

## **VOCAL LEARNING IN FUNCTIONALLY REFERENTIAL CHIMPANZEE FOOD CALLS**

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One standout feature of human language is our ability to reference external objects and events with socially learnt symbols, or words. Exploring the phylogenetic origins of this capacity is therefore crucial to a comprehensive understanding of the evolution of language. While non-human primates can produce vocalizations that function as if they refer to external objects in the environment, the psychological mechanisms underlying call production in terms of a caller's motivation and a caller's ability to alter the structure of these calls is likely different to humans (Wheeler and Fischer, 2012). Indeed it is generally argued that the acoustic structure of context specific calls elicited by salient external stimuli (e.g. food, predator) is directly determined by arousal states induced by the external stimuli (Wheeler and Fischer, 2012). This apparent lack of flexible control over the structure of functionally referential vocalizations represents a key discontinuity with language. We tested the degree of flexibility in the acoustic structure of functionally referential chimpanzee food calls (Slocombe and Zuberbuhler, 2005) and whether the structure of these calls could be influenced by vocal learning processes.

We examined the food preferences and acoustic structure of food calls of two groups of adult chimpanzees, prior to and for 3 years after their integration into a single group at Edinburgh Zoo, UK. Prior to social integration in 2010 the resident Edinburgh (ED) chimpanzees ( $N = 6$ ) and the immigrant Beekse Bergen (BB) chimpanzees ( $N = 7$ ) had significantly different preferences for apples and produced acoustically distinct calls whose structure, in line with previous research, matched their preferences for this food (Slocombe and Zuberbühler 2006). Apples were regularly fed to both groups for at least 3 years before integration, so were not a novel food for either group. General arousal levels may have been elevated in 2010 as both groups adjusted to a new social environment and BB chimpanzees habituated to a new enclosure. However, in 2011, one year after integration and habituation to the new social and physical environment, the call structures and preferences for apples of the two groups remained stable, indicating changes in general arousal were not affecting call structures. Social network analysis (SNA) revealed two distinct subgroups in 2011, with individuals still preferring to associate with members of their original group and maybe lacking the motivation to converge their calls. In 2013, SNA showed the subgroups had dissolved and strong inter-group relations had developed. Although the ED calls stayed stable in their structure 2010–13, in 2013 BB calls changed significantly to converge with the lower frequency ED calls. Importantly this call convergence occurred independently of preferences for apples, which stayed stable over all years for both groups. This shows a decoupling of the affective response induced by the external stimulus (apples) and the structure of the call produced. We argue that these data represent the first evidence of non-human animals actively modifying and socially learning the structure of a meaningful functionally referential vocalization from conspecifics. Our findings indicate that functionally referential call structure is not solely determined by arousal processes in our closest living relative. Although this modest degree of acoustic change within an existing call type is not analogous to the impressive vocal learning shown by humans, this flexibility may be an important evolutionary *precursor* to socially learnt referential words that are so central to human communication.

## References

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