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16 Recognition of Third-party Pair-bond Relationships in Budgerigars, *Melopsittacus undulatus*

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I. Introduction

Animals living in a stable group are required to behave appropriately with considering a variety of social relationships between group members. They may need to discriminate group members, form dominant and/or alliance for conflict resolution, or even understand relationships between third-party group members. These possible socio-ecological demands might play a role as evolutional drive of "logical" cognitive ability in animals including human.

Previous studies showed that not only primates (Seyfarth and Cheney, 1988; Bergman et al. 2003) but also corvid birds, such as pinyon jays (*Gymmorhinus cyanocephalus*; Paz-y-Mino et al., 2004), recognized third-party relationships of others. These studies provide an assumption that the logical mind, such as recognizing third-party relationship, might not be yielded through primate evolution but rather emerge in distant species, such as birds, as a case of evolutional convergence by the socio-ecological demands.

In this study, we investigated whether budgerigars (*Melopsittacus undulates*) recognize the third-party pair-bond relationships. Similar to corvids, budgerigars are known as a highly social species that form fission-fusion societies and to form long-term monogamous relationships with extra-pair copulation (Wyndham, 1980; Wyndham, 1981). Recognizing third-party pair-bond relationships could allow especially males to choose appropriate opportunities to court females for extra pairing. If budgerigar males recognize the third-party pair-bond relationships, it is expected that the males would show more affliative behaviours to females selectively during the temporal absence of her partner males.

II. Method

1. Subjects

Subjects were 10 sexually mature budgerigars. Their age ranged 2 to 4 years old at the beginning of the experiment. Five pair-bonds and one single male were included. Note that one male was found to pair-bond with two females. All birds were obtained commercially from a local supplier. Their sex was determined by blood DNA analysis (Fridolsson and Ellegren, 1999). Subjects were identified based on their feather color variations.

All birds were housed together in an indoor home aviary (W0.9×L0.9×H1.3m^2). They were daily fed a standard seed mixture in a food container. Fresh water was available at libitum. The experiment room was set at 25 C° under 12h-light : 12h-dark (light, 0900-2100; dark, 2100-0900) condition.

2. Apparatus

The experiment was carried out in the home aviary. Four wooden perches were placed at the both two corners on the back-side wall. Four video cameras were fixed outside the aviary, all of which were connected to a quadro-split video monitor and covered simultaneously four perches and the food tray in the aviary.

3. Experimental procedure

The potential change of affiliation/aggression of males to a female was examined by comparing two conditions, one in which her male partner was removed (removal condition) and the other when her male partner was not present (unremoval condition) from the aviary. We conducted a total of eight 120-min daily observation sessions, which consisted of a 60-min control phase followed by an additional 60-min test phase. In each session, one of the four pair-bonded males was removed by the experimenter immediately after the control phase. The removed male in each session was determined quasi-randomly across the sessions and the number of removals was counterbalanced between the four pair-bonded males. Thus, each pair-bonded male was removed in two of the eight sessions. A female whose male partner was removed was defined as 'focal female.'

In each session, behavioural interactions were video-recorded. A session started with a 60-min control phase immediately after the experimenter prepared the video-recoding setup and exited the experimental room. There was a 10-min pause when the experimenter removed a male, followed by a control phase and the subsequent 60-min recording started the test phase. During the test phase, the removed male was placed in a separate small bird cage in a sound attenuated room. The removed male was taken back to the aviary immediately after the end of the test phase.

4. Behavioural observation

Observations were performed using video-recorded data. For each session, the numbers of affiliative (affiliative approaching, bill touching, head bobbing, bill hitting, active feeding, allopreening, mounting) and agonistic (agonistic approaching, pecking motion, pecking attack, displacement) interactions and participant identities were scored.

5. Statistical analysis

To examine whether social interactions between focal females and non-partner males would increase upon the removal of male partner, differences in the number of affiliative/agonistic interactions of focal females with non-partner males and other females were compared between the test and control phase during the removal and unremoval conditions by Wilcoxon's signed-rank test.

The effect of removing males on affiliative/agonistic interactions within unremoved pair-bonds was also examined by comparing the number of affiliative/agonistic interactions between the control and test phases using Wilcoxon's signed-rank test.

III. Result

Affiliative and agonistic interactions between focal females and non-partner males increased when the male partners of focal females were removed (Fig. 1). Wilcoxon's signed-rank test revealed that the difference in the number of affiliative and agonistic interactions of focal females with non-partner males between control and test phases was significantly higher in the removal condition than the unremoval condition (Affiliative interaction, Z = -2.03, p = 0.043; Agonistic interaction, Z = -2.01, p = 0.045). On the other hand, there was not an increase in agonistic interactions between focal females and other females after the removal of male partners. Wilcoxon's signed-rank test showed that the difference in the number of agonistic interactions of focal females with other females between control and test phases

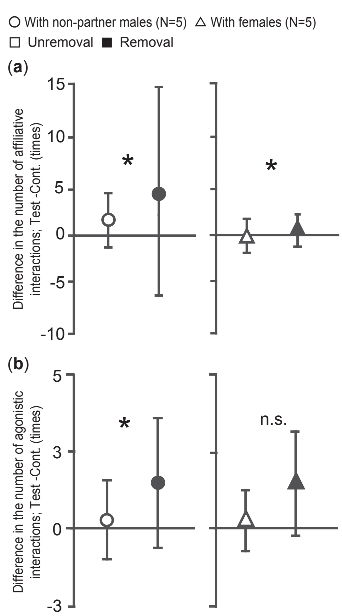

Figure 1. Removing partner males increased affiliative (**a**) and aggressive (**b**) interactions between focal females and non-partner males (circle) and affiliative interactions with other females (triangles). Both affiliative and agonistic interactions between focal females and non-partner males increased when partner males were removed. Error bars indicate ±1SD. Wilcoxon's signed-rank test was performed at the significant level of 0.05.

was not significant (Affiliative interaction, Z = -2.39, p = 0.017; Agonistic interaction, Z = -0.21, p = 0.836).

Removing males had no effect on social interactions within pair-bonds. Wilcoxon's signed-rank test did not yield a significant difference in either affiliative or agonistic interactions between the control and test phases (Affiliative interaction, males to females, Z = -1.21, p = 0.225, females to males, Z = -0.14, p = 0.893; Agonistic interaction, males to females, Z= -1.21, p = 0.225, females to males, Z = -1.84, p = 0.066). These results suggest that interactions within unremoved pair-bonds were stable.

IV. Discussion

This study showed that both affiliative and agonistic interactions between focal females and non-partners increased when male partners of the focal females were temporally absent. Removing the male partner had no effect on the level of either affiliative or aggressive interaction within unremoved pair-bonds. These results indicated that pair-bonded males increase their social interactions specifically with non-partner females when their male partners are not present. This is the first evidence of extra-pair social interactions most probably based on the recognition of third-party pair-bond relationships in budgerigars. It suggests the understanding of the pair-bond relationship between the non-partner females and the absent males, in other words, the recognition of pair-bond relationships of third-parties.

One of the most possible functions of the ability to understand the third-party pair-bond relationships is extra-pair copulation strategy for males. The reason for this could be the breeding ecology of this species. Budgerigars are known to breed seasonally and colonially (Wyndham 1981). This breeding ecology could cause the time limitation for monogamous breeding with steady partners but also the close proximity between pair-bonds. In such ecology, extra-pair copulation could be a good strategy likely to increase the breeding opportunities. To choose the appropriate opportunity, the cognitive skill could be advantageous for males.

References

Bergman, T. J., Beeher, J. C., Cheney, D. L., and Seyfarth, R. M. (2003). Hierarchical classification by rank and kinship in baboons. Science, 302, 1234–1236.

Fridokfsson, A. K., and Ellegren, H. (1999). A simple and universal method for molecular sexing of non-ratite birds. Journal of Avian Biology, 30, 116–121.

Seyfarth, R. M., and Cheney, D. L. (1988). Do monkeys understand their relations? Machiavellian Intelligence.Social Expertise and the Evolution of Intellect in Monkeys, Apes, and Humans. 69–84.

Paz-y-Miño C. G., Bond, A. B., Kamil, A. C., and Balda, R. P. (2004). Pinyon jays use transitive inference to predict social dominance. Nature, 430, 778–781.

Wyndham, E. (1980). Diural cycle, behaviour and social organization of the budgerigars *Melopsittacus undulates*, Emu, 80, 25–33.

Wyndham, E. (1981). Breeding and mortality of budgerigars (*Melopsittacus undulatus*). Emu, 81, 240–243.