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PECKING AND INITIAL DRINKING RESPONSES IN YOUNG DOMESTIC FOWL[1]

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Naive chicks of Gallus domesticus displayed a visually elicited pecking response to various stimuli with characteristics of both food and water drops; pecking was directed at small objects contrasting with their backgrounds, especially shiny, high-contrast targets. Chicks' drinking response was not elicited on initially seeing pools of water, and usually appeared only after water had been taken inside the bill. The preferred characteristics of targets for pecking would lead chicks to dew and rain drops, and provide 1 opportunity for learning the visible characteristics of water. Other opportunities are also available, and inheritance of an ability to respond with drinking to the 1st sight of water is apparently unnecessary.

Most workers who have observed naive young of *Gallus domesticus* have commented on the variety of small objects at which the chicks peck, and have noted that this response to visible features of their environment leads the chicks to discover food. Lloyd Morgan (1896), Katz (1937), and others have noted that the same chicks failed to drink from pools of water, even when standing in them; seemingly, thus, chicks lack a response to the visible properties of water which will lead them to drink. Although it does not often seem to be visually elicited, naive chicks do have a motor pattern which has been called a drinking response, and which can usually be observed shortly after a chick first gets water within its bill.

The purpose of these experiments was to determine why no drinking response is shown by naive chicks to the sight of pools of water, and to show that none is necessary. If one behavioral response will accomplish two physiological objectives with sufficient efficiency, natural selection will not necessarily operate to encode a second behavioral response if the economics of genetic encoding are restrictive. The experiments attempted to find some of the visual clues to which a chick responds and to show that these can lead it both to food and to water. Our concern is only with the visual clues, and not with the different motor patterns needed to ingest solids and liquids, except insofar as it is necessary to distinguish a whole "pecking response" from a whole "drinking response." If an initial downward pecking motion of the bill will achieve contact with both food and water, and if the subsequent activity can vary appropriately, what will elicit that initial movement?

There would seem to be several possible means by which a chick could first encounter water: (*a*) by performing a pecking or a drinking reaction to pools of water, either when first seen or at least through maturation of the behavior within the first few days, before the chick dies of desiccation; (*b*) by imitating the response of a hen or an experienced sibling (Baeumer, 1955; Lloyd Morgan, 1896); (*c*) by a pecking response directed at some object at the surface of, or in, a pool; or (*d*) by pecking not at a pool of water, but at dew drops or rain drops. This last suggestion has been made previously by at least Wing (1935) and Katz (1937), the latter on the basis of the observation that chicks seemed to prefer pecking at small shiny objects to objects of any other description. He did not attempt to prove this preference.

As already mentioned, the first possibility has been refuted by the observations of many workers. But each of the other three possibilities may be of some importance. The third is mentioned by most authors, and occurred often during our attempts to demonstrate the absence of

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a. We have not tested the possibility of imitation, although it has often been noted that when one *S* is pecking at something others will hurry to join it and peck vigorously at the same target. These experiments tested the fourth suggestion, that *Ss* may first get water into their bills by having pecked at drops of it.

For the experienced chick both pecking and drinking responses usually begin with an unhurried extension of the neck and peering at some visible feature of the environment as *S* apparently judges the target's position (this will be referred to as the "aiming" phase). There follows a rapid downward or forward and downward thrust of the head; it is sometimes less rapid in the case of drinking. The bill is opened near the termination of the thrust. If the response is pecking, the object to be seized is struck forcefully, the bill is closed about the object, and the head is withdrawn immediately along the same trajectory it followed to the object. In the case of drinking, the bill is held in the water and the muscles of the throat are moved in such a way as to suggest that water is being drawn into the mouth. After a short interval the head may be lowered and the bill pushed forward with a scooping motion until it is in a horizontal position. Even without scooping, however, if much water is taken into the bill the head is raised and tilted back, and the water is swallowed with much movement of the tongue and throat.[2] Note that these two responses are similar in form up to the point when the bill comes into contact with the object sought.

As will be seen below, pecking is elicited by a variety of visual stimuli, and many characteristics of these can be specified. At least in very young *Ss* pecking may also apparently occur spontaneously, and even when the eyes are closed or when *Ss* are blind or reared in darkness (Breed, 1911, p. 7).

The appearance of still pools of water fails to elicit the drinking reaction. In observations of over 300 naive *Ss*, we never saw a complete drinking response given in the absence of water in the bill. Rarely, one would peck and then hold the bill against a dry surface or object. Some of these are probably correctly construed as drinking responses, especially since in two cases of holding the bill against dry surfaces there was pushing forward (although not scooping) and in one of these cases tongue movements could be discerned. Other *Os* have commented on similar behavior in a variety of situations involving both naive and experienced *Ss*. While we believe this rare behavior to be aberrant and probably of little or no functional significance, it is puzzling and will be discussed further below.

[2] Observations supplemented with 64-fps motion pictures.

Experiment 1

Experiment 1 demonstrated that while pools of water appear to elicit no response from naive chicks, a variety of stimuli, including drops of water, readily elicit pecking. Further, it attempted to elucidate the apparently conflicting results of other workers which suggested that the drinking response was visually elicited. Careful observations were made of naive *Ss* standing in pools of water, with a mirror in front of them, and naive *Ss* with a field of drops or with both a field of drops and a pool.

Method

Subjects. The *Ss* were 2- to 4-, and occasionally 5-day-old, straight-run White Rock chicks which were removed from the hatchery within 6–12 hr. of hatching. They were kept in either straw-lined shipping boxes or wire rabbit cages until the time of testing, and given neither food nor water during this period. They had ample opportunity to peck at their feces, egg shells, each other, and bits of straw both in the hatchery trays and the subsequent containers. Group A consisted of 45 *Ss* 3–4 days old, Group B of 15 *Ss* 3–5 days old, Group C of 77 *Ss* from two hatchery lots, 3–5 days old, and Group D of 11 *Ss* 3–4 days old. Initial, and in some cases subsequent, responses were tabulated in each test situation.

Procedure. To verify that still pools of water are usually ignored, each *S* in Group A was placed alone in a petri dish containing ¼ in. of water which covered its feet. We then observed *S* closely from different angles to determine the stimulus eliciting a response, and the type of initial response given by each chick. To test whether misjudgment of distance to surface during the aiming

TABLE 1

FREQUENCY OF INITIAL RESPONSES TO VARIOUS STIMULI

Stimulus	N	Initial response			
		Pecking	Drinking	Ambiguous	No response
Pool of water	45	41	1	3	0
Mirror	15	6	1	5	3
Drops of water	77	75	2	0	0
Pool and drops of water	11	11	0	0	0

phase in Group B could be responsible for prolonged contact with reflecting surfaces, reactions of *Ss*, tested individually, to a glass mirror lying flat on the substrate in front of them were recorded. To demonstrate that the first reaction of a naive chick to a drop of water was a pecking response, *Ss* in Group C were placed alone facing a field of water drops about ¼ in. in diameter aligned in rows on wax paper, and watched until some reaction was directed toward the drops. To demonstrate that naive chicks will choose water drops while ignoring a pool of water, *Ss* in Group D were placed 4 in. from a glass petri dish, tilted on one side so that the lower half could be filled with a pool of water, and the remainder of the bottom covered with water drops approximately ¼ in. in diameter and ¼ in. apart.

Results and Discussion

The *Ss* of both Groups A and D ignored the pool of water. All members of Group D pecked instead at the drops; those of Group A apparently took notice of the water only when it was set in motion, though while ignoring the water some did peck at a bulge (which somewhat resembled a water drop) in the glass rim of one dish. Of the 45 *Ss* of Group A, 41 obtained first contact of the bill with water by pecking at a specific target and not at the water per se (Table 1). In three instances, *S* was making a slow aiming extension of its head toward a toe or other target and its bill met the surface before the shift to a rapid pecking thrust had occurred; all three *Ss* paused at that point, one withdrew its bill still closed, and the other two began to drink. These three reactions are not judged to have initiated as drinking responses. As no target was identified in the case of the fourth chick, it may have made a drinking reaction.

Breed (1911) reported drinking reactions directed to dry surfaces by several *Ss* (mostly experienced) and proposed that in cases of physiological dehydration the response may be given indiscriminately. Similarly, in the present experiment, two naive *Ss* pecked, then held the bill down and pushed along a dry, polished tabletop, and two experienced *Ss* held their bills against a dull test object. Such responses were so rare we cannot be sure that they were visually elicited.

Observations of Rheingold and Hess (1957) required that the subject be left open. They presented liquids and solids in small dishes recessed below the substrate. Although we found that neither pools nor drops of water initially elicited a drinking response, their *Ss* "almost always" reacted with drinking. Young chicks have poor balance, and in trying to peck below the surface level *Ss* may have made relatively slow approaches to the test objects. Those which obtained water within the bill may, if moving slowly, have been able to shift to the drinking response immediately. A larger group which responded to mercury probably could not seize it, and may have tried to lap it up.

The remainder responded to either clear plastic or polished aluminum, and suggested our tests of Group B. A transparent surface might not be perceived by *S* peering at a target below it, and a highly reflective surface might cause misjudgment of striking distance; in either case, contact with the surface could occur in the slow aiming phase of the pecking response. This appeared to happen in the cases of 3 of the 45 *Ss* in dishes of water, which gave no indication of being aware of the surface of the water before touching it.

When a glass mirror provided a reflecting surface under a transparent surface, five *Ss* put their closed bills against the mirror and pushed (one eventually began throat movements). Their closed bills suggest that the responses were incomplete when contact was made; recall that in both drinking and pecking the bill is opened during the termination of the thrust. Another six *Ss* pecked from very close to the surface, and in some cases made con-

tact gently; they would not respond further. The experiment lends itself to no simple interpretation, but shows that some apparent drinking responses could be the initial aiming phase of either reaction.

Finally, Baeumer (1955) states briefly that various highly reflective objects elicit attempts to drink (*veranlassen eintägige Kücken zu Trinkversuchen*), but he does not describe these attempts or give data. The caption of his photograph showing *Ss* with a shiny metal object describes them as pecking, making it unclear how consistently the apparent attempts to drink were observed, and what the original responses were in each case.

It is disappointing to leave the matter of the occurrence of drinking responses in the absence of water unresolved, but there are good reasons for believing it to be of no critical importance to this investigation. It is, in most instances, rare. Further, *Ss* have been shown to peck if there is any pecking stimulus available, while at the same time ignoring water.

Of 57 chicks in Group C for which records of subsequent activity were kept, 17 followed the initial peck with further pecking and were not seen to use any other response during a period in which they took several drops. They lifted their heads and swallowed after several pecks—presumably when the beaks had been at least partly filled. Within a few pecks 16 changed to a peck-and-hold drinking response; the remaining 24 changed to this response on their second peck. Even those which changed to a drinking response were not always consistent, and several again pecked at drops without holding.

Only 2 of 77 gave drinking responses to their first sight of water drops, yet chicks that have not discovered water by their third to fifth day of life have little time left in which to do so. If there is maturation of a drinking response given immediately to visible stimuli alone, it should have been prominent in this group.

The different tests of Experiment 1 showed that while pools of water appeared to elicit no response from naive chicks, a variety of stimuli, including drops of water, readily elicited the pecking response.

Experiment 2

Our observations of the variety of objects at which *Ss* will peck parallel those of earlier workers such as Breed (1911) and Katz (1937). Chicks neither peck, nor peck equally readily, at all manner of objects, and some work has been done to specify what visible characteristics they prefer. Fantz (1957), for instance, found an innate preference for round forms and, of the stimuli he tested, for small, round forms. We sought to determine if other preferred properties were such that they would result in *Ss*' having a ready reaction to water drops without at the same time resulting in a reaction to pools of water. Small size would be expected to work in this fashion, for drops are included and pools excluded if *Ss* react to small but not to large objects.

Method

Subjects. As in Experiment 1, straight-run White Rock chicks 2–4 days of age were used; 10 *Ss* were used in each comparison, except Pairs F and H, for which 21 and 25, respectively, were used.

Procedure. Four objects of each of two sorts were arranged in alteration in a single straight row, ¼ in. apart. A single naive *S* was placed facing the center of the line, approximately 4 in. from it. Sometimes it was necessary to position *S* several times, as some *Ss* were quite active and ran to one end or the other, potentially prejudicing their choices. Others tended to fall asleep where placed, and these were instigated to activity by prodding, lifting, or by some abrupt noise made nearby. A "choice" was scored when *S* walked forward and pecked at a stimulus; only first choices were tabulated here. Those *Ss* that would not respond to the objects within 5 min. were set aside and tried later if they became more active, but no *S* was used in a second experiment.

The 5¾ × 7½ in. area was bounded by 8-in.-high brown cardboard walls with a floor of dull gray-white paper. A 100-w. General Electric reflector flood light suspended approximately 2 ft. above the center of the experimental area was covered with a sheet of tracing paper to reduce glare. The light also helped to keep the temperature between 90 and 95° F., which appeared to be comfortable for the *Ss*.

The test objects were: (*a*) dull black sphere—made from Harbutt's gray "plasticine" modeling material impregnated with black India ink and then rolled into a ball of the desired size; (*b*) shiny black sphere—made in the same way as *a*, and subsequently covered with a coating of Duco cement, which gave it a shiny surface; (*c*) dull black spot—made with a paper punch from dull

TABLE 2
FREQUENCY OF RESPONSES TO VARIOUS STIMULUS PAIRS

Stimulus pairs	Score
(A) dull black spots / dull gray spots	10/0
(B) shiny black spots / dull black spots	10/0
(C) shiny black spots / shiny clear spots	8/2
(D) shiny clear spots / dull black spots	4/6
(E) shiny black spheres / dull black spheres	10/0
(F) shiny glass spheres / dull glass spheres[a]	18/3
(G) shiny black spheres / shiny clear spheres	8/2
(H) shiny clear spheres / dull black spheres[b]	18/7
(I) shiny clear spheres / water drops	8/2

[a] $N = 21$.
[b] $N = 25$.

black drawing paper; (*d*) shiny black spot—made by putting a layer of cellophane tape on the black paper before punching; (*e*) gray spot—obtained by placing a dull black spot under a single layer of tracing paper on the floor of the experimental area (control tests showed this to be visible to *Ss*); (*f*) gray sphere—made from the modeling material without the addition of India ink; (*g*) shiny glass sphere—industrially prepared glass bead used in a filter; (*h*) dull glass sphere—prepared by buffing *g* until it was uniformly dull; (*i*) clear shiny spot—made by placing two layers of cellophane tape together and then punching out disc.

A preliminary series of tests showed that targets with a diameter of 1/16–1/2 in. were acceptable. For convenience, we chose 1/4-in. diameter to be standard. Further attempts to test the relevance of size were made by presenting long edges of contrast. First, a simple contrast was provided by covering half of the dull white floor with a piece of black paper. Next the black paper was arranged so that it impinged on the lighter floor as one large, right-angled corner, and finally the edge of the black paper was cut into serrations (making a series of smaller corners).

Results and Discussion

The simple straight-line edge of contrast on the floor elicited no response, and the single right-angled corner and the serrated edge were no more effective. Apparently simple visual contrast was not a sufficient stimulus to evoke pecking. Figure/ground contrast was relevant, however, as a characteristic of a suitably small stimulus, and *Ss* did peck at black spots on a white background. As can be seen from Table 2, degree of contrast was also relevant, since dull black spots were preferred to similarly sized dull gray ones. (The *Ss* preferred white spots on black paper to black spots on white paper, but the significance of this was not clear.)

The *Ss*, ignoring the test objects, often pecked at their toes. This was noted in all trials, but was not scored as a preference as we did not try to classify the sorts of visual stimuli presented by a toe. All chicks peck at their toes, again and again. Without attempting to search for cases, we note that Andrew (1956, p. 89) described odd occurrences of similar behavior in adults of four *Emberiza* species (Aves, Fringillidae), and Meyerriecks (1960, p. 11) described a similar action in herons (Aves, Ardeidae) during preening. The functional significances, if any, are obscure.

In all instances where test objects were equal in all respects except shininess, the shinier was preferred. From trials on Pairs C and G (see Table 2) it was apparent that the effectiveness of shininess was enhanced by increasing figure/ground contrast. For spots (Pair D) shininess and degree of contrast could compete, but for spheres (H) shininess was more important—although degree of contrast was perhaps not irrelevant (F vs. H). When shiny, clear glass spheres were tested against water drops of about the same size, the spheres, which had a better reflecting surface than the water, were preferred.

The different comparisons of Experiment 2 thus indicate that chicks peck at any reasonably small object which contrasts visibly with its background, and prefer objects of high contrast. That shiny objects are the highest order of preference helps explain the observation of Rheingold and Hess (1957) that a bright reflecting surface attracted chicks. Fantz (1957) has shown in addition that round objects are preferred to angular ones. Considering the whole set of preferences, it seems that the most common naturally occurring objects

which they describe would be small shiny seeds, fruits, insects, and water drops.

Experiment 3

Finally, would a chick prefer stimuli in some positions to those in others, and would any attractive stimulus within reach be accepted?

Method

Subjects. Straight-run White Rock chicks 3–4 days old were used, as in Experiments 1 and 2; 10 *Ss* were used in Trial A, and 8 in Trial B.

Procedure. In Trial A, two 3 × 4 in. cards of black drawing paper were covered with grids of white spots of 1/16-in. diameter and 1/4 in. apart; one card was placed on the floor and the second vertically upright and contiguous with the first. In Trial B, two similar cards of white paper were covered with grids of water drops. The water drops were controlled to diameters of about 1/4 in. by mounting them on 1/4-in.-diameter pieces of white paper which were fixed on the cards; the cards were aligned as in Trial A. Trials were conducted in the test chamber used in Experiment 2, and *Ss* were placed about 4 in. from the stimulus arrangement. In Trial B, after making a first choice, each *S* was presented with a vertical string of 1/4-in.-diameter water drops on a narrow piece of white card, 7 in. tall, to test for height preference.

Results and Discussion

All 10 *Ss* in Trial A and all 8 in Trial B pecked first at a stimulus on the horizontal field. The chicks of Trial B went on to take water drops from the vertical line from a height of less than 1/2 in. up to a height of 5 in. (the latter required stretching to reach). The first drop taken by each *S* was generally at eye level. Wing (1935), working with chicks of two other galliform species (*Tympanuchus cupido* and *Phasianus colchicus*), got results indicating a more restricted acceptable range of heights. His procedure, however, differed in various ways from ours, including his presentation of water drops singly by extruding them from the end of a pipette in the chicks' presence.

Apparently, then, chicks prefer objects on a horizontal surface, but will take them at any height they can reach on a vertical surface if no horizontal targets are available. This is consistent with observations that while the objects at which *Ss* will peck can be ranked according to their preferences, low-ranking objects do elicit pecking in some circumstances. A further characteristic to which chicks respond, but on which we attempted no quantitative observations or experiments, is motion. The *Ss* almost invariably peered more intently at a moving stimulus and usually struck quickly. However, ripples induced on the surface of standing water were actively watched (close peering and following with the head) but were not struck.

The hierarchically arranged set of preferences which has been demonstrated should act to bias *S* toward choosing relatively rare natural objects. Water drops are possibly the rarest objects which must be encountered and ingested, and their size, contrast with the background, shininess, and perhaps motion should make them rapidly chosen when encountered. Natural food objects such as small seeds, fruits, and possibly invertebrates are probably more common than water drops, but still rarer than the assorted nonfood objects of all sizes, shapes, degrees of contrast, etc., that litter the forest floor in the habitat of the ancestral Red Burmese Jungle Fowl. Most of the food objects may lack the shininess of water, and possibly contrast less well; at least some of them are less likely to be in motion.

Discussion

The young of *Gallus domesticus* probably do not need genetic information enabling them to drink by responding to the visual characteristics of pools of water. Naive chicks do not, in fact, respond at all to the sight of pools, although a variety of other objects elicit pecking responses. They do have a drinking reaction which does not appear to be elicited visually, but customarily occurs only after water has entered the bill. Probably the naive chick can encounter water in a variety of ways, one of which is by pecking at small drops. The various stimuli which are shown by experiments to elicit a pecking response should lead to experience with both natural foods and water drops.

REFERENCES

ANDREW, R. J. Normal and irrelevant toilet behaviour in *Emberiza* species. *Brit. J. anim. Behav.*, 1956, **4**, 85–91.

BAEUMER, E. Lebensart des Haushuhns. *Z. Tierpsychol.*, 1955, **12**, 387–401.

BREED, F. S. The development of certain instincts and habits in chicks. *Behav. Monogr.*, 1911, **1**, 1–78.

FANTZ, R. L. Form preference in newly hatched chicks. *J. comp. physiol. Psychol.*, 1957, **50**, 422–430.

KATZ, D. *Animals and men—Studies in comparative psychology.* New York: Longmans, Green, 1937.

LLOYD MORGAN, C. The habit of drinking in young birds. *Science*, 1896, N.S., III, 900.

MEYERRIECKS, A. J. Comparative breeding behavior of four species of North American herons. *Publ. Nuttall Ornithol. Club*, 1960, **2**, 1–158.

RHEINGOLD, H. L., & HESS, E. H. The chick's preference for some visual properties of water. *J. comp. physiol. Psychol.*, 1957, **50**, 417–421.

WING, L. W. On the drinking habits of gallinaceous young. *Condor*, 1935, **37**, 211–212.

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