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# *THE QUAIL, Coturnix coturnix, AS A LABORATORY ANIMAL*

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**The quail, *Coturnix coturnix*, is small, gentle, hardy, adaptable, easy to house, and economical to maintain. Wetherbee and Jacobs (1960) call it the "*Drosophila* of the avian laboratory," and yet this charming bird is virtually unknown to the psychological laboratory. Our preliminary investigations show that the pecking operant is readily conditioned and that little or no deprivation is necessary to maintain behavior with food as a reinforcer. Visual and temporal discriminations were very quickly made. Our observations suggest that the social behavior of these birds might be a fruitful area for psychological study. On the basis of our somewhat limited observations, we believe that *C. coturnix* should prove a useful experimental animal for comparative studies, for basic research in learning, motivation, and perhaps social behavior, and for teaching the analysis of behavior in demonstrations and laboratory courses.**

In the Spring of 1960, Professor Lawrence M. Bartlett and Dr. David Kenneth Wetherbee introduced us to *Coturnix coturnix*, the common European Quail, and suggested that it might prove a satisfactory member of the class *Aves* for laboratory work in psychology.[1] Wetherbee (1961, p. 182) has written, "It is ironic that this, the first bird species domesticated by man (The Mastaba of Mereruka, pt. 2, University of Chicago Art Institute, Sakkarah Expedition, 1938) should only in the 20th century be recognized for its potentialities as a pilot species for biological laboratory research. The adaptability of the bird to battery breeding cages, its prolificacy, and its accelerated ontogeny make it analogous to the white rat or fruit fly in its utility for laboratory experiments."

A migratory game bird that readily adapts to close confinement in the laboratory offers interesting possibilities for comparative study. Padgett and Ivey (1959) point out that the domestic fowl is the only other bird that is so hardy, adaptable, and easy to raise under laboratory conditions. This is the more remarkable because the gallinaceous birds have a reputation for being difficult to handle under close confinement. One of our male *Coturnix* was maintained indoors in apparent perfect health in a cage 7 by 11 in. by 10 in. high, with three sides and the top opaque, in an artificially lighted basement room. However, for humane reasons alone, we do not recommend such close confinement; and this male is now living in a large outdoor cage with one of the hens. In England, the comfort of caged birds is protected. Russell, twelfth Duke of Bedford reports: "It is now, I believe, the law of the land that no bird, except when on a railway journey or at a show, may be kept in a cage which does not allow him freely to stretch his wings." (Bedford, 1954, p. 1)

## GENERAL DESCRIPTION

The following general description of *C. coturnix* is derived from Wetherbee's summary of the existing literature on this quail (Wetherbee, 1961) and from our observations of the three birds we are studying in our laboratory. It is a small, cinnamon-colored, terrestrial galliform, 7-8½ in. long, weighing approximately 100 g, and considerably smaller than the Bobwhite (*Colinus virginianus*).

*Coturnix coturnix*, subspecies *japonica* (Temminck & Schlegel), was introduced into North America from Japan during the late 1950's. This is a subspecies of the common European quail, referred to in the Old Testament and pictured in bas reliefs of ancient Egypt.

Although the incubation period of *C. coturnix* is 16-17 days (a week shorter than that

[1]Professor Bartlett, who is currently studying imitative behavior in *C. coturnix*, is a zoologist at the University of Massachusetts, where Dr. Wetherbee, of the U. S. Fish and Wild Life Service, is presently stationed.

of the Bobwhite and other quail), its bones are much further ossified at hatching (Wetherbee, 1959). Other acceleration of growth is evidenced by the fact that in captivity, males mature sexually at 28 days, and females lay fertile eggs as early as 31 days. These accelerated growth characteristics may prove valuable for comparative study.

In the wild, this quail inhabits agricultural fields and upland grassland, feeding on the ground along the periphery of dense vegetation. It eats fallen seeds and ground-dwelling insects, apparently fulfilling its water requirements from insects and dew. In captivity, it is given dry food, and drinks considerable amounts of water. Wetherbee's colony at the University of Massachusetts is fed dry game-bird-mash developed at Cornell, but any commercial game-bird-mash is adequate. (Our birds are presently thriving on chick growing mash until we can replenish our supply of game bird food.) This bird has been domesticated in Japan since ancient times for eggs and meat; in Germany, as a pet; and in southern China during cold weather, it is carried about as a handwarmer.

In its social behavior, *C. coturnix* is not gregarious except to dust bathe. The birds do not perch; they roost separately even during very cold weather. Migratory flocks separate by day. The male is pugnacious toward competitors and its mate, but the female is more docile. Mating behavior includes a courtship dance by the male. In captivity, the male is so persistent in copulating that the female is unable to incubate her eggs. The birds under observation here have tamed readily and will eat from the hand following only a few hours' food deprivation (Fig. 1).

Wetherbee (1961) lists the known diseases and parasites and has told us that the bird is much healthier in captivity than the Bobwhite. However, it is susceptible to a form of erysipelas found in hogs and turkeys in Nebraska and communicable to man. It is physiologically very adaptable and will withstand Massachusetts winters.

The best way to obtain these quail is to hatch the eggs and brood the poults in the laboratory (which also minimizes their chances of meeting up with a Nebraskan hog). The percentage of fertile eggs is high, but the percentage of live hatched poults is low; 40% is considered excellent. The short incubation

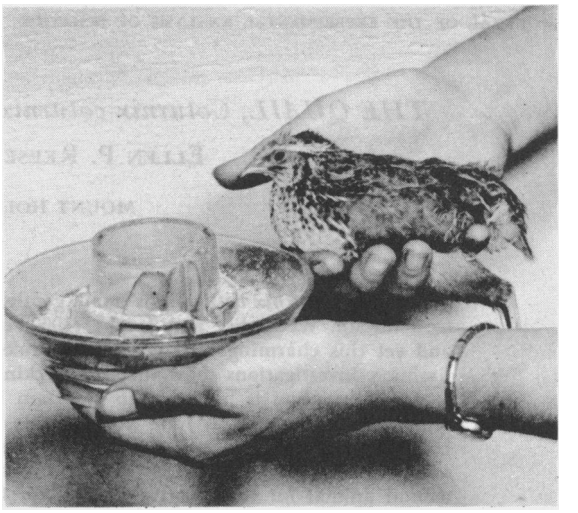

Fig. 1. Female *C. coturnix* being hand fed.

time and the speed with which they reach maturity are a great advantage. (To obtain birds or eggs, consult your State Fish and Game Commission.)

The quail have three somewhat undesirable characteristics as laboratory animals. Unless housed separately, the constant copulation results in the females losing their spinal and cervical feathers. In addition, the birds jump in the air, hitting their heads on the roofs of their cages with sometimes fatal force. Uncaged birds may jump as high as 3 or 4 ft. This behavior is part of the courtship dance of the male, but also appears to us to be the initial part of an escape flight because it occurs frequently when the birds are frightened. The jumping can be greatly reduced, if not eliminated, if the top of the cage is covered and the birds are allowed to see light only from the sides. The third inconvenience is the secretion of a meringue-like substance that adheres to the droppings of the males and causes the feet of the caged birds to accumulate large balls of dung. (Our birds live in cages with wire floors, and we have had no problem with caked feet.)

## EXPERIMENTAL FINDINGS

We obtained three birds, two males and one female, from Wetherbee's colony, and housed them in separate cages with food, water, and fine grit available. One was kept in a transparent cage in the writer's office to facilitate observation. In addition, the birds were freed

in a small room for 2 hr each day so that their behavior might be observed. A large pan containing flat rocks and water to a depth of 2 in. was in one area of the room, and a dust bath was provided in another.

After a few days, during which the birds were handled frequently and deprived of food for short periods of time (a maximum of 17 hr), the birds were introduced to a modified pigeon box for magazine training. The top and three sides of the experimental box were of transparent plastic. The floor of the cage was raised to a level 2 in. below the feeding aperture, and a square patch of drafting tape was placed above the feeder, approximately 5 in. above the floor. The patch was the "key" which we hoped the birds would peck. (The apparatus was crude and the experimental conditions far from optimal. The purpose of these preliminary investigations was merely to see if the quail performed some operant that might easily be controlled and measured. The transparent cage was used so that the birds could be observed and also to learn if they would be distracted by outside visual stimuli. Although conditions were not optimal, some of the early results are presented because they are so promising.)

Two of the three birds were easily trained to approach the food magazine (a pigeon feeder) and eat. The third did not go near that end of the box, even when the magazine was raised and food was available for 20 min. Recalling Bartlett's report that this quail is quick to imitate, a previously conditioned bird (J) was introduced into the box along with the reluctant one (H). Immediately, J approached the food magazine and ate, whereupon H, jostling her aside, followed suit. Then J was removed from the box, and magazine training of H proceeded. On the following day, at 20 hr of deprivation, H was returned to the experimental box and shaping of the pecking response was attempted. The results are shown in the upper half of Fig. 2. Note that only a few minutes was required to shape the behavior of pecking the stimulus patch. (The time required for shaping is the time between the origin and the first response in Fig 2.) The learning curve shows initial acceleration, followed by a fairly steady rate of response. The plateau occurred when someone came into the room; but after this visual and auditory disturbance, the stable rate of response was resumed. The extinction curve is similar to those of rats and pigeons. The lower half of Fig. 2 shows conditioning and extinction on a fixed-ratio schedule for the same bird at 17 hr of deprivation on the following day. The schedule was 10 CRF, 10 FR 5, followed by 20 FR 10. As would be expected, the ratio schedule produced more

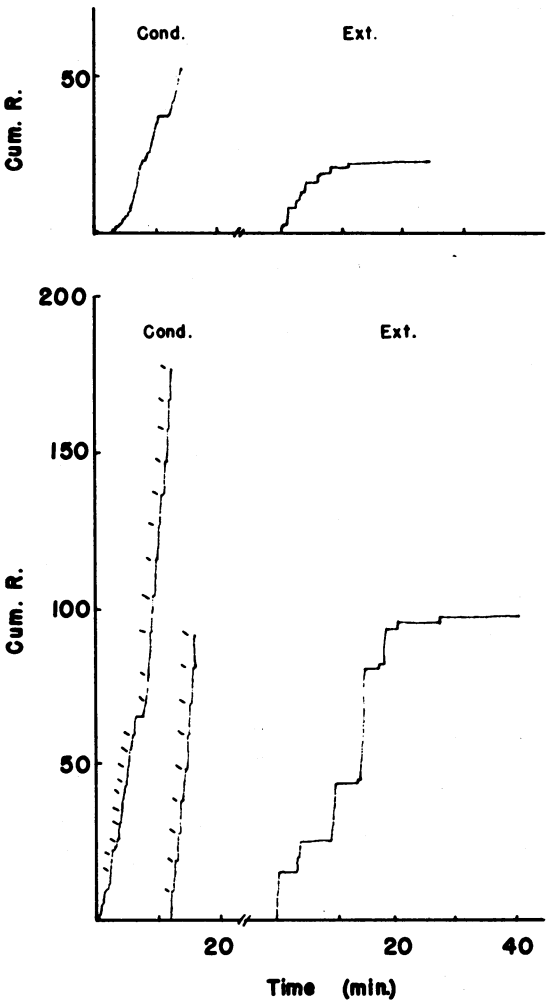


Fig. 2. Cumulative-response curves of conditioning and extinction of the pecking operant in *C. coturnix*. Upper curves: continuous reinforcement followed by extinction, 20-hr deprivation. Lower curves: Fixed-ratio reinforcement and extinction, 17-hr deprivation. *S*: H.

responses in extinction than did continuous reinforcement; and when the bird responded at all, it did so at a rapid rate.

Pecking was easily conditioned in the first two birds at 17 and 20 hr of deprivation, with not more than 5 min required to shape the

response. Consequently, shaping was attempted in the third bird at the shorter deprivation times of 5 and 11 hr. Although the bird ate when the food was presented, we were unable to condition the pecking response. Perhaps, food deprivation of approximately 20 hr is necessary for original conditioning, even though, as Fig. 3 shows, behavior already conditioned can be maintained following little or no deprivation. Figure 3 is a record of the performance of the female, J, following no food deprivation. Two days previously, she had received 40 reinforcements on a fixed-ratio schedule, and on the day before that, 40 CRF. These two sessions constituted the total of her conditioning; and in both sessions, extinction followed conditioning. The record shows that immediately upon being placed in the experimental box, the quail went to the stimulus patch and pecked, even though she had been on free feeding for 2 days. She maintained a steady rate of pecking and eating for 45 min, with one interruption (the short plateau at "x" in Fig. 3), when the telephone rang. Because the experimenter was the only person in the laboratory (at 6 P.M.) and did not wish the quail to undergo extinction (the feeding apparatus was not automatic), the quail was taken from the box and carried to the telephone. Upon being returned to the box, she immediately resumed pecking and eating. These quail would then seem to be emotionally stable experimental animals.

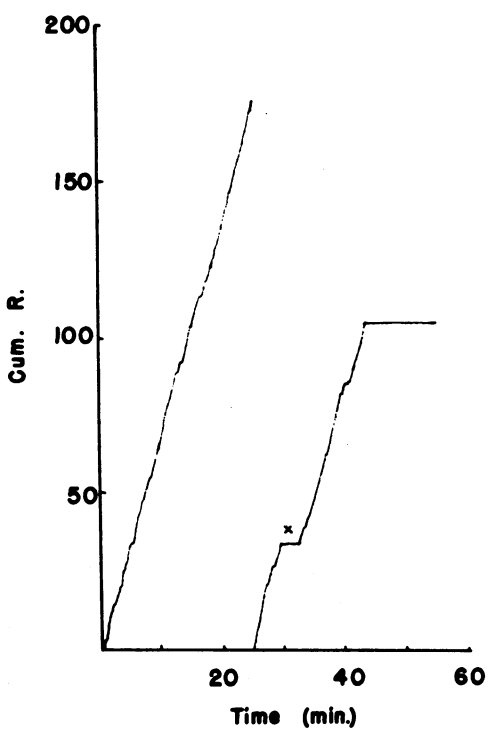


Fig. 3. Satiation curve following 0-hr deprivation. At "x," quail briefly removed from experimental box. *S*: J.

In addition to the ease with which they can be conditioned to peck, the short deprivation times necessary to produce motivation for food, and the stability of the performance under far from optimal experimental conditions, these quail seem capable of making discriminations in phenomenally short periods of time. Figure 4 shows the "light-on, light-off" discrimination of one of the males (H) following 22-hr deprivation. Cumulative responses are plotted as a function of 1-min intervals. Two days before this discrimination, the bird had received 40 CRF; and on the preceding day, 40 FR; both schedules were followed by extinction. For the discrimination session, a light was placed above the stimulus patch. Responses made while this light was turned on ($S^D$) were reinforced; responses made with the light off ($S^\Delta$) were not reinforced. For the first 15 min, the light was alternately on for 1 min and off for 1 min. Thereafter, the 1-min intervals were randomized. Figure 4 shows the concomitant maintenance of the pecking response in the presence of the light ($S^D$) and the extinction of the response in its absence ($S^\Delta$). The high rate of response during the early $S^\Delta$ intervals, compared with that in the $S^D$ intervals, occurs because the bird was responding throughout the $S^\Delta$ interval, whereas a good proportion of the $S^D$ interval was spent in consuming the reinforcement. (As noted above, the apparatus was not fully automatic, and the cumulative recorder was not turned off during eating.) After the 6th $S^\Delta$ interval, essentially no responses were made when the light was off except during the 9th interval, which was the first time two $S^\Delta$ intervals occurred in a row.

Figure 5 shows the beginning of another, quite unexpected, discrimination. The other male, W, which had previously received only continuous reinforcement, was put on a fixed-

interval schedule following 22-hr deprivation. We had intended to gradually work up to a 2-min interval, but changed plans midstream because the record proved so interesting. The actual procedure involved 5 CRF, 5 FI 15 sec, 5 FI 30 sec, and 25 FI 1 min. We had expected a comparatively low rate of response on an interval schedule, but were more than surprised to find that after the second 1-min

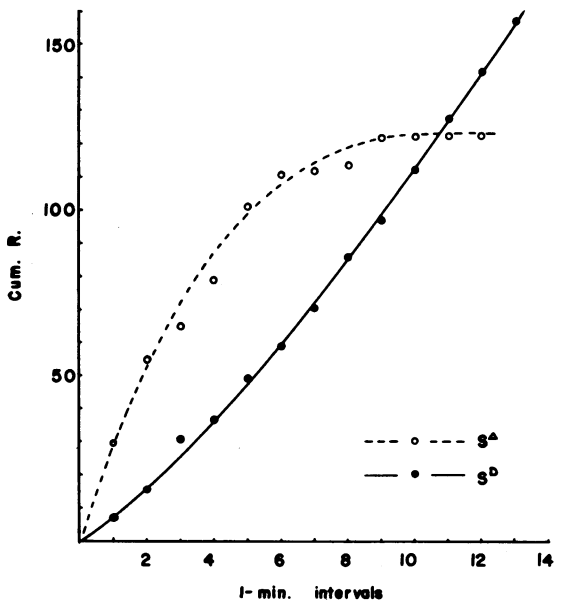


Fig. 4. Discrimination curves in *C. coturnix*: pecking responses made in presence of light ($S^D$) were reinforced; those made in absence of light ($S^{\Delta}$) were not reinforced and extinguished; 22-hr deprivation. *S*: H.

interval, the quail's responding approximated the reinforcement contingency. From the 2nd through the 25th 1-min interval, the bird averaged 1.4 responses per minute.The curve is ragged, to be sure; but during 12 of the 23 intervals, the bird made no responses until the interval elapsed. He often waited longer than the 1-min interval before responding; but Fig. 5 suggests that with a little more training, these birds might be capable of fine temporal discriminations.

An advantage of *C. coturnix* over many laboratory animals is its ability to work under conditions that are far from optimal. All of the present records were obtained in the presence of many uncontrolled visual and auditory distractions, including the sexual crowing of the males. This stability of performance should make the quail a good animal for demonstration purposes and for laboratory courses in experimental psychology. In addition, because of their size and disposition, these quail are easy to handle and to tame. (They are also most attractive and "personable," and we have yet to have a visitor meet our trio and go away uncharmed.)

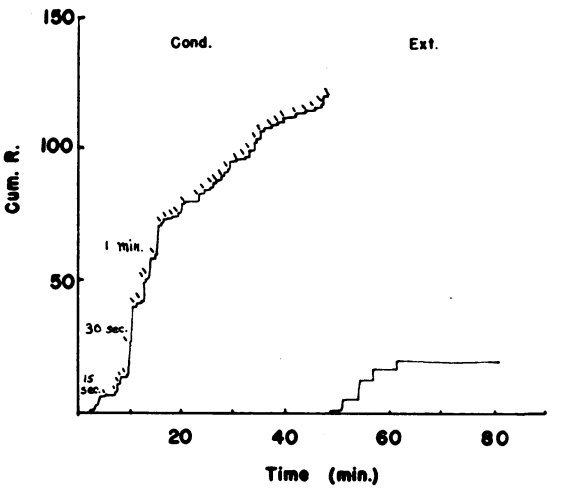


Fig. 5. Fixed-interval conditioning and extinction in *C. coturnix*, 22-hr deprivation. Average rate of response after second 1-min interval was 1.4 *S*: W.

Perhaps the most convenient attribute of *C. coturnix* is its nearly insatiable hunger drive. Whereas it takes a matter of weeks to determine the free-feeding weight of a pigeon and to reduce it to 75-80% of that weight, the quail can be conditioned on less than 24-hr deprivation. One of our birds made nearly 500 pecking *and* eating responses following continuous access to food for 24 hr, and was still responding when it was taken from the experimental box. Since this quail is a migratory game bird, with the related characteristics of such species including the addition of weight in the autumn, its hunger drive deserves particular attention.[2]

[2]The present authors have received a small grant from the Public Health Service to study the hunger drive and the eating behavior of *C. coturnix*.

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