

## Effects of treadle training on autoshaped keypecking: Learned laziness and learned industriousness or response competition?\*

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Pigeons either trained to treadle hop for food or given response-independent food were exposed to positive and negative keypeck automaintenance procedures. Effects of pretraining on *acquisition* of keypecking were minimal. Measures of asymptotic levels of pecking indicated that treadle-trained pigeons with access to the treadle during automaintenance and pigeons that had obtained free food pecked less than either naive pigeons or treadle-trained pigeons that did not have access to the treadle during automaintenance. On negative automaintenance, treadle-trained pigeons pecked substantially more than either naive or free-food pigeons. These data suggest that prior experience influences automaintenance via response competition, rather than by inducing states of learned laziness or industriousness in organisms, as suggested by Engberg, Welker, Hansen, and Thomas (1973).

If a response key is briefly illuminated and followed by access to grain, pigeons come to peck the key and pecking is maintained despite the absence of a dependency between pecking and food (Brown & Jenkins, 1968). This phenomenon, which is procedurally identical to classical conditioning, has been called "autoshaping" and "positive automaintenance." Engberg, Hanson, Welker, and Thomas (1973) have recently shown that, if pigeons are given response-independent (free) food prior to exposure to the autoshaping procedure, acquisition of keypecking (to a criterion of pecks in 8 of 10 successive trials) is substantially retarded. This phenomenon might be explained on the basis of response competition. During free-food delivery, some behavior is adventitiously reinforced (e.g., Skinner, 1948; Herrnstein, 1966) and this behavior persists during autoshaping and competes with the development of keypecking. To test this explanation, Engberg et al trained a group of pigeons to hop on a treadle for food. The treadle was located in a place which made simultaneous keypecking and treadle hopping impossible. Engberg et al argued that, if response competition retards autoshaping in pigeons that have been obtaining free food, an explicitly reinforced incompatible response, like treadle hopping, should retard autoshaping still more. However, when the treadle-hopping pigeons were exposed to the autoshaping procedure (with the treadle removed from the chamber), they acquired keypecking *more rapidly* than experimentally naive control pigeons. Engberg et al concluded that a competing response explanation of their findings was inadequate. They proposed instead the concepts "learned laziness" and "learned industriousness" to account for their results. Both

concepts refer to a generalized expectancy in the organism about the relation between its behavior and reinforcing events. The "lazy" organism learns that its behavior and reinforcing events are independent, and as a result, is slow to behave. This expectancy presumably characterizes the pigeons in the free-food group. On the other hand, the "industrious" organism learns that there is a positive relation between its behavior and reinforcing events, and is thus quick to respond. This expectancy presumably characterizes pigeons in the treadle group. "Laziness" retards acquisition of keypecking while "industriousness" facilitates acquisition of keypecking. These concepts appear to be appetitive analogs of the concept of learned helplessness (e.g., Maier, Seligman, & Solomon, 1969).

Engberg et al's experiment has recently been criticized on a variety of grounds, both methodological and theoretical (Gamzu, Williams, & Schwartz, 1973). First, Engberg et al's dependent variable, a criterion of one peck in 8 of 10 trials, makes it difficult to decide whether the effects they observed are on acquisition or maintenance of keypecking. Other manipulations which have resulted in interference with keypecking on procedures similar to autoshaping have had their effects on maintenance rather than acquisition (Gamzu & Williams, 1971, 1973). It would be valuable to know whether free-food delivery similarly retards maintenance of pecking rather than acquisition. Second, in the Engberg et al study, when the treadle group was exposed to autoshaping, the treadle was removed from the chamber. This procedural detail makes it difficult to decide between a competing response explanation of the result and a learned laziness-industriousness explanation. Consider again a competing response explanation. A superstitious response pattern develops in the free-food group, and an explicitly incompatible response is developed in the treadle group. Then, both groups are exposed to the autoshaping procedure. The superstitious

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response continues in the free-food group. However, with the treadle out of the apparatus, the explicitly trained incompatible response cannot occur. As a result, the past experience of the treadle group interferes less with autoshaping than the past experience of the free-food group. While this account can not explain the fact that the treadle group autoshaped more rapidly than a naive control group, that effect was small in Engberg et al's experiment, and it might be explained by the greater familiarity with the apparatus of the treadle group relative to the control group. Thus, to disambiguate the two possible explanations, a group of pigeons trained to treadle hop should be exposed to autoshaping procedure with the treadle still present in the chamber.

The present experiment was designed to clarify these ambiguities in the Engberg et al experiment. In addition, it was designed to put one implication of Engberg et al's explanation of their findings to experimental test. One of the most striking phenomena observed with autoshaping procedures is that when a response-key illumination signals food delivery, keypecking is established and maintained even when keypecks *prevent* the delivery of food (Schwartz & Williams, 1972a, b; Williams & Williams, 1969). This phenomenon has been called "negative automaintenance," and it suggests that the keypecks which occur on autoshaping procedures are relatively insensitive to their consequences. The concept "learned industriousness" is based upon the assertion that the organism learns that reinforcing events are dependent upon its behavior. Said another way, "industrious" organisms are sensitive to contingencies between their behavior and its consequences. If treadle-trained pigeons are industrious, i.e., sensitive to the consequences of their behavior, then on exposure to an autoshaping procedure in which the contingency between pecking and food is negative, their keypecking should cease, or at least decrease relative to the keypecking of pigeons in the other groups. Similarly, "lazy" pigeons, which have learned that reinforcing events are independent of their behavior, should be minimally affected by a negative contingency between pecking and food. In summary, the implication of the Engberg et al argument is that on positive automaintenance, the treadle group should peck most and the free-food group least, while on negative automaintenance the treadle group should peck least and the free-food group most.

## METHOD

### Subjects

Twelve adult male White Carneaux pigeons, maintained at 80% of free feeding weight, were experimentally naive at the start of the experiment.

### Apparatus

A foot treadle was installed in a standard Lehigh Valley pigeon chamber panel (Model No. LVi519C). The treadle was 20.5 cm long and 7.5 cm wide. It was located 9 cm from the

panel and 3.5 cm from the floor of the chamber. The middle of the treadle was in line with the response key, which was 24.5 cm from the floor of the chamber. It was thus possible for pigeons to orient toward and peck the response key while treadle hopping. A houselight was located directly above the key, and it was shielded so that light was directed toward the ceiling of the chamber. A food magazine located beneath the key permitted 4 sec access to mixed grain. During food delivery, a light was on in the feeder and the houselight was off. At all other times, the houselight was illuminated. Treadle hops went through a normally closed pulse former to recording and control equipment. Thus, the effective component of the treadle hops was movement off the treadle, effectively eliminating treadle perching by the pigeons.

### Procedure

**Pre-training.** The pigeons were trained in one session to eat from the feeder, until the latency of approach to the feeder was minimal in 10 successive feeder operations. They were then divided into four groups. One group (naive) was immediately exposed to the autoshaping procedure described below. Two other groups (treadle and treadle out) were trained to treadle hop by the method of successive approximations. Initially, all treadle hops were reinforced. The reinforcement schedule was gradually changed to a fixed ratio of 10 over the course of 2 sessions. When treadle hopping appeared stable, all animals were shifted to a variable interval 30-sec (VI 30 sec) schedule, which was in force for 21 daily sessions. Each session consisted of 30 reinforcements. Finally, pigeons in the fourth group (free food) received response-independent food presentation for 21 30-reinforcement sessions. The food was delivered at variable intervals averaging 30 sec and was thus identical in frequency to the reinforcements obtained by pigeons in the treadle groups.

**Autoshaping.** All 12 pigeons were then exposed to fixed-trial positive autoshaping procedure. Periodically, the response key was illuminated with red light for 6 sec, and followed by 4 sec access to grain. Pecks had no programmed consequence. Trials were separated by a variable intertrial interval (ITI) with a mean of 30 sec, and each session contained 30 trials. After 14 sessions of positive automaintenance, the procedure was changed to fixed-trial negative automaintenance. Here, on trials with no peck, the feeder operated after 6 sec. If the pigeon pecked the illuminated key, the trial still terminated after 6 sec, but in this case, without food delivery. After 21 sessions of exposure to the negative automaintenance procedure, the experiment was terminated. For the pigeons in three of the groups (treadle, naive, and free food), the treadle was present in the chamber during automaintenance sessions, and treadle hops were counted. For the treadle-out group, the treadle was absent in all automaintenance sessions.

## RESULTS

One of the problems suggested with Engberg et al's experiment is the potential confusion of acquisition and maintenance posed by trials to criterion as a dependent variable. Thus, a number of different measures of keypecking were taken in the present experiment. Figure 1 presents trial of the first peck, and the trial in which a criterion of at least one peck in 8 of 10 successive trials (Engberg et al's criterion) was met, for each pigeon. Vertical lines separate the groups and the mean for each group is included in the figure. The differences among the groups is small. The naive pigeons pecked the key for the first time in the fewest trials and the treadle pigeons were the slowest, but there is substantial overlap among the groups. With respect to

the trials to criterion measure, the effects reported by Engberg et al and the present data are consistent. The treadle pigeons reached criterion in fewer trials than the naive pigeons, and the free-food pigeons required more trials than the naive pigeons. However, these differences resulted almost entirely from the behavior of 2 pigeons—1 each in the naive and the free-food groups. The behavior of the other 10 pigeons was roughly homogeneous. It should be noted in this regard that there was virtually no difference between the treadle and treadle-out groups. Thus, with respect to the acquisition of keypecking, the differences among the groups were not impressive. Both measures of acquisition were not significant by a Kruskal-Wallis one-way analysis of variance.

Figure 2 presents data on maintenance of keypecking. The top portion of the figure reports the percentage of trials with at least one response over the last 5 sessions of the positive automaintenance procedure. All 3 pigeons in the treadle-out group responded in every trial. The naive pigeons responded in 91% of the trials, while the treadle and free-food pigeons responded in 85% of the trials. Thus, there is a difference in maintenance level as a function of whether the treadle is present or not during automaintenance trials. When it is present, treadle and free-food groups are indistinguishable. When it is not present, more pecking occurs. While these differences are not significant (Kruskal-Wallis one-way analysis of variance), they are inconsistent with the model proposed by Engberg et al.

The point is amplified in the middle portion of the figure, which presents responses per trial averaged across the last 5 sessions of positive automaintenance. This

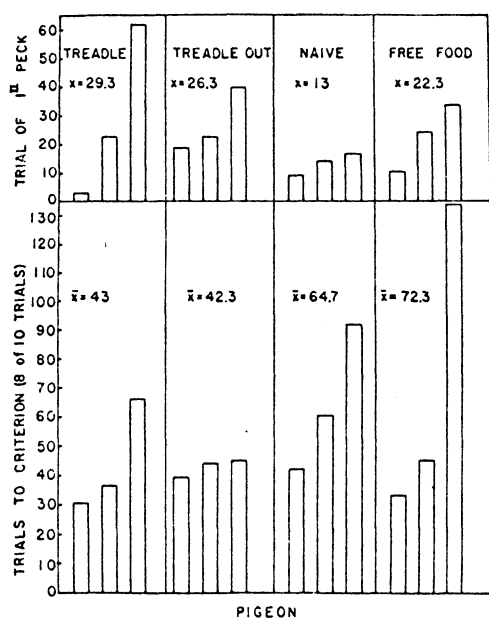


Fig. 1. Trial of the first keypeck (upper portion), and trial on which a criterion of a peck in 8 of 10 successive trials was reached for each pigeon. The groups are separated by vertical lines, and the group mean is presented in each panel.

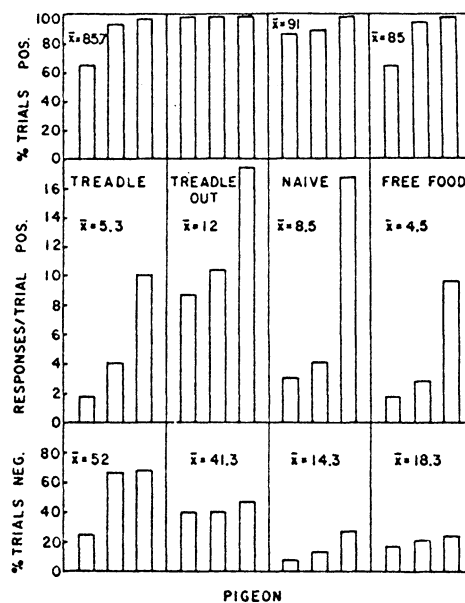


Fig. 2. Proportion of positive automaintenance trials with a response (upper portion), responses per trial on positive automaintenance (middle portion), and proportion of negative automaintenance trials with a response (lower portion) for each pigeon. Data are averaged across the last 5 sessions of each procedure. Group means are presented in each panel.

statistic was obtained by dividing the total number of pecks by the number of trials in which at least one peck occurred. Trials with no peck are not included. Thus, this response rate measure is relatively independent of the response probability measure in the upper part of the figure. The pigeons in the treadle-out group pecked 12 times per trial, or 120 times per minute. This is substantially more than in the other three groups. Again, the treadle and free-food groups were approximately equal, averaging 5.3 and 4.5 responses per trial, respectively. The naive pigeons were in between, averaging 8.5 responses per trial. While these effects were also not significant, on both measures of maintenance presented, the presence or absence of the treadle seemed to have an effect. With the treadle absent, the conclusions of Engberg et al were supported; with the treadle present, they were contradicted.

The bottom portion of the figure presents the proportion of trials with at least one response over the last 5 sessions of negative automaintenance. Recall that the implication of Engberg et al's argument is that the treadle groups would decrease pecking rapidly relative to the other two groups. As is evident from Fig. 2, just the opposite occurred. After 21 sessions, the treadle-out group was responding in 41% of the trials, and the treadle group in 52% of the trials while the naive and free-food groups were responding in 14% and 18%, respectively ( $p < .05$ , Kruskal-Wallis one-way analysis of variance). Thus, the treadle animals are substantially less sensitive to the negative response-reinforcer contingency than the animals in the other groups. Note that for the first time, the behavior of treadle and free-food animals

diverged significantly. Measures of response rate during negative automaintenance are not presented. The responding of all pigeons was reduced to between one and two responses per trial within 10-14 sessions of the negative automaintenance procedure.

### DISCUSSION

The results of the present experiment do not support Engberg et al's (1973) conclusion that specific experiences may induce organismic states of laziness or industriousness, which subsequently retard or facilitate autoshaping. The problem is not that the present experiment failed to replicate Engberg et al's findings. It is, rather, that the findings in the present experiment, which amplify those of Engberg et al, argue against an organismic interpretation and for a competing response interpretation of all the findings. For example, Engberg et al's explanation does not suggest that whether or not the treadle is present during autoshaping is significant. For a competing response view, the presence or absence of the treadle is crucial. With treadle present, treadle pigeons and free-food pigeons should behave similarly. With treadle absent, treadle pigeons and naive pigeons should behave similarly. The present data are consistent with these expectations. Also, the Engberg et al position leads to the prediction that treadle-trained pigeons will be especially sensitive to a negative response-reinforcer dependency and thus be fastest to stop responding on negative automaintenance. Again, the present data are inconsistent with this position. It could be argued with respect to the negative automaintenance phenomenon that since Engberg et al refer to learned industriousness as a "set to respond," they would expect treadle-trained pigeons to peck more rather than less than the other groups, which is what we found. However, they presented no data indicating that treadle-trained pigeons *respond* more than other groups—only that they peck the key more. Moreover, the learned helplessness model on which Engberg et al's predictions are based clearly involves learning about contingencies, and not merely learning to respond.

The fact that the concepts of learned laziness and learned industriousness fail to explain the data from this experiment does not necessarily imply that the concepts are generally faulty, of course. It is possible that autoshaping of keypecking is simply the wrong phenomenon for assessing the presence of such organismic states. A large and rapidly growing literature strongly suggests that autoshaping involves a classical conditioning process, and that autoshaped keypecks are not appropriately viewed as instrumental (Gamzu & Williams, 1971, 1973; Jenkins & Moore, 1973; Schwartz & Williams, 1972). Thus, the treadle train-autoshape paradigm may be viewed as an instance of instrumental conditioning followed by classical conditioning. Now consider the concept of learned helplessness (Maier et al, 1969), on which learned laziness and learned industriousness are modeled. Learned helplessness results from classical conditioning *prior* to instrumental conditioning, and the order in which animals experience these procedures is crucial. Indeed, there is a

very large number of studies employing aversive stimuli in which classical conditioning followed instrumental conditioning, with no sign of learned helplessness (e.g., Rescorla & Solomon, 1967). The fact that learned helplessness does not develop in such situations does not necessarily imply that laziness or industriousness will not develop when organisms are exposed to classical conditioning procedures after instrumental ones. However, it does suggest that there may be procedures which are better suited to producing such effects if they are demonstrable at all. Indeed, even if industriousness or laziness were learned, it is unclear what effect knowledge of the relation between one's behavior and reinforcing events could have on the formation of conditioned reflexes.

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