

closed but for an occasional twitching of its ears during the more energetic plucking activity.

Such hair-plucking of Koalas for nesting material has not been recorded previously, although some honeyeaters are credited with the habit of obtaining nesting material from cows, large marsupials such as possums, and even man (Salmonson & Ford 1985). Chisholm (1956) gives an account of the White-eared Honeyeater *Lichenostomus leucotis* stealing human hair. Many passerines use mammal hair and fur for nest lining (e.g. Ehrlich *et al.* 1988, p. 391), presumably for its insulative properties. Indeed, the practice is diagnostic of some species, e.g. the horse-hair nest lining of European Robins *Erithacus rubecula*. Noisy Friarbirds *Philemon carunculatus* are known to make extensive use of sheep's wool in their nests. W. Stull (in Bent, 1968) reports the use of cattle, bison, deer, raccoon and human hair in nest linings of North American Chipping Sparrows *Spizella passerina*, that are sometimes known as 'hair-birds'; Stull used horsehair as an effective bait for trapping these birds. Typically, mammal hair or fur is taken for nest-lining from snags, barbed wire, or from the ground, and most birds would seem to acquire furred nest-linings opportunistically rather than by active depilation of live mammals.

The practice of plucking hair from live mammals is not entirely unnoticed around Los Angeles, U.S.A.,

where Northern Mockingbirds *Mimus polyglottos* sometimes pester sleeping dogs by their hair plucking; Eastman (1962) records the habit in the popular literature. Another recorded example is in African oxpeckers (Buphagidae), which extend their use of veld mammals as feeding substrates to live-plucking the hair from their backs for lining their tree-hole nest cavities (Maclean 1985).

My thanks go to Jiro Kikkawa for supplying additional references for this note, and to the National Geographic Society for funding my field work in Queensland.

References

- Bent, A.C., 1986. Life Histories of North American Cardinals, Grosbeaks, Buntings, Towhees, Finches, Sparrows and Allies. Pt. 11. Dover, New York.
- Chisholm, A. 1956. Bird Wonders of Australia, 5th edn. Angus & Robertson, Sydney.
- Eastman, P.D. 1962 The Best Nest. Beginner Books, Division of Random House, New York.
- Ehrlich, P.R., Dobkin, D.S. & Wheye, D. 1988 The Birder's Handbook. Simon & Schuster, New York and Sydney.
- Maclean, G.L. 1985 Robert's Birds of Southern Africa. John Voelcker Bird Book Fund, Cape Town.
- Salmonson, F. & Ford, H.A. 1985. Honeyeaters. Pp. 287-288 in A Dictionary of Birds. Eds B. Campbell & E. Lack. Poyser, Calton.

Domestication and Song Learning in Zebra Finches *Taeniopygia guttata*

P.J.B. Slater and N.S. Clayton¹

Department of Biology and Preclinical Medicine, University of St Andrews, Fife KY16 9TS, U.K.

¹ Present address: Department of Zoology, South Parks Road, Oxford OX1 3PS, U.K.

EMU Vol. 91, 126-128, 1991. Received 3-4-1990, accepted 27-8-1990

The Zebra Finch *Taeniopygia guttata* is a common cage bird which was first taken to Europe from Australia in the late 18th century (Immelmann 1965). It breeds well in captivity and, over the past few decades, captive stock in Europe has been, to a large extent, isolated from birds in the wild due to tight controls on the export of birds from Australia. Domestication has led to a

number of differences in behaviour between captive and wild Zebra Finches (Immelmann 1965; Sossinka 1970) but song has not hitherto been examined in this respect. Only the male Zebra Finch sings and each male has a single song phrase, used in similar form when directed to females during courtship and during 'undirected' song (Sossinka & Böhner 1980). The latter is thought to

have various social functions but is not used in territorial defence (Immelmann 1968).

The Zebra Finch has been commonly used in studies of song development and it is known that young males learn their songs from adults that they hear during the first two months of life (Slater *et al.* 1989; Zann 1990). As song is learnt, the possibility exists for it to change with time, young males failing to learn the songs that they hear with complete accuracy or building their songs by combining features of those sung by several individuals. Where two bird populations are isolated from each other, as often happens in the wild, differences can arise in their songs so that dialects are formed. Dialects have not been described in the Zebra Finch but the isolation of captive and wild birds, together with the fact that conditions in captivity cannot mimic exactly those in the wild, may nevertheless have led to differences in the features of song between the two groups of birds. This could be of interest and importance as far as the interpretation of the results of song learning experiments is concerned.

Methods

To examine whether such differences have arisen we compared songs of individuals in each of three captive colonies — St Andrews, U.K. (labelled as S; $n = 20$); Groningen, Netherlands (G; $n = 21$); Bielefeld, West Germany (B; $n = 20$) — with those of 18 birds recorded in the wild by R.A. Zann and by PJBS, six at Alice Springs, Northern Territory and 12 at Shepparton, Victoria (W). These two groups were combined, as no significant differences were found between them. Most of the songs used were undirected songs but those from Groningen were recorded during courtship and this may also have been so for some of those from the wild. This is unlikely to make an important difference. Although the tempo of courtship songs tends to be slightly faster for any given individual, the variance between birds is very great and there is no difference in the number of elements per phrase (Sossinka & Böhner 1980). Furthermore, had any such difference had a strong effect we would have expected the results of the G group to stand out from those of the other laboratory ones and this is not the case. The song of each bird was sonagrammed (Kay Digital Sonagraph 7800) and the following measures were scored: (1) phrase length: the duration of a single song phrase in seconds; (2) the number of different element types found in the song; (3) the number of elements per second during the phrase; (4) the

number of distance call notes incorporated into the phrase; and (5) the number of birds showing repetitions: the occurrence of the same element more than once in a single phrase.

Results and discussion

The results are summarised in Table 1. Although some birds repeated elements within their phrase, this was not common in any of the groups and they certainly did not differ in this respect. There was also no difference between them in the number of different element types used. In other respects there was an overall difference, but the B and W birds showed no differences from each other, and the G and S groups also showed no significant differences. Significance of the overall comparisons arose because the B and W birds differed from the G and S ones in various respects. The tempo of the song was faster (more elements per second) in G and S, and sufficiently so in the latter group to be significantly different from both B birds (Mann-Whitney *U*-test, $P < 0.05$) and W ones ($P < 0.01$). Phrase length was longer in B birds than in W, and shorter in G and S birds, so that both these groups showed a significant difference from the B one ($P < 0.01$ and $P < 0.001$ respectively). The most striking difference between groups, however, stems from the fact that S and G birds use fewer dis-

Table 1 Comparison of various measures of song between wild Australian birds (W), and captive birds from colonies at Bielefeld (B), Groningen (G) and St Andrews (S). Ranges given are standard errors.

	Group				Test ¹
	W	B	G	S	
Mean phrase length (s)	0.81 ± 0.07	0.95 ± 0.06	0.72 ± 0.05	0.70 ± 0.04	**
Mean different elements	7.7 ± 0.5	9.5 ± 0.6	7.6 ± 0.4	8.5 ± 0.5	n.s.
Mean elements per second	10.1 ± 0.5	11.0 ± 0.6	11.8 ± 0.9	12.9 ± 0.7	*
Mean distance calls/phrase	2.9 ± 0.4	3.1 ± 0.3	1.3 ± 0.3	1.4 ± 0.2	***
Number of birds with repeats	2	3	2	3	n.s.
Sample size	18	20	21	20	

¹ Kruskal-Wallis Test: * $P < 0.05$; ** $P < 0.01$, *** $P < 0.001$. The results of Mann-Whitney *U*-tests for the significance of differences between individual groups are given in the text.

tance calls in their songs. There was no difference between these groups on this measure, nor between W and B birds, but all the other four comparisons (B/G, B/S, W/G, W/S) were highly significant ($P < 0.003$). Distance calls are the longest elements that appear in song (difference in duration highly significant for each of the groups, $P < 0.001$). Their paucity probably accounts for both the high number of elements per second and the low phrase duration of the S and G birds.

The difference between these populations is not a substantial one and is most likely to have arisen through conditions in captivity. Recordings from the Bielefeld colony were made within a few years of new birds being imported into it from the wild, although none of the birds included was wild caught. Nevertheless, this is likely to account for the lack of difference between B and W. The S and G birds were standard aviary stock, bred in the laboratory and bought from dealers. Why might differences from wild birds have arisen in these groups? One possibility is that breeders have selected individuals with more complex songs (i.e. more elements per second) to form their breeding stock and thus reduced the proportion of call notes in the song. While much of the selection on zebra finches in captivity has been for increased productivity, this could have had related or incidental effects on song. A reduction in distance call use would not be likely to stem from an impoverished auditory environment, as Eales (1987) has found that young birds reared by females alone produce songs consisting only of call notes. On the other hand, our laboratory situation and that of many aviculturalists, with many pairs of birds in the same room and young birds continuously exposed to singing adults, may be just the situation where distance calls are least likely to be used as song elements. Distance calls may only be incorporated if the young bird hears rather little song and cannot therefore build an adequate song of his own without them.

Another possibility might be that, in captivity, with many birds in close proximity, distance calls may be used less and the young may therefore be exposed to them less than in the wild. While it is an intriguing thought that the lack of distance calls in captive Zebra Finch song may stem from an enriched auditory environment rather than an impoverished one, this explanation does not seem likely. Distance calls are used in a

variety of contexts and are very common in laboratory colonies. They do, however, often develop abnormally (Zann 1984) and, at an extreme, this might lead them to be unrecognisable as such and so under-estimated in our samples of domesticated birds (R.A. Zann pers. comm.).

The distance calls which occur in song may have been learnt either as part of another individual's song or as independent call notes. Because song is a cultural phenomenon, a very slight tendency to eliminate these calls from song would become greatly amplified over successive generations. Such an amplification effect could account for the difference which now exists between birds in the Groningen and St Andrews stocks and those in Bielefeld and in Australia.

Acknowledgements

This study was assisted by funds from the Royal Society, the Science and Engineering Research Council and the European Community. We thank Dr Richard Zann for hospitality and recordings, colleagues in the groups of the late Professor Klaus Immelmann at Bielefeld and of Professor Jaap Kruijt at Groningen for recordings, and Dr Zann and Dr Carel ten Cate for helpful comments on earlier drafts of the manuscript.

References

- Eales, L.A. 1987. Song learning in female raised Zebra Finches: another look at the sensitive phase. *Animal Behaviour* 35, 1356-1365.
- Immelmann, K. 1965. *Australian Finches*. Angus & Robertson, Sydney.
- Immelmann, K. 1968. Zur biologischen Bedeutung des Estrildidengesanges. *Journal für Ornithologie* 109, 284-299.
- Slater, P.J.B., Eales, L.A. & Clayton, N.S. 1989. Song development in Zebra Finches: progress and prospects. *Advances in the Study of Behavior* 18, 1-34.
- Sossinka, R. 1970. Domestikationserscheinungen beim Zebrafinken *Taeniopygia guttata castanotis* (Gould). *Zoologischer Jahrbuch* 97, 455-521.
- Sossinka, R. & Böhner, J. 1980. Song types in the Zebra Finch *Poephila guttata castanotis*. *Zeitschrift für Tierpsychologie* 53, 123-132.
- Zann, R.A. 1984. Structural variation in the zebra finch distance call. *Zeitschrift für Tierpsychologie* 66, 328-345.
- Zann, R.A. 1990. Song and call learning in wild Zebra Finches in south-eastern Australia. *Animal Behaviour* 40, 811-828.