

MOBBING BEHAVIOR BY CROWS: THE EFFECT OF THE "CROW-IN-DISTRESS" MODEL

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Lorenz (King Solomon's Ring, p. 141, Crowell, New York, 1952) reported that tame Jackdaws (*Corvus monedula*) attacked his hand when he carried a pair of black swimming trunks; he went on to suggest that "dangling black" releases an innate predator-attacking mechanism in these birds. The phenomenon of mobbing closely approximates this behavior, although studies by Hartley (Symp. Soc. Exp. Biol. 4:313-336, 1950) and Nice and Ter Pelwijk (Auk 58:195-214, 1941) were unable to identify a simple stimulus configuration that consistently released mobbing of owl models. I pursued this question by observing the mobbing response of free-living Common Crows (*Corvus brachyrhynchos*) in experiments on the campus of the University of Washington, Seattle.

I presented three different models to the breeding population of crows during the period 1 March-1 May 1974. The models consisted of a 38-cm plastic replica of a perched Great Horned Owl (*Bubo virginianus*), either (1) alone, (2) with a 28-cm black plastic replica of a crow lying on its side in front of the owl, or (3) with a 28-cm piece of black velvet cloth lying in front of the owl. The models were always presented atop a 1.5-m wooden perch, and all tests were conducted from 11:00 to 11:20. The tests occurred on alternate days, with each model set-up used once each week and the association of models to days determined randomly each week.

Mobbing in free-living animals is a complex behavior that involves many individuals in a temporally varying pattern of physical approaches and vocalizations. Hartley (op. cit.) and Hammerstrom (Condor

59:192-194, 1957) reported the number of "mobbing" animals under various experimental conditions. However, without explicit criteria of approach distance or intensity of calls, such data are of limited value. In my study, I evaluated mobbing intensity in two ways: (1) a tripod-mounted camera with a telephoto lens was placed 30 m from the model. Standardized photographs were taken at 1-min intervals so that counts of the number of crows visible in successive pictures provided a quantitative record of the mobbing response over time. (2) I measured the loudness of mobbing calls with a decibel meter and a microphone installed on the perch, concealed near the base of the model. A measure of noise level was obtained by point-censusing the decibel level at 15-sec intervals. The results of these measurements are given in table 1.

Both the owl-crow model and owl-cloth model elicited significantly more mobbing crows than did the owl alone (*t*-test, $P < 0.01$). The differences between the owl-crow and the owl-cloth models, however, were not significant. Likewise, both the owl-crow model and the owl-cloth model elicited significantly higher mean decibel levels than did the owl alone (*t*-test, $P < 0.01$). Again, the difference between the owl-crow and the owl-cloth models was not significant. Considering the means for each day's results separately, the owl model produced a slight, nonsignificant trend of habituation during the course of the experiment—a reduction in both number of mobbers ($r = -0.24$) and decibel level ($r = -0.18$). Both the owl-crow and the owl-cloth models elicited nonsignificant positive correlations of both numbers of mobbers ($r = 0.21$ and 0.18) and decibel level ($r = 0.35$ and 0.26) from 1 March until 1 May. Throughout this study, habituation may have been confounded with effects due to seasonal progression of the nesting cycle.

This brief study presents the first potentially replicable quantitative data of mobbing behavior in free-living birds. It supports Lorenz's contention that the presence of a black object stimulates corvid aggressiveness toward potential predators although it does not examine the supposed innateness of that behavior. The significantly heightened intensity of mobbing elicited by both the owl-crow and owl-cloth models in comparison with the owl model alone, combined with the similarity of response to the owl-crow and owl-cloth models, suggest that a simple "releasing mechanism," whether innate or learned, is involved.

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TABLE 1. Comparison of mobbing responses by Common Crows, as elicited by three models.

Model	Mean no. of mobbers ^a	Mean decibel level ^b
Owl	6.2 (SD 2.7)	18 (SD 11.1)
Owl-crow	14.7 (SD 4.9)	41 (SD 22.3)
Owl-cloth	12.9 (SD 4.9)	36 (SD 21.8)

^a Based upon at least 160 photographs in each case.

^b Based upon at least 600 point-censuses in each case.

REACTIONS OF QUAIL TO FLYING VULTURES

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I have been investigating the recognition of aerial predators by birds. The fortuitous appearance of a flock of 12 Bobwhite (*Colinus virginianus*) at my home offered an opportunity to observe closely their reactions to overflights by birds. I watched the quail for about 15-20 min on 6 and 8 December 1973, noting no apparent reaction to Red-bellied Woodpeckers

(*Centurus carolinus*), Cardinals (*Cardinalis cardinalis*), and smaller birds which flew about 2-5 m over the quail while passing from trees to an elevated feeder.

On 8 December, a Turkey Vulture (*Cathartes aura*) passed almost overhead at an elevation of about 50 m, and I noted no overt reaction by the quail. On 9 December, I watched the quail for about 50 min while they fed, apparently on crushed acorns on my driveway, during which time they remained within 15 m of my home. At 11:10, an immature Turkey Vulture passed directly overhead at an elevation of about 30 m. The quail appeared to "freeze"

for a second or two, and at least two birds appeared to be watching the vulture. When the vulture had soared to about 50 m away from the quail, it suddenly turned, dropped to an elevation of about 20 m (just above the treetops), and approached the vicinity of the quail, flapping its wings three times. Two quail flew about 30 m; the remaining ten ran rapidly some 3 or 4 m from the driveway into the adjacent open oak forest, crouched and "froze." The vulture turned overhead, again flew about 50–70 m away and returned. The vulture repeated the performance five more times, and the quail remained motionless during the entire episode. The quail were so cryptic among the leaf litter that I was able to locate only three of the ten that were less than 15 m from my window. I noted the first movement of quail approximately 40 sec after the last pass of the vulture. Within another 30 sec all quail appeared to resume movement, although I had the impression that the activity was more hesitant than before and that the quail were more alert. I heard no vocalizations during the encounter but the closed double window would have prevented my hearing faint sounds.

I doubt that the vulture was interested in the quail; I believe the attraction was the odor from the remains of a large fish that my neighbor had thrown out for his cat.

Turkey Vultures roost about two miles from my home and many times each day fly along the ridge on which my house is situated. In the next few days I observed four more incidents of vultures flying over the vicinity while quail were feeding near my house. In all four cases the vulture was at least 70 m from the quail, and I noted no reaction.

These observations suggest that the quail were habituated to distant overflights of vultures, while a near overflight elicited a brief freezing response, and direct approach by the vulture, similar to an "at-

tack," elicited fleeing responses followed by prolonged immobility. In my 25 years of watching and trapping hawks, I often have been impressed with the lack of overt reactions by birds to hawks unless the hawk appears to be attacking. Whenever I was able to observe closely the behavior of birds used as lures in hawk traps, it seemed to me that the birds were watching the hawk, but overt reactions were rare unless the hawk approached directly and rapidly.

Laboratory experiments by Melzack (J. Comp. Physiol. Psychol. 52:694, 1961) have shown that young Mallards (*Anas platyrhynchos*) continue to watch models of hawks after habituation has eliminated overt fear responses. He suggested that birds may escape direct attack by hawks by maintaining a "state of vigilance" and by reacting to "swooping, change of speed compared with size . . . and the like." My natural observations appear to be in general agreement with the inferences of Melzack.

Willis (Condor 65:313, 1963) suggested that the Zone-tailed Hawk (*Buteo albonotatus*) is an aggressive mimic of the Turkey Vulture and that the similarity between the two species permits the hawk to approach prey that are habituated to the vulture. I (Condor 74:221–222, 1972) have suggested that the similarities in shape and manner of flight are due to aerodynamic requirements, not mimicry. My observations, and those of Melzack, suggest that habituation may not play a significant role in reactions to predators and thus add further doubt that the Zone-tailed Hawk is a mimic of the Turkey Vulture.

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EXISTENCE METABOLISM

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Existence metabolism is the energy required by birds for "normal" (non-flying, non-breeding, non-molting) activities over at least one 24-hr period under air temperatures which are controlled but which do not necessarily lead to minimum (basal) energy requirements. Its prediction for birds of different weights under different conditions of photoperiod and temperature is of interest to ecologists who might use such relationships to estimate energy intake by correcting these estimates for activities and for assimilation efficiency. This paper identifies limitations of previous analyses and presents an analysis of the functional relationship between existence metabolism and the variables of body weight, ambient temperature and photoperiod, using regression techniques on data from the literature. The importance of these are evaluated using an analysis of variance.

MATERIALS AND METHODS

Data on existence metabolism at various temperatures were obtained from a variety of sources. All were used in a previous analysis by Kendeigh (1970) and many were undertaken by his students; this probably

indicates a certain consistency in the data and the definition of "existence metabolism" used. These sources were: Yellow-bellied and Variable seed-eaters (*Sporophila nigricollis* and *S. minuta*), Blue-backed Grassquit (*Volatinia jacarina*) and Green-backed Sparrow (*Arremonops conirostris*) from Cox (1961), Zebra Finch (*Taeniopygia castanotis*) from El-Wailly (1966), Common and Hoary redpolls (*Acanthis flammea* and *A. hornemanni*) from Brooks (1968), Tree Sparrow (*Spizella arborea*) from West (1960), House Sparrow (*Passer domesticus*) from Kendeigh (1949) and Davis (1955), White-throated Sparrow (*Zonotrichia albicollis*) from Kontogiannis (1968), Dickcissel (*Spiza americana*) from Zimmerman (1965) and Evening Grosbeak (*Hesperiphona vespertina*) from West and Hart (1966). With only a few exceptions, observed values of existence metabolism could be related to specific observations of body weight (or the mean of a small group of individuals) and air temperature; data above 30° C were excluded.

I analyzed data using methods of linearizable and intrinsically non-linear multiple regression as described by Draper and Smith (1966). The computer programs used were those of the University of California (Biomedical Computer Programs, BMD02R and BMD07R), (Dixon 1973). Lack of fit statistics were calculated by hand. Initially a linearizable model was analyzed. This was the form: