

AUTOSHAPING OF KEY PECKING IN PIGEONS WITH NEGATIVE REINFORCEMENT¹

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Pigeons exposed to gradually increasing intensities of pulsing electric shock pecked a key and thereby reduced the intensity of shock to zero for 2 min. Acquisition of key pecking was brought about through an autoshaping process in which periodic brief keylight presentations immediately preceded automatic reduction of the shock. On the occasions of such automatic reduction of shock preceding the first measured key peck, little or no orientation to the key was observed. Observations of pigeons with autoshaping of positive reinforcement also revealed little evidence of orientation toward the key.

Brown and Jenkins (1968) trained pigeons to peck a key by periodically illuminating the key for a few seconds, then presenting food reinforcement. If the pigeons pecked the illuminated key, the food was presented immediately after the peck. If the pigeons did not peck the key, food was presented anyway, after 8 sec (or, in one control procedure, after 3 sec) of illumination. With this procedure, all subjects, previously trained only with the food hopper, pecked the key within 160 trials. Brown and Jenkins called this process "autoshaping". Control procedures showed that in order to generate reliable pecking, food presentation was necessary and the key had to be illuminated just before the food was presented.

Sidman and Fletcher (1968) trained monkeys to press keys with a similar procedure. They paired a lighted key with food presentation and found that each of four monkeys pressed the key within 60 pairings of light and food. In both studies, the basic movements involved in the response to the key were similar to the movements involved in the response to the food. In the Brown-Jenkins experiment, the pigeons pecked both the food and the key. In the Sidman-Fletcher experiment, while the acts of pressing the key and picking

up the food had different topographies, they both involved reaching and touching. Also, both key pecking of food-deprived pigeons and key pressing of food-deprived monkeys are common laboratory responses, easily shaped by more conventional techniques.

The present experiment extends autoshaping to a form of behavior that has been difficult to condition with negative reinforcers by normal laboratory techniques—key pecking by pigeons reinforced by escape from electric shock. Pigeons subjected to electric shock have been trained to peck a key by slowly increasing the shock from zero and reinforcing approaches to the key by periods of no shock (Rachlin and Hineline, 1967). However, as opposed to the ease of training pigeons to peck keys with positive reinforcement, the training of pigeons to peck a key with shock removal (negative reinforcement) often takes as much as 10 or 15 hr of patient shaping. Perhaps, as a result, there are almost no published studies of key pecking in pigeons established or maintained by negative reinforcement. Hoffman and Fleshler (1959) studied negative reinforcement in pigeons, but used a head-raising response, and reported that key pecking was impossible to obtain with the procedures used. Azrin (1959*b*) obtained key pecking with one pigeon, but only temporarily.

The primary purpose of the present experiment was to develop a practical laboratory method for training pigeons to peck a key with escape from shock as reinforcement. In addition, it extends the generality of the auto-

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shaping procedure. The present experiment differs from other autoshaping procedures in two respects: there is no specific consummatory response so the response being conditioned cannot resemble the consummatory response; the response being conditioned has a low operant level in the experimental situation. Because of these differences, some light may be thrown on the nature of the autoshaping process itself.

METHOD

Subjects

Twenty-six adult male White Carneaux pigeons were used; all were experimentally naive. Twenty-two were implanted with gold or stainless steel wire under the pubis bones (Azrin, 1959a) and given free access to food and water in their home cages. Four were not implanted and were kept at 80% of their free-feeding weight.

Apparatus

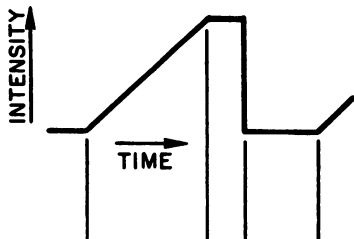
The experimental chamber was of standard dimensions (Ferster and Skinner, 1957), made of wire mesh, and coated with an insulating spray. The shock was 110 v ac transformed by a 0- to 110-v variable transformer, then stepped up by a 400-v transformer, and run through a 25 K ohm or larger resistor, through relay contacts which closed to produce a 35-msec pulse every second, and through a Gerbrands mercury swivel mounted on the ceiling of the chamber. The variable transformer was driven by a motor and a gear changer with a clutch arrangement. This apparatus provided for trains of shock with intensity linearly increasing with time, and for sudden reset of the intensity to zero. The experimental chamber was contained in a sound-resistant chest; white noise was supplied throughout the session. There was a houselight on the roof of the experimental chamber and a trans-illuminated key was mounted on the wall 10 in. above the floor. Mounted on the key was a hemispherical transparent plastic extension protruding 1.3 cm into the chamber. This extension allowed for greater latitude than an ordinary key for the kinds of movement that would be recorded as key pecks. For all but four subjects, a food hopper in the chamber was blocked off by a steel plate.

Procedure

The basic experimental paradigm is shown in Fig. 1. The naive, food-satiated pigeons were exposed to shock pulses at 1 per sec increasing from zero to a maximum, usually 6 ma. The time for the shock to reach maximum was 77 sec. The shock pulses remained at 6 ma for 7 sec more, and then shock was automatically terminated. A peck on the key, or any other action of the pigeons that would depress the key 1 mm during the 77-sec rise of the shock or during the subsequent 7 sec of constant intensity would also terminate shock. Hereafter, the sudden termination of shock, whether presented automatically after the 7 sec of constant intensity or presented as a result of a key peck, will be called negative reinforcement. During the periods of pulsing shock, the houselights were lit and at other times they were out. In addition, during the 7 sec of constant-intensity pulses just preceding negative reinforcement, the key was trans-illuminated with an orange light. At other times, the key was dark. The duration of the shock-off period following negative reinforcement was manipulated during the experiments. Pecks during this period had no scheduled consequences. At the end of the shock-off period, the houselights came on and the shock started increasing again from zero. The daily sessions lasted 90 min, except as noted.

Key presses were counted during the rise of the shock, during the period of constant intensity with the key lit, and during the shock-off period. Also, the number of 1-per-sec pulses between each two successive shock-off periods was recorded.

Hand shaping of key pecking for negative reinforcement had been facilitated by the addition of a hemispherical extension attached to the key, protruding 1.3 cm into the chamber (research in collaboration with P. N. Hine-line). This extension was retained during most of the autoshaping experiments. With the extension, the pigeons could easily press the key by means other than pecking. During most of the following experiments the only way to tell whether a press was due to a peck or a wing-flap (the other frequent means of depressing the key) was occasional visual observation. Once key pressings became frequent, however, they became stereotyped, so a pigeon observed pecking at the key with its beak one



Time (seconds)	77	7	20	CONDITION A
Max. Intensity (ma)	6		0	
Houselights	ON		OFF	
Keylight	OFF	ON	OFF	
Pecks effective	YES		NO	
Time (seconds)	77	7	120	CONDITION B
Max. Intensity (ma)	6		0	
Houselights	ON		OFF	
Keylight	OFF	ON	OFF	
Pecks effective	YES		NO	
Time (seconds)	77	7	120	CONDITION C
Max. Intensity (ma)	3,4,5,6		0	
Houselights	ON		OFF	
Keylight	OFF	ON	OFF	
Pecks effective	YES		NO	
Time (seconds)	77	7	120	CONDITION D
Max. Intensity (ma)	3,4,5,6		0	
Houselights	ON		OFF	
Keylight	ON			
Pecks effective	YES		NO	
Time (seconds)	77	7	4(FOOD)	CONDITION E
Max. Intensity (ma)	0			
Houselights	ON		OFF	
Keylight	OFF	ON	OFF	
Pecks effective	YES		NO	

Fig. 1. A diagram of the variation of shock intensity with time, and a table of experimental procedures. While the lines in the diagram are continuous, the shock is actually pulsing.

time was likely to peck at it the next time also. Photographs of the pigeons pressing the key confirmed this observation. In the earlier experiments, where photographs were not taken, only occasional visual observation was used to determine whether a given depression of the key was a peck or a wing-flap. Where the means of pressing the key is unknown, we will speak of key presses. Where pecks were observed, we will speak of key pecks. Where pigeons were observed to press the key with their wings, we will speak of wing-flaps.

EXPERIMENT I: 20-SEC SHOCK-OFF PERIOD

Four naive pigeons were exposed to the basic procedure with a shock-off period following negative reinforcement of 20 sec (condition A, Fig. 1). This condition continued for 20 sessions, during which two of the birds pressed the key, once each. One bird pressed the key during its fifth session, while the shock was at maximum intensity. The other pressed the key during its fourth session while shock was increasing.

EXPERIMENT II: 2-MIN SHOCK-OFF PERIOD

Several experiments with pigeons exposed to shock have led the present author and P. N. Hineline to speculate that adaptation to shock plays a large role in the escape and avoidance behavior of pigeons. If pigeons were adapting to shock during an increasing series of shocks, it is possible that the 20-sec shock-off period would not be sufficient time to lose the adaptation. The next series of shocks, presented to an adapted organism, would not be as aversive as the first; thus, escape behavior might not develop. It is also possible that 20 sec is not a sufficient magnitude of reinforcement. For this reason, six naive pigeons were given a procedure identical to that of Exp. I, except that each shock-off period following negative reinforcement lasted 120 sec. For four of the six pigeons, a camera and an electronic flash were fitted to the chamber to photograph the pigeon at the moment of each negative reinforcement. For these pigeons each session was about 90 min, covering 25 or more trials. Key presses shortened trials and hence increased the number of trials per session. For

the other two pigeons each session was about 150 min. With this procedure, all six pigeons pressed the key during the first session. Of the six birds, one (S-100) came eventually to press the key consistently with its wings; one (S-27) usually pressed the key with its wings, and occasionally pecked the key, while the other

four (S-7, S-26, S-28, and S-29) eventually pecked the key consistently. In this experiment, as well as in those to follow, there were very few presses during the shock-off period; at the most, two or three per session. Figure 2 shows, for one pigeon (S-7) that pecked the key, the development and subsequent fading

X AUTOMATIC NEGATIVE REINFORCEMENTS
 O REINFORCEMENTS AS A RESULT OF A PRESS ON KEY

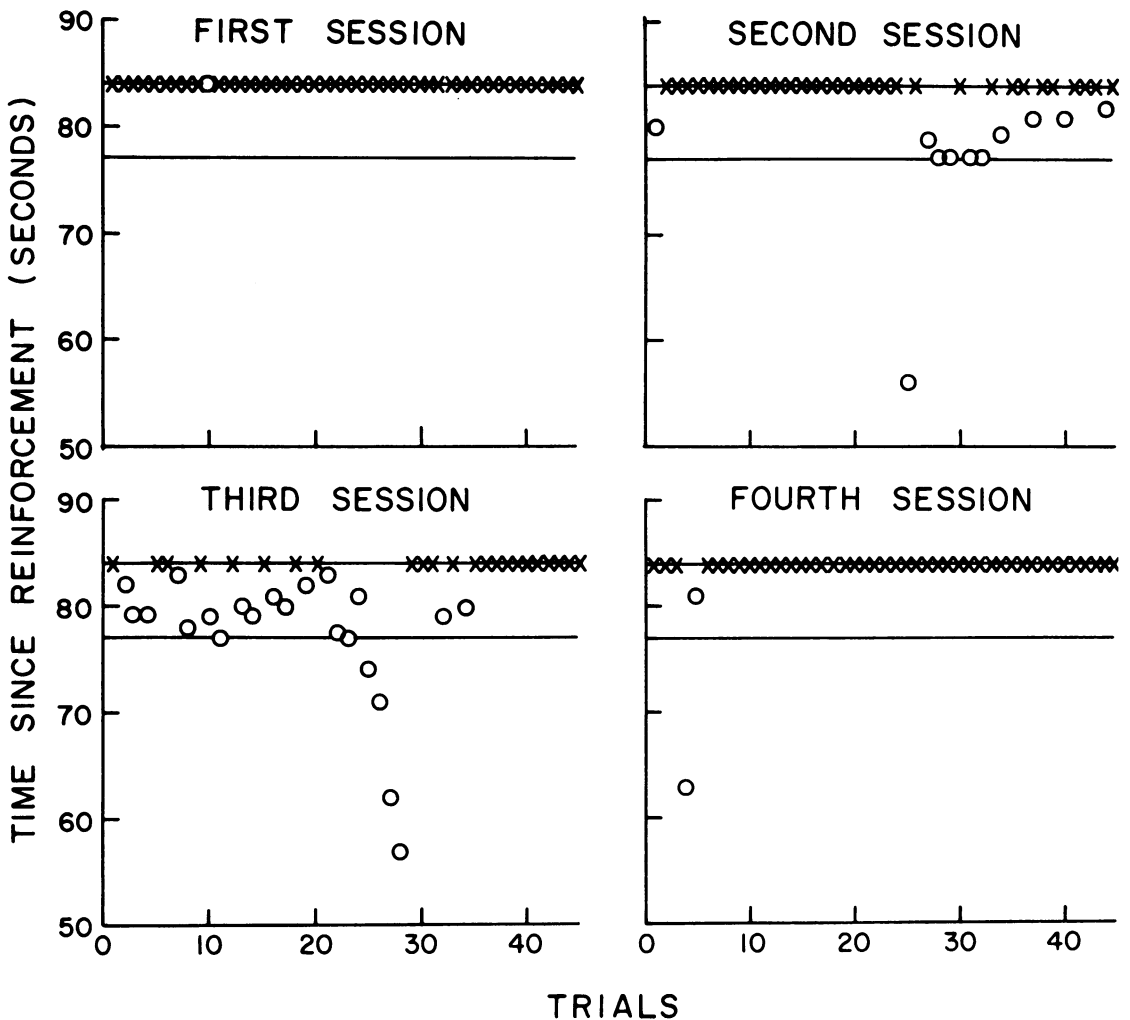


Fig. 2. The point at which reinforcement occurs measured since the end of the last reinforcement as a function of successive trials for subject No. 7. The lower horizontal line is at the time at which the shock reached maximum. The upper horizontal line is at the time at which automatic reinforcement occurred. Automatic reinforcements are indicated by a cross on the upper horizontal line. Presses of the key before this point are indicated by circles. If the circle is between the two horizontal lines, the press occurred on a lit key. If the circle is below the lower horizontal line, the press occurred on a dark key while the shock was rising. All presses, whether on lit or dark keys produced reinforcement.

out of key pecking. The first two or three presses were unobserved and could have been wing-flaps. The remaining presses were frequently observed and were all key pecks. Pecking started during the 7-sec period of constant intensity. However, by the third session several pecks were made during the period when the shock was rising. Within each session, pecking ceased to occur on the later trials. During the fourth session there were only two pecks. For this pigeon, in the fifth session, the automatic reinforcements were discontinued; the shock was held at 6 ma until a peck occurred. This caused pecking to start again, but it still decreased at the end of each session. At the ninth session, the maximum shock intensity was changed from 6 ma to 12 ma. The shock intensity rose at the same rate and took 154 sec to reach maximum, where it stayed until the key was pressed. This procedure decreased the latencies and, again, the shortest latencies for key pecking occurred at the beginning of the sessions.

The appearance of pecking and its subsequent disappearance and the increase in latencies as the session progressed were typical for those birds that pecked the key. The reappearance of pecking, after it had disappeared, when the shock was held at its maximum or when the maximum intensity was increased, was also typical. The bird that pressed the key consistently with wing-flaps started earlier than those that pecked, but pressing by this method was never as efficient, generally giving larger response latencies.

One may ask about this method of auto-shaping: "How much shaping is involved?" "Does the key peck, when it appears, appear gradually?" According to Brown and Jenkins, ". . . the emergence of the key peck may be characterized as a process of auto-shaping on which a direction is imposed by the species-specific tendency of the pigeon to peck the things it looks at. The bird notices the onset of the light and perhaps makes some minimal motor adjustment to it. The temporal conjunction of reinforcement with noticing leads to orienting and looking toward the key. The species-specific look-peck coupling eventually yields a peck to the trial stimulus."

If, as the above paragraph implies, adventitious reinforcement is responsible for the maintenance of orientation to the key and for the evolution of orientation into a peck, then

on trials just before the first peck the pigeon's head will be close to the key at the moment of reinforcement. Assuming that "noticing" involves orientation toward the key, photographs of the pigeons at the moment of reinforcement ought to reveal whether "temporal conjunction" of noticing and reinforcement has taken place. Of the four birds photographed, three eventually pecked the key consistently. Figure 3 shows for these three pigeons, photographs of the first key peck (N), photographs of the pigeon at the moment of negative reinforcement on the trial before the first key peck (N-1), and on the trial before that (N-2). The pictures show no steady progression towards key pecking. In fact, rarely do the pigeons seem to be looking at the key, except when they actually peck it. The moment of reinforcement is not a random moment with respect to the 7 sec of keylight. That particular moment plays a critical role in Brown and Jenkins' argument. Even if noticing and reinforcement were in "temporal conjunction" at trial N-5, say, and noticing increased in frequency yet did not result in pecking as of trial N-1, then the conjunction of not noticing with reinforcement found here at trial N-1 should have *decreased* the probability of a peck at N (by the same mechanism by which the "temporal conjunction" of noticing and pecking is purported to increase the probability of a peck). In order to extend Brown and Jenkins' argument from positive to negative reinforcement, the pigeon ought to have been noticing or looking at the key on trial N-1 *at the moment of negative reinforcement*.

If we abandon the assumption that only adventitious reinforcement maintains orientation and causes pecking to evolve, the moment of negative reinforcement loses its relevancy to the question of orientation. It may well be that the pigeons in the present experiment were oriented toward the key at moments other than the particular one of the photographs. It is therefore still possible that orientation occurs, is maintained, and evolves into a peck by factors other than adventitious reinforcement.

EXPERIMENT III: POSITIVE REINFORCEMENT

Four naive pigeons were run, under condition E, Fig. 1, with no shock, but with posi-

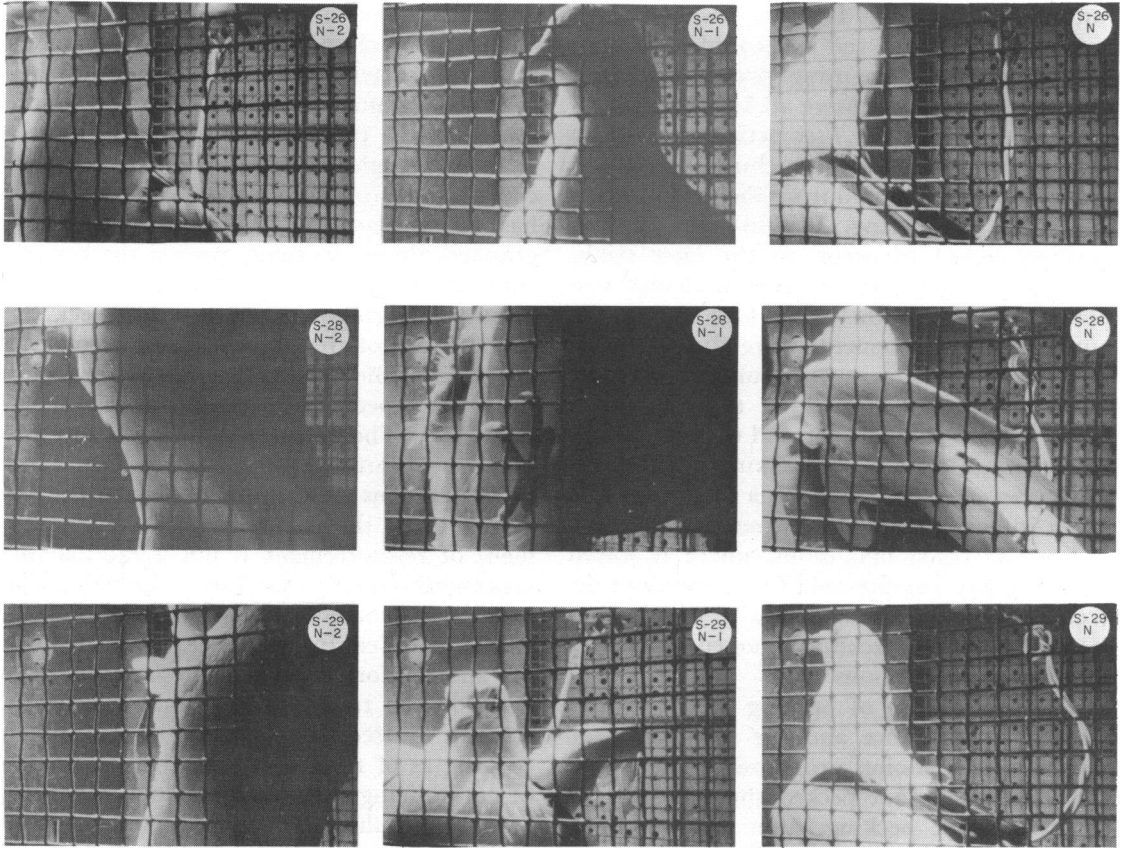


Fig. 3. Photographs of three pigeons at the moment of negative reinforcement. Photograph N shows the first peck on the key. Photograph N-1 shows the pigeons at the moment of automatic reinforcement on the trial before the first peck. Photograph N-2 shows the pigeons at the moment of automatic reinforcement, two trials before the first peck.

tive reinforcement instead. As in Exp. II, photographs were taken of the pigeons at the moment of each reinforcement, whether automatic or resulting from a peck. The purpose of this experiment was to see whether the failure to observe gradual shaping of the key peck as part of the autoshaping procedure was peculiar to negative reinforcement, and to compare negative and positive reinforcement with regard to the speed of conditioning under parallel conditions.

The first and most startling difference between positive and negative reinforcement is the relative speed of conditioning of the key peck with positive reinforcement. Despite the fact that these birds had no previous training with the food magazine, all four pecked the key within two sessions. Two of them pecked the key during the first session, after about 25 reinforcements, and the other two pecked the key after totals of 32 and 46 reinforcements.

Once pecking started, it was maintained consistently for all birds. The first peck by two birds occurred while the key was lit; the first peck of the other two birds was at a dark key. All pecks were effective. Within two or three trials after the first peck, all birds pecked almost immediately after each reinforcement. The schedule was now simply continuous reinforcement (CRF). Figure 4 shows photographs of the four pigeons at the first peck (N) and for the two reinforcements preceding the first peck (N-1 and N-2). As with negative reinforcement there is no discernible systematic progression toward the key peck except for one pigeon (S-30) that was oriented toward the key at N-2. The other pigeons do not seem to be looking at the key on the trials immediately preceding the peck. The topography of the peck itself seems to vary considerably between birds, but as far as can be judged from the pictures, pecks are not strik-

ingly dissimilar from pecks for negative reinforcement.

EXPERIMENT IV: INCREASING MAXIMUM SHOCK INTENSITY

The procedure of this experiment (Fig. 1, Condition C) was identical to that of Exp. II (Condition B) except that the maximum intensity of shock was 3 ma for the first two sessions, 4.5 ma for the next two sessions, and 6 ma thereafter. Five naive pigeons were sub-

jects. Three eventually pecked the key consistently and two hit the key with their wings. At 3 ma and 4.5 ma there were some stray presses but no consistent pressing from any of the birds. At 6 ma, four of the five birds pressed the key the first day. Two pecked and two flapped their wings. On the seventh session at 6 ma (the eleventh session of this procedure) after 250 trials with a total of 10 presses irregularly distributed among them, the fifth bird began to peck the key consistently. As opposed to the results of Exp. II, the

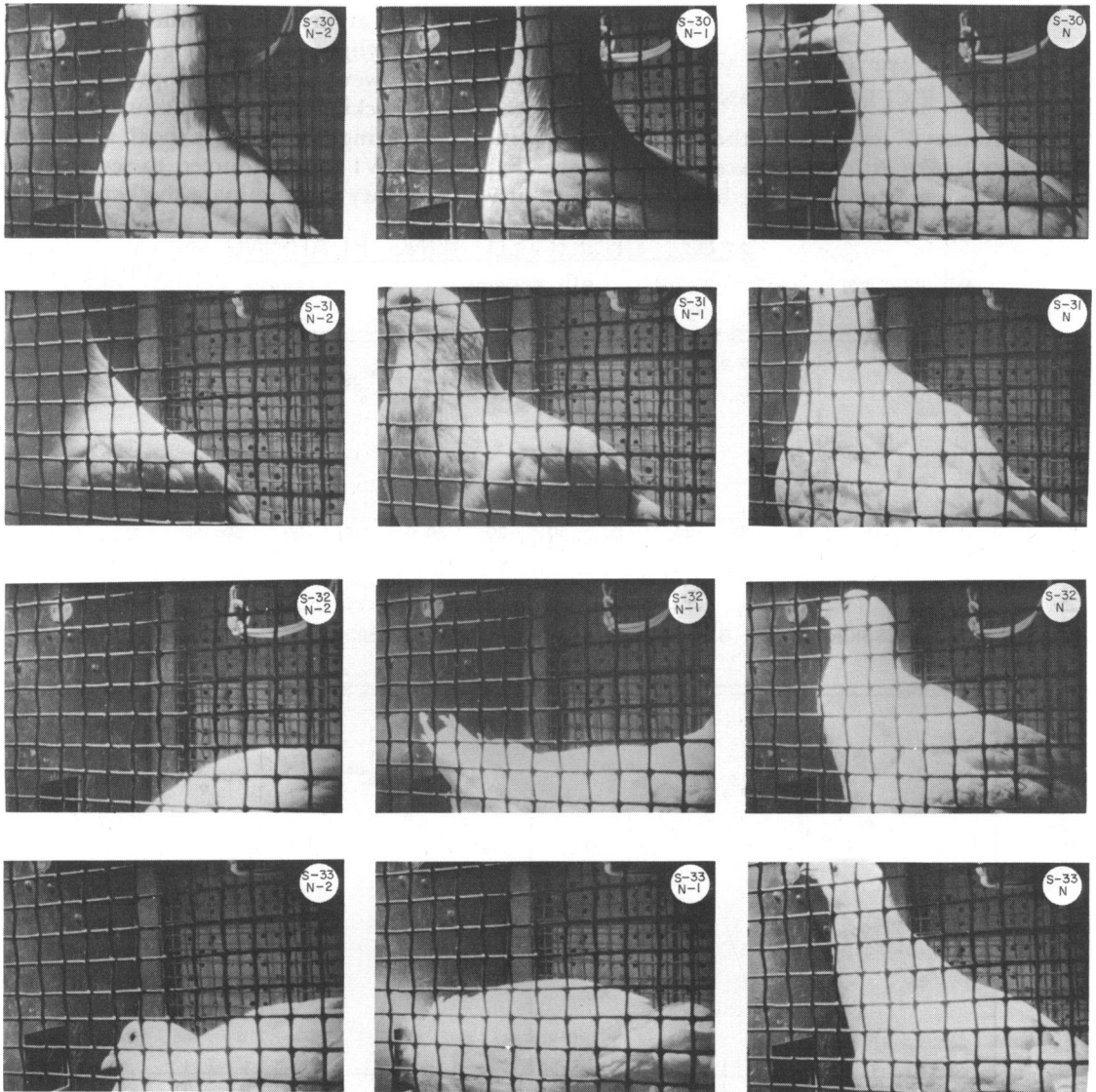


Fig. 4. Photographs of four pigeons at the moment of positive reinforcement. Photograph N shows the first peck on the key. Photograph N-1 shows the pigeons at the moment of automatic reinforcement of the trial before the first peck. Photograph N-2 shows the pigeons at the moment of automatic reinforcement, two trials before the first peck.

pecking and wing-flapping of the birds did not disappear. Therefore, there was no need to hold the shock at maximum to restore pecking and the autoshaping contingency with automatic negative reinforcement was maintained throughout.

Figure 5 portrays the performance of one bird that pecked and of one bird that hit the key with its wings. On the fourteenth day of this procedure, the extension was removed from the key. This did not affect the pecking, but greatly impaired performance when the presses were by means of wing-flaps.

**EXPERIMENT V:
NO EXTENSION ON KEY.**

Experiment V was exactly the same as Exp. IV (Fig. 1, Condition C), except that three naive birds were run from the beginning with

no extension on the key. Without the extension, one bird pecked during the fifth session at 6-sec maximum (ninth session of the procedure) and the other two did not press the key. The pecking of the one bird faded out after a few sessions, but was restored by holding the shock at maximum and discontinuing the automatic negative reinforcements.

**EXPERIMENT VI:
CONTINUOUS KEY LIGHT**

Most of the birds that came to peck consistently did so at first during the 7-sec period when the keylight was on (Fig. 2 and 5 are typical). However, occasional presses before consistent pecking appeared occurred on the unlit key during the time the shock was rising. Experiment VI was conducted to see whether it was necessary to illuminate the key 7 sec be-

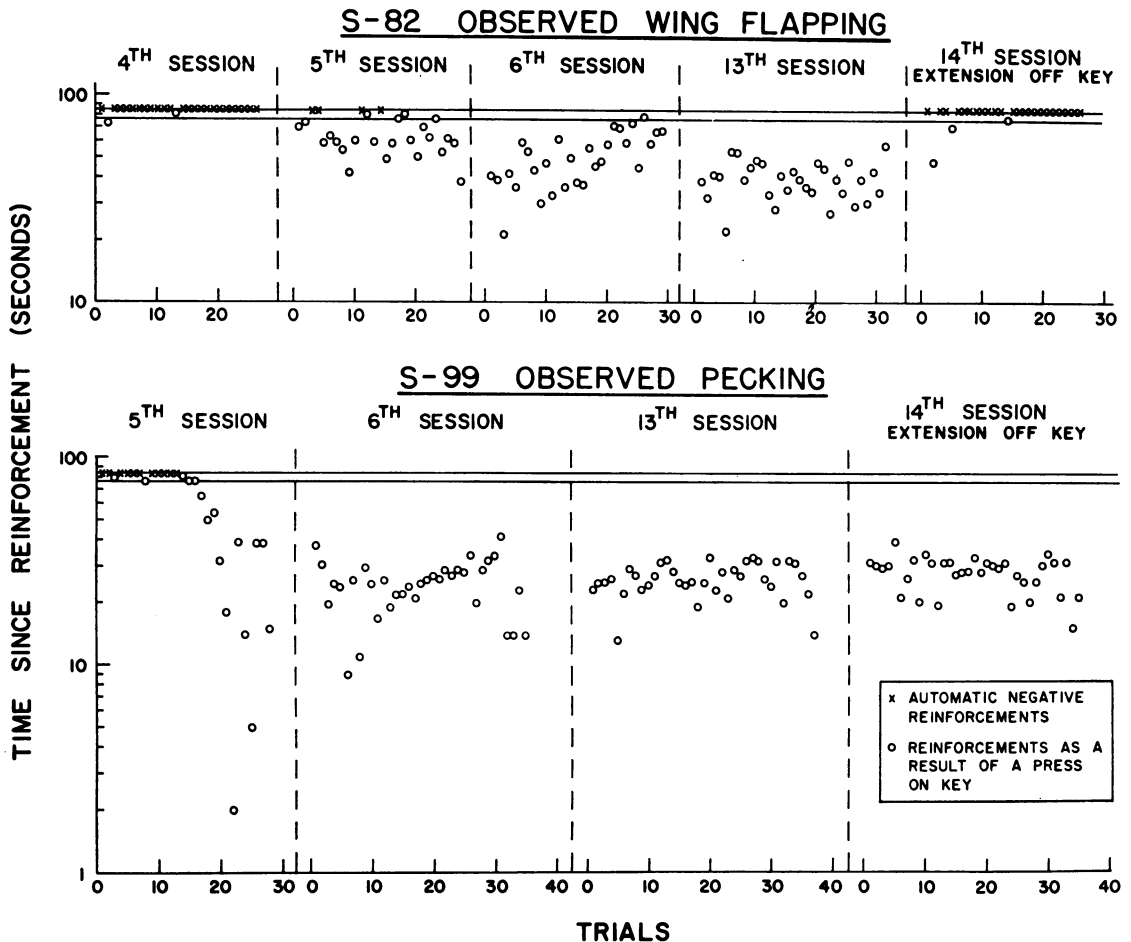


Fig. 5. The point at which reinforcement occurs measured since the end of the last reinforcement as a function of successive trials for two subjects for various sessions. See legend of Fig. 2 for interpretation.

fore negative reinforcement. In this experiment (Fig. 1, Condition D), four naive birds were run under conditions identical to Exp. IV (with the extension on the key) except that the key was continuously illuminated. With this procedure, two of the birds emitted wing-flaps and two did not press the key at all. One bird started to wing-flap when the maximum shock was at 4.5 ma (during the third session—after 55 trials) while the other did not wing-flap until the second session of 6-ma maximum shock. Once wing-flaps appeared they were sustained.

DISCUSSION

None of these experiments used enough subjects to be in any way statistically significant. They indicate what is possible, rather than what is probable. With regard to their primary purpose, however, the development of an efficient way to train pigeons to peck a key with negative reinforcement, they were at least partially successful. The method of Exp. II succeeded with four of six subjects, and the method of Exp. IV succeeded with three of five subjects in training key pecking and the other subjects pressed the key with their wings. Undoubtedly, parametric studies would reveal more efficient methods. Rachlin and Himeline (1967) found that pecking could be maintained both at faster and slower rates of increase of shock. Possibly some other rate of increase would yield faster shaping. Regarding the duration of the shock-off period after negative reinforcement, Exp. I showed that 20 sec is too short, but 120 sec may be longer than necessary. The rate of shock pulses at 1 per sec was also arbitrary. The extension on the key increased the probability of wing-flapping and pecking. However, with no extension on the key it was still possible to autoshape key pecking. A keylight that is sometimes dark seems to be necessary for generating key pecking, but wing-flapping will occur with a continuously present keylight, at least with the small number of birds in the present experiment.

Since autoshaping is a recently reported process, it is important to be specific about what sort of evidence might be required to establish that it has occurred. One possible criterion is that there be some shaping involved in the sense of a gradual approach to

the key. In the present experiments, this criterion was not satisfied with negative or positive reinforcement. With positive reinforcement, Jenkins reports (personal communication) having seen repeated instances of orientation toward the key well before the first peck, and Brown (1968) had human observers report orienting responses corresponding to photocell beam interruptions in the vicinity of a key. Given the difficulty of determining exactly where a pigeon is looking from the photographs of Fig. 3 and 4, and the fact that one of the pigeons seems to be oriented toward the key, progressive approximations to the key peck in all cases of autoshaping cannot be ruled out. However, it must be noted that the present experiments, to the extent that they provide evidence at all, provide evidence against orientation to the key at the moment of negative reinforcement on trials before the first peck. If proof of such orientation is a criterion for calling a process "autoshaping", the present experiments, including Exp. III, are not autoshaping experiments.

Another possible criterion is that the occurrence of the first peck be a function of the pairing of the keylight and the reinforcement. The present experiments provide suggestive, but not conclusive, evidence that such pairing is necessary. The fact that Exp. I and VI (where keylight and shock were both present) produced no consistent pecking, is evidence that a keylight and shock are not sufficient for generating pecks. The wing-flapping of Exp. II and IV could be explained as a simple increase in probability by the shock as might occur if wing-flapping were a pain-induced aggressive response, such as those reported by Ulrich and Azrin (1962). However, the same cannot be said of pecking, since pecking did not appear in Exp. VI where the stimuli were equally painful and the keylight was present. Evidently, the briefly lit key is necessary for autoshaping of pecks with negative reinforcements. However, it is conceivable that the electric shock somehow sensitizes the pigeons so that they are more likely to peck at a briefly lit key. If this hypothesized sensitization were indeed effective, it could account for the present results without the necessity of the keylight and negative reinforcement being paired. A better test of the necessity for pairing keylight and reinforcement was made by Brown (1968) with positive reinforcement. He pre-

sented two keys, one with illumination paired with reinforcement and the other with illumination unrelated to reinforcement. The pigeon's first peck was invariably on the paired key, showing the relative power of pairing in autoshaping with positive reinforcement. Unfortunately a similar test with negative reinforcement has not yet been made.

A third possible criterion for calling a process "autoshaping" is that it provides an automatic method at least as efficient as hand shaping for generating the required behavior. This criterion was satisfied by the present experiments.

The ambient stimuli are important in determining not only whether key pressing occurs, but also the kind of key pressing obtained. Another experiment, not reported in the previous section, might be worth mentioning here in this connection. An attempt was made to take motion pictures of the movements of the pigeons in the box during the 7 sec that the keylight was on, just before negative reinforcement. In order to do this, five naive pigeons were exposed to the conditions of Exp. IV, except that when the keylight came on, a bright floodlight also came on to provide enough light for the motion pictures. With this procedure, none of the five subjects pecked the key, although four of them hit the key with their wings. The floodlights prevented the key from standing out in the total stimulus configuration in the box. Illuminating the key for a short period of time with a light contrasting significantly with its surroundings is required for key pecking to emerge with negative reinforcement. Obviously, key pecking will not occur unless something about the key draws the pigeons' attention to it. A randomly selected unmarked area of the wall equal to the area of the key would rarely be pecked by a bird being shocked, or by a hungry bird.

Despite the fact that there was no evidence of shaping in the sense of a gradual approach to the key, it is reasonable to assume that something about the key caused the pigeon to look at it before the peck. The same need not be true, however, with regard to wing-flapping. The fact that wing-flapping was obtained with the key continuously lit and with the photographic floodlights on indicates that, at first, the contact between the wing and the key could have been fortuitous. Later, however,

wing-flaps become stereotyped. Birds that developed early consistent wing-flapping did not peck the key.

Thus, behavior with a low operant level in the experimental situation is susceptible to autoshaping provided that a balance is struck between two somewhat contrary conditions:

a. The situation should be manipulated to increase the probability of the response in question, *e.g.*, by the extension on the key and by making the key distinct from its background;

b. But, in doing this, the class of behavior acting as an operant must not be broadened so extensively as to allow topographies with higher operant levels than the behavior-to-be-shaped to fall into that class.

For example, in the present experiment, wing-flapping, with a higher operant level than pecking in the experimental situation, could have the same effect on the environment as pecking (it could press the key). A still larger extension on the key would increase the probability of reinforcement from a peck, but it also would increase the probability of reinforcement from a wing-flap. Wing-flapping occurs more frequently than pecking with naive shocked pigeons, and when wing-flaps are successful they become stereotyped and interfere with the acquisition of the pecking response. So it is possible that a larger extension on the key would actually reduce the proportion of birds that would peck despite the fact that it increases the operant level of pecking. A balance must be reached, apparently, between increasing the operant level of the response to be shaped, and increasing the operant level of other, perhaps undesired, responses.

Finally, the difference between the rapid acquisition of key pecking with positive reinforcement (an average of 32 trials) and the slow acquisition of key pecking with negative reinforcement (about 90 trials in comparable cases) needs to be accounted for. A major factor, almost certainly, is the relatively high operant level of pecking in a situation where a hungry pigeon is fed *versus* the low level of pecking in a situation where a pigeon is shocked. However, another factor may be that even naive pigeons are experienced with food and with food deprivation. Also, they are experienced with making instrumental responses to obtain food (*e.g.*, hunting on the

floor of their cages). It is possible that comparable experience with shock would reduce the number of trials necessary to autoshape key pecking with negative reinforcement.

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