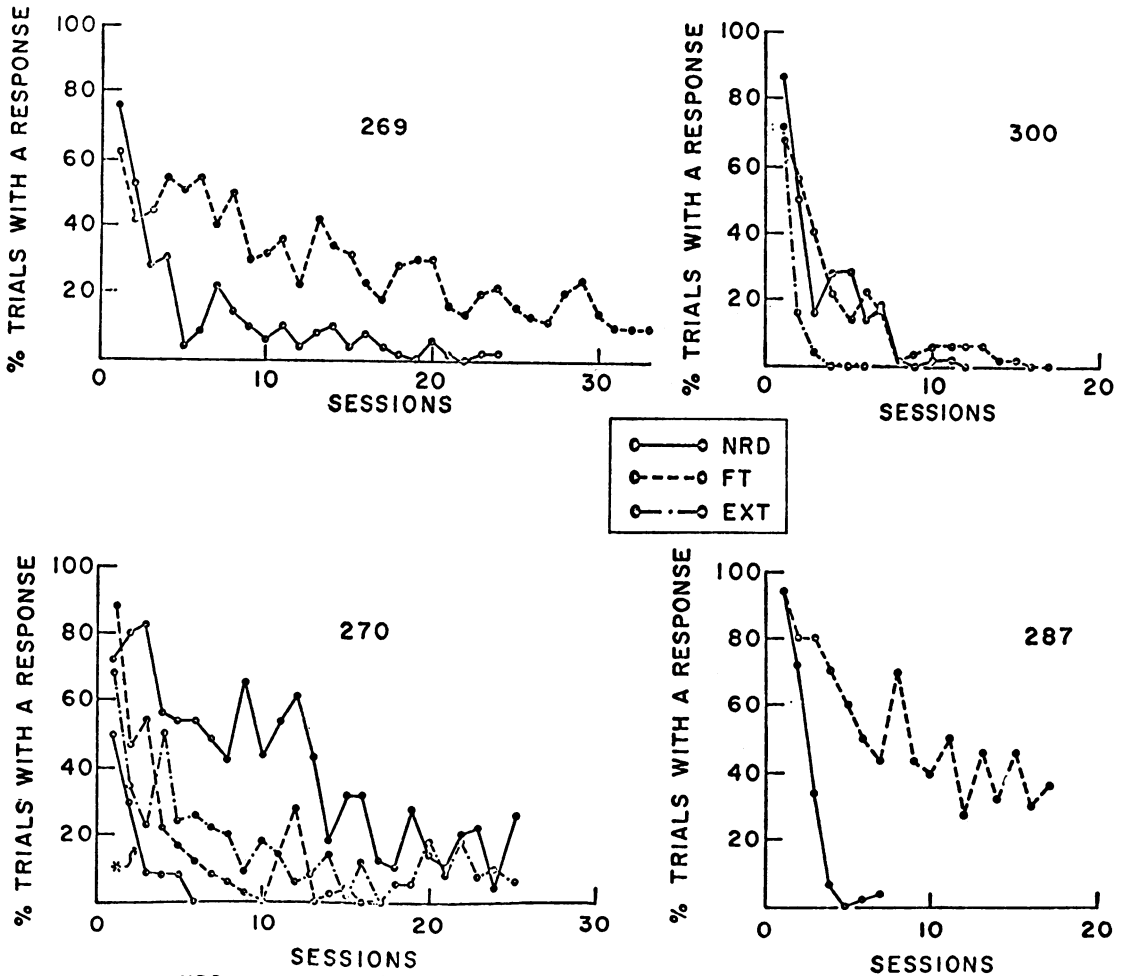


Fig. 4. A comparison of the per cent of daily trials to which there was at least one response during the negative response-dependency (NRD), fixed-trial (FT), and extinction (EXT) procedures for each of four squirrel monkeys. Monkey 270 was given a second exposure to the negative response-dependency procedure and, therefore, its data differ from those in Figure 3.

sponse declined slowly from 60% on the first session to 10% on the thirty-third session. For Monkey 287, the per cent of trials with a response declined to 45% by Session 7 and then declined slightly to between 30% to 40% by Session 17, at which point the experiment was terminated. It should be noted that before being exposed to each of these conditions in Figure 4, the monkeys had reached a given criterion of responding. For Monkeys 270 and 300, the three procedures had essentially the same effect on responding. This is particularly true if one ignores 270's atypically high level of responding when it was first exposed to the negative response-dependency condition. While the fixed-trial procedure considerably reduced responding for Monkeys 269 and 287, it was clearly less effective in eliminating the key-press response than was the negative response-dependency procedure.

DISCUSSION

The data indicate the lack of importance of the stimulus-food relationship in maintaining autoshaped key pressing in the squirrel monkey. The key-press response was extinguished when responding prevented food presentation, even though key illumination and food became paired again once key pressing ceased. This reduction in responding paralleled the effects of extinction. When food presentations were response-independent in the fixed-trial procedure, key pressing was considerably reduced and actually eliminated in two monkeys. This contrasts sharply with the results obtained in pigeons using similar procedures in which consistently high rates of responding were maintained in from 50% (Brown and Jenkins, 1968) to 100% (Gamzu and Williams, 1971) of the birds.

The difference in the rate of decrease in responding during the fixed-trial procedure between Monkeys 269 and 287 as opposed to Monkeys 270 and 300 requires some explanation. It is probably a result of the fact that the latter two subjects (270 and 300) had been exposed to additional procedures first. Both of these monkeys received at least one additional cycle of exposure to a procedure in which key pressing resulted in the immediate delivery of food, followed by a procedure in which key pressing was negatively related to food presentations (see Table 1). This additional experi-

ence seems to have facilitated the discrimination of the lack of response-food dependency in the fixed-trial procedure, in a manner similar to the progressive decrease in response rate seen during extinction as a consequence of repeated extinction-reacquisition cycles (Bullock, 1960; Bullock and Smith, 1953).

The present data extend the species in which autoshaping can be obtained. However, many aspects of these data differ markedly from previous work and especially from the investigation of autoshaping in pigeons. These differences were found both in the acquisition and in the maintenance of the autoshaped key press. Acquisition of the key press was quite prolonged, requiring 15 to 20 sessions as opposed to one to two sessions in pigeons (Brown and Jenkins, 1968). In addition, there were a considerable number of intertrial interval responses and even once the monkeys were responding, they did not respond to every trial stimulus. Pigeons, on the other hand, made few intertrial interval responses and rarely failed to peck at the illuminated key (Brown and Jenkins, 1968). More striking were the differences between our monkey data and those reported in pigeons in the maintenance of autoshaped responding. Key pressing was eliminated by the introduction of a negative response-reinforcer dependency, and drastically reduced (eliminated in two cases) when the key and food were paired without any response-reinforcer dependency.

In explaining these data it is helpful to examine previous accounts of autoshaping in pigeons. Gamzu and Williams (1971, 1973) pointed out that the stimulus-reinforcer relationship controls both the acquisition and maintenance of autoshaped key pecking in pigeons. Moreover, many aspects of the source of control parallel those to be found in classical Pavlovian conditioning. Jenkins has claimed that an organism will attempt to approach and make contact with a stimulus that reliably predicts the presentation of a reinforcer (Jenkins, 1973). The actual nature of the response topography is not directly determined by either of these accounts. However, the Pavlovian mechanism of stimulus substitution or surrogation has been suggested as the mechanism with varying degrees of reservation by a number of authors (Brown and Jenkins, 1968; Gamzu, 1971; Moore, 1973; Peterson *et al.*, 1972). Some credence is given to this po-

sition by the similarities in topography of the autoshaped and consummatory responses mentioned in the introduction. Indeed, in pigeons (Jenkins, 1973; Jenkins and Moore, 1973; Moore, 1973) and in rats (Peterson *et al.*, 1972), at least two distinctly different topographies can be obtained by the use of different classes of reinforcers.

In the present experiments, however, the topography of the autoshaped response was quite different from that of the consummatory response. It is interesting, therefore, that autoshaping and particularly automaintenance in the squirrel monkey and in the pigeon should be so different. The source of these differences appears to be in the nature of the behavior patterns leading to ingestion. In the pigeon, food can be ingested only if a quite invariable motor pattern of pecking occurs. On the other hand, the squirrel monkey can bring food to its mouth for ingestion by variable forelimb motor patterns, and indeed, forelimb movements are not even necessary. Unfortunately, this distinction, *per se*, does not explain the data.

It is tempting to provide a purely operant explanation based on the nature of the relationships between the key-press response and the presentation of food. If so, acquisition would simply depend on an initial random key press, subsequently reinforced by the immediate delivery of food. However, it is clear from the first experiment that the stimulus-reinforcer pairing is a necessary feature of the acquisition stage, even if it plays no discernible role in the maintenance of the response. It is this fact that makes it insufficient merely to invoke species differences as the source of all the discrepancies.

In accounting for the data, it is necessary first to distinguish between the orientation/approach and the contact components of the behavior generated in these procedures. Such distinctions are relevant to the classification of certain components of behavior as "minimal units" (Segal, 1972; Skinner, 1969). Certainly "pecking at food" and "pecking at key" are, at the very least, more closely related in terms of Segal's "structural response class" (neuromuscular organization) than are "orientation/approach" and "key pressing" in the monkey. One can then speculate that in the squirrel monkey, the approach component is controlled by stimulus-reinforcer pairings and the

contact component is controlled by response-reinforcer pairings, as is indicated by the results of Experiment 2. More specifically, pairings of illuminated key and food resulted in orientation and approach to the key. Once the monkey was consistently approaching the key, it would occasionally make a response that was sufficient to close the key microswitch, at which point a reinforcer was immediately delivered. This increased the probability that the response would occur when the monkey was again orienting and approaching the key. Thereafter, the key-contact response came under operant control. Discriminative control of the key-press response developed slowly because the response was only indirectly controlled by the key-food relationship. This explains the relatively large number of intertrial interval responses in acquisition.

When a negative response-reinforcer contingency was introduced, key pressing extinguished, as one would expect from a response under operant control. While orientation to the key appeared to be maintained by the key-food pairings, the contact component of the response was not. Thus, it is not surprising that reacquisition was quite prolonged. In order for the operant contingency to take effect, the monkey would have to make a response sufficient to close the microswitch. The process by which this response was generated was quite slow and was clearly independent of stimulus-reinforcer pairings. In the fixed-trial procedure, there was no response-reinforcer dependency. This reduced the tendency to press the key. Since other behaviors were also reinforced, key pressing decreased and could even be eliminated, depending on the actual temporal relationship between key press and food that each monkey obtained.

It is obvious from this account of autoshaping in squirrel monkeys, that all instances of autoshaping are not equivalent. In the pigeon, both the acquisition and maintenance of the key-pecking response are controlled to a large degree directly by the stimulus-reinforcer association, whereas in the squirrel monkey, the key-press response is largely unaffected by this variable. It is possible, of course, that our results would have paralleled those of Williams and Williams (1969) if we had defined the response differently, *e.g.*, eye movements towards the key. However, it is the "arbitrary" nature of the response studied that makes these dis-

crepancies more interesting. Without comparable data on other species, one can only speculate on which cases of autoshaping are comparable in terms of the predominant underlying processes. If indeed, the stimulus substitution or stimulus surrogation notion is correct, then all instances in which the autoshaped response appears similar in topography to the consummatory response might be equivalent. On this assumption, one would predict that "negative automaintenance" would be obtained in all of these cases. Since negative automaintenance is the most potent demonstration of control by stimulus-reinforcer relationships, we suggest that it be used as a criterion test. Responses maintained in that procedure can be considered to be very susceptible to control by Pavlovian-like variables, and possibly are quite invariant components of the sequences of the behavior leading to consummation. Where the topographies of the autoshaped and consummatory response are different, negative automaintenance should not occur. This is true in the present experiment, and might be the case in autoshaping of key pressing in rhesus monkeys (Sidman and Fletcher, 1968) and in autoshaping in pigeons using shock (Rachlin, 1969). In the latter studies, aspects of the data are dissimilar from autoshaping using food in pigeons. In acquisition of autoshaping in rhesus monkeys, there are many intertrial interval responses, and the monkeys do occasionally miss the key even once they are responding. The similarity to the results of Experiment 1 is apparent. When pigeons were autoshaped using shock, the response was either pecking or wing flapping at the protruding key. This sort of variable contact topography suggests that the response in this instance was not controlled by the stimulus-reinforcer pairings.

On a pragmatic level, two aspects of the present study require further comment. The first is that results indicate that analyses of autoshaping of key pecking in the pigeon ought not to be applied to the key-press response in the squirrel monkey. Secondly, the negative response-reinforcer procedure of Williams and Williams (1969) appears to be an important tool in making distinctions between responses that are relatively sensitive or insensitive to stimulus-reinforcer control. Until further evidence is available, distinctions of this nature seem to indicate limitations on the extent to

which the control of "operant" behavior by stimulus-reinforcer variables (Gamzu and Schwartz, 1973) can be generalized. Thus, a taxonomy of response classes along this dimension of control is clearly desirable (see also: Jenkins, 1973; Schwartz and Williams, 1972) and may eventually lead to a deeper understanding of the underlying learning process or processes.

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