S35-3  Alarm calls, communication and cognition in Australian magpies
(Gymnorhina tibicen)

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Abstract  Alarm calls have served a model function to test hypotheses about intentional signaling as an integral, if not key element, in the expression of higher cognition. The alarm signals of some avian species, including alarm and distress calls, may be generalized and so be understood by mammals and other birds. Some species, including primates and ground-dwelling mammals, have developed specific alarm calls that convey meaning beyond communicating a general state of arousal or fear. They indicate specific types of predators, for example ground or aerial. Similar distinctions in alarm calls had been shown only in one avian species, the domestic chicken. I investigated the alarm calls of Australian magpies in the field and found that magpies may use as many as eight well-defined types of alarm calls, only one of which is used for a general alert. This was used in playback experiments. I also identified a specific alarm call that seemed to be reserved for birds of prey alone; recordings of them were taken in response to wedge-tailed eagles. The same alarm calls were then used experimentally in playbacks to other groups of magpies. The results demonstrate that magpies respond differently to this alarm, suggesting that they may also use referential signaling.

Key words  Alarm calls, Cognition, Communication, Australian magpie

1 Introduction

Alarm calls are a class of vocalizations of significance to research into the evolution of signal structure and function because they warn receivers of the appearance of threat, such as a predator. The question concerning higher cognition is whether species can actually discriminate between classes of threat and demonstrate this by selective use of alarms. To be regarded as intentional, one expects alarms to be given only in the presence of an audience of conspecifics. This would demonstrate that the sender was acting not merely on impulse (expressing a state of emotion), but with intent to communicate a specific message to conspecifics within auditory range. Hence, an intentional raptor alarm call should be emitted after sighting a bird of prey, and a snake alarm call after the sighting of a snake, only when others are present.

It has been argued that alarm calls are simply an automatic, unintentional signal of emotional state, because predators induce a state of fear (Rogers and Kaplan, 2000). An aerial predator might elicit more fear than a ground predator (or vice versa), and different calls for either might thus reflect the differences in perceived danger. In fact, even switching from one call to another may indicate increased fear, and this does seem to occur in some species. For instance, two types of alarm calling have been reported in black-winged stilt (Himantopus himantopus), the type of call depending on the distance of the predator (Emlen, 1972).

Since renewed interest in cognition in animals and the work by Seyfarth, Cheney and Marler (1980), Greene and Meagher (1998), Manser (2001), Blumstein and Armitage (1997) and Zuberbühler (2000), it has been confirmed that the ability to discriminate between different alarm calls signaling threat from different predators is present in a variety of species, and that such signals lead to predictable behavioral responses in the receivers. Research has also established that domestic chickens (Gallus gallus) have different alarm calls for ground and aerial predators (Marler and Evans, 1996; Evans, 1997). Thus, alarm calls may be intentional and convey meaning beyond a simple “readout” of the emotional state of the sender (Kaplan and Rogers, 2001).

2 Vocalization research on the Australian magpie

There is good information available on the biophysical properties of alarm calls in Australian birds in general, including the Australian magpie (Gymnorhina tibicen) (Jurisevic and Sanderson, 1994, 1998; Wood et al., 2000). Yet there have been only two major published studies on magpie vocalizations so far, one concentrating on group interactions between territorial owners and neighbors (Brown et al., 1988, 1991) and the other on mimicry (Kaplan, 2000). Australian magpies (Fig. 1) are territorial and communal ground-feeders, foraging in loose groups of diverse hierarchy and engaging in extensive communication that is context-dependent (Farrabaugh et al., 1992). Both visual and vocal signals are used. As Brown and Farabaugh (1991)
have shown, some geographic variation occurs in alarm calls.

3 Methodology

I undertook extensive field observations on Australian magpies over a three year period, collecting a range of vocalizations including alarm calls in inland and coastal New South Wales and, as far as possible, establishing the context in which the calls were made. The calls of 20 different magpie tribes (only established territorial groups or pairs, not bachelor groups) were collected. Alarm calls elicited by the presence of an eagle were recorded in two separate geographical locations, inland and coastal, involving unrelated tribes.

Three types of calls formed the basis for playback experiments. One sequence comprised the “eagle” alarm call alone (Fig. 2C). The second call was the most commonly heard alarm call through eastern Australia; it comprises repeats of the same call and is referred to as the “generic” alarm call (Fig. 2B). The third call, used as a control, was a short segment of song or “warble” (Fig. 2A). In addition to these calls, two extra types were generated from the existing samples: (1) the “eagle” alarm call was reversed in note order with maintenance of its temporal integrity (spacing between syllables); and (2) the “eagle” alarm call was mixed with the generic “alarm” in a semi-randomized blend. The “generic-plus-eagle-alarm” call was used to test whether a composite call elicited stronger responses; and the reversed “eagle” alarm was used to test whether chronological sequence is essential for its message.

Initial tests varied the duration of playbacks to test responses, establishing that the five-minute playback was the most effective. That five minutes in turn determined an observational period of 15 minutes per playback experiment: five minutes pre-playback silence, five minutes playback, and five minutes post-playback silence. Behaviors recorded during the 15 minutes of playback covered foraging, walking, standing, running, vocalizing, looking down, scanning and, in particular, looking up, i.e. overhead. Because of the lateral position of the eyes, looking up was defined as raising the head so that the beak was above horizontal, with or without tilt of the head.

Playback experiments were carried out in five different magpie territories in different areas and in different seasons. Each magpie group was exposed to the five types of calls in semi-randomized order on every second day for eight days at three times a day (8 am, 12 noon, 4 pm). The portable cassette unit had two loudspeakers producing 68 dB at 10 m attenuation and was placed on the ground. Observers were placed ten meters away from the sound source, and recorded any change in magpie behavior. The results were weighted for number of magpies in each group.

4 Results

Across all playback tests, the “eagle” alarm call yielded

Fig. 1  The Australian magpie (Gymnorhina tibicen), one of Australia’s foremost songbirds

Song is not used in breeding display, and males and females sing almost equally all year round.

Fig. 2  Three specific vocalizations of an Australian magpie

A. Typical song, sometimes called “warble”, usually in the frequency range 500 Hz –2 kHz; B. “generic” alarm call, shared by magpie populations across eastern Australia, in a frequency range of 5–7 kHz; C. “eagle alarm call”, almost always in excess of 6 kHz and with complex structure and layers of harmonics.
the strongest response. The most conclusive single re-
response was undoubtedly the “looking up” behavior, which
would scan for an aerial predator, even though the sound
source was at ground level. Results for mean numbers of
recorded events of “looking up” are presented below (Fig.
3).

It is noteworthy that playback of normal song yielded
negligible looking up in any trials for any of the five groups.
This behavior was usually absent in most trials using con-
trol song (warble) or the generic (nonspecific) alarm call.
Some looking up occurred in the phase of playback of “ge-
eric” calls but was significantly enhanced once the “eagle”
alarm call was added. For all call types, looking up is higher
during playback than before playback and remains elevated
after the “eagle” alarm call has been played, and also after
the reversed “eagle” call. Indeed, the post-playback period
was as important as the actual playback period. For reasons
of space, the results of overall reactivity scores have not
been presented here but they are statistically significant in
the post-playback period. Generally, the post-playback pe-
riod indicated high levels of arousal and very watchful be-
behavior that subsided only gradually; it sometimes took over
half an hour before activities returned to normal foraging
patterns.

5 Discussion

It is too early yet to say whether “eagle” alarm calls
are intentional signals because I have not yet tested their
use in the absence of an audience. It can be suggested,
however, that that alarm call has a specific meaning, since
magpies respond to it not just by general arousal but by
looking overhead as they would only for an aerial predator.
As magpies respond to the “reversed eagle” alarm call
equally strongly, it seems that they may obtain meaning
from the frequency ranges of the overtones in the call and
not from the chronological sequence of notes.

This project will continue to address the important
question of referential signals, contributing as it does to
cognition in the wider sense. Intentional communication is
an integral, if not key, element in the expression of higher
cognition. Debate on higher cognitive abilities has tended
to focus on the great apes, often tacitly assuming that many
traits associated with higher cognition first evolved in the
great apes linked to the development of a large neocortex
and a complex social life-style. However, some higher cog-
nitive characteristics have also evolved in avian species,
on a different evolutionary trajectory than in apes; birds do
not have a neocortex. Recent research shows that many of
the traits once considered unique to humans, and later also
to great apes, are shared with similar ability by some birds.
Examples are tool using, problem solving, deception, con-
cept development, and spatial abilities, as discussed in other
papers in this symposium. Referential signaling is another
important piece in the puzzle of cognitive abilities in birds.

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References
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Fig. 3 Australian magpie responses to playbacks of three different types of their calls, and two experimental modifications of them
The y-axis shows the mean number of events for all magpie groups tested. The x-axis shows the responses during the three phases of the
experiment. All “looking up” responses are significantly higher during playback of “eagle” alarm calls than prior to playback.