Oral | Language, Animal

Sun. Oct 19, 2025 10:45 AM - 12:15 PM JST | Sun. Oct 19, 2025 1:45 AM - 3:15 AM UTC Venue 3(KOMCEE W Lecture Hall)

[O8] Oral 8: Language, Animal

Chair:Hiroki Koda(The University of Tokyo)

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

[O8-01]

Towards Differentiating Endogenously and Exogenously Driven Rhythms in the Brain: Syntax, Prosody and Delta-Band Activity

*Leonardo Zeine[1,2], Peter Donhauser[1], David Poeppel[3] (1. Ernst Strüngmann Institute for Neuroscience (Germany), 2. Max Planck School of Cognition (Germany), 3. New York University (United States of America))

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

[O8-02]

Reversible inactivation of insular and prelimbic cortices in a temporal decision-making task in rats

*Marcelo S Caetano[1], Estela B Nepomoceno[2] (1. Universidade Federal do ABC (UFABC) (Brazil), 2. Universidade São Caetano do Sul (USCS) (Brazil))

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

[O8-03]

Temporal Strategies and Cue Integration in Rats: Evidence from Operant and T-Maze Midsession Reversal Tasks

*Marcelo Bussotti Reyes[1], Marcelo Salvador Caetano[1], Armando Machado[2] (1. Universidade Federal do ABC (Brazil), 2. University of Aveiro (Portugal))

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

[O8-04]

Implicit timing in a group of freely behaving Guinea baboons

*Jennifer T Coull[1], Nicolas Claidière[1,2], Adrien Meguerditchian[1,2], Siham Bouziane[1] (1. Centre for Research in Psychology & Neurosciences, CNRS & Aix-Marseille University (France), 2. Station de Primatologie-Celphedia, UAR846, CNRS, Rousset (France))

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

[O8-05]

Spontaneous temporal predictions in Guinea Baboons: Insights from a sequential variable foreperiod paradigm

*Siham Bouziane[1], Adrien Meguerditchian[1,2], Nicolas Claidière[1,2], Jennifer T Coull[1] (1. Centre de Recherche en Psychologie et Neurosciences (France), 2. Station de Primatologie-Celphedia UAR846 CNRS - Rousset France (France))

12:00 PM - 12:15 PM JST | 3:00 AM - 3:15 AM UTC

[O8-06]

An evolutionary model of vocal accelerando in African penguins

*Yannick Jadoul[1,2,3], Taylor A. Hersh[2,4], Elias Fernández Domingos [3,5], Marco Gamba[6], Livio Favaro[6], Andrea Ravignani[1,2,7,8] (1. Department of Human Neurosciences, Sapienza University of Rome, Rome (Italy), 2. Comparative Bioacoustics Group, Max Planck Institute for Psycholinguistics, Nijmegen (Netherlands), 3. Artificial Intelligence Lab, Vrije Universiteit

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Towards Differentiating Endogenously and Exogenously Driven Rhythms in the Brain: Syntax, Prosody and Delta-Band Activity

*Leonardo Zeine[1,2], Peter Donhauser[1], David Poeppel[3]

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During speech processing, the brain tracks acoustic fluctuations across multiple timescales. In the context of neural oscillations for language perception, theta-band activity (4–8 Hz) is argued to phase-lock with the occurrences of syllables, and delta-band activity (<3 Hz), with syntactic and/or prosodic events—a claim that has sparked intense debate in the field (Kazanina & Tavano, 2024). On one hand, syntax and prosody are naturally intertwined; on the other, delta-band activity is both widespread across the brain and sensitive to low-level acoustic features such as onsets.Here, we introduce a novel data-driven method to disentangle sentence-internal from boundary (onset/offset) activity. Our approach consists of two consecutive sets of spatial filters: the first, a denoiser, that captures language-related activity, and the second, a functional filter, that isolates sentence-internal responses.By analyzing an open dataset of source-localized MEG recordings from 140 participants (Schoffelen et al., 2019) who listened to sentences in Dutch, we identified two distinct timescales of sentence-internal activity: one, predominantly delta-band, in the right superior temporal gyrus (STG); and another in both delta and theta bands in the left STG. Both components exhibited higher phase clustering in the delta-band around strong prosodic boundaries compared to weak boundaries and random timepoints.We also identified two distinct onset/offset-related components: one sustained (bilateral) and another transient (right-lateralized), neither modulated by prosodic or syntactic representations. We argue that they reflect low-level acoustic responses typically conflated with endogenously driven responses in conventional sensor-space analysis. Altogether, our findings offer a comprehensive characterization of key temporal profiles in speech processing, and point to delta-band phase-locking as a candidate mechanism for integration of prosodic information.

Keywords: Syntax, Prosody, Delta-band oscilaltions, Spatial filtering

Reversible inactivation of insular and prelimbic cortices in a temporal decision-making task in rats

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The anterior insular cortex (AIC), an area of sensory integration, detects salient events to guide goal-directed behavior, track errors, and estimate the passage of time. Projections between the AIC and medial prefrontal cortex (mPFC) are found both in rats and humans, and suggest a possible role for these structures in the integration of autonomic responses during ongoing behavior. Few studies, however, have investigated the role of AIC and mPFC in decision-making and time estimation tasks. Here, we employed bilateral inactivations to describe the role of AIC and mPFC in a temporal decision-making task in rats. In this task (the "switch task"), rats are placed in a standard operant chamber with two levers. In some trials, presses on one of the levers will lead to reinforcement after a short interval (3 s). In other trials, a press on the other lever will lead to reinforcement after a long interval (6 s). Since short and long trials are randomly presented (i.e., unpredictable), optimal performance requires a switch from the short to the long lever after the short fixed interval elapses and no reinforcement is delivered. In a first experiment, we showed that successful switch from the short to the long lever was dependent on AIC and mPFC. During AIC inactivation, switch latencies became more variable; and during mPFC inactivation switch latencies became both more variable and less accurate. In a follow-up experiment, we manipulated the probabilities associated with the occurrence of a short or a long trial, and observed that the animals were sensitive to changes in these probabilities, adjusting switch latencies in order to maximize reinforcement. These findings point to a dissociation between AIC and mPFC in temporal decision-making, and contribute to the understanding of the neural substrates involved in the encoding of uncertainty as a function of time.

Keywords: Decision-making, Timing, Probability estimation, Switch task, Muscimol

Temporal Strategies and Cue Integration in Rats: Evidence from Operant and T-Maze Midsession Reversal Tasks

*Marcelo Bussotti Reyes[1], Marcelo Salvador Caetano[1], Armando Machado[2]

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The midsession reversal (MSR) task assesses cognitive flexibility by requiring animals to switch from one correct choice (S1) to another (S2) halfway through a session, without any explicit cue signaling the change. Although the task includes no formal timing component, species such as pigeons and starlings rely heavily on temporal cues, often committing anticipatory or perseverative errors. In contrast, monkeys and humans typically adopt the optimal win-stay/lose-shift (WSLS) strategy, shifting behavior only after the first error. In rats, the strategy depends on the experimental context: in T-mazes, they tend to rely on timing, whereas in operant chambers, behavior is often dominated by WSLS, with little evidence of timing during training. Here, we directly tested the temporal hypothesis in rats using both paradigms. In the operant task, rats learned to discriminate between steady and flickering lights, always presented on the same side, with the reinforced stimulus reversing midway through each session. During training —and consistent with prior studies— rats showed no anticipation of the reversal, relying instead on WSLS. However, when we manipulated the intertrial interval (ITI), rats adjusted their responses according to elapsed time, indicating that timing can guide behavior when the task’s temporal structure is altered. In the T-maze version, rats relied on temporal cues already during training, committing both anticipatory and perseverative errors. When the ITI was manipulated, rats adopted a mixed strategy, combining timing (primarily) and trial counting. These findings demonstrate that rats flexibly integrate multiple cues depending on task dynamics, challenging the notion that they rely solely on reinforcement history in operant chambers or exclusively on timing in spatial tasks.

Keywords: reversal learning, cognitive flexibility, decision-making, strategy use

Implicit timing in a group of freely behaving Guinea baboons

*Jennifer T Coull[1], Nicolas Claidière[1,2], Adrien Meguerditchian[1,2], Siham Bouziane[1]

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We gradually develop our sense of time through experience. It helps us predict when events will occur, allowing us to direct attention and adapt behavior accordingly. Yet even though all living beings need to make temporal predictions to survive, our understanding of the evolutionary origins of such a capacity is relatively unknown. Here we used free-access operant conditioning devices to investigate temporal predictions in 15 freely behaving captive Guinea baboons. In two separate experiments, individuals were trained to optimize their response timing by touching a target that appeared after a fixed foreperiod (FP) of either 600ms or 300ms. During the testing phase, the FP was either the trained ("standard") FP (60% of trials) or was randomly selected from one of six equiprobable shorter or longer intervals (30% of trials). In the remaining 10%, the target was absent (catch trials). Results revealed a U-shaped profile of performance with RTs being fastest for the most probable FP, getting gradually slower for increasingly shorter or longer FPs. Crucially, this pattern was observed even though all non-standard FPs were equiprobable, indicating that the metrical properties of FP duration had been implicitly integrated into baboons' performance. In addition, during the longer FP trials, baboons often responded before the target even appeared. Since most of these anticipatory responses occurred around the time of the standard FP and were produced in the absence of an external stimulus, these data suggest FP probabilities had been internalized into a temporal expectation for the standard FP. Our results demonstrate, for the first time in such a large group of non-human primates, that baboons use statistical learning of temporal probabilities to implicitly form expectations about event timing, which helps them optimize behavior. These findings contribute to the growing body of evidence suggesting that predictive timing abilities may be widespread across the primate lineage and beyond.

Keywords: temporal prediction, temporal expectation, foreperiod, statistical learning, non-human primates, ethology

Spontaneous temporal predictions in Guinea Baboons: Insights from a sequential variable foreperiod paradigm

*Siham Bouziane[1], Adrien Meguerditchian[1,2], Nicolas Claidière[1,2], Jennifer T Coull[1]

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Predicting the arrival time of an event is key to navigating our environment. Previous research on temporal predictions in non-human primates (NHPs) has primarily taken place in laboratory settings, limiting both natural engagement and sample size. Here, we adopt a naturalistic approach by studying temporal prediction in a group of 20 captive Guinea baboons, using free-access operant conditioning devices that allow for voluntary participation in cognitive tasks.In two separate studies, baboons performed a simple reaction time (RT) task in which four visual targets appeared sequentially after either regular (500 ms) or irregular (300-700ms) foreperiods (FP). In both studies, the target was more likely to appear after the "standard" 500ms FP than any of the others. Importantly, baboons were free to choose their own response speed and were not rewarded for particularly fast RTs. Nevertheless, we found significant effects of FP probability on RT. First, RTs were globally faster for temporally regular sequences than irregular sequences, indicating that the temporal predictability of the sequence speeded performance. Second, within the irregular sequences, RTs were faster for targets appearing after longer FPs, indicating an influence of the hazard function. Nevertheless, an asymmetric sequential effect revealed that RTs were also influenced by the FP of the previous target, indicating an effect of temporal trial history on performance. RTs were slower when the current FP was shorter, rather than longer, than the previous one. Most importantly, this effect varied as a function of the signed temporal difference (deltaFP) between FPs on successive trials ($FP_{current}$ - $FP_{previous}$). RTs were progressively slower as deltaFP decreased, indicating an influence of FP magnitude on performance. Finally, individual differences in performance indicated statistical learning of the most common 500ms FP, demonstrating that some baboons were sensitive to more global temporal probabilities. Our results demonstrate, for the first time in such a large group of NHPs, that baboons spontaneously use temporally predictable information to optimise performance, despite never having been trained to do so, and further informs our understanding of the evolutionary roots of time processing.

Keywords: Implicit Timing, Rhythms, Non-Human Primates, Comparative Psychology, Statistical learning

An evolutionary model of vocal accelerando in African penguins

*Yannick Jadoul[1,2,3], Taylor A. Hersh[2,4], Elias Fernández Domingos [3,5], Marco Gamba[6], Livio Favaro[6], Andrea Ravignani[1,2,7,8]

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In animal behavior and communication, regularly-timed movement and sounds are ubiquitous, as many underlying physiological processes generate isochronous sequences of events. When it comes to rhythm and music, however, isochrony is only the simplest building block possible. For example, accelerando is a rhythmic structure which consists of an increasing tempo throughout a temporal sequence, and has been described in a wide range of animal displays. One such display are the ecstatic display songs (EDSs) produced by African penguins. During high arousal breeding seasons, individuals produce these energetically costly, multisyllabic songs. We rhythmically analyzed recordings from 26 male African penguins and found that the vocalizations within an EDS reliably exhibit accelerando and crescendo (i.e., syllables follow each other faster and become louder as an EDS progresses). We modeled the production of these temporal sequences and their interaction and used evolutionary game theory and computer simulations to link two aspects of temporal structure, acceleration and overlap: We tested whether rhythmic accelerando could evolve under a pressure for acoustic overlap in time. Both a mathematical analysis and computational simulations of our model showed that evolutionary pressure for more overlap can indeed cause a population of initially isochronous individuals to evolve the production of sequences with a moderate level of acceleration. Our model and results demonstrate a potential evolutionary trajectory for the emergence of accelerando or other forms of tempo modulation within an initially isochronous population, and suggest new hypotheses to be tested empirically. Future studies combining empirical data and computer models in such a comparative approach can provide further insight into the function and evolutionary pressure at play, here and in other model species, and will boost our understanding of the evolution of rhythm.

Keywords: evolutionary game theory, tempo, animal communication, computer simulations