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J. Diamond, A. Bond, 'Social Play in Kaka (*Nestor meridionalis*) with Comparisons to Kea (*Nestor notabilis*)'. *Behaviour*. 141/7, 777-782, 787, 792-795 (2004).



Social Play in Kaka (*Nestor meridionalis*) with Comparisons to Kea (*Nestor notabilis*)

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Summary

Social play in the kaka (*Nestor meridionalis*), a New Zealand parrot, is described and contrasted with that of its closest relative, the kea (*Nestor notabilis*), in one of the first comparative studies of social play in closely related birds. Most play action patterns were clearly homologous in these two species, though some contrasts in the form of specific play behaviors, such as kicking or biting, could be attributed to morphological differences. Social play in kaks is briefer, more predictable, and less sequentially diverse than that shown by keas. Kaka play also appears to be restricted to fledglings and juveniles, while the behavior is more broadly distributed among age groups in keas. Play initiation behaviors were relatively more frequent in kaks and more tightly intercorrelated in occurrence. A primary grouping of action patterns in kaks consisted of arboreal play, which was rare in keas. The most striking species difference was exhibited in social object play, which is pervasive among keas, but which was not observed in kaks. Although the two species are morphologically similar, they differ strikingly in several aspects of their ecology and social behavior, including the duration of the association between juveniles and adults, the degree of exploratory behavior, and the flexibility of their foraging strategies. The observed species differences in play behavior are discussed in relation to the contrasting life histories in the two species, suggesting that many features of social play may reflect evolutionary responses to particular ontogenetic and ecological constraints.

Introduction

Although play has long been recognized in birds, it is not nearly as prevalent as it is in mammals (reviews in Fagen, 1981; Ortega & Bekoff, 1987; Power, 2000). Play has been described in only ten avian orders (Fagen, 1981; Skeate, 1985; Ortega & Bekoff, 1987), and in our review of social play in birds (Diamond & Bond, 2003), we found only five avian orders in which there was unambiguous evidence of social play. Three of these, the parrots, corvids and babbblers, showed evidence of such extensive social play as to be on a par with that of many groups of mammals. Within these orders, social play has been most extensively studied in keas, ravens (*Corvus corax*), Australasian magpies (*Gymnorhina tibicen*) and Arabian babbblers (*Turdoides squamiceps*) (reviewed in Diamond & Bond, 2003).

There is a well-established literature on the definition of play and the criteria by which it can be distinguished from other forms of social behavior (e.g. Bekoff & Byers, 1981; Fagen, 1981; Barber, 1991; Bekoff, 1995; Pellis & Pellis, 1996; Power, 2000; Burghardt, 2001; Spinka *et al.*, 2001). Social play involves at least two individuals that interact with and respond to each other, it incorporates actions from a variety of contexts into labile temporal sequences, and the actions are often repeated by mutual initiative (Bekoff, 1974; Ficken, 1977; Fagen, 1981). The interactions in social play lack consummatory behaviors; thus, they are frequently not resolved, but rather are repeated until the play partners are distracted by other stimuli (Lorenz, 1956). Social play may include components that are facilitated, but facilitation alone does not constitute sufficient evidence for social play (Diamond & Bond, 2003). Social play is characteristic of juvenile animals, but its incidence among different developmental stages varies across species and types of play (Bekoff, 1974; Fagen, 1981; Simmons & Mendelsohn, 1993; Diamond & Bond, 1999; Power, 2000). In this study, we categorized behaviors as constituting social play if they fell within the limits of the readily identified play categories described in Diamond & Bond (2003): Play chasing, play fighting, play invitations, and social object play.

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Age and sex can generally be determined at a distance in these parrots. Fledgling and juvenile kakas are identifiable by a pale periophthalmic ring until they are nearly a year old, and as they age, their eye rings gradually fade. Females appear to retain eye-rings longer than males (Moorhouse *et al.*, 1999). Keas are even more amenable to age categorization, displaying distinctive morphological features for up to four years after fledging (Diamond & Bond, 1991). Adult females of both species have conspicuously shorter bills than males and are significantly smaller, though sex differences are less conspicuous and less reliable in younger birds (Bond *et al.*, 1991; Moorhouse & Greene, 1995).

Method

In 2001 and 2003, we observed the behavior of kakas that aggregated at a sugarwater feeder adjacent to a private residence in the village of Oban on Stewart Island. Below the feeder and extending to each side was a cultivated flower garden that sloped down away from the lawn, terminating in a thick growth of native forest, primarily tree fuchsia (*Fuchsia excorticata*), kamahi (*Weinmannia recemosa*), and tree ferns (*Dicksonia* spp.). In addition to the sugar water, kakas fed on both the flowers and fruits of the fuchsia and took nectar from the kamahi and most of the flowers in the garden. This was a well-established resource, in that kakas had been making use of the feeder during the spring months for at least ten years. The kaka population using the feeder was unbanded, but we were able to reliably identify about twenty individuals on the basis of unique patterns of erosion and fracture lines on their bills (Pepper, 1996). Several of these individually identified birds appeared to be local residents, in that they visited the feeder several times each day. One mated pair held territory in the tree ferns and tree fuchsia adjoining the feeder, giving song and aggressively asserting their priority at the resource. Several other mated pairs of recognizable individuals also made regular, but less frequent, use of the feeder, sometimes temporarily displacing the primary residents. The feeder was visited by up to 20 kakas at a time in 2001 and up to 13 in 2003 during the early morning and again during late afternoon and early evening. Over the course of 110 hours of observations at this site, we recorded 41 instances of social play among juvenile and fledgling kakas on the lawn below the feeder, on the top of tree ferns, and in the nearby tree fuchsia.

Observations of kaka play behavior were contrasted to a database of records of kea play that we accumulated between 1988 and 1991 from a population at the Halpin Creek refuse dump, adjacent to Arthur's Pass National Park (Diamond & Bond, 1991, 1999; Bond & Diamond, 1992). Additional observations of kea play were made during the spring of 2000 at a refuse dump near Fox Glacier in Westlands National Park. From these studies, totaling over 450 hours of observation, we obtained 21 instances of kea social play on open ground, on piles of rock scree, or among beech trees surrounding the refuse dumps. Both settings offered numerous objects that could potentially be incorporated into play. The garden on Stewart Island was littered with shells, small stones, sticks of all sizes, and pieces of flowers. The refuse dump at Arthur's Pass and Fox Glacier contained many similar small objects, ranging from food containers and pieces of plastic to bones, stones, sticks, and flowers.

Instances of play in both species were generally recorded on video (18 instances for kakas; 3 for keas), as time-event sequences on a computer-based event recorder (8 instances for keas), or documented in detailed, written field notes (23 instances for kakas; 10 for keas). Each play instance consisted of one or more bouts. A bout was defined as beginning with the first recognizable play behavior, usually a play invitation, and terminating when the individuals separated, either when there was a pause in the action long enough for the birds to begin to engage in other behaviors or as a result of one of the play partners' leaving the area. When a pair of birds terminated a play bout by engaging in other behaviors for up to two minutes and then subsequently resumed social play, they were recorded as beginning a new bout within the same play instance.

We constructed ethograms of the play repertoire of each species, and we recorded the time of day and duration for each play bout, which we subsequently analyzed for species differences. To avoid biased sampling, we used only the time of the first bout in each play instance in the analysis of time of day.

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Discussion

The social play of kakas on Stewart Island is as robust and interactive as that of keas, and many of the action patterns appear to be homologous. Kakas and keas do, however, differ in the structure and context of their play behavior. Kakas play in smaller groups, they play in shorter bouts, and they are less likely than keas to play in the early morning. There were also striking differences between the species in the relative frequency of particular action patterns and in the correlational structure of play interactions. Ritualized play initiation behaviors, such as head cocking or rolling over, were relatively more frequent in kakas and clustered in a tighter, more coherent grouping. The other primary cluster of action patterns in kakas was dominated by arboreal play, which was relatively uncommon in keas. Keas generally showed a less tightly correlated behavior structure, with one cluster of intense, close-contact action patterns and another, looser collection of larger-scale movements and play initiation behaviors. Actions involving social object play collected in a third, virtually independent cluster for keas, but these were not observed in kakas at all.

The size of the displayed play repertoire increased significantly with bout length in kakas, something that was not observed in keas. Short bouts in kaka consist mainly of initiation behaviors, with long bouts displaying a larger portion of the repertoire. Keas exhibit a repertoire of behaviors that does not vary with bout length, suggesting greater variability in the sequence of action patterns. The implication of the cluster results, as well as the analysis of the relationship between repertoire size and bout duration, is that social play in kakas is in some ways more predictable and less sequentially diverse than that shown by keas.

Other species differences in play behavior may be dictated in part by differences in morphology. The frequency of bite attempts did not differ between the species. Kakas appeared less likely to grasp their play partners with their bills, seldom locking bills or biting down on legs or feathers. This may reflect a species difference in how hazardous a bite can be. Kakas have a powerful, shearing bill that can break open the toughest nuts and bark. Keas tend to grasp and twist or pry, rather than to crush or shear, and when they bite other keas, they do not generally draw blood. The contrast between keas and kakas in the use of the bill during play may, thus, be evolutionarily similar to the differences in aggressive behavior that Serpell (1982) observed among species of lorikeets, in which the birds with the most formidable weaponry were the least likely to use them in conspecific interactions.

Both species use their feet to push and kick at each other during fighting play, but keas are far more likely to kick their partner from a standing position. Again, this may be a morphological difference. Keas have much longer legs than kakas; the individual leg bones are 16-24% longer in keas than in the South Island kaka subspecies (Holdaway & Worthy, 1993) presumably as an adaptation to foraging on the ground. It may be that kakas cannot readily stand on a level surface and kick forward. The absence in kakas of the mutual jumping and flapping that is a dominant element of kea play may also be a consequence of the kaka's primary adaptation to arboreal movement. During this display, keas generally hold their bodies and heads almost vertically while striking out with wings and feet, and it may not be possible for kakas to adopt the same erect stance.

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In kakas, social play appears to be restricted to fledglings and juveniles, while play is much more broadly distributed among age groups in keas. Birds with a clearly adult appearance were not observed to participate in kaka play interactions, though we did see several instances of kakas that were morphologically adult unsuccessfully attempting to solicit play from younger birds. In contrast, we have commonly observed play between juvenile and subadult keas, and we recorded a number of instances of social play between adult females and younger birds. Keas also exhibit a separate, distinctive form of social play between adult or subadult males and females ('toss' play; Diamond & Bond, 1999), which may be part of the process of courtship and pair formation. No such behavior was exhibited in our kaka population.

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Kakas and keas do exhibit a variety of significant differences in the structure and context of their social play, however. Kakas engage in play bouts that are shorter and less variable than those in keas, they play only during a more limited developmental period, and they do not display social object play. This suggests that ontogenetic and ecological factors, such as differences in the length of association of juveniles with adults, degree of exploratory behavior, or flexibility in foraging, may also influence the structure of social play.

Two conspicuous differences in the biology of these species may have been influential in determining the manifestation of their social play. First, young kakas remain in the presence of adults for a much shorter period than do keas (6 months vs. 2 years), and social play is commonly less extensive in species with more limited associations between juveniles and adults (Pellis & Iwaniuk, 2000; Diamond & Bond, 2003). Our observations provide some support for this interpretation, in that kaka play is less structurally complex than that of keas, and individual bout lengths are shorter.

Secondly, kakas are more neophobic and far less flexible and exploratory in their behavioral ecology than keas, and the occurrence of play behavior has often been linked to exploratory behavior (Vandenberg, 1978; Hall, 1998; Power, 2000), innovation (Fagan, 1982; Spinka *et al.*, 2001), or ecological generality (Fagan, 1981; Ortega & Bekoff, 1987). Although kakas do play socially, they do not engage in social object play, and it is this behavior that may show the strongest relationship to foraging flexibility. Social object play is relatively common among the larger Corvidae, suggesting that it may be related to their reliance on exploration and neophilia in foraging contexts, which is more characteristic of keas (Diamond & Bond, 2003).