

DWARF MONGOOSES COMBINE MEANINGFUL ALARM CALLS

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Syntax, the combination of meaningful words into larger meaningful structures, is a key feature of language that is responsible for much of language's generative power. Comparative data from animal communication studies can help unpack the evolution of syntax, which in turn is a necessary step towards better understanding the evolution of language as a whole. While syntax is present in all human languages, it is rare in animal

communication, though examples of call combinations that can be described as rudimentary syntax exist (Collier et al., 2014). These syntax-like combinations can be compositional, where the meaning of the combination is derived from the meaning of the component calls, as seen in Campbell monkey (*Cercopithecus campbelli campbelli*) alarm calls (Ouattara et al., 2009) or idiomatic or combinatorial, where the meaning of the combination is not related to the meaning of the component calls, as for putty-nosed monkey (*Cercopithecus nictitans*) alarm calls (Arnold & Zuberbühler, 2006).

Whilst comparative data outside of primates remains scarce, it can provide insights into the ecological or social factors that may be important in promoting the emergence of syntax. In this study we investigated alarm call combinations in dwarf mongooses (*Helogale parvula*), small, social living, cooperative breeding mammals. Similarly to other terrestrial mammals, recordings of natural predator encounters and experimental predator presentations suggest that dwarf mongooses produce, among others, one type of alarm call to aerial predators and another structurally distinct variant to terrestrial predators. Interestingly, dwarf mongooses also seem to combine these aerial and terrestrial calls into a third combination alarm, consisting of an aerial alarm followed immediately by a terrestrial alarm. Contextual data suggests these combination alarms are more often produced after the group had already been alerted to the presence of an aerial predator by an aerial alarm and so the function of the combination does not seem to be directly related to the independent functions of both the comprising aerial and terrestrial calls.

In order to verify if the combination alarm really is composed of independent aerial and terrestrial alarms, we first used acoustic analysis to compare whether there were structural differences between the alarm calls occurring alone and those comprising the combination. Secondly, we implemented playback experiments of synthetically constructed combination alarms (aerial + terrestrial alarm) and assessed receiver responses in relation to playbacks of naturally produced combination alarms.

Acoustic analyses revealed that the aerial component of the combination was not structurally different from the independently occurring aerial alarm, whereas the terrestrial component of the combination, on average, differed from the terrestrial alarm. However, the mongooses demonstrated similar behavioural reactions when hearing playbacks of both natural and synthetic combination alarm stimuli.

Thus, dwarf mongooses combine two meaningful alarm calls into a third alarm call whose meaning is not, *a priori*, a function of the meanings of its component calls, making this a potential example of a combinatorial call combination in a non-primate species. Interestingly, we did find acoustic variation between the terrestrial call within the combination alarm and the independent terrestrial alarm. Given these acoustic differences, yet the similar behavioural responses to artificial and natural versions of the combination alarm, it is possible that these subtle structural variations may not be perceived by the mongooses or relevant for their communication. The second half of the combination alarm and the terrestrial alarm call could therefore represent “allomorphs”: two acoustically distinct variants of the same call type that are perceived identically by the mongooses but used in different contexts.

In conclusion, dwarf mongooses combine meaningful alarm calls suggesting that concatenation of semantic units may be more widespread in animal communication than previously thought. Given the relatively large phylogenetic distance between dwarf mongooses and humans, these data can begin to unpack candidate selective pressures driving the emergence of a syntactical combinatorial level.

References

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