Primate duet display via arboreal locomotor predictability: emergent height and variety as selecting for more complex gibbon great calls

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Disciplinary background A. Behavioral ecology is the science of modeling a species' adaptive fit of their behavior to their environment (Fox and Westneat, 2010). Primates exhibit a vast array of behavioral modes and live in a wide variety of habitats across the world, but primarily in forested environs (Fleagle, 1999). Consequently, such a profusion of possible tree species exerting selection pressures on this array of primate positional and communicative modes challenges researchers with myriad habitat considerations. Presumably, such a wide variety of tree shapes, sizes, and statures should exert a corresponding diversifying selection on the behavior of its residents. This exceptional behavioral diversity of primates, incidentally makes them ideal models for testing evolutionary theories that interpenetrate the noesis of human behavior. Unlike our species, gibbons sleep in tall trees—that emerge through the forest canopies of southeast Asia—which also often serve as the primary setting for their exceptional vocal displays Alexander et al., 2018).

Disciplinary background B. Many pair bonded primates participate in coinciding vocal behavior that often manifests in the form of calls with interacting male and female contributions. Socially monogamous gibbons (Geissmann, 1986), tarsiers (Clink, Tasirin and Klink, 2020), and callitrichids (Muller and Anzenberger, 2002) produce mutable vocal duets that feature such acoustic patterning. Gibbons, in particular, routinely exhibit duetting behaviors in all but a few species. The females' "great call" forms the center-piece of such elaborate displays—often featuring a diversity of syllables which typically increase in frequency and accelerate into a rapid series of upward frequency sweeps (Raemaekers, Raemaekers and Haimoff, 1984) blurring repetition into both transposition and trill. Theories on the function of these calls range from resource spacing Mitani, 1985), to pair-bonding and mate attraction (Geissmann, 1986). But few studies to date have looked at various features, especially in combination, and how display structure could relate to ecology.

Abstract

Such structured patterning (e.g. rhythm) of collaborative primate calls may facilitate turn-taking between mated pairs. Such joint vocal coordination could signal corresponding locomotor coordination to neighboring conspecifics. Species that duet with such acoustic features (e.g. rhythmic tempo) likely evolved mental capacities conducive to riskier arboreal locomotion in taller trees. I tested this idea with a species-level dataset of spectrographic vocal duets of gibbons—specifically, assessments of musical features (e.g. repetition, transposition, and syllable) present in each song. For each gibbon species, these features were compared with a dataset of associated indigenous species of "emergent" trees from genus Shorea (of family Dipterocarpaceae) (Ashton, 2003).

Surprisingly, only a few of the features that distinguish primate calls as musical (e.g. rhythm and syllabic diversity) corresponded to these ecological features—primarily only diversity and height of associated emergent tree species. Specifically, emergent height correlated the most consistently with the spectral complexity of the protracted (female) components of the gibbon great call. Contrary to my main prediction, however, arboreal height did not correlate positively with musical rhythm, although it did with percentage of non-overlapping units. And there are marginal indications that it could instead correlate with the diversity of these gibbon-associated emergent tree species.

Interdisciplinary implications. Here, I have questioned the primacy of rhythm as the sole indicator acrobatic primates (here gibbons) use in their acoustic coordination displays (e.g. the great call duet), and a solid case is emerging for the importance of spectral features. Syllabic diversity, for example, was not ruled out as compensating for reduced chemical signaling. As humans, we constitute the only musical ground-primate and we owe our profuse variety of modern musical forms not only to cultural transmission within and between large groups (Street, Eerola and Kendall, 2022), but also, ultimately, to sensory constraints inherited from our ancient olfactory-impoverished primate progenitors. The additional, and somewhat serendipitous finding—that arboreal (emergent) variety and height correlates with musical complexity in the longer female-component of gibbon great calls—provides additional support for an arboreal locomotion conducive cognition signaling related function of primate duets.

References

Alexander, C. et al. (2018). Locating emergent trees in a tropical rainforest using data from an Unmanned Aerial Vehicle (UAV). *International journal of applied earth observation and geoinformation, 72*, 86–90. doi:10.1016/j.jag.2018.05.024.

Ashton, P.S. (2003). Dipterocarpaceae. In *Flowering Plants· Dicotyledons* (pp. 182–197). Berlin, Heidelberg: Springer.

Clink, D.J., Tasirin, J.S. and Klinck, H. (2020). Vocal individuality and rhythm in male and female duet contributions of a nonhuman primate. *Current zoology*. *66*(2), 173–186. doi:10.1093/cz/zoz035.

Fleagle, J.G. (1999). *Primate adaptation and evolution*. New York: Academic Press.

Fox, C.W. and Westneat, D.F. (2010). Adaptation. In Westneat, D.F. and Fox, C.W. (Eds.), *Evolutionary behavioral ecology*. New York: Oxford University Press.

Geissmann, T. (1986). Mate change enhances duetting activity in the siamang gibbon (Hylobates Syndactulus). *Behaviour, 96*(1–2), 17–27.

Mitani, J.C. (1985). Gibbon song duets and intergroup spacing. *Behavior, 92*(1/2), 59–96.

Muller, A.E. and Anzenberger, G. (2002). Duetting in the titi monkey Callicebus cupreus: Structure, pair specificity and development of duets. *Folia Primatologica, 73*, 104–115.

Raemaekers, J.J., Raemaekers, P.M. and Haimoff, E.H. (1984). Loud calls of the gibbon (Hylobates-Lar) - Repertoire, organization and context. *Behaviour, 91*, 146–189.

Street, S.E., Eerola, T. and Kendal, J.R. (2022). The role of population size in folk tune complexity.*Humanities and social sciences communications, 9*(1), 152. doi:10.1057/s41599-022-01139-y.