# Immediate reward followed by extinction vs. later reward without extinction[1]

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*Pigeons could obtain reinforcements either by pecking at a key immediately after it was trans-illuminated by red light or by delaying their pecks until the light turned green. Each reinforcement for pecking at the red key was followed by a period of extinction, but no penalty followed reinforcement for pecking at the green key. Although pigeons did not delay often, their tendency to do so increased in proportion to the advantages of delaying.*

Several experiments have demonstrated that organisms can delay or withhold the emission of a particular response in order to obtain reinforcement (e.g., Reynolds, 1961; Ferster, Appel, & Hiss, 1962; Findley, 1962). In these experiments emission of a response delays the reinforcing event. But when emission of the response leads to *immediate* reinforcement and a lower overall rate of reinforcement will the organism still delay? In other words, will the organism's behavior be partially controlled by the events that occur subsequent to the immediate reinforcement? If so, the organism should delay more often as the penalties subsequent to the reinforcement increase. Similarly, as the rewards for delaying are increased, delays should be more frequent. For example, in the present experiment with pigeons, a single peck in the presence of a red light produces food, followed by an extinction period. Non-emission of a response in red, however, produces a green light during which one or three reinforcements, without subsequent extinction periods, are available on an intermittent schedule of reinforcement. The advantages of delaying, in terms of reinforcement density, increase as the length of the extinction period increases and are greater when three reinforcements are made available following delay. If the pigeon is capable of delaying it would be expected to delay more often as the advantages of delay increase.

## Method

The Ss were three adult male, White Carneaux pigeons maintained at 80% of their free-feeding body weights. All were experimentally naive. A conventional experimental chamber for pigeons (Ferster & Skinner, 1957) contained one Plexiglas response key, trans-illuminated by red or green Christmas tree lights fixed behind it. Below the key was an opening through which grain was sometimes available for 3 sec. (reinforcement). The chamber was illuminated by two 6-w lamps.

At the onset of the experimental session the key was red and remained so for d sec. (a variable), unless S pecked at it. A peck at the red key was reinforced, but reinforcement was followed by a period of time (1 or 30 min.) during which the key remained red and further pecks were ineffective. At the end of this extinction period the key turned green and S could obtain a single reinforcement after five responses (FR 5). The key then turned red once again, and the above sequence of events could recur. If at any time S did not peck for the duration of time d after the onset of the red key, the key turned green. In this event also, a FR 5 schedule was associated with the green stimulus but now either one or three reinforcements were programmed. After these reinforcements the key again turned red. Thus, S was offered the choice of obtaining immediate access to food for a single peck at the red key, followed by an extinction period, or of delaying in order to obtain one or three reinforcements afterwards.

Although S's rarely delayed in the first few weeks of training in this procedure their tendency to do so increased and stabilized during six months of daily preliminary training. Three test conditions were then introduced. These conditions varied the length of the extinction period following reinforcement for pecking at the red key and the number of reinforcements following delay. They may be summarized as follows:

I. Delay → (green) one reinforcement → return to red
   no delay → reinforcement plus 1-min. extinction → (green) one reinforcement → return to red

II. delay → (green) three reinforcements → return to red
   no delay → reinforcement plus 1-min. extinction → (green) one reinforcement → return to red

III. delay → (green) three reinforcements → return to red
   no delay → reinforcement plus 30-min. extinction → (green) one reinforcement → return to red

The required delay time (d) was varied throughout from 1/2 sec. (close to the time pigeons take to rise from the food-magazine and peck at the key) up to the value at which delays occurred on less than 5 percent of the trials. The order of conditions with delay time and number of sessions for each were as follows: III, 1-1/2 sec., 4; III, 2 sec., 4; III, 1 sec., 4; III, 2-1/2 sec., 4; III, 3 sec., 4; II, 1-1/2 sec., 11; II, 1 sec., 6; II, 2 sec., 7; I, 1-1/2 sec., 8; I, 1 sec., 16; I, 1/2 sec., 5; III, 1/2 sec., 7; II, 1/2 sec., 8. Finally there were nine sessions in which the extinction period following immediate reinforcement was removed. In these ses-

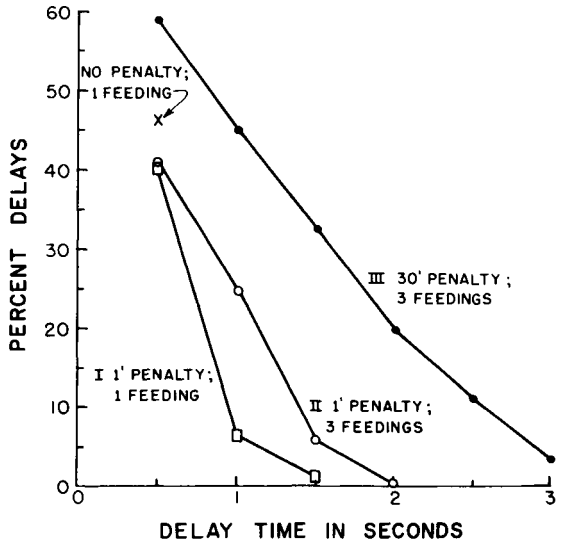


**Fig. 1. The greater the advantage to delay, the greater the percentage of delays. Hence the curve for Condition III is highest and that for Condition I lowest. Each point represents the average for the three birds over the last three sessions under each test situation.**

sions the delay time was 1/2 sec. and one reinforcement was obtainable after delay. All test sessions terminated after 50 reinforcements.

## Results and Discussion

In Condition III the advantages of delaying, in terms of reinforcement density, are most pronounced; in Condition I, least. Hence, if pigeons are capable of withholding a response which would produce immediate reinforcement they would be expected to do most often in Condition III and least often in Condition I. This is confirmed by an increase in percent delays for a constant delay time as one moves from Condition I to Condition III, as seen in Fig. 1, where each point represents the average for three Ss over the last three sessions under each test procedure. Delay time is represented on the abscissa; percent delays (trials in which pecks were not made at the red key divided by total trials, multiplied by 100), along the ordinate. The only ambiguous point is at d=1/2 sec. where the value for Condition II is only 1.2 percent above that for Condition I. But 1/2 sec. is close to the pigeon's reaction time and inter-session results were variable here. In fact, when the extinction period following reinforcement for pecking at the red key was removed altogether, the Ss still "delayed" often enough to establish the point marked by an "X" at 1/2 sec. While the individual data reveals individual differences in degree of delaying, each S delayed most in Condition III and least in Condition I.

In a related experiment, Hendry (1962) showed that rats would respond at a lower rate throughout a fixed-interval schedule of food reinforcement when larger amounts of food were contingent upon long terminal inter-response times. The individual data in the present experiment reveal that each S's overall rate of key pecking was virtually unaffected by the condition employed. Moreover, the S which generated the lowest response rate delayed *least* often. Hence, the degree of delaying could not be a result of changes in the overall rate of responding.

In the presence of the red stimulus food may be obtained immediately after a single response. If no response occurs, whatever behavior occurred in lieu of the response is reinforced by the onset of the green stimulus, in which presence one or three reinforcements are available on FR 5. But such reinforcements occur several seconds after the onset of the red stimulus, whereas the primary reinforcement for an immediate response to the red occurs immediately. Since it is well established that immediate reinforcement is more effective than delayed reinforcement in strengthening a response (e.g., Logan, 1952; Fantino, 1964) the pigeons' failure to delay for longer periods is not surprising. Indeed, it is encouraging that the pigeons delayed at all and that their delays increased as the number of reinforcements for delaying increased and as the penalty for *not* delaying increased.

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## Note

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