

ZEBRA FINCH BEHAVIOUR AND EFFECT OF MODEST ENRICHMENT OF STANDARD CAGES

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Abstract

Animal Welfare 1995, 4: 3-9

Zebra finches are often housed in monogamous pairs in small barren cages. In the present study it was investigated whether modest enrichment resulted in behavioural changes. Four plywood box cages of two different lengths were compared. A small and a large cage were used for the barren environment. Another small and large cage were used for the enriched environment, and included additional perches, twigs as well as sand and water baths. An ethogram consisting of 19 different behavioural patterns was used. The behaviour of the birds was studied using a combination of alternating (20s) one-zero and instantaneous sampling, one hour per day during a continuous four-week period.

Locomotor activity, vocalization and singing was significantly increased in the enriched cages and flying was more frequent in the large enriched cage than in any of the other cages. The study demonstrated the usefulness of behavioural analyses to determine to what extent simple enrichment allows the birds to exhibit a wider range of their natural behaviour.

Keywords: *animal welfare, behaviour, cage enrichment, zebra finches*

Introduction

The zebra finch (*Poephila guttata* synonym *Taeniopygia guttata castanotis*) is a native of Australia, and already by the first issue of the journal *Die Gefiederte Welt* in 1872 breeding of zebra finches in captivity was well established in Europe. Zebra finches have thus for many generations been bred in captivity and they are extremely popular as pets. They are now regarded as a truly domesticated species (Blackwell 1988) like the budgerigar and the canary. Zebra finches are very robust small birds breeding throughout the year and because of their high fecundity they are inexpensive and readily available in most pet shops.

Although it was recognized many years ago that the zebra finch is ideal for laboratory studies of bird behaviour (Morris 1954) and studies of fear (Russell and Burch 1959), more recent scientific use of zebra finches has concentrated mainly on neurological studies and the influence of hormones on sexual characters, often analysed using changes in the males' song. However, in a few instances zebra finches have also been used in toxicity studies (Scheuhammer 1988) and behavioural studies, eg studies of extra-pair copulation and sperm competition (Birkhead 1988).

Unfortunately many small finches are kept in small cages although they are very social and gregarious birds preferring to live in flocks or colonies in the wild. Because of its high activity level and many different characteristic behavioural patterns it was decided to use zebra finches as a model bird for small foreign finches. Domestic zebra finches are often kept in pairs in small barren cages where they will breed but not be able to exhibit many facets of their characteristic behaviour.

The aim of the present study was to employ scientific ethological observation studies to test the hypothesis that enrichment elicits specific behaviour patterns more often, and results in a wider repertoire resembling behaviour in semi-natural aviaries.

Methods

Animals

Four pairs of five-month old male and female zebra finches; eight normal greys, fawns and chestnut flanked white (Enehjelm 1956) were used for the study. They all came from the same breeder (Elstree Birds, Crews Hill Enfield, Middlesex, UK) and were sexed according to the presence of male markings. The birds used were clinically healthy. They were maintained at a temperature of $20 \pm 5^\circ\text{C}$ and the animal room had natural daylight. All cages were placed in such a way that they received a similar light intensity. By convention, rings (bands) were placed on the left leg for males and on the right leg for females and the colours used in this experiment were black and yellow respectively. The finches were paired randomly and each cage received one monogamous pair of birds. The birds were placed in the cages on a Friday and allowed to settle over the weekend before results from observations were collected on the Monday. Zebra finches are renowned for not requiring time for adaptation to a new environment before displaying their typical behaviour (Morris 1954).

The birds were studied during a continuous four-week period.

Cages and husbandry

Four commercial box cages of two different sizes were used, with the two larger cages being double the length (depth) of the smaller ones.

The dimensions were:

SMALL	length	45.0cm
	breadth	24.5cm
	height	38.0cm
LARGE	length	90.0cm
	breadth	24.5cm
	height	38.0cm

Each cage had five wooden (plywood) surfaces with a wire mesh front and was equipped with a basket nest in one upper corner. Nesting material was provided in all four cages. The cages were separated into barren and enriched environments, resulting in small and large control cages and small and large enriched cages.

In both the large and the small barren cages there were two perches. In the small enriched cage there were three perches, and in the large enriched cage there were four perches. Additionally, in both the enriched cages there were twigs, a sand bath and a water bath. In

all cages birds were given food (Foreign Finch Mix) mixed with grit, water and cuttlefish. The cages were cleaned out daily after the second sampling results were taken. This allowed the birds to settle into the clean environments overnight and prevented the cleaning regime adding day-to-day variation to the results.

Observation methods

In the present study of zebra finches observations were restricted to monogamous pairs in small cages; more specifically male behaviour during the first four weeks after the animals were paired. Studies were restricted to the males because they exhibit a wider range of behavioural characteristics (courtship, nest building) and, based on experience, the female would spend considerable time inside the nest from almost the very beginning. One of the authors (JH) has bred zebra finches for more than 30 years and based on this experience the following ethogram was defined for this study:

Table 1 Ethogram for male zebra finches.

Behaviour	Definition
<i>Feeding</i>	Eating either seed or cuttlefish bone, or drinking
<i>Defaecation</i>	-
<i>Static hop</i>	Moving sideways on a perch, or hopping along the ground
<i>Hop</i>	Moving from perch to perch, or perch to ground without the use of wings
<i>Sit/stand</i>	The bird is motionless for more than three seconds
<i>Fly x-x</i>	The bird leaves perch X, flies (wings move) and returns to perch X
<i>Fly y-z</i>	The bird flies to another perch or to the ground with the use of wings
<i>Preening</i>	Grooming the feathers and stretching the wings
<i>Allopreening</i>	Male grooming the female's feathers
<i>Beakstrike</i>	Striking the beak on a solid object
<i>Vocalization</i>	Single chirps
<i>Singing</i>	The male produces a song when not near the female (usually to claim territory)
<i>Courting</i>	The male sings whilst performing a pivotal dance or sitting next to the female and may make advances towards the female or ruffle his feathers
<i>Attack</i>	Pecking the female
<i>Fleeing</i>	Moving away from the female if she is attacking him
<i>Water bath</i>	Preening in the water
<i>Sand bath</i>	Preening in the sand
<i>Nesting</i>	Sitting in the nest
<i>Nest building</i>	Collecting and/or placing material in the nest

Video recordings (2x15min) of a pair of birds were used to conduct a pilot study. This determined intra-individual and inter-individual variation in the observers, and the most suitable sampling technique for this study. Two different observation methods were tested in the pilot study: a combination of one-zero sampling and instantaneous sampling; and instantaneous sampling only. One-zero sampling is recording at the end of the sample interval, whether or not the behaviour has occurred during that interval (Martin & Bateson 1993). Instantaneous sampling is recording on the instant of the end of each sample interval, whether or not the behaviour pattern is occurring (Martin & Bateson 1993). Both observational methods were carried out for 10s intervals, 15s intervals and 20s intervals. Their reliability was assessed in comparison with continuous focal animal sampling: which is observing one animal for a period of time and recording all instances of its behaviour (Martin & Bateson 1993).

As a result of this initial study the sampling method employed was the combination of one-zero and instantaneous sampling with 20s time intervals. This method was not significantly different from using shorter intervals (10s and 15s).

The birds were observed and behaviour recorded twice daily, once in the morning and once in the afternoon. Both one-zero and instantaneous samplings were performed until 30 minutes of data were collected. Therefore, one hour of data was collected each day. The data were collected separately for each cage and for each of the morning and afternoon sessions. The results for the sessions were pooled.

Statistics

One way analyses of variance (ANOVA) employing *F* tests were used for statistical analysis of the data. Differences with $P < 0.05$ were considered statistically significant.

Results

There was no significant difference ($P > 0.8$) between the scorings of the individual observers, nor between repeated scorings of the same video recording of individual observers.

During the observation periods there was no use of either the sand bath or the water bath nor was fleeing observed. Consequently these activities cannot be compared.

The birds in the small enriched cage and in the large barren cage had clutches of eggs at the end of the study period. Although most of the incubation was done by the females the males also took part in the incubation.

The cage environment had no significant effect on the level of activity with regard to feeding, defaecation, courting, attacking and nesting (Table 2).

Vocalization and singing were significantly more frequent in the large enriched cage than in any of the others.

In the small barren cage there were significantly more bouts of hopping in comparison to all other cages. There was no significant difference between the two large cages, but all other one-to-one comparisons of cages were highly significant.

The x-x flying in the small barren cage was significantly more frequent than in the other cages and flying y-z was significantly more frequent in the large cages. The birds in the small

cages could not feasibly fly to any great extent, but the birds in the small barren cage did fly more frequently than the birds in the small enriched cage. The y-z flying was highly significant in the large enriched cage.

Preening and allopreening were significantly higher in the large barren cage and small enriched cage than in the two others. Nest building took place in the small enriched cage and in the large barren cage.

There was significantly more sit/stand behaviour in the barren cages.

Table 2 Activity scoring of male zebra finch behaviour for each cage type.

Behaviour	Large enriched	Large barren	Small barren	Small enriched	Overall significance
<i>Feeding</i>	246	266	284	248	ns
<i>Defaecation</i>	23	15	23	17	ns
<i>Static hop</i>	157	129	42	98	s
<i>Hop</i>	241	192	1054	692	s
<i>Sit/stand</i>	893	1311	996	579	s
<i>Fly x-x</i>	64	5	513	27	s
<i>Fly y-z</i>	1252	137	81	10	s
<i>Beakstrike</i>	159	119	246	66	s
<i>Preening</i>	216	324	129	404	s
<i>Allopreening</i>	16	83	9	187	s
<i>Vocalization</i>	732	97	232	218	s
<i>Singing</i>	83	54	19	37	s
<i>Courting</i>	29	35	10	16	ns
<i>Attack</i>	0	2	3	0	ns
<i>Nesting</i>	0	81	0	309	ns
<i>Nest Building</i>	0	9	0	288	s

s significant ns not significant

Discussion

Animal behaviour may be defined as continuous activity observed as movements and events. Before these can be recorded and quantified, the movements must be divided up into discrete units and categories.

It has been reported that zebra finches are not disturbed by the presence of an unconcealed observer (Morris 1954) and this was confirmed in the present study comparing direct observations with video recordings (data not shown).

The sampling system employed in the present study was a combination of one-zero sampling and instantaneous sampling which we have previously used (Saibaba *et al* 1995). This combination allows rare events of short duration to be recorded. Housing the birds in monogamous pairs does not make it possible to study typical zebra finch behavioural traits, such as aggression associated with territorial defence and typical displacement activities such as displacement (d)-preening, d-scratching, d-shaking, d-stretching, d-yawning, d-feeding and d-beak wiping as described in great detail by Morris (1954). The object of the present paper was to study the behaviour of the finches when not rearing young, so the design of the study did not include studies of reproductive behaviour apart from the very early phase of nest building and, in two cages, the females incubating eggs at the end of the study period.

Vocalization and singing were most pronounced in the large enriched cage which may indicate that a larger more varied environment is conducive towards greater vocalization.

The vocalization not associated with male singing was the low communication call. The loud identity call (Immelmann 1972) was rarely heard and not included in the ethogram.

The significantly higher hopping activity in the small barren cage may suggest that hopping is a displacement activity or a stereotypy since hopping in the small enriched cage, where there was also less opportunity to fly, was less frequent. In the small barren cage where there was little room for flying, the birds tended to hop and fly from a perch in a circle back to the same perch. The twigs in the two enriched cages were used as perches, therefore in the small enriched cage it was difficult for the birds to fly compared with the three other cages.

The birds in the two barren cages were significantly less active than the birds in the enriched cages showing high scores for sit/stand.

Flying from one perch to another was significantly more frequent in the large enriched cage than in any of the others indicating that a large enriched environment stimulates flying.

Preening and allopreening were significantly higher in the two pairs producing eggs and it seems likely that the two activities were associated.

Although this must be considered a rather limited behavioural study and potentially biased by individual differences in the behaviour of the birds, it does illustrate the usefulness of behavioural studies to determine how simple enrichment of bird cages stimulates the birds. They exhibit behaviour more similar to the normal behaviour in the wild and in aviaries. In aviaries with semi-natural conditions zebra finches are very active both with regard to locomotor activity and, vocalization and singing.

One conclusion of this study with regard to animal welfare is that zebra finch behaviour is significantly influenced by the surrounding environment. The larger cages stimulated flying and the simple enrichment resulted in an overall increase in activity of the birds, including singing.

Caged birds, like any other animal kept in captivity, ought to be given an environment that allows them to exhibit a maximal range and intensity of natural behaviour; with the single restriction that the social environments should be adjusted to avoid excessive aggression, causing reduced welfare of weaker birds. However, a certain amount of aggression and territorial defence should be accepted as a result of an enriched environment and the optimal

system for housing zebra finches is probably aviaries, allowing the housing of a flock of birds with a density low enough to allow pairs individual territories.

To substantiate and extend the findings of the present study further studies need to be carried out. These studies should analyse the behaviour of many pairs of birds in surroundings which differ from each other in the amount of space available, type of enrichment and social groupings.

Acknowledgements

This study was generously supported by SmithKline Beecham.

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