

# FUNCTIONALLY FLEXIBLE VOCALIZATIONS IN WILD BONOBOS

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## 1. Introduction

A core component underlying the evolution of language and the development of speech in human infants is the emergence of functional flexibility, the capacity to produce vocalizations independent of a fixed function in order to express a full range of emotional content across different situations (Griebel & Oller, 2008). Research has demonstrated that, even before speech emerges in infancy, 3-to-4 month old human infants produce a class of vocalizations—known as ‘protophones’— in functionally flexible ways to express a full range of emotional content (Oller et al., 2013). This finding has been contrasted with an apparent absence of evidence for this capacity in non-human primates, leading to the conclusion that the functional flexibility of human infant vocalizations marks an evolutionary transition between primate vocal communication and human speech (Oller et al., 2013). Here, we addressed this proposed evolutionary discontinuity by examining evidence for functional flexibility in the vocalizations of wild bonobos (*Pan paniscus*), one of our closest living relatives. We focussed on the ‘peep’, a commonly-produced vocalization

specific to bonobos. The ‘peep’ is a closed mouth vocalization that is high in frequency, short in duration and flat in acoustic form.

## **2. Methods & Results**

We conducted behavioral observations and recorded vocalizations of wild adult bonobos at Lui Kotale in DR Congo using focal animal sampling. We analysed the acoustic structure of peeps produced in different behavioural contexts relating to the three principal valence dimensions (positive-neutral-negative) to explore acoustic cues relating to the inferred affective valence. We used Discriminant Function Analyses to examine if peep structure varied across valence contexts and caller identity.

Acoustic analyses revealed that wild bonobos produce a specific call type—the ‘peep’— across the full valence range in every major aspect of their daily lives, including feeding, travel, rest, aggression, alarm, nesting and grooming. Despite differences in the eliciting contexts, peep acoustic structure did not vary between contexts associated with neutral and positive valence. However, peeps produced in negative valence contexts were acoustically distinct, suggesting that vocal flexibility is more constrained by vocal production mechanisms in negatively charged situations. Peeps could be distinguished based on caller identity alone.

## **3. Discussion**

In contrast to earlier conclusions (Oller et al., 2013), our results indicate that functionally flexible vocal signaling is a capacity shared with our closest living ape relatives, demonstrating its deep evolutionary roots. The finding of greater flexibility present in some contexts but not others suggests an evolutionary transition in hominids from functionally fixed to functionally flexible vocalizations. Identifying non-human primate vocalizations that are used in flexible ways, rather than being tied to fixed biological function, can provide relevant insights for the evolution of human speech. We will discuss these results in light of on-going analyses examining the pragmatic responses of receivers to peeps when combined in sequences with other calls.

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## References

- Griebel, U., & Oller, D. (2008). Evolutionary forces favoring communicative flexibility. In D. K. Oller and U. Griebel (Eds.), *Evolution of communicative flexibility: complexity, creativity, and adaptability in human and animal communication*, (pp. 9–40). Cambridge: MIT Press.
- Oller, D. K., Buder, E. H., Ramsdell, H. L., Warlaumont, A. S., Chorna, L., Bakeman, R. (2013). Functional flexibility of infant vocalization and the emergence of language. *Proceedings of the National Academy of Sciences of the United States of America*, 110(16), 6318–6323.