

Context-dependent vocal mimicry in a passerine bird

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How do birds select the sounds they mimic, and in what contexts do they use vocal mimicry? Some birds show a preference for mimicking other species' alarm notes, especially in situations when they appear to be alarmed. Yet no study has demonstrated that birds change the call types they mimic with changing contexts. We found that greater racket-tailed drongos (*Dicrurus paradiseus*) in the rainforest of Sri Lanka mimic the calls of predators and the alarm-associated calls of other species more often than would be expected from the frequency of these sounds in the acoustic environment. Drongos include this alarm-associated mimicry in their own alarm vocalizations, while incorporating other species' songs and contact calls in their own songs. Drongos show an additional level of context specificity by mimicking other species' ground predator-specific call types when mobbing. We suggest that drongos learn other species' calls and their contexts while interacting with these species in mixed flocks. The drongos' behaviour demonstrates that alarm-associated calls can have learned components, and that birds can learn the appropriate usage of calls that encode different types of information.

Keywords: alarm calls; context-dependent mimicry; *Dicrurus paradiseus*; mixed-species flocks; mobbing calls; vocal mimicry

1. INTRODUCTION

Vocal learning is considered by cognitive scientists to be a special form of social learning that is not as complex as other forms of imitation (Shettleworth 1998). This is because motor output can be directly compared to audio input; in contrast, visual imitation (imitating the externally visible actions of another organism) is considered to require greater cognitive processing because the performer often cannot see the output in order to compare it to the input (Bryne 2005). But vocal learning is not simply a process by which animals learn to produce a particular sound: in some cases animals also learn how to use that sound, and in what contexts it is appropriate (Janik & Slater 2000). Such contextual vocal learning requires the cognitive capacity to store information from multiple stimuli detected at different times and in different conditions, and then choose, from among the different sets of stored information, the set appropriate for the current condition (Pepperberg 1998).

Bird song has been a major model for vocal learning, and thus the study of contextual learning has focused for birds on how they learn to match the songs of other individuals (Burt *et al.* 2002) or learn the sequence of different songs in a song repertoire (Todt & Hultsch 1996). But birds also have a large repertoire of calls that encode different types of information, such as the presence of food or predators (Marler 2004). Although many calls are believed to be unlearned, evidence is accumulating that some are copied from other individuals (Mundinger 1970; Nowicki 1989; Wright 1996). If a bird has the potential to learn an array of different calls, this leads to

the question of whether birds have the cognitive capacity to learn the context of these different calls as well.

One way to study the contextual learning of bird calls is to investigate birds that mimic other species. If a bird mimics the calls of a diversity of other species accurately, one can trace the source and context of the modelled calls and then determine whether mimicry is random or whether certain calls are used only in certain circumstances. One laboratory study has focused on African grey parrots (*Psittacus erithacus*), which have learned to use English words both referentially (as labels) and functionally (to produce a result; Pepperberg 1998). In-depth field studies of wild birds, however, have yet to show systematic non-random patterns in sound selection (Hindmarsh 1984; Chu 2001). Some authors have noted that birds appear to preferentially mimic the calls of predators or the alarm or mobbing calls of other birds (Robinson 1974; Greenlaw *et al.* 1998) especially during alarm contexts (Chisholm 1932; Vernon 1973; Morton 1976). But, as yet, no study has shown that birds change the calls they mimic depending on the context.

We here investigate whether birds have the cognitive capacity to learn the context of calls, by studying the greater racket-tailed drongo (*Dicrurus paradiseus*), a species renowned for the accuracy of its mimicry (Ali & Ripley 1987; Henry 1998). We have previously studied the alarm calls of drongos and other species that participate with them in mixed-species flocks in Sri Lanka (Goodale & Kotagama 2005). We found that drongos were imitating the alarm calls of other species, as well as their songs and contact calls. In the current study, we investigated two questions. We first examined whether drongos preferentially mimic alarm-associated calls.

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