Cracking the Code: Communication and Cognition in Birds
Christopher S. Evans

> Since monkeys certainly understand much that is said to them by man, and when wild, utter signal-cries of danger to their fellows; and since fowls give distinct warnings for danger on the ground, or in the sky from hawks ... may not some unusually wise apelike animal have imitated the growl of a beast of prey, and thus told his fellow-monkeys the nature of the expected danger? This would have been a first step in the formation of a language. ...When we treat of sexual selection we shall see that primeval man, or rather some early progenitor of man, probably first used his voice in producing true musical cadences, that is in singing, as do some of the gibbon-apes at the present day; and we may conclude from a widely-spread analogy, that this power would have been especially exerted during the courtship of the sexes,- would have expressed various emotions, such as love, jealousy, triumph,- and would have served as a challenge to rivals. (Darwin 1871: 56-57.)

Charles Darwin clearly believed that language had evolved from precursors in the natural signals of animals. As with so much of his writing, these passages anticipate recent research programs. He points out that monkeys and chickens have distinctive alarm calls for different kinds of danger, and goes on to suggest that language is the product of sexual selection. Darwin's argument is a case for continuity.

Over a hundred years later, this idea is still treated with considerable skepticism (e.g., Premack 1975; Luria 1982; Wallman 1992; Lieberman 1994). Critics typically take the Cartesian position that language is special, in the sense that all of its attributes are unique to humans. It follows that comparative studies should fail to reveal any comparable traits in non-human animals. These reservations are often summarized in two related assertions: first, that animal signals are simply a read-out of emotional state and, second, that production is reflexive or involuntary. Resolving this controversy is important because, if Darwin was right, then we can use communication as a window on the minds of non-human animals. Evidence for continuity would also force us to re-think assumptions about the nature and extent of human uniqueness.

My research program focuses on the relationship between acoustic signalling and cognition in birds. I have adopted an ethological approach (Tinbergen 1963) choosing to study natural behavior of obvious functional importance. Techniques include both controlled laboratory experiments to characterize mechanism and studies of social groups under natural conditions to obtain insights about function. The theoretical assumption underpinning this work is that cognitive processes are adaptations, in just the same way as physical structures.

Referential signals

The first evidence that animal communication might be more complex than traditional models had anticipated came from Struhsaker's (1967) pioneering field studies of vervet monkeys (*Cercopithecus aethiops*). This work established that vervets have acoustically-distinct alarm calls corresponding to their three principal classes of predator: eagles, leopards, and snakes. Seyfarth and Cheney followed up this work with playback experiments, demonstrating convincingly that calls are sufficient to evoke responses appropriate to the type of predator that had originally elicited the sound (Seyfarth et al. 1980). Macedonia's (1990) studies of ring-tailed lemurs (*Lemur catta*) provide similar evidence of predator-class-specific alarm calls.

Vervets and lemurs have *referential signals*. In both species, identifiable external events reliably elicit a particular type of call and these signals are sufficient to evoke adaptive responses, even when contextual cues are unavailable. The strategy for exploring the characteristics of any system of referential signals involves mapping these relationships between eliciting conditions and signal structure, and between signal structure and receiver