Orientation by Untrained Pigeons Requires the Sun

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Abstract. Untrained homing pigeons released on sunny days oriented homeward regardless of the direction of the release site from the loft. Similar pigeons released under total overcast vanished randomly, whereas experienced birds released on the same days at the same sites oriented homeward. Apparently untrained pigeons require the sun for orientation but experienced pigeons do not.

It has recently been shown that homing pigeons with limited previous training can orient toward home at an unfamiliar release site under total overcast; i.e., they can orient in the absence of both familiar landmarks and the sun. We wished to determine whether completely untrained pigeons can also do this, or whether some previous homing experience is necessary.

The birds used in our tests had previously been given daily exercise flights at the loft, including flights on overcast or rainy days to make them accustomed to flying in inclement weather, but they had never been taken away from the loft until the test flights. No bird was used in more than one test release.

The birds were carried to the release sites in closed vehicles. They were tossed individually from the hand, the directions of toss being randomized. Each bird was observed with 10 X 50 binoculars until it vanished from sight, and a compass bearing for the vanishing point was recorded to the nearest five degrees. The circular mean for the vanishing bearings of each release was calculated by vector analysis. Bearings were tested for randomness by the Rayleigh test.

The birds used in the first series of releases, in November and December 1968, were unmated youngsters, mostly four to five months old. All were housed together in the same pen and thus had identical feeding and exercise schedules, a procedure that should minimize differences in homing performance due to differences in the physical condition or motivation of the birds.

On November 23, we conducted simultaneous releases under sun from 16.6 miles north, 20.8 miles east, and 20.3 miles south, and 21.1 miles west. Twelve birds were used in each of these releases. In all four releases, the vanishing bearings were nonrandom (P > 0.005, < 0.001, 0.002, and 0.002, respectively), and in all four the mean bearing was in the homeward half of the circle. A fifth release of untrained birds under sun was conducted on December 12 from a site 30.4 miles north of the loft. Again the bearings (Fig. 2A) were nonrandom (P < 0.001) homeward.

Having shown that our young untrained pigeons could orient under sunny...
Fig. 1.—Releases at Marathon, 20.8 miles. Home bearing, 269°. (In this and the later figures, the home bearing is indicated by an unlabeled dashed arrow, the mean bearing of nonrandom releases by a solid arrow labeled M, and true north by a thin line at the top of the circle. Each symbol on the periphery of the large circle indicates the vanishing bearing of one bird.) 1(A) Young untrained pigeons under sun, November 23, 1968; mean bearing, 228°. 1(B) Young untrained pigeons under total overcast, December 2, 1968; bearings random. 1(C) Experienced pigeons under total overcast, December 2, 1968; mean bearing, 263°.

Fig. 2.—Releases at Fleming, 30.4 miles from Cornell. Home bearing of Cornell birds 164°. 2(A) Young untrained pigeons under sun, December 12, 1968; mean bearing, 139°. 2(B) Young untrained pigeons under total overcast, November 29, 1968; bearings random. 2(C) Schenectady birds under total overcast, November 29, 1968; mean bearing, 50° (home bearing, 98°).

conditions from five different locations, we chose two of those locations for releases of untrained birds under total overcast. One of these releases was conducted on December 2 from Marathon, New York (20.8 miles east). For comparison, nine experienced birds were also released. The vanishing bearings (Fig. 1B) of the 12 untrained birds were random ($P = 0.44$), whereas those of the nine experienced birds (Fig. 1C) were nonrandom ($P = 0.009$) homeward. The performance of the experienced birds demonstrated that there were no special conditions prevailing on that day that could prevent pigeons from orienting, yet the untrained birds behaved very differently under total overcast from the untrained birds released under sun at this same location on November 23 (compare Fig. 1B with Fig. 1A).

The other release of young untrained pigeons under total overcast was performed on November 29 from Fleming, New York (30.4 miles north). For comparison, nine birds belonging to a breeder in Schenectady, New York (156
miles east of Fleming) were also released; these birds had had some homing experience but had never previously been released near Fleming. The vanishing bearings of the untrained Cornell birds (Fig. 2B) were random ($P = 0.54$), whereas the bearings of the Schenectady birds (Fig. 2C) were nonrandom ($P < 0.001$).\textsuperscript{4} Again the behavior of untrained pigeons under total overcast had differed markedly both from that of experienced birds\textsuperscript{6} and from that of other untrained birds released under sun at the same location (compare Fig. 2B with Fig. 2A).

It seemed to us that the absence of an important, though redundant,\textsuperscript{1} source of information, i.e., the sun, might have been so disturbing to young birds in the already distressing context of their first release away from home that their poor orientation resulted from their "nervous" state rather than from a true inability to respond to the available orientational cues. Distinguishing between the effects of motivational state, physical condition, and orientational ability is always difficult in studies of this type. In an effort to enhance motivation and hence to increase the chances that the birds would orient if they were capable of doing so, we performed a second series of releases in the spring of 1969, using older (nine to ten months) untrained pigeons that were mated and had nests with eggs or young. All the birds were housed in the same pen and were handled identically.

All the releases in this second series were from a site near Locke, New York, 16.6 miles north of the loft. First we performed two releases under sun on April 25 and May 2. In both cases the vanishing bearings (Fig. 3A) were nonrandom ($P 0.004$ and $<0.001$, respectively) homeward, as had been the case in the test conducted at this same location with very young untrained birds on November 23, 1968 (discussed above). A third group of birds was released under total overcast on May 23; for comparison, ten experienced birds were also released. The vanishing bearings (Fig. 3B) of the eleven untrained birds were random ($P = 0.53$), whereas those of the experienced birds (Fig. 3C) were

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**Fig. 3.** —Releases near Locke, 16.6 miles. Home bearing, 171°. 3(A) Mature untrained pigeons under sun, April 25, 1969 (black symbols), and May 2, 1969 (open symbols); mean bearing, April 25, 175°; mean bearing, May 2, 152°. 3(B) Mature untrained pigeons under total overcast, May 23, 1969; bearings random. 3(C) Experienced pigeons under total overcast, May 23, 1969; mean bearing, 181°.
nonrandom ($P < 0.001$) homeward. The presumed greater motivation of these older untrained pigeons had not resulted in any better orientation than had been exhibited by the very young untrained birds used in the first series of releases.

These tests demonstrate that our completely untrained pigeons can orient toward home when the sun is visible, as several other investigators have already reported,\(^6\) and furthermore that they can do this from all directions and hence are not simply exhibiting "nonsense" orientation.\(^7\) Yet similar birds released under total overcast at the same locations did not orient. Some previous homing experience appears to be necessary before pigeons can orient in the absence of the sun, though our earlier studies\(^1\) have shown that this previous experience need not be extensive nor from the particular release sites where orientation under overcast is to be exhibited. Perhaps whatever orientational cues are used by experienced birds under overcast are ones to which pigeons become sensitive only by actual homing flights. What this indicates about the nature of the cues is unclear, though one possibility is that there is a force gradient to which the birds become responsive as a result of the experience of flying along it.

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\(^3\) Winds on the test releases were as follows: November 23, from southeast, less than 3 mph at start, gradually increasing to 12 mph by end of release; November 29, from 225°, 7 mph; December 2, from 205°, 7 mph; December 12, from 160°, 6 mph; April 25, from 300°, 11 to 12 mph, with occasional stronger gusts; May 2, from 240°, 7 mph; May 23, from 290°, 3 to 4 mph.
\(^4\) The orientation of the Schenectady birds demonstrates that the ability to orient under total overcast at an unfamiliar location is not limited to Cornell pigeons, as discussed in reference 1, but is instead more general.
\(^5\) The random bearings of untrained Cornell birds at Fleming under total overcast may be compared both with the bearings of the more experienced Schenectady birds and with the bearings of experienced Cornell birds released under total overcast at Fleming on May 17, 1968, and illustrated in Figure 1 of reference 1.
\(^7\) Nonsense orientation is the tendency of some birds always to fly in a particular compass direction, which may bear no relation to the true home direction. Matthews, G. V. T., Ibid. 103a, 211 (1961); Ibid. 105, 185 (1963); Proc. 13th Int. Ornithol. Congr. (1963), p. 415; Bird Navigation (London: Cambridge Univ. Press, 1968): 2nd ed.