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Author	脇田, 真清(Wakita, Masumi) 坂本, 淳子(Sakamoto, Junko) 渡辺, 茂(Watanabe, Shigeru)
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BEHAVIORAL SCALING OF VISUAL PREFERENCE BY BENGALESE FINCHES (*Lonchura striata var. domestica*)

Masumi Wakita,[1] *Junko Sakamoto*[2] *and Shigeru Watanabe*[3]

Visual preference by Bengalese finches (*Lonchura striata var. domestica*) was behaviorally measured for six species: Bengalese finch, zebra finch (*Taeniopygia guttata catanotis*), white eye (*Zosterops japonica*), Java sparrow (*Padda oryziora*), masked dove (*Oena capensis*) and budgerigar (*Melopsittacus undulataus*). By testing the Bengalese finches on all possible pair-wise combinations among these six species of birds, preference matrices were generated using the time spent near one species rather than the other. The scale of preference toward the stimulus birds was produced by INDSCAL to reveal patterns of visual preference among the six species. The results showed that there were two distinct clumps; one clump consisted of the zebra finch and the white eye and the other clump consisted of the masked dove and the Java sparrow. These results suggested that dark coloration (darkness rather than brightness) and body size were positive factors in the visual preference. However, the species preference of Bengalese finches was not fully determined by any single factor.

INTRODUCTION

An organism's survival depends on perceptual classification. An organism must deal correctly and efficiently with stimulus complexity in detecting predators, locating food, selecting a mate, and recognizing members of its own species. Many different stimuli might be used to form perceptual classifications.

Male and female zebra finches have been shown to be affected by the color of a plastic leg band worn by an opposite-sex conspecific (Burley et al., 1982). Females preferred red-banded males over unbanded ones and avoided light-blue- and light-green-banded males. Males preferred black- and pink-banded females and avoided those wearing light-blue or light-green bands. Zebra finches of both sexes of adults were shown in another study to have preferences and aversions to certain colors of plastic leg bands worn by conspecifics of the opposite sex (Burley, 1988). With the double-bar finch (*Poephila bichenovii*), it was further shown that the leg band colors preferred in heterosexual tests were typical of that species, while the colors that were avoided were species-atypical and characteristic of other species (Burley, 1986). Finally, bill color appears to be more important in heterosexual than in isosexual interactions (Burley & Coopersmith, 1987). Females preferred to associate with males having the reddest, brightest bills. Males preferred to associate with females having bill colors in the middle of the phenotypic range.

Field experiments using models showed that Darwin's ground finches can recognize conspecifics by their morphology and that this recognition depends on the combined stimuli of both the head and body. In choice experiments, males and females responded more aggressively toward male conspecific models than toward heterospecific ones, females also chose to attack conspecific female models, and males preferentially courted conspecific females in natural encounters and during experiments (Ratcliff & Grant, 1983).

These results suggest that there might be mechanisms dedicated to the processing of species-specific features. It is important, therefore, to find the factors which influence visual preference of similar species. In the present experiment, we used Bengalese finches as the subject and six bird species, including a conspecific, as stimuli. These six species were paired in all possible ways and the Bengalese finch's preference between the pairs was measured to construct the scale of preference. The principal aim

[1] Biomedical Research Center, Osaka University
[2] Medical School, Osaka University
[3] Department of Psychology, Keio University. Corresponding Author

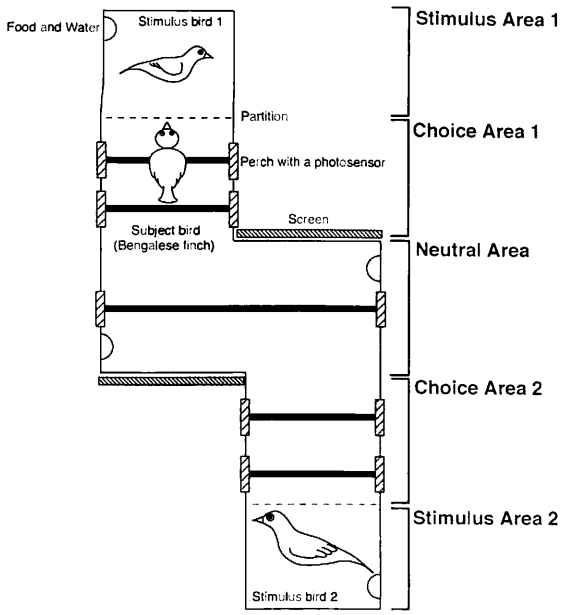

Fig 1. The top view of the experimental chamber. It consisted of two choice areas an one neutral area. There were stimulus areas at the ends of the choice areas and were separated with transparent acrylic partitions from the choice areas. The subject birds were allowed to move freely in the chamber and their movement was measured by photosensors fixed at the end of each perch.

of this experiment was to construct a classification for six bird species based on the preference of the Bengalese finch.

METHOD

Subjects

Two male and two female Bengalese finches (*Lonchura striata var. domestica*) were used as subjects. They were 90 days old at the start of experiments. They were kept in individual cages (15×30×22 cm) one month prior to the experiment and were visually isolated from the stimulus birds described below.

Apparatus

The experimental chamber consisted of three compartments (Figure 1). There were stimulus areas at both ends and these were separated with transparent acrylic partitions from the choice areas. The subject birds were allowed to move around the neutral and choice areas. Five perches were located in the apparatus: two in each choice area and one in the neutral area. The movement of the stimulus bird was measured by a personal computer through photosensors fixed at the end of each perch. The distance between the partition to the nearest perch was 5cm. Grey walls were attached to the outside of the neutral area and these walls prevented the subject bird from seeing one stimulus bird wherein the choice area of the other stimulus bird.

The experimental chamber was surrounded by a grey curtain. There was a 20W fluorescent ceiling lamp above the chamber. Continuous white noise was presented during the experiment. Food and water containers were located in the neutral area and both stimulus areas and they were freely available duing the experiment.

Procedure

The six species used as stimuli were the Bengalese finch (*Lonchura striata var. domestica*), the zebra finch (*Taeniopygia guttata catsanotis*), the white eye (*Zosterops japonica*), the Java sparrow (*Padda oryziora*), the masked dove (*Oena capensis*) and the budgerigar (*Melopsittacus undulataus*). All stimulus birds were male but the sex of white eyes was unknown. All birds were kept in separate aviaries.

Two species of stimulus birds were placed individually in the stimulus areas and allowed to habituate for one hour. The subject was admitted into the central compartment and given 30 minutes to habituate. After this period, the subject Bengalese finches were allowed to choose and approach between the two stimulus birds and the position of the subject was sampled every second for 7 hours. The experiment started at 9:00 and terminated at 17:00. Each subject received one test every second day.

Fifteen different pairs were generated out of the six species and each pair was tested twice with the positions of stimuli counter-balanced. A total of 30 tests were therefore carried out in a quasi-random sequences. Any given pair was not presented successively in two or more test sessions, and the same species never appeared in

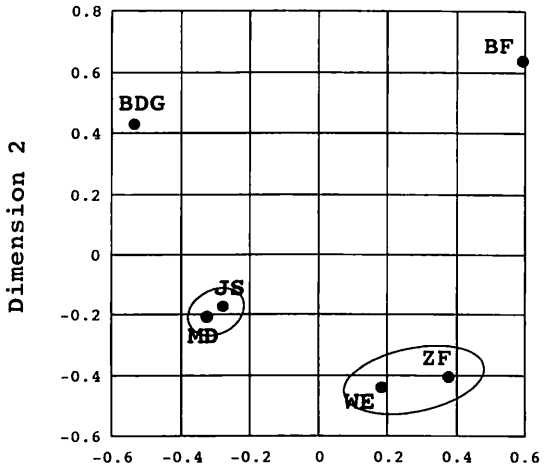

Fig 2. INDSCAL result are shown in two-dimensional space. Each plot represents preference constellations of each stimulus species. Abbreviations: BF, Bengalese finch; ZF, Zebra finch; WE, white eye; MD, masked dove; JS, java sparrow; BDG, budgerigar.

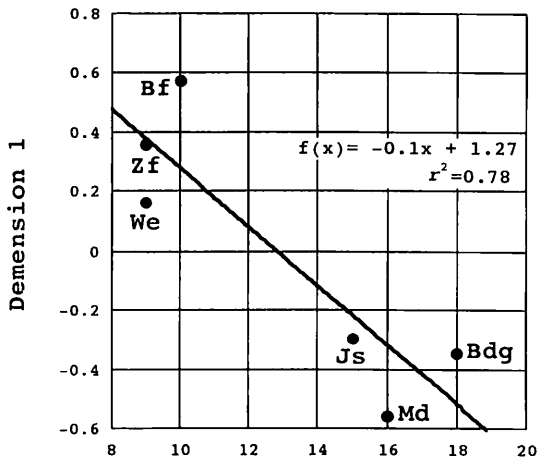

Fig 3. Correlation between scores in the dimension 1 of Fig. 2 and body size (cm) of stimulus species is exhibited. These scores correlate moderately (Spearmann's rank correlation, $r^2=0.78$). Abbreviations: same as Fig. 2

succession for three or more sessions.

Data Analysis

The total perching time spent on the closest of the two perches to the stimulus areas was used to construct a preference matrix and this was converted to a probability matrix. Individual difference scaling (INDSCAL) was then conducted on the obtained probability values. Proximity of constellations of the subject species in n-dimensional space are therefore directly related to preference of species apprearance as taken by the behavioural measure. Response tendencies were similar for all subjects and so the data were pooled across the subjects.

RESULTS

Figure 2 presents the INDSCAL results in two-dimensional space. The variance accounted for (VAF) was 0.86. There were two clumps. One consisted of the zebra finch and Java white eye and the other of the Java sparrow and masked dove. The Bengalese finch and budgerigar were isolated from two clumps, suggesting that different perceptual features were being utilized in making preferences.

The two distinct clumps in Figure 2 do show some different perceptual features. One clump, containing the zebra finch and white eye, was a group of colorful small birds. The other clump, containing the Java sparrow and masked dove, was a group of colorless large birds. This suggests that either coloration or body size was being used in preference. However, although the Bengalese finches were colorless and the budgerigar was colorful, they were located closer to the contrasting rather than corresponding clumps. Figure 3 further shows that the preference scale for dimension 1 inversely corresponds to body size (Spearmann's rank correlation, $r^2=0.78$). Combined with Figure 2, these results indicate that the Bengalese finches categorize their preference according to body size rather than body coloration.

DISCUSSION

The Bengalese finch belongs to the evolutionarily older order of Psittaciformes, whereas the zebra finch belongs to the evolutionarily newer order of Passeriformes. Among the stimulus birds, the zebra finch is the phylogenetically

closest species to the Bengalese finch. However, the Java sparrow, which is the next closest species to the Bengalese finch among species used, was configured relatively close to zebra finch although the Java sparrow was associated in the other clump with the masked dove. The Bengalese finches distinguished the conspecific from the zebra finch and Java sparrow instead of their closer phylogenetic relations to the Bengalese finch, suggesting that phylogenetic relation had little substantial influence in deciding visual preference.

In conclusion, Bengalese finches' species preference was not fully determined by any single factor. That is, almost any visual parameters might have been used in visual recognition. The recognition, in turn, usually depends on a configuration of features, all of which are necessary to evoke a full response of preference. Among the many factors, however, body size was the most significant one found here, and no evidence for the use of coloration or phylogenetic relationship was found.

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