

Symposium | Birds, Humans, and Primates

📅 Sat. Oct 18, 2025 10:45 AM - 12:15 PM JST | Sat. Oct 18, 2025 1:45 AM - 3:15 AM UTC 🏠 Venue
4(KOMCEE W B1F-011)

[S6] Symposium 6: Rhythmic sound development and plasticity in birds, humans, and primates

Chair: Andrea Ravignani (Sapienza University of Rome)

Rhythm and timing capacities are fundamental aspects of cognition, movement, and communication, essential for human expression, social interaction, and cognitive development. Studying these capacities from a combined developmental and cross-species perspective offers a comprehensive understanding of their complexities, nuances, and evolutionary roots. In this proposed symposium we focus on rhythm in the acoustic domain and discuss its many developmental and cross-species facets.

Why sound? Surely timing and rhythm capacities can manifest in multiple dimensions and modalities. Here we focus on sound as a common thread connecting the different talks because: 1) it is easy to record and measure in empirical contexts; 2) it is also easy to control and administer in experimental contexts; 3) it can be sampled at high temporal resolutions; 4) it connects with abilities that appear early in human life, are plastic, and are present in other species.

Why rhythm? Timing and rhythm have had an interesting historical relationship. By some they are seen as strongly related. Others consider them mechanistically unrelated systems. In both cases, rhythm provides a “twin system” for timing, i.e. the other side of the coin of human timing.

Why development and plasticity? Infants as young as a few months old exhibit rhythmic entrainment, synchronizing their movements with external beats. This capacity develops and refines throughout early childhood, laying the foundation for music and language acquisition. Rhythm and timing abilities are closely tied to cognitive development, in e.g. attention, memory, and executive functions.

Studying these relationships provides insights into cognitive development and potential interventions for developmental disorders. Studying infant responses to rhythmic sounds can reveal the earliest manifestations of timing and time perception, shedding light on their developmental origins.

Why cross-species? This approach can show similarities and differences with animal groups closer or farther from us. Studying rhythmic behaviors in animals, such as songs of songbirds or drumming in great apes, can reveal shared neural mechanisms and cognitive processes underlying timing and time perception. How do these arise? On the one hand, common ancestry can give rise to “homologies”: comparative neuroanatomy can uncover homologous brain structures involved in timing and rhythm, providing clues about the evolutionary conservation of these mechanisms. On the other hand, convergent evolution can create “analogies”: finding rhythmic abilities in diverse species can suggest convergent evolutionary pressures that have shaped timing and rhythm across the animal kingdom. Finally, animal work can discover new animal models for human disorders. Research on animal models can help us better understand those human disorders – e.g. Parkinson's disease, schizophrenia, and autism spectrum disorder – which often involve disruptions in rhythmic and timing abilities.

Together, the cross-species and plasticity angles allow comparing developmental trajectories of rhythm and timing capacities across species. One of our goals is to showcase how colleagues working on timing and time perception can connect to the study of rhythmic sounds in other species and human development. A comparative and developmental approach can pinpoint evolutionary trends, test the boundaries of cognitive and neural plasticity, and provide testable hypotheses for timing and time perception.

10:45 AM - 11:00 AM JST | 1:45 AM - 2:00 AM UTC

[S6-01]

Rhythmic sound development and plasticity in birds, humans, and primates

*Andrea Ravignani¹ (1. Dept. of Human Neurosciences, Sapienza University of Rome (Italy))

11:00 AM - 11:15 AM JST | 2:00 AM - 2:15 AM UTC

[S6-02]

Developmental Changes in the Temporal Properties of Preverbal Vocalizations in Early Human Infancy

*Miki Takahasi¹ (1. RIKEN (Japan))

11:15 AM - 11:30 AM JST | 2:15 AM - 2:30 AM UTC

[S6-03]

The ontogeny of vocal rhythms in a non-human primate

*Teresa Raimondi^{1,2}, Lia Laffi^{1,2}, Chiara De Gregorio², Daria Valente², Walter Cristiano^{2,3}, Filippo Carugati², Valeria Ferrario², Valeria Torti², Jonah Ratsimbatsafy⁴, Cristina Giacomini², Andrea Ravignani^{1,5,6}, Marco Gamba² (1. Sapienza University of Rome (Italy), 2. University of Turin (Italy), 3. Italian National Institute of Health (Italy), 4. Groupe d'Étude et de Recherche sur les Primates de Madagascar (Madagascar), 5. Aarhus University (Denmark), 6. The Royal Academy of Music (Denmark))

11:30 AM - 11:45 AM JST | 2:30 AM - 2:45 AM UTC

[S6-04]

Individual temporal plasticity in singing in the adult indris

*Marco Gamba¹, Lia Laffi¹, Silvia Leonetti¹, Filippo Carugati¹, Valeria Ferrario¹, Flavie Eveillard¹, Teresa Raimondi¹, Chiara De Gregorio¹, Longondraza Miaretsoa¹, Olivier Friard¹, Cristina Giacomini¹, Valeria Torti¹, Andrea Ravignani¹, Daria Valente¹ (1. Università di Torino (Italy))

11:45 AM - 12:00 PM JST | 2:45 AM - 3:00 AM UTC

[S6-05]

Social inheritance of Java sparrow rhythms

*Anthony Kwong¹, Rebecca N Lewis¹, Masayo Soma¹, Andrea Ravignani¹, Taylor Hersh¹ (1. University of Manchester (UK))

Rhythmic sound development and plasticity in birds, humans, and primates

*Andrea Ravignani¹

1. Dept. of Human Neurosciences, Sapienza University of Rome

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Keywords: development, plasticity, infancy, comparative, vocal rhythm

Developmental Changes in the Temporal Properties of Preverbal Vocalizations in Early Human Infancy

*Miki Takahasi¹

1. RIKEN

The production of vocal sounds shares peripheral organs with vital functions such as breathing, sucking, mastication, and swallowing. Human infants begin performing these functions immediately after birth, and they consist of rhythmic movements driven by central pattern generators (CPGs) in the medulla oblongata. In this study, we explore how voluntary vocal control develops from these foundational rhythmic behaviors, focusing on developmental changes in the temporal characteristics of early vocalizations in human infants. Drawing on previous findings regarding the developmental shift in the timing of continuous vocalizations and the intervals of vocalization observed during mother-infant interactions, we consider the adaptive significance of the evolution of vocal control in humans.

Keywords: Preverbal Vocalizations

The ontogeny of vocal rhythms in a non-human primate

*Teresa Raimondi^{1,2}, Lia Laffi^{1,2}, Chiara De Gregorio², Daria Valente², Walter Cristiano^{2,3}, Filippo Carugati², Valeria Ferrario², Valeria Torti², Jonah Ratsimbatsafy⁴, Cristina Giacomini², Andrea Ravignani^{1,5,6}, Marco Gamba²

1. Sapienza University of Rome, 2. University of Turin, 3. Italian National Institute of Health, 4. Groupe d' Étude et de Recherche sur les Primates de Madagascar, 5. Aarhus University, 6. The Royal Academy of Music

A building block of human music is the production of small-integer ratios: almost universally, units start predictably in time, at an integer multiple of a base temporal unit. Humans produce integer ratios as adults cross-culturally, but the production of ratios crystallises over development. Is the development of small-integer ratios human-specific? Here we look for the development of small-integer ratios in the song of the only singing lemur, *Indri indri*, by integrating comparative and developmental angles. We compute rhythmic ratios between adjacent intervals and test whether these ratios match small-integer values. Our data show high levels of rhythmic stability around isochrony, the 1:1 ratio, like a ticking metronome, in both sexes and at every developmental stage. As in humans, two additional small-integer ratios (1:2 and 2:1) emerge over development. Similarly to us, another mammal displays developmental changes in rhythm production, a crucial feature of human musicality.

Keywords: vocal rhythms, non-human primate

Individual temporal plasticity in singing in the adult indris

*Marco Gamba¹, Lia Laffi¹, Silvia Leonetti¹, Filippo Carugati¹, Valeria Ferrario¹, Flavie Eveillard¹, Teresa Raimondi¹, Chiara De Gregorio¹, Longondraza Miaretsoa¹, Olivier Friard¹, Cristina Giacomini¹, Valeria Torti¹, Andrea Ravignani¹, Daria Valente¹

1. Università di Torino

Only long-term studies can answer how individual characteristics vary over time. Regarding the timing of vocal emissions in non-human primates, many studies argue that genetics plays a key role in limiting intra and inter-individual variations and allowing the species to which a vocalizer belongs to be easily recognized. These considerations appear limiting when applied to singing primates, which have shown significant flexibility in adulthood. We investigated the variation over time in the temporal structure of songs the indris gave. We mapped categorical rhythmic production of individuals of both sexes, showing that the number of rhythmic categories can change within and between individuals. Indris exhibit three small integer-ratio rhythms, but the three rhythms are not present in all individuals. Although we do not know whether perception is similarly biased towards the same categories, the occurrence of particular rhythmic categories may serve to build particular rhythmicity of the collective singing.

Keywords: indris

Social inheritance of Java sparrow rhythms

*Anthony Kwong¹, Rebecca N Lewis¹, Masayo Soma¹, Andrea Ravignani¹, Taylor Hersh¹

1. University of Manchester

Rhythm is observed in the vocalizations of a range of species. Animal rhythms frequently favour small integer ratios (SIRs), with isochrony being especially common. We analysed song rhythms in a population of Java sparrows (*Padda oryzivora*); a species in which juvenile males learn songs from adult male tutors. We introduce a new method of rhythm analysis to test the significance of nonstandard SIRs, commonly found in this species. We showed that birds mirror the rhythmic preferences of their song tutors; the effect persisting over several generations. Different song lineages develop their own rhythms, resembling distinct rhythm preferences seen across human musical cultures. Moreover, bird culture overpowers a tendency towards stable equilibria in dynamical systems, moving away from integer ratio attractors. Our findings underscore social learning as the main mode of rhythm transmission in Java sparrows, with implications for conservation for this endangered species.

Keywords: Java sparrows