Sat. Oct 18, 2025

Invited | Other

Sat. Oct 18, 2025 3:15 PM - 4:15 PM JST | Sat. Oct 18, 2025 6:15 AM - 7:15 AM UTC Room 2(West B1)

[K2] ECR Keynote: Devika Narain

Chair:Martin Wiener(George Mason University)

3:15 PM - 4:15 PM JST | 6:15 AM - 7:15 AM UTC

[K2-01]

Prior beliefs for timing movements: from neurons to manifolds

*Devika Narain[1] (1. Erasmus Medical Center (Netherlands))

Symposium | Space-Time Interference

Sat. Oct 18, 2025 10:45 AM - 12:15 PM JST | Sat. Oct 18, 2025 1:45 AM - 3:15 AM UTC Room 3(East B1)

[S5] Symposium 5: Space-time interference in behavior and neuronal processing

Chair:Martin Riemer(Technical University Berlin)

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

[S5-01]

Space-time interference in behavior and neuronal processing

*Martin Riemer[1] (1. Technical University Berlin (Germany))

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

[S5-02]

Cross-dimensional interference between illusory size and duration

*Daniel Bratzke[1], Rolf Ulrich[2] (1. University of Bremen (Germany), 2.University of Tübingen, Germany)

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

[S5-03]

Using speed to think about space and time

*Martin Riemer[1] (1. Technical University Berlin (Germany))

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

[S5-04]

The neural link between stimulus duration and spatial location in the human visual hierarchy

*Gianfranco Fortunato[1], Valeria Centanino[1], Domenica Bueti[1] (1. International School for Advanced Studies (SISSA) (Italy))

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

[S5-05]

A different angle on space-time interference: Disentangling cognitive maps and graphs in the human brain

*Yangwen Xu[1], Max A.B. Hinrichs[1], Roberto Bottini[2], Christian F Doeller[1,3] (1. Max Planck Institute for Human Cognitive and Brain Sciences (Germany), 2. Center for Mind/Brain Sciences, University of Trento (Italy), 3. Kavli Institute for Systems Neuroscience (Norway))

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 Room 2(West B1)

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

Chair:Andrea Ravignani(Sapienza University of Rome)

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 Ravignani[1] (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 Takahasi[1] (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 Gregorio[2], Daria Valente[2], Walter Cristiano[2,3], Filippo Carugati[2], Valeria Ferrario[2], Valeria Torti[2], Jonah Ratsimbatsafy[4], Cristina Giacoma[2], Andrea Ravignani[1,5,6], Marco Gamba[2] (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 Gamba[1], Lia Laffi[1], Silvia Leonetti[1], Filippo Carugati[1], Valeria Ferrario[1], Flavie Eveillard[1], Teresa Raimondi[1], Chiara De Gregorio[1], Longondraza Miaretsoa[1], Olivier Friard[1], Cristina Giacoma[1], Valeria Torti[1], Andrea Ravignani[1], Daria Valente[1] (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 Kwong[1], Rebecca N Lewis[1], Masayo Soma[1], Andrea Ravignani[1], Taylor Hersh[1] (1. University of Manchester (UK))

Oral | Memory, Emotion, Decision

Sat. Oct 18, 2025 9:00 AM - 10:30 AM JST | Sat. Oct 18, 2025 12:00 AM - 1:30 AM UTC Room 3(East B1)

[20301-06] Oral 4: Memory, Emotion, Decision

Chair:Müge Cavdan(Justus Liebig University Giessen)

9:00 AM - 9:15 AM JST | 12:00 AM - 12:15 AM UTC

[20301-06-01]

Investigating the effect of emotion on the temporal resolution of visual processing in viewing flickering LED.

*Makoto Ichikawa[1], Misa Kobayashi[2] (1. Graduate School of Humanities, Chiba University (Japan), 2. Graduate School of Science and Engineering, Chiba University (Japan))

9:15 AM - 9:30 AM JST | 12:15 AM - 12:30 AM UTC

[20301-06-02]

Alpha power indexes working memory load for durations

*Sophie Herbst[1], Izem Mangione[1], Charbel-Raphael Segerie[2], Richard Höchenberger[2], Tadeusz Kononowicz[4,1,3], Alexandre Gramfort[2], Virginie van Wassenhove[1] (1. Cognitive Neuroimaging Unit, INSERM, CEA, Université Paris-Saclay, NeuroSpin, 91191 Gif/Yvette, France (France), 2. Inria, CEA, Université Paris-Saclay, Palaiseau, France (France), 3. Institute of Psychology, The Polish Academy of Sciences, ul. Jaracza 1, 00-378 Warsaw, Poland (Poland), 4. Institut NeuroPSI - UMR9197 CNRS Université Paris-Saclay (France))

9:30 AM - 9:45 AM JST | 12:30 AM - 12:45 AM UTC

[20301-06-03]

Mentally shifting in time induces a shift in the amplitude of evoked responses

*Anna Maria Augustine Wagelmans[1], Virginie van Wassenhove[1] (1. Cognitive Neuroimaging Unit, INSERM, CEA, Université Paris-Saclay, NeuroSpin (France))

9:45 AM - 10:00 AM JST | 12:45 AM - 1:00 AM UTC

[20301-06-04]

Mental Time Travel Impairments in Neurodegenerative Diseases

*Valentina La Corte[1,2], Pascale Piolino[1,2] (1. Memory, Brain and Cognition lab,UR 7536, University Paris Cité (France), 2. Institut Universitaire de France (France))

10:00 AM - 10:15 AM JST | 1:00 AM - 1:15 AM UTC

[20301-06-05]

Level of Detail in Near and Far Future Imagined Events

*Ori Levit[1], Guy Grinfeld[1], Cheryl Wakslak[2], Yaacov Trope[3], Nira Liberman[1] (1. School of Psychological Science, Tel Aviv University (Israel), 2. Department of Management and Organization, University of Southern California, Los Angeles, California (United States of America), 3. Department of Psychology, New York University, New York (United States of America))

10:15 AM - 10:30 AM JST | 1:15 AM - 1:30 AM UTC

[20301-06-06]

Perceptual decision making of nonequilibrium fluctuations

*Aybüke Durmaz[1], Yonathan Sarmiento[1,2], Gianfranco Fortunato[1], Debraj Das[2], Mathew Ernst Diamond[1], Domenica Bueti[1], Édgar Roldán[2] (1. Sissa (International School for Advanced Studies) (Italy), 2. ICTP (The Abdus Salam International Centre for Theoretical Physics) (Italy))

Oral | Prediction, Temporal perception, Computational Modeling

Sat. Oct 18, 2025 1:00 PM - 2:30 PM JST | Sat. Oct 18, 2025 4:00 AM - 5:30 AM UTC Room 3(East B1)

[O6] Oral 6: Prediction, Temporal perception, Computational Modeling

Chair:Pascal Mamassian(CNRS & Ecole Normale Supérieure Paris)

1:00 PM - 1:15 PM JST | 4:00 AM - 4:15 AM UTC

[O6-01]

Temporal Prediction through Integration of Multiple Probability Distributions of Event Timings

*Yiyuan Teresa Huang[1], Zenas C Chao[1] (1. International Research Center for Neurointelligence, The University of Tokyo (Japan))

1:15 PM - 1:30 PM JST | 4:15 AM - 4:30 AM UTC

[O6-02]

The anticipation of imminent events is time-scale invariant

*Matthias Grabenhorst[1,2], David Poeppel[3], Georgios Michalareas[4,1,2] (1. Ernst Struengmann Institute for Neuroscience (Germany), 2. Max Planck Institute for Empirical Aesthetics (Germany), 3. New York University (United States of America), 4. Goethe University (Germany))

1:30 PM - 1:45 PM JST | 4:30 AM - 4:45 AM UTC

[O6-03]

The timing of neural-cardio-respiratory network states predicts perception across the senses

*Andreas Wutz[1] (1. University of Salzburg (Austria))

1:45 PM - 2:00 PM JST | 4:45 AM - 5:00 AM UTC

[O6-04]

What does the Fröhlich effect tell us about sensation time?

*Pascal Mamassian[1] (1. CNRS & Ecole Normale Supérieure Paris (France))

2:00 PM - 2:15 PM JST | 5:00 AM - 5:15 AM UTC

[O6-05]

Oscillatory Entrainment in Non-Deterministic Continuous Environments, Independent of Bayesian Interval Learning: Computational and Behavioral Evidence

*Elmira Hosseini[1,2], Assaf Breska[1] (1. Max-Planck Institute for Biological Cybernetics (Germany), 2. Tübingen University (Germany))

2:15 PM - 2:30 PM JST | 5:15 AM - 5:30 AM UTC

[O6-06]

An investigation of auditory rhythms with a spiking neural network autoencoder

*Rodrigo Manríquez[1,2], Sonja A. Kotz[2,3], Andrea Ravignani[4,5], Bart de Boer[1] (1. Vrije Universiteit Brussel (Belgium), 2. Maastricht University (Netherlands), 3. Max Planck Institute for Human Cognitive and Brain Sciences (Germany), 4. Sapienza University of Rome (Italy), 5. Aarhus University & The Royal Academy of Music (Denmark))

Oral | Computational Modeling, Neural Mechanisms

Sat. Oct 18, 2025 9:00 AM - 10:30 AM JST | Sat. Oct 18, 2025 12:00 AM - 1:30 AM UTC Room 2(West B1)

[O5] Oral 5: Computational Modeling, Neural Mechanisms

Chair:Assaf Breska(Max-Planck Institute for Biological Cybernetics)

9:00 AM - 9:15 AM JST | 12:00 AM - 12:15 AM UTC

[O5-01]

Centralized mechanisms of explicit and implicit timing in the human cerebellum: a neuropsychological approach

*Chiara Zanonato[1,2], Richard Ivry[3,4], Assaf Breska[1,3] (1. Max-Planck-Institute for Biological Cybernetics, Tübingen (Germany), 2. University of Tübingen (Germany), 3. Department of Psychology, University of California, Berkeley, CA (United States of America), 4. Helen Willis Neuroscience Institute, University of California, Berkeley, CA (United States of America))

9:15 AM - 9:30 AM JST | 12:15 AM - 12:30 AM UTC

[O5-02]

Unique Effect of Entrainment on Perception? Context-Specific Temporal Prediction Mechanisms in Multiple Aspects of Perception

*Christina Bruckmann[1,2], Assaf Breska[1] (1. Max Planck Institute for Biological Cybernetics (Germany), 2. University of Tübingen (Germany))

9:30 AM - 9:45 AM JST | 12:30 AM - 12:45 AM UTC

[O5-03]

Rationalizing temporal decision making and the neural representation of time

*Marshall G Hussain Shuler[1,2] (1. Johns Hopkins (United States of America), 2. Kavli Neuroscience Discovery Institute (United States of America))

9:45 AM - 10:00 AM JST | 12:45 AM - 1:00 AM UTC

[O5-04]

A Methodology to Accelerate Our Information Processing Toward Revealing the Relation between Process Speed and Time Perception

*Oki Hasegawa[1], Shohei Hidaka[1] (1. Japan Advanced Institute of Science and Technology (Japan))

10:00 AM - 10:15 AM JST | 1:00 AM - 1:15 AM UTC

[O5-05]

Sensory Reliability Shapes Sequential Effects in Human Duration Perception

*Taku Otsuka[1,2], Joost de Jong[1,3], Wouter Kruijne[1], Hedderik van Rijn[1] (1. University of Groningen (Netherlands), 2. The University of Tokyo (Japan), 3. Université de Paris (France))

10:15 AM - 10:30 AM JST | 1:15 AM - 1:30 AM UTC

[O5-06]

Bach and Bayes: Prediction in Noisy Musical Sequences

*Akanksha Gupta[1], Alejandro Tabas[2,3] (1. INS, INSERM, Aix-Marseille University, Marseille (France), 2. Perceptual Inference Group, Basque Center on Cognition, Brain and Language, San Sebastian (Spain), 3. Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig (Germany))

Poster | Other

Sat. Oct 18, 2025 12:45 PM - 2:45 PM JST | Sat. Oct 18, 2025 3:45 AM - 5:45 AM UTC MM Hall (KOMCEE-B1)

[P2] Poster: Day 2

[P2-01]

Disentangling the effects of movement speed and travel distance on perceived traveled time

*Cindy Jagorska[1], Christopher Hilton[1], Martin Riemer[1] (1. Technical University Berlin (Germany))

[P2-02]

withdrawn

. (.)

[P2-03]

Impaired Temporal Perception Following Sight Restoration After Congenital Cataracts

*Abel Mewleddeg Legu[2], Gianluca Mariscano[1], David Melcher[1,4], Ehud Zohary[2,3] (1. Department of Psychology, New York University Abu Dhabi (United Arab Emirates), 2. Project Eyeopener (Ethiopia), 3. The Hebrew University of Jerusalem (Israel), 4. Center for Brain and Health, New York University Abu Dhabi (United Arab Emirates))

[P2-04]

Decoding the reproduction of durations in size-varying virtual environment

*Camille L. Grasso[1], Matthew Logie[1], Virginie van Wassenhove[1] (1. CEA/DRF/Inst. Joliot, NeuroSpin; INSERM, Cognitive Neuroimaging Unit; Université Paris-Saclay, Gif/Yvette, 91191 France (France))

[P2-05]

Ticking Forward or Counting Down: The Impact of Clock Format on Time Perception and Task Performance

Maria Nogales[1], *Judit Castellà[1] (1. Autonomous University of Barcelona UAB (Spain))

[P2-06]

Electrophysiological signatures of post-interval activity in explicit and implicit timing

*Mariagrazia Capizzi[1], Cristina Narganes Pineda[1], Pom Charras[3], Giovanna Mioni[2], Antonino Visalli[4] (1. Mind, Brain and Behavior Research Center (CIMCYC), University of Granada; Department of Experimental Psychology, University of Granada, Granada, Spain (Spain), 2. Department of General Psychology, University of Padua, Padua (Italy), 3. Univ Paul Valéry Montpellier 3, EPSYLON EA 4556, F34000, Montpellier, France (France), 4. Department of Biomedical, Metabolic and Neural Sciences, University of Modena and Reggio Emilia (Italy))

[P2-07]

Time in the primate hippocampus during a metronome task

*Mildred Salgado-Menez[1], Ana Maria Malagon[1], Victor de Lafuente[1] (1. Universidad Nacional Autonoma de Mexico (Mexico))

[P2-08]

Effects of simultaneity and arm posture on tactile time perception in young and older adults

*Chika Goto[1], Naoya Tachibana[1], Shogo Sugiyama, Yuko Yotsumoto[1] (1. the University of Tokyo (Japan))

[P2-09]

Hand proximity enhances visual encoding via anticipatory processing

*Ankit Maurya[1,3], Tsukasa Kimura[2,3], Minto Hashimoto[4,3], Masamichi J. Hayashi[3,4], Tony Thomas[1] (1. Department of Humanities and Social Sciences, Indian Institute of Technology Roorkee, Roorkee (India), 2. Graduate School of Human Sciences, The University of Osaka, Suita (Japan), 3. Center for Information and Neural Networks (CiNeT), Advanced ICT Research Institute, National Institute of Information and Communications Technology, Suita (Japan), 4. Graduate School of Frontier Biosciences, The University of Osaka, Suita (Japan))

[P2-10]

Role of Supplementary Motor Areas in temporal estimation using tDCS.

*Claire TERRAN[1], Laurence CASINI[1] (1. CRPN - Centre for Research in Psychology and Neuroscience, AMU, CRNS (France))

[P2-11]

Duration Underestimation in Peripheral Visual Field

*YUHUI ZHOU[1], Sae Kaneko[1] (1. Hokkaido University (Japan))

[P2-12]

Embodying the expanded moment: the role of bodily awareness in temporal production during meditation-like attentional states

*Ludovica Ortame[1,2], Michele Pellegrino[2], Joseph Glicksohn[3,4], Patrizio Paoletti[2], Fabio Marson[5], Stafno Lasaponara[1,6], Maria Sofia Romano[1], Fabrizio Doricchi[1,6], Filippo Carducci[1], Tal Dotan Ben-Soussan[2] (1. Sapienza University of Rome (Italy), 2. Research Institute of Neuroscience, Education and Didactics (RINED) (Italy), 3. Bar-Ilan University (Israel), 4. The Leslie and Susan Gonda (Goldschmied) Multidisciplinary Brain Research Center, Bar-Ilan University, Ramat Gan (Israel), 5. University of Milano-Bicocca (Italy), 6. RCCS Fondazione Santa Lucia (Italy))

[P2-13]

Temporal unfolding contributes to interocular comparison for motion-in-depth perception in peripheral vision

*Ikuya Murakami[1] (1. The University of Tokyo (Japan))

[P2-14]

Assessing Temporal Resolution in Amblyopic and Fellow Eyes Using the Two-Flash Fusion Paradigm

*Aysha Hamkari[1], Gianluca Marsicano[1], Katja Cundric[1], David Melcher[1] (1. New York University Abu Dhabi (United Arab Emirates))

[P2-15]

Neural Bases of the Audiovisual Temporal Binding Window Using TMS

*Solène Leblond[1], Tutea Atger[1], Franck-Emmanuel Roux[1,2], Robin Baurès[1], Céline Cappe[1] (1. CerCo (Centre de Recherche Cerveau et Cognition), CNRS UMR 5549, University Toulouse (France), 2. Pôle neurochirurgie, CHU Purpan, Toulouse (France))

[P2-16]

Temporal Binding Across Timing Domains: Behavioural Evidence and a Protocol for Causal Manipulation via Transcranial Direct Current Stimulation

*Gustavo Brito de Azevedo[1], André Mascioli Cravo[2] (1. Graduate Program in Neuroscience and Cognition, Federal University of ABC (UFABC) (Brazil), 2. Center for Mathematics, Computing and Cognition, Federal University of ABC (UFABC) (Brazil))

[P2-17]

Modality-Specific Temporal Assimilation in a Bisection Task

*Gabriel Cafeu Brandão[1], Gustavo Brito de Azevedo[1], Peter Maurice Erna Claessens[1], André Mascioli Cravo[1] (1. Center for Mathematics, Computing and Cognition, Federal University of ABC (UFABC) (Brazil))

[P2-18]

Serial dependence between duration and numerosity perception

*Takuma Hashimoto[1,2], Yuko Yotsumoto[1] (1. The University of Tokyo (Japan), 2. Research Fellow of Japan Society for the Promotion of Science (Japan))

[P2-19]

Effects of attentional orienting on the production of temporal durations: an eye-tracking study

*Mariagrazia Ranzini[1], Sebastiano Cinetto[3], Sara Noacco[1], Zaira Romeo[2], Mario Bonato[4], Marco Zorzi[4], Giovanna Mioni[1] (1. Department of General Psychology (DPG), Univ. of Padova (Italy), 2. Neuroscience Institute, National Research Council, Padova (Italy), 3. Padova Neuroscience Center (PNC), Univ. of Padova (Italy), 4. Department of General Psychology (DPG) and Padova Neuroscience Center (PNC), Univ. of Padova (Italy))

[P2-20]

Retrospective Passage of Time Judgments in a Population of Parkinson's Disease Patients: A Matter of Self-Projection in Time

*Florie MONIER[1], Michael DAMBRUN[1], Pierre-Michel LLORCA[2], Sylvie DROIT-VOLET[1] (1. Université Clermont-Auvergne (France), 2. Université Clermont-Auvergne, CHU clermont-ferrand (France))

[P2-21]

Cardiac Rhythms, Interoception and Temporal Counting: Dynamic Interactions across Time Ranges

*Mai Sakuragi[1,2], Elisa M. Gallego Hiroyasu[1,2], Satoshi Umeda[1] (1. Keio University (Japan), 2. Japan Society for the Promotion of Science (Japan))

[P2-22]

When do we perceive our heartbeats? Exploring temporal dynamics in interoception

*Yusuke Haruki[1], Keisuke Suzuki[2], Yuri Terasawa[3], Kenji Ogawa[4], Olaf Blanke[5], Yuko Yotsumoto[1] (1. Department of Life Sciences, The University of Tokyo (Japan), 2. Center for Human Intelligence, Artificial Intelligence, and Neuroscience, Hokkaido University (Japan), 3. Department of Psychology, Keio University (Japan), 4. Department of Psychology, Hokkaido University (Japan), 5. Laboratory of Cognitive Neuroscience, Ecole Polytechnique Federal de Lausanne (Switzerland))

[P2-23]

Distributional Variability Increases Uncertainty in Mean Duration Judgments

*Taku Otsuka[1,2], Hakan Karsilar[1], Hedderik van Rijn[1] (1. University of Groningen (Netherlands), 2. The University of Tokyo (Japan))

[P2-24]

Image Memorability Shapes the Temporal Structure of Memory

*Marianna Lamprou Kokolaki[1], Virginie van Wassenhove[1] (1. CEA/DRF/Inst. Joliot, NeuroSpin; INSERM, Cognitive Neuroimaging Unit; Université Paris Saclay (France))

[P2-25]

Effects of Network Topology and Goals on Interpersonal Synchronization in a Virtual 'Rhythm Network'

*Jonathan Kirsh[1], Sharanya Badalera[1], John Rehner Iversen[1] (1. McMaster University (Canada))

[P2-26]

EEG Correlates of Movement-Induced Enhancements of Beat Timing

*April M Joyner[1], Martin Wiener[1] (1. George Mason University (United States of America))

[P2-27]

The effect of repetitive transcranial magnetic stimulation (rTMS) over the supplementary motor area on the groove experience

*Takahide Etani[1,2,3], Mitsuaki Takemi[4,5], Tomohiro Samma[6], Jun Nitta[7], Saki Homma[6,8], Kenta Ueda[6], Keigo Yoshida[9,6], Kenjun Hayashida[4,5], Tatsuro Fujimaki[4], Sotaro Kondoh[6,9,10], Kazutoshi Kudo[7], Shinya Fujii[9] (1. Keio Research Institute at SFC (Japan), 2. Keio Univ. Hospital (Japan), 3. Japanese Red Cross Ashikaga Hospital (Japan), 4. Graduate School of Science and Technology, Keio Univ. (Japan), 5. Graduate School of Advanced Science and Engineering, Hiroshima Univ. (Japan), 6. Graduate School of Media and Governance, Keio Univ. (Japan), 7. Graduate School of Arts and Sciences, The Univ. of Tokyo (Japan), 8. Department of Neuropsychiatry, Keio Univ. School of Medicine (Japan), 9. Faculty of Environment and Information Studies, Keio Univ. (Japan), 10. Japan Society for the Promotion of Science (Japan))

[P2-28]

Timing Difficulties in Developmental Language Disorder and Stuttering: A planned study on the Role of Dysfunctional Synchronization of Brain Rhythms

*Christian A. Kell[1], Lars Meyer[2], Joachim Gross[2], Katrin Neumann[2] (1. Goethe University (Germany), 2. Muenster University (Germany))

[P2-29]

Contributions of cognitive abilities and attention to Motor Timing in Parkinson’s Disease

*Elisa M. Gallego Hiroyasu[1], Yuko Yotsumoto[2], Giovanna Mioni[3] (1. Keio University (Japan), 2. The University of Tokyo (Japan), 3. Universita di Padova (Italy))

[P2-30]

Exploring the role of rhythmicity for infant word learning by entrainment of brain and behaviour in social contexts: A preliminary study

*Erica Flaten[1], Cristina Conati[2], Janet Werker[1] (1. Department of Psychology, University of British Columbia (Canada), 2. Department of Computer Science, University of British Columbia (Canada))

[P2-31]

Pre-motor and auditory processing for inner and overt speech

*Lachlan James Hall[1], Thomas J Whitford[2], Mike E Le Pelley[2], Bradley N Jack[1] (1. Australian National University (Australia), 2. University of New South Wales (Australia))

[P2-32]

Neural correlates of changes of mind and confidence in the judgement of elapsed time

*Chetan Desai[1], Martin Wiener[1] (1. George Mason University (United States of America))

[P2-33]

Metacognition of Time Discrimination

*Valdas Noreika[1], Stefano Arlaud[1] (1. Queen Mary University of London (UK))

[P2-34]

Timing Control of Upper Body Movements in Playground Swing Pumping: The Role of External Forces

*Chiaki Hirata[1], Shun'ichi Kitahara[1] (1. Jumonji University (Japan))

[P2-35]

Social modulation of sense of responsibility and subjective time experience in semi-automated motor tasks

*Sayako Ueda[1,2] (1. Japan Women's University (Japan), 2. RIKEN CBS (Japan))

[P2-36]

When Time Stands Still: Altered spatiotemporal experiences in depersonalization

*Julia Ayache[1], Malika Auvray[2], Anna Ciaunica[3,4] (1. EuroMov Digital Health in Motion, Univ. Montpellier IMT Mines Alès, Montpellier (France), 2. Institut des Systèmes Intelligents et de Robotique, Sorbonne Université, CNRS, Paris (France), 3. GAIPS INESC-ID, Instituto Superior Tecnico, University of Lisbon, Lisbon (Portugal), 4. Institute of Cognitive Neuroscience, University College London, London (UK))

[P2-37]

Recalibrating perceptual time through motor learning

*Nicola Binetti[1], Federico Mancinelli[3], Marco Zanon[2], Domenica Bueti[2] (1. Università degli studi di Roma Tor Vergata (Italy), 2. International School for Advanced Studies (Italy), 3. University of Bonn (Germany))

[P2-38]

Beyond Pacemaker Speed: A Planned Investigation into Atemporal Perceptual Processes Underlying Differences in Auditory-Visual Duration Judgments

*Valtteri Arstila[1], Jarno Tuominen[1] (1. University of Turku (Finland))

[P2-39]

Influence of turn-taking regularity on respiratory activity in human conversation

*Mirei Kin and Hiroki Koda (Graduate School of Arts and Sciences, The University of Tokyo)

[P2-40]

Female gibbons’ great calls change tempo in the presence of their offspring

*Yoichi Inoue[1], Waidi Sinun[2], Kazuo Okanoya[1] ([1]Teikyo University, [2]Research and Development Division, Yayasan Sabah Group)

TRF

Sat. Oct 18, 2025 8:00 AM - 10:00 AM JST | Fri. Oct 17, 2025 11:00 PM - 1:00 AM UTC TCVB tour

[T04] TCVB tour @ Zazen Experience

TRF

Sat. Oct 18, 2025 5:45 PM - 8:30 PM JST | Sat. Oct 18, 2025 8:45 AM - 11:30 AM UTC Shibuya

[T05] Conference Dinner

Invited | Other

Sat. Oct 18, 2025 3:15 PM - 4:15 PM JST | Sat. Oct 18, 2025 6:15 AM - 7:15 AM UTC Room 2(West B1)

[K2] ECR Keynote: Devika Narain

Chair:Martin Wiener(George Mason University)

Timing and motor control are inextricably linked, giving rise to the remarkable feats of motor precision observed across the animal kingdom. Laboratory assessments of movement timing, however, often reveal significant variability and systematic biases, presenting a seemingly contradictory picture. Previous research has attempted to reconcile this discrepancy through Bayesian frameworks, which describe how prior beliefs about temporal variables guide precise actions in the face of environmental uncertainty. While these models successfully account for a wide range of behaviors across different domains, the neural mechanisms responsible for forming and utilizing such prior beliefs remain poorly understood. In this work, we propose a role for cerebellar circuits in the acquisition of prior knowledge that shapes basic predictive motor behaviors, specifically, the conditioned eyelid response observed in Pavlovian eyeblink conditioning. We present evidence suggesting that cerebellar Purkinje cells encode probability distributions of sensory stimuli and propose a mechanism by which this encoding influences motor output kinematics. At the population level, we demonstrate that cerebellar cortical activity exhibits a topological organization characterized by curved manifolds, with prior knowledge encoded along the curvature of these structures, consistent with previous work in monkeys. In the second part of the talk, we introduce methodological advances aimed at identifying and embedding neural manifolds formed by the dynamics underlying these tasks within their intrinsic dimensions, enabling the decoding of task-relevant information. Using this approach, we test the hypothesis that the curvature of neural manifolds reflects the encoding of prior knowledge in sensorimotor timing tasks. Overall, we propose a neural mechanism through which prior beliefs governing the temporal control of movement are acquired at the cellular level and subsequently represented in the topological structure of neural populations, consistent with normative theories that explain the emergence of precise timing behavior.

3:15 PM - 4:15 PM JST | 6:15 AM - 7:15 AM UTC

[K2-01]

Prior beliefs for timing movements: from neurons to manifolds

*Devika Narain[1] (1. Erasmus Medical Center (Netherlands))

Prior beliefs for timing movements: from neurons to manifolds

*Devika Narain[1]

1. Erasmus Medical Center

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Keywords: Bayesian frameworks

Symposium | Space-Time Interference

Sat. Oct 18, 2025 10:45 AM - 12:15 PM JST | Sat. Oct 18, 2025 1:45 AM - 3:15 AM UTC Room 3(East B1)

[S5] Symposium 5: Space-time interference in behavior and neuronal processing

Chair:Martin Riemer(Technical University Berlin)

Time perception is related to the perception of space. This idea has received support from behavioral and neuroscience studies. At the behavioral level, mutual interference between the perception of time and space have been demonstrated. Larger objects are perceived as lasting longer, and the physical duration of stimuli affect their perceived size. Casasanto and Boroditsky (2008) reported evidence for an asymmetric relationship between space and time, with time being more affected by space than vice versa. This finding has stimulated the idea of a hierarchical representation of space and time, which is in line with conceptual metaphor theory but has also invoked skepticism (Riemer & Cai, 2024). The theory of an asymmetric representation of time and space is one focus of this symposium.
At the neuronal level, evidence for a common processing of time, space and other magnitudes in the parietal cortex (especially the right intraparietal sulcus; Bueti & Walsh, 2009) has led to the idea of a dimension-unspecific magnitude system. The idea of a common mechanism for the processing of temporal and spatial information has been reinforced by the discovery of time cells in the medial temporal lobe, a brain structure primarily known for its role in spatial processing (Eichenbaum, 2017). Together, these findings represent potential neuronal origins for the emergence of space-time interference in behavior.
The first two talks of the symposium are predominantly focused on behavioral studies about the (a)symmetric representation of time and space, while in the last two talks we will take a look at the neuronal processes underlying time and space perception.

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

[S5-01]

Space-time interference in behavior and neuronal processing

*Martin Riemer[1] (1. Technical University Berlin (Germany))

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

[S5-02]

Cross-dimensional interference between illusory size and duration

*Daniel Bratzke[1], Rolf Ulrich[2] (1. University of Bremen (Germany), 2.University of Tübingen, Germany)

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

[S5-03]

Using speed to think about space and time

*Martin Riemer[1] (1. Technical University Berlin (Germany))

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

[S5-04]

The neural link between stimulus duration and spatial location in the human visual hierarchy

*Gianfranco Fortunato[1], Valeria Centanino[1], Domenica Bueti[1] (1. International School for Advanced Studies (SISSA) (Italy))

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

[S5-05]

A different angle on space-time interference: Disentangling cognitive maps and graphs in the human brain

*Yangwen Xu[1], Max A.B. Hinrichs[1], Roberto Bottini[2], Christian F Doeller[1,3] (1. Max Planck Institute for Human Cognitive and Brain Sciences (Germany), 2. Center for Mind/Brain Sciences, University of Trento (Italy), 3. Kavli Institute for Systems Neuroscience (Norway))

Space-time interference in behavior and neuronal processing

*Martin Riemer[1]

1. Technical University Berlin

Time perception is related to the perception of space. This idea has received support from behavioral and neuroscience studies. At the behavioral level, mutual interference between the perception of time and space have been demonstrated. Larger objects are perceived as lasting longer, and the physical duration of stimuli affect their perceived size. Casasanto and Boroditsky (2008) reported evidence for an asymmetric relationship between space and time, with time being more affected by space than vice versa. This finding has stimulated the idea of a hierarchical representation of space and time, which is in line with conceptual metaphor theory but has also invoked skepticism (Riemer & Cai, 2024). The theory of an asymmetric representation of time and space is one focus of this symposium.

At the neuronal level, evidence for a common processing of time, space and other magnitudes in the parietal cortex (especially the right intraparietal sulcus; Bueti & Walsh, 2009) has led to the idea of a dimension-unspecific magnitude system. The idea of a common mechanism for the processing of temporal and spatial information has been reinforced by the discovery of time cells in the medial temporal lobe, a brain structure primarily known for its role in spatial processing (Eichenbaum, 2017). Together, these findings represent potential neuronal origins for the emergence of space-time interference in behavior.

The first two talks of the symposium are predominantly focused on behavioral studies about the (a)symmetric representation of time and space, while in the last two talks we will take a look at the neuronal processes underlying time and space perception.

Keywords: Space-time interference, spatial, speed, fMRI, time cells

Cross-dimensional interference between illusory size and duration

*Daniel Bratzke[1]

1. University of Bremen

Ono and Kawahara (2007) were the first to demonstrate that illusory size differences, as induced by the Ebbinghaus illusion, can interfere with the perception of duration and vice versa. This talk will present two studies, illustrating that this type of space-time interference (a) generalizes across various visual spatial illusions, including the Müller-Lyer, Ponzo, and horizontal-vertical illusions, (b) can be observed with different timing methods (categorization and temporal reproduction), (c) resembles space-time interference between physical size and duration, and (d) likely occurs fairly late in the processing stream.

References

Ono, F., & Kawahara, J.-I. (2007). The subjective size of visual stimuli affects the perceived duration of their presentation. Perception & Psychophysics, 69(6), 952–957. https://doi.org/10.3758/bf03193932

Keywords: size and duration

Using speed to think about space and time

*Martin Riemer[1]

1. Technical University Berlin

The observation of asymmetric interference between time and space, with time being more influenced by space than vice versa, has often been interpreted as reflecting a hierarchical representational structure. In this talk I will describe how the factor of speed, which is inherent in many experiments on space-time interference (e.g., growing lines, moving dots), can contribute to the observed asymmetry. I will present theroretical and empirical evidence that the introduction of speed leads to a more pronounced effect of space-on-time, and hence larger asymmetry. I conclude that the speed account provides a straightforward explanation for the phenomenon of asymmetric space-time interference in experiments using dynamic stimuli.

Keywords: space-time interference

The neural link between stimulus duration and spatial location in the human visual hierarchy

*Gianfranco Fortunato[1], Valeria Centanino[1], Domenica Bueti[1]

1. International School for Advanced Studies (SISSA)

A critical aspect of perception is the brain’s ability to integrate multiple sensory dimensions. While spatial influences on duration perception have been documented, the neural link between spatial and temporal coding remains underexplored. Using ultra-high-field fMRI and neuronal-based modelling, we investigated where and how the processing and representation of visual duration and spatial location are related. We found that duration coding transforms along the cortical hierarchy—from monotonic and spatially dependent in early visual cortex to unimodal and spatially invariant in frontal areas.
Notably, in the dorsal visual stream, especially the intraparietal sulcus (IPS), neuronal populations show common selective responses for both spatial and temporal stimulus dimensions. Furthermore, spatial and temporal topographies are systematically linked in IPS. These findings provide insights into the neural mechanisms underlying visual duration perception and emphasize the importance of interactions between multiple sensory dimensions—space, time, numerosity, speed, etc.—in shaping brain responses.

Keywords: cortical hierarchy

A different angle on space-time interference: Disentangling cognitive maps and graphs in the human brain

*Yangwen Xu[1], Max A.B. Hinrichs[1], Roberto Bottini[2], Christian F Doeller[1,3]

1. Max Planck Institute for Human Cognitive and Brain Sciences, 2. Center for Mind/Brain Sciences, University of Trento, 3. Kavli Institute for Systems Neuroscience

Our mental representations can be structured into two basic formats. One is cognitive maps, where representational contents are arranged in a space and encoded as coordinates. The other is cognitive graphs, where representational contents are associated through co-occurrence in time and encoded among relations. However, these two forms of representations are usually correlated and confounded, making their neural underpinnings challenging to verify. For example, the "place cells" found in the hippocampus, which fire at particular locations in an environment, can also be interpreted as "time cells", which fire following a particular temporal sequence. In this symposium, I will present our recent fMRI study aiming to illuminate this puzzle. We let participants learn a virtual environment of an Euclidean graph where map and graph information is orthogonalized, and the neural underpinnings of these two forms of mental representations were unraveled using both univariate and multivariate fMRI methods.

Keywords: space-time interference

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 Room 2(West B1)

[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 Ravignani[1] (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 Takahasi[1] (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 Gregorio[2], Daria Valente[2], Walter Cristiano[2,3], Filippo Carugati[2], Valeria Ferrario[2], Valeria Torti[2], Jonah Ratsimbatsafy[4], Cristina Giacoma[2], Andrea Ravignani[1,5,6], Marco Gamba[2] (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 Gamba[1], Lia Laffi[1], Silvia Leonetti[1], Filippo Carugati[1], Valeria Ferrario[1], Flavie Eveillard[1], Teresa Raimondi[1], Chiara De Gregorio[1], Longondraza Miaretsoa[1], Olivier Friard[1], Cristina Giacoma[1], Valeria Torti[1], Andrea Ravignani[1], Daria Valente[1] (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 Kwong[1], Rebecca N Lewis[1], Masayo Soma[1], Andrea Ravignani[1], Taylor Hersh[1] (1. University of Manchester (UK))

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

*Andrea Ravignani[1]

1. Dept. of Human Neurosciences, 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.

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

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

*Miki Takahasi[1]

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 Gregorio[2], Daria Valente[2], Walter Cristiano[2,3], Filippo Carugati[2], Valeria Ferrario[2], Valeria Torti[2], Jonah Ratsimbatsafy[4], Cristina Giacoma[2], Andrea Ravignani[1,5,6], Marco Gamba[2]

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 Gamba[1], Lia Laffi[1], Silvia Leonetti[1], Filippo Carugati[1], Valeria Ferrario[1], Flavie Eveillard[1], Teresa Raimondi[1], Chiara De Gregorio[1], Longondraza Miaretsoa[1], Olivier Friard[1], Cristina Giacoma[1], Valeria Torti[1], Andrea Ravignani[1], Daria Valente[1]

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 vocalizerbelongs 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 Kwong[1], Rebecca N Lewis[1], Masayo Soma[1], Andrea Ravignani[1], Taylor Hersh[1]

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

Oral | Memory, Emotion, Decision

Sat. Oct 18, 2025 9:00 AM - 10:30 AM JST | Sat. Oct 18, 2025 12:00 AM - 1:30 AM UTC Room 3(East B1)

[20301-06] Oral 4: Memory, Emotion, Decision

Chair:Müge Cavdan(Justus Liebig University Giessen)

9:00 AM - 9:15 AM JST | 12:00 AM - 12:15 AM UTC

[20301-06-01]

Investigating the effect of emotion on the temporal resolution of visual processing in viewing flickering LED.

*Makoto Ichikawa[1], Misa Kobayashi[2] (1. Graduate School of Humanities, Chiba University (Japan), 2. Graduate School of Science and Engineering, Chiba University (Japan))

9:15 AM - 9:30 AM JST | 12:15 AM - 12:30 AM UTC

[20301-06-02]

Alpha power indexes working memory load for durations

*Sophie Herbst[1], Izem Mangione[1], Charbel-Raphael Segerie[2], Richard Höchenberger[2], Tadeusz Kononowicz[4,1,3], Alexandre Gramfort[2], Virginie van Wassenhove[1] (1. Cognitive Neuroimaging Unit, INSERM, CEA, Université Paris-Saclay, NeuroSpin, 91191 Gif/Yvette, France (France), 2. Inria, CEA, Université Paris-Saclay, Palaiseau, France (France), 3. Institute of Psychology, The Polish Academy of Sciences, ul. Jaracza 1, 00-378 Warsaw, Poland (Poland), 4. Institut NeuroPSI - UMR9197 CNRS Université Paris-Saclay (France))

9:30 AM - 9:45 AM JST | 12:30 AM - 12:45 AM UTC

[20301-06-03]

Mentally shifting in time induces a shift in the amplitude of evoked responses

*Anna Maria Augustine Wagelmans[1], Virginie van Wassenhove[1] (1. Cognitive Neuroimaging Unit, INSERM, CEA, Université Paris-Saclay, NeuroSpin (France))

9:45 AM - 10:00 AM JST | 12:45 AM - 1:00 AM UTC

[20301-06-04]

Mental Time Travel Impairments in Neurodegenerative Diseases

*Valentina La Corte[1,2], Pascale Piolino[1,2] (1. Memory, Brain and Cognition lab,UR 7536, University Paris Cité (France), 2. Institut Universitaire de France (France))

10:00 AM - 10:15 AM JST | 1:00 AM - 1:15 AM UTC

[20301-06-05]

Level of Detail in Near and Far Future Imagined Events

*Ori Levit[1], Guy Grinfeld[1], Cheryl Wakslak[2], Yaacov Trope[3], Nira Liberman[1] (1. School of Psychological Science, Tel Aviv University (Israel), 2. Department of Management and Organization, University of Southern California, Los Angeles, California (United States of America), 3. Department of Psychology, New York University, New York (United States of America))

10:15 AM - 10:30 AM JST | 1:15 AM - 1:30 AM UTC

[20301-06-06]

Perceptual decision making of nonequilibrium fluctuations

*Aybüke Durmaz[1], Yonathan Sarmiento[1,2], Gianfranco Fortunato[1], Debraj Das[2], Mathew Ernst Diamond[1], Domenica Bueti[1], Édgar Roldán[2] (1. Sissa (International School for Advanced Studies) (Italy), 2. ICTP (The Abdus Salam International Centre for Theoretical Physics) (Italy))

Investigating the effect of emotion on the temporal resolution of visual processing in viewing flickering LED.

*Makoto Ichikawa[1], Misa Kobayashi[2]

1. Graduate School of Humanities, Chiba University, 2. Graduate School of Science and Engineering, Chiba University

We investigated how emotional responses with different degrees of valence and arousal evoked by viewing a photograph of various facial expressions affects temporal resolution of the visual processing. In Experiment 1, we measured the critical flicker-fusion frequency (CFF) as an index of temporal resolution of visual processing. We used the method of constant stimuli to measure CFF. We presented facial photographs with different expressions (anger, sad, or neutral) in an upright or an inverted orientation. Then, we presented flickering LED with seven different temporal frequencies of LED flicker, and the stimuli in which the duration of on and off of LED was 5ms (100 Hz) as catch stimuli. In each trial, participants reported whether they found the LED flickered or consistent by pressing keys. We found that CFF was smaller for the angry face than for the neutral face only with the upright presentation. In Experiment 2, we measured the detection rate of LED flicker with different ISI (20 or 100ms) between the facial photographs with different expressions (fear, sad, or neutral) and flicker of LED. We prepared four temporal frequency conditions for the LED flashing (15, 17, 19 ms conditions of the on-off of the flashing, and no flickered-consistent condition). Participants reported whether they found the LED flickered or consistent by pressing keys. Results showed that the detection rate for fearful face was significantly higher than the detection rate of the neutral face, and that the detection rate correlated with rating for arousal positively, and with rating for valence negatively only at short ISI. These results suggest that emotion evoked by viewing pictures may elevate the temporal resolution of the visual processing which was measure as CFF only with the upright presentation, and that this effect would decay within short period.

Keywords: critical flicker-fusion frequency, arousal, valence, facial expression, method of constant stimuli

Alpha power indexes working memory load for durations

*Sophie Herbst[1], Izem Mangione[1], Charbel-Raphael Segerie[2], Richard Höchenberger[2], Tadeusz Kononowicz[4,1,3], Alexandre Gramfort[2], Virginie van Wassenhove[1]

1. Cognitive Neuroimaging Unit, INSERM, CEA, Université Paris-Saclay, NeuroSpin, 91191 Gif/Yvette, France, 2. Inria, CEA, Université Paris-Saclay, Palaiseau, France, 3. Institute of Psychology, The Polish Academy of Sciences, ul. Jaracza 1, 00-378 Warsaw, Poland, 4. Institut NeuroPSI - UMR9197 CNRS Université Paris-Saclay

Seminal models of explicit duration perception include a working memory component, serving the comparison between just encoded durations and durations stored in long-term memory. Yet, neither time perception models, nor time memory models provide clear predictions as to the representation of duration in memory. Previously, we have been able to show based on a novel n-item delayed reproduction task, that the precision of duration recall decreases with the number of items to be remembered in sequence, but not with the duration of the sequence (Herbst et al., 2025). This suggests that durations are maintained as discrete items, rather than a continuous temporal code. Here, we investigated the neural signatures of a sequence of durations (n-item sequence) held in working memory. We recorded human participants using magnetoencephalography (MEG) while they performed the n-item delayed reproduction task, which required to encode a sequence of durations, maintain it, and then reproduce it. The number of items in a sequence (one or three) and the duration of the sequence were varied orthogonally. Our results show that during working memory maintenance, the number of durations, but not the duration of the sequence, affected recall precision and could be decoded from alpha and beta oscillatory activity. Parieto-occipital alpha power showed a direct link with the precision of temporal reproduction. Our results extend the earlier behavioral findings suggesting that durations are itemized in working memory and that their number, not their duration, modulates recall precision. Crucially, we establish that alpha power reflects a universal signature of working memory load and mediates recall precision, even for abstract information such as duration.

Keywords: duration perception, working memory, alpha oscillations, beta oscillations, duration reproduction

Mentally shifting in time induces a shift in the amplitude of evoked responses

*Anna Maria Augustine Wagelmans[1], Virginie van Wassenhove[1]

1. Cognitive Neuroimaging Unit, INSERM, CEA, Université Paris-Saclay, NeuroSpin

Through mental time travel (MTT), humans can explore past events or possible futures. One hypothesis is that MTT builds on flexible temporal cognitive maps of events' position in time (Gauthier & van Wassenhove, 2016). Previous studies have shown the implication of the hippocampal-entorhinal system for MTT (Gauthier et al., 2019; 2020), where the sequential firing of neuronal assemblies on shifting phases of theta oscillations codes for spatial position and distance (Dragoi & Buzsáki, 2006). Yet, the computation of temporal distances remains to be characterized. In a novel paradigm (N = 63), participants mentally projected themselves to different dates in the past or future. They were shown historical events, and had to report whether the event would happen before or after, with respect to their temporal position. We found that the further away in time participants imagined themselves to be, the slower their reaction times. This parametric shift shows that distance computations can be captured during MTT at a behavioural level, and grounds the hypothesis of a similar shift in neural responses. Herein, we adapted this task to magnetoencephalography (N = 31). We show that the amplitude of neural responses evoked by mentally projecting in time increased compared to being in the present, but did not shift along temporal distance. This suggests that the evoked response captures the operation of mentally projecting oneself in time, but not the underlying distance computations. Source reconstruction based on anatomical scans is ongoing to identify the regions contributing to this increase in evoked activity, with a primary focus on the hippocampus.

Keywords: mental time travel, cognitive map, MEG, hippocampus

Mental Time Travel Impairments in Neurodegenerative Diseases

*Valentina La Corte[1,2], Pascale Piolino[1,2]

1. Memory, Brain and Cognition lab,UR 7536, University Paris Cité , 2. Institut Universitaire de France

In recent decades, research on memory processes has expanded to include the mechanisms involved in envisioning future events, within the broader framework of mental time travel (MTT). *Prospection* refers to a broad and complex set of cognitive processes that enable individuals to anticipate, plan for, and mentally simulate future experiences.This study focuses on a specific form of episodic prospection known as episodic future thinking (EFT)—the capacity to project oneself forward in time to pre-experience personal future events.Previous studies have documented impairments in EFT among individuals with neurodegenerative diseases such as Alzheimer's disease (AD) and semantic dementia (SD), often related to long-term memory deficits. However, the neurocognitive mechanisms underlying these deficits remain poorly understood—particularly regarding the role of temporal distance.The aims of the present study were:
(i) to investigate MTT capacities across different temporal distances in AD and SD patients;
(ii) to disentangle the relationship between EFT and long-term memory deficits in these neurodegenerative profiles.Our results show that AD patients exhibited significant impairments in EFT for near-future events, while their performance for distant-future scenarios was relatively preserved. Additionally, they demonstrated deficits in past event recollection regardless of temporal distance. In contrast, SD patients showed an opposite pattern: preserved EFT for near and intermediate future events, but impaired performance for distant ones. Regarding the past dimension, SD patients showed deficits specifically for remote events.These findings contribute to a more nuanced understanding of how episodic and semantic memory impairments differentially affect past and future-oriented cognition in neurodegenerative conditions. The results carry both theoretical significance and potential clinical applications.

Keywords: mental time travel, memory, neurodegenrative diseases, personal temporality, episodic future thinking

Level of Detail in Near and Far Future Imagined Events

*Ori Levit[1], Guy Grinfeld[1], Cheryl Wakslak[2], Yaacov Trope[3], Nira Liberman[1]

1. School of Psychological Science, Tel Aviv University, 2. Department of Management and Organization, University of Southern California, Los Angeles, California, 3. Department of Psychology, New York University, New York

How does psychological distance influence the level of detail in our mental representations of future imagined events? According to Construal Level Theory (CLT), there are four psychological distance dimensions: events can feel distant in time (temporal), space (spatial), social relationship (social), or probability (hypothetical). Yet we lack direct measures of how these distances affect the level of detail in mental representations. We bridged this gap by adapting Reality Monitoring Theory's Memory Characteristics Questionnaire to measure the level of detail in future imagined scenarios. Across six studies (N=1,749), we demonstrated that psychological distance, including the temporal dimension, systematically reduces the level of detail in mental imagery. Study 1 found that more psychologically distant imagined scenarios were rated as significantly less detailed ($r = -.16$, $p = .005$). Studies 2-3 manipulated hypotheticality, showing that probable future meetings were imagined with greater detail than improbable future meetings ($d = 0.47$, $p < .001$). Study 4 examined the same idea in spatial distance ($d = 0.20$, $p = .007$), and Study 5 examined social distance ($d = 0.31$, $p = .01$). Study 6 specifically examined temporal distance: older adults closer to retirement age imagined their future retirement with greater detail than younger adults ($r = .23$, $p < .001$), and this increased temporal detail mediated the relationship between temporal closeness and actual retirement savings behavior (indirect effect: $b = 0.06$, 95% CI [0.01, 0.03]). These findings demonstrate that psychological distance systematically affects the level of detail in future mental representations. For timing research, this reveals how temporal distance affects mental representation: feeling temporally closer to events increases mental detail, which influences real-world planning behavior

Keywords: Psychological Distance, Temporal Distance, Mental Imagery, Future thinking, Construal level

Perceptual decision making of nonequilibrium fluctuations

*Aybüke Durmaz[1], Yonathan Sarmiento[1,2], Gianfranco Fortunato[1], Debraj Das[2], Mathew Ernst Diamond[1], Domenica Bueti[1], Édgar Roldán[2]

1. Sissa (International School for Advanced Studies), 2. ICTP (The Abdus Salam International Centre for Theoretical Physics)

A pedestrian deciding when to cross a busy street must consider not only the average traffic flow but also the fluctuations in the movement of individual cars. Similarly, the perceptual system must handle both local fluctuations in individual elements and the global patterns that emerge from their interactions. To investigate how the brain makes efficient decisions in such nonequilibrium systems—where evidence changes over time—we conducted three experiments with sixty-seven human participants who judged the direction of a particle exhibiting drifted Brownian motion. The entropy production rate extracted from the particle’s trajectory served as a measure of noise dynamics.

We found that mean decision time was inversely proportional to the entropy production rate, establishing an analytical approach to predict the amount of time required to extract the signal given stimulus parameters. Moreover, participants required more time than predicted, indicating suboptimal decision times. An evidence integration approach, equipped with a memory time constant, resulted in tighter fits, indicating that participants adjusted their integration time window to stimulus dissipation, favoring the global trajectory of the stimulus over local fluctuations when the stimuli exhibited higher entropy production.

Furthermore, comparisons between blocked and intermixed conditions revealed that environmental stability was directly linked with decision optimality as well as the flexibility in adjusting integration time window. Complementary approaches indicated that decision optimality was linked to (I) memory load, (II) the recency effect, and (III) the ability to detect meaningful statistical cues in the evidence.

Overall, our work shows that providing a detailed model of the physical properties of the stimuli allows for a better characterization of the variables influencing perceptual decision-making, and refines our understanding of the temporal dynamics of efficient evidence integration.

Keywords: perceptual decision making, nonequilibrium systems, decision optimality, evidence integration, stimulus statistics, integration time window

Oral | Prediction, Temporal perception, Computational Modeling

Sat. Oct 18, 2025 1:00 PM - 2:30 PM JST | Sat. Oct 18, 2025 4:00 AM - 5:30 AM UTC Room 3(East B1)

[O6] Oral 6: Prediction, Temporal perception, Computational Modeling

Chair:Pascal Mamassian(CNRS & Ecole Normale Supérieure Paris)

1:00 PM - 1:15 PM JST | 4:00 AM - 4:15 AM UTC

[O6-01]

Temporal Prediction through Integration of Multiple Probability Distributions of Event Timings

*Yiyuan Teresa Huang[1], Zenas C Chao[1] (1. International Research Center for Neurointelligence, The University of Tokyo (Japan))

1:15 PM - 1:30 PM JST | 4:15 AM - 4:30 AM UTC

[O6-02]

The anticipation of imminent events is time-scale invariant

*Matthias Grabenhorst[1,2], David Poeppel[3], Georgios Michalareas[4,1,2] (1. Ernst Struengmann Institute for Neuroscience (Germany), 2. Max Planck Institute for Empirical Aesthetics (Germany), 3. New York University (United States of America), 4. Goethe University (Germany))

1:30 PM - 1:45 PM JST | 4:30 AM - 4:45 AM UTC

[O6-03]

The timing of neural-cardio-respiratory network states predicts perception across the senses

*Andreas Wutz[1] (1. University of Salzburg (Austria))

1:45 PM - 2:00 PM JST | 4:45 AM - 5:00 AM UTC

[O6-04]

What does the Fröhlich effect tell us about sensation time?

*Pascal Mamassian[1] (1. CNRS & Ecole Normale Supérieure Paris (France))

2:00 PM - 2:15 PM JST | 5:00 AM - 5:15 AM UTC

[O6-05]

Oscillatory Entrainment in Non-Deterministic Continuous Environments, Independent of Bayesian Interval Learning: Computational and Behavioral Evidence

*Elmira Hosseini[1,2], Assaf Breska[1] (1. Max-Planck Institute for Biological Cybernetics (Germany), 2. Tübingen University (Germany))

2:15 PM - 2:30 PM JST | 5:15 AM - 5:30 AM UTC

[O6-06]

An investigation of auditory rhythms with a spiking neural network autoencoder

*Rodrigo Manríquez[1,2], Sonja A. Kotz[2,3], Andrea Ravignani[4,5], Bart de Boer[1] (1. Vrije Universiteit Brussel (Belgium), 2. Maastricht University (Netherlands), 3. Max Planck Institute for Human Cognitive and Brain Sciences (Germany), 4. Sapienza University of Rome (Italy), 5. Aarhus University & The Royal Academy of Music (Denmark))

Temporal Prediction through Integration of Multiple Probability Distributions of Event Timings

*Yiyuan Teresa Huang[1], Zenas C Chao[1]

1. International Research Center for Neurointelligence, The University of Tokyo

Our brain uses prior experience to anticipate the timing of upcoming events. This dynamical process can be modeled using a hazard function derived from the probability distribution of event timings. However, the contexts of an event can lead to various probability distributions for the same event, and it remains unclear how the brain integrates these distributions into a coherent temporal prediction. In this study, we create a foreperiod sequence paradigm consisting of a sequence of paired trials, where in each trial, participants respond to a target signal after a specified time interval (i.e. foreperiod) following a warning cue. The prediction of the target onset in the second trial can be based on the probability distribution of the second foreperiod and its conditional probability given the foreperiod in the first trial in the context of foreperiod sequence. These probability distributions are then transformed into hazard functions to represent the temporal predictions. The behavioral model incorporating both of the prediction and the contextual prediction significantly improves fit of reaction times to the target signal, indicating that both regularities of temporal information contribute to making predictions. We further show that electroencephalographic source signals are best reconstructed when integrating both predictions. Specifically, the prediction and the contextual predictions are separately encoded in the posterior and anterior brain regions, and to achieve synergy between both predictions, a third region—particularly the right posterior cingulate area—is needed. Our study reveals brain networks that integrate multilevel temporal information, providing a comprehensive view of hierarchical predictive coding of time.

Keywords: Temporal prediction, Multiple probability distributions, Hazard functions, Forward encoding analysis, EEG source

The anticipation of imminent events is time-scale invariant

*Matthias Grabenhorst[1,2], David Poeppel[3], Georgios Michalareas[4,1,2]

1. Ernst Struengmann Institute for Neuroscience, 2. Max Planck Institute for Empirical Aesthetics, 3. New York University, 4. Goethe University

Humans predict the timing of imminent events to generate fast and precise actions. Such temporal anticipation is critical over the range of hundreds of milliseconds to a few seconds. However, it was argued that timing mechanisms differ below and above a boundary at around 1–2 seconds in time perception and interval discrimination (Grondin, J Exp Psychol, 2012; Gibbon et al., Curr Opin Neurobiol, 1997) and duration discrimination (Rammsayer & Lima, Percept Psychophys, 1991; Rammsayer et al, Frontiers in Psychology, 2015) which may affect timing behavior in the anticipation of imminent events. Recent work showed that the brain models the probability density function of events across time, suggesting a canonical mechanism for temporal anticipation (Grabenhorst et al., Nat Commun, 2019 & 2025). Here we investigate whether this core computation remains stable across the described temporal boundaries when the distribution of events is stretched across different time spans. In a Set - Go task, the time between the two cues was randomly drawn from probability distributions which, across experimental blocks, were defined over different time spans. Participants were asked to react as fast as possible to the Go cues and generated > 52000 reaction times (RT). We found that, irrespective of the time span, anticipation, measured as RT, scales with the event distribution. This shows that the key computation –the estimation of event probability density –is invariant across temporal scales. We further found that the variance in anticipation is also scale invariant which contradicts Weber’ s law. The results hold in vision and audition, suggesting that the core computations in anticipation are independent of sensory modality. These findings demonstrate that –independent of temporal scale –perceptual systems estimate probability over time to anticipate the timing of future events. We conclude that temporal anticipation, a basic function in cognition, is time-scale invariant.

Keywords: Temporal prediction, Probability estimation, Time estimation, Temporal cognition, Weber's law

The timing of neural-cardio-respiratory network states predicts perception across the senses

*Andreas Wutz[1]

1. University of Salzburg

For the past decades, neuroscience research has repeatedly highlighted the pivotal role of observer-dependent, internal network states predisposing sensory experiences in the external world. Nevertheless, many open questions remain: How are these internally generated processes implemented in the perceiver? How are they controlled and timed relative to each other and to sensory inputs? And, do they generalize across different sensory systems? In this talk, I present novel magneto-encephalography (MEG), cardiac and respiratory data that conclusively demonstrate top-down brain networks influencing perception across different sensory modalities and their relationships to ongoing dynamics in the body. On each trial, different visual, auditory or tactile stimuli were shown at individual perceptual thresholds, such that about half of the stimuli were consciously detected, while the other half were missed. The main findings show neural activity bursts occurring shortly before stimulus onset across frontal and posterior cortex in the brain's dominant alpha-frequency band rhythm (8-13 HZ). The precise timing of these neural activity bursts is predictive of subsequent perceptual outcomes generalized across all three senses. Moreover, the neural activity bursts happen at specific phases of the participants' cardiac cycle, suggesting a crucial role of pre-stimulus neural-cardio network timing for conscious perception. Because cardiac activity is strongly coupled to respiration, neural-cardio network interactions may be top-down controlled and timed by the participants' breathing behavior. In line with this hypothesis, the participants strategically regulate their respiratory activity during the task both relative to stimulus onset and to neural burst onset. The participants' breath out earlier for successfully detected vs. missed stimuli with respect to the onset of the activity bursts in the brain. Overall, our results reveal an interactive, multi-stage temporal processing cascade bridging both neural and bodily systems and preparing the perceiving organism for the optimally timed integration of conscious experiences.

Keywords: perception , oscillations, MEG, brain-body interactions

What does the Fröhlich effect tell us about sensation time?

*Pascal Mamassian[1]

1. CNRS & Ecole Normale Supérieure Paris

When an object suddenly appears and starts moving, its initial position is often mislocalized in its direction of motion. In 1923, Friedrich Fröhlich used this effect to measure the "sensation time", i.e. the time between the impact of light on the retina and the corresponding visual sensation. He reasoned that sensation time can be directly inferred from the spatial bias, given the object speed. This reasoning has since been heavily criticised and new interpretations for the Fröhlich effect have been offered, in particular one based on a spatial prediction that extrapolates into the future to compensate for neural delays. Does this mean that the Fröhlich effect is useless to measure sensation time? We addressed this question by manipulating the duration of a moving object from 50 to 300ms. For the same observers in different experiments, we asked them to report the perceived spatial onset of a small moving disc, its perceived offset, its perceived duration, and its perceived speed. To control for possible eccentricity effects, the object rotated along a visible circle centered on the fixation point. This path was divided into two sectors of different colours, half was blue and the other half orange, and the colour boundaries defined reference marks that observed used to report their perceived onset or offset (e.g. "was stimulus onset in the blue or orange sector?"). Surprisingly, we found an "anti-Fröhlich" effect: the perceived spatial onset was before the start of the motion, at a location that the object never occupied. We also found that perceived speed was largely overestimated, and more so for shorter durations. Finally, we did not find any significant bias in perceived offset or perceived duration. Overall, these results are consistent with a global inference of perceived duration, speed, onset and offset locations, all at the same time at the end of the motion. We argue that this delay relative to the object appearance is informative about sensation time.

Keywords: sensation time, Fröhlich effect, motion perception, visual psychophysics

Affective modulation of temporal binding using linguistic stimuli

*Felipe Toro Hernández[1], Theresa Moraes Ramalho[2], André Mascioli Cravo[2], Peter M. E. Claessens[2]

1. Graduate Program in Neuroscience and Cognition, Federal University of ABC (UFABC), São Paulo, Brazil, 2. Center for Mathematics, Computing and Cognition, Federal University of ABC (UFABC), São Paulo, Brazil

Temporal binding (TB)—the perceived shortening of time between a cause (event A) and its effect (event B)—is often associated with voluntary action. This temporal compression is typically stronger when the action is self-generated, making TB a widely used implicit marker of the sense of agency (SoA). Whereas explicit measures of SoA are usually sensitive to outcome valence (positive outcomes yield higher agency ratings than negative ones), implicit measures such as TB have produced less consistent findings. We examined whether emotional valence influences TB using a two-alternative forced-choice (2AFC) interval discrimination task in three experiments, varying the predictability of outcome valence. Emotional words (e.g., “joy,” “death,” “chair”) served as outcomes, categorized as positive, negative, or neutral. Relevant psycholinguistic variables were matched across valence groups using previous normatization studies for Brazilian Portuguese and two online surveys (N = 54). In Experiment 1 (N = 33), agency (active vs. passive) and word valence were fixed within blocks. In Experiment 2 (N = 40), valence was either fixed or varied across trials, depending on the block. Experiment 3 (N = 40) used only trial-wise variation in valence. Across all experiments, generalized linear mixed models (GLMMs) replicated the TB effect: active trials were perceived as more temporally compressed than passive ones. However, outcome valence did not interact with agency in any of the experiments, suggesting no affective modulation of TB. These findings suggest that emotional valence alone may not be sufficient to influence implicit measures of agency, such as TB. Future research should investigate additional factors and methodologies to gain a deeper understanding of how emotion, agency, and time perception interact.

Keywords: Temporal binding, Sense of Agency, temporal cognition, psychophysics, cognitive-affective neuroscience

An investigation of auditory rhythms with a spiking neural network autoencoder

*Rodrigo Manríquez[1,2], Sonja A. Kotz[2,3], Andrea Ravignani[4,5], Bart de Boer[1]

1. Vrije Universiteit Brussel, 2. Maastricht University, 3. Max Planck Institute for Human Cognitive and Brain Sciences, 4. Sapienza University of Rome, 5. Aarhus University & The Royal Academy of Music

Here, we present a biologically inspired spiking neural network, or SNN, framework that learns auditory rhythms from acoustic data by exploiting the exact spike timing of spikes. Although classic deep learning models have been applied to investigate temporal sequences, spiking NNs more accurately reflect the temporal dynamics of biological neural systems.

We first encoded acoustic waveforms containing rhythmic information into spike trains and considered a subcortical model of the peripheral auditory pathway [1.] This model reproduces cochlear transduction and auditory-nerve firing across characteristic frequencies, yielding parallel streams of precisely timed spikes that retain the temporal structure of the input. These spike trains were then used to train a purely spike-based autoencoder. In this framework, the encoder compresses input data into a latent representation, i.e. a simplified representation that captures underlying features of the data, while the decoder reconstructs the amplitude envelope of the original sound, preserving rhythmic features.

By training on isochronous sequences, where consecutive onsets were separated by identical intervals, we demonstrate that rhythmic structure is preserved in the latent space representation. Moreover, the network develops predictive behaviour, by anticipating subsequent beat onsets even in the absence of a beat. This sensitivity reflects a form of temporal expectation embedded in the SNN. To evaluate how the network internalises rhythmic structures, we tested it with sequences that missed beats and inspected the resulting latent representations. By analysing the spiking activity and internal variables within this hidden layer, we revealed how the model encodes temporal regularities and reconstructs the expected onset pattern, in a way that would not be possible in a non-spiking neural network.

1. Zuk, N., Carney, L., Lalor, E. 2018. Preferred Tempo and Low-Audio-Frequency Bias Emerge From Simulated Sub–cortical Processing of Sounds With a Musical Beat. *Front. Neurosci.*, *12*.

Keywords: Spiking Neural Networks, Auditory Processing, Rhythm Processing

Oral | Computational Modeling, Neural Mechanisms

Sat. Oct 18, 2025 9:00 AM - 10:30 AM JST | Sat. Oct 18, 2025 12:00 AM - 1:30 AM UTC Room 2(West B1)

[O5] Oral 5: Computational Modeling, Neural Mechanisms

Chair:Assaf Breska(Max-Planck Institute for Biological Cybernetics)

9:00 AM - 9:15 AM JST | 12:00 AM - 12:15 AM UTC

[O5-01]

Centralized mechanisms of explicit and implicit timing in the human cerebellum: a neuropsychological approach

*Chiara Zanonato[1,2], Richard Ivry[3,4], Assaf Breska[1,3] (1. Max-Planck-Institute for Biological Cybernetics, Tübingen (Germany), 2. University of Tübingen (Germany), 3. Department of Psychology, University of California, Berkeley, CA (United States of America), 4. Helen Willis Neuroscience Institute, University of California, Berkeley, CA (United States of America))

9:15 AM - 9:30 AM JST | 12:15 AM - 12:30 AM UTC

[O5-02]

Unique Effect of Entrainment on Perception? Context-Specific Temporal Prediction Mechanisms in Multiple Aspects of Perception

*Christina Bruckmann[1,2], Assaf Breska[1] (1. Max Planck Institute for Biological Cybernetics (Germany), 2. University of Tübingen (Germany))

9:30 AM - 9:45 AM JST | 12:30 AM - 12:45 AM UTC

[O5-03]

Rationalizing temporal decision making and the neural representation of time

*Marshall G Hussain Shuler[1,2] (1. Johns Hopkins (United States of America), 2. Kavli Neuroscience Discovery Institute (United States of America))

9:45 AM - 10:00 AM JST | 12:45 AM - 1:00 AM UTC

[O5-04]

A Methodology to Accelerate Our Information Processing Toward Revealing the Relation between Process Speed and Time Perception

*Oki Hasegawa[1], Shohei Hidaka[1] (1. Japan Advanced Institute of Science and Technology (Japan))

10:00 AM - 10:15 AM JST | 1:00 AM - 1:15 AM UTC

[O5-05]

Sensory Reliability Shapes Sequential Effects in Human Duration Perception

*Taku Otsuka[1,2], Joost de Jong[1,3], Wouter Kruijne[1], Hedderik van Rijn[1] (1. University of Groningen (Netherlands), 2. The University of Tokyo (Japan), 3. Université de Paris (France))

10:15 AM - 10:30 AM JST | 1:15 AM - 1:30 AM UTC

[O5-06]

Bach and Bayes: Prediction in Noisy Musical Sequences

*Akanksha Gupta[1], Alejandro Tabas[2,3] (1. INS, INSERM, Aix-Marseille University, Marseille (France), 2. Perceptual Inference Group, Basque Center on Cognition, Brain and Language, San Sebastian (Spain), 3. Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig (Germany))

Centralized mechanisms of explicit and implicit timing in the human cerebellum: a neuropsychological approach

*Chiara Zanonato[1,2], Richard Ivry[3,4], Assaf Breska[1,3]

1. Max-Planck-Institute for Biological Cybernetics, Tübingen, 2. University of Tübingen, 3. Department of Psychology, University of California, Berkeley, CA, 4. Helen Willis Neuroscience Institute, University of California, Berkeley, CA

Humans keep track of temporal intervals for various purposes, ranging from explicitly reporting perceived durations to implicitly orienting attention in time. Whether shared or segregated timing mechanisms subserve these timing processes is a key neuroscientific question. While neuroimaging studies revealed task-dependent functional dissociations, mostly at the cortical level, recent behavioral work hints at potential computational overlap. Moreover, separate lines of research have implicated the cerebellum in both explicit and implicit interval timing, but whether this reflects one shared or two task-specific cerebellar circuits is unknown. Here, we investigated how the cerebellum might act as a central timing circuit in implicit and explicit interval timing. Cerebellar Ataxia (CA) patients (N=18) and age-matched neurotypical controls (N=16) performed explicit (temporal discrimination) and implicit (cued temporal orienting for speeded detection) interval timing tasks, as well as a control task to account for non-temporal factors. Two intervals (S1, S2) were sequentially presented: S1 was either short (700ms) or long (1200ms), while S2 spanned between the short and long S1. CA patients' performance was impaired compared to healthy controls in both tasks, showing lower temporal sensitivity in temporal discrimination and smaller validity effect in temporal orienting, in line with previous studies. Critically, the performance in the two tasks was more strongly associated in the patient than the control group, with only the former showing a significant correlation, as predicted by a shared process model. Moreover, this was not explained by non-temporal factors. These findings establish the cerebellum as a central sub-second interval timing hub, causally involved in timing intervals independently of the final purpose.

Keywords: explicit timing, implicit timing, interval timing, cerebellum, cerebellar ataxia

Unique Effect of Entrainment on Perception? Context-Specific Temporal Prediction Mechanisms in Multiple Aspects of Perception

*Christina Bruckmann[1,2], Assaf Breska[1]

1. Max Planck Institute for Biological Cybernetics, 2. University of Tübingen

Temporal prediction and preparation are essential for adaptive behavior, and can be generated based on various temporal regularities, including rhythms and interval memory. In rhythmic streams temporal predictions are thought to uniquely rely on phase-aligning neural oscillations to the external rhythm. However, in motor tasks, previous studies found similar behavioral benefits and neural phase alignment patterns for rhythm- and interval-based temporal predictions, questioning the unique role of entrainment in these phenomena. Yet, if rhythmic entrainment acts at low-level sensory circuits, its unique effect might only be revealed under high perceptual load. Here we address this using a challenging perceptual discrimination task, in which visual target timing is either non-predictable, is on-beat with a preceding rhythm (~1.11 Hz), or matches a previously presented interval (900 ms). Examining the differential effect of temporal expectation on multiple levels of perception, we collect both objective classification accuracy and subjective visibility reports, a fundamental distinction in consciousness research that has been overlooked in the temporal attention literature. In line with previous findings, both interval- and rhythm-based temporal expectations improve performance compared to the irregular stream, but to a similar degree, which is inconsistent with the idea that rhythmic entrainment provides a unique perceptual benefit beyond temporal prediction. In EEG, we critically found similar increases in occipital delta phase alignment in the rhythm and interval conditions. This was not found in central channels, demonstrating the independence of sensory from high-level phase alignment. Taken together, these results show that phase alignment can occur in the absence of oscillatory entrainment and call into question whether rhythmic entrainment provides perceptual benefits beyond what would be expected by temporal prediction alone.

Keywords: temporal attention, rhythmic entrainment, interval, EEG, visual discrimination

Rationalizing temporal decision making and the neural representation of time

*Marshall G Hussain Shuler[1,2]

1. Johns Hopkins, 2. Kavli Neuroscience Discovery Institute

By what neural means do we represent the passage and structuring of time and decide how to spend time? How do these representations of value and time relate to evolutionary pressure to maximize reward accumulation? To address these questions, we evaluate whether the temporal difference reinforcement learning (TDRL) algorithm can rationalize temporal decision-making. First, we derive the *optimal solution* for reward accumulation and demonstrate that TDRL's value estimates—infinite sums of exponentially discounted future rewards—systematically deviate from this optimum. Then we show how TDRL, operating over a time state-space representation using regular intervals, fails to learn values that rationalize the curious pattern of decision-making errors exhibited by humans and animals. Our insight, however, is that this failure can be best mitigated by representing time using a time-dilating state-space, wherein the amount of time spent in a subsequent state increases by a precise proportion. TDRL applied to such a time-dilating state-space then learns values that rationalize the diverse suboptimalities observed over decades of investigating how animals and humans decide to spend time. Specifically, it affords optimal forgo behavior, minimizes a suboptimal bias toward sooner-smaller rewards in mutually exclusive choices, and leads to a suboptimal unwillingness to abandon engaged pursuits (sunk cost). In proposing PARSUIT theory (Pursuit-based Atomized Reinforcement of State-value Using Increasing Timesteps), we provide 1) a general, mechanistically descriptive explanation of temporal decision making, 2) a normative rationalization for why time takes the neural form that it does, and 3) advance TDRL as the learning algorithm used in temporal decision-making.

Keywords: Temporal Difference Reinforcement Learning, reward-rate maximization, dilating time state-space, temporal decision-making

A Methodology to Accelerate Our Information Processing Toward Revealing the Relation between Process Speed and Time Perception

*Oki Hasegawa[1], Shohei Hidaka[1]

1. Japan Advanced Institute of Science and Technology

The subjective experience of time slowing down during peak performance, or 'flow', suggests a link between cognitive processing speed and time perception. However, this relationship is not well understood due to the limitations of short-duration tasks, which are typically employed in psychological and neurological laboratory studies. This is a critical limitation, as the phenomena of interest typically emerge during continuous, sustained activities in the real world. Therefore, to properly test our central hypothesis—an extension of Treisman’ s internal clock model which posits that a high-arousal state accelerates an internal pacemaker to simultaneously improve information processing speed and extend subjective time —an experimental paradigm capable of inducing and continuously sustaining such a state is first necessary. Here, we present this paradigm, which involves an adaptive Tetris game designed to induce a flow-like state and enable a continuous study of the aforementioned link. The system uses a Markov process model to estimate players' abilities and adjust the task's difficulty in real time. To validate this approach, we first measured baseline performance in an ideal, untimed version of the task, confirming that player performance fell within the range predicted by our model. We then investigated the effect of three patterns of difficulty change —linear increase, linear decrease and random —on processing speed (lines cleared per minute). Although players achieved a similar maximum performance level at the end of the game in all conditions, performance improved most quickly under the linearly increasing difficulty condition. These results demonstrate that an adaptive challenge that continuously and predictably increases in response to a player's ability is a key factor for accelerating cognitive processing. At this conference, we will report on the preliminary performance evaluation of the developed task system.

Keywords: Flow State, Infomation Processing Speed

Sensory Reliability Shapes Sequential Effects in Human Duration Perception

*Taku Otsuka[1,2], Joost de Jong[1,3], Wouter Kruijne[1], Hedderik van Rijn[1]

1. University of Groningen, 2. The University of Tokyo, 3. Université de Paris

Perceived durations are biased towards immediately preceding percepts. Although such sequential effects in time perception have long been recognized, the Bayesian framework has recently emerged as a compelling account of these phenomena. Crucially, while the Bayesian framework posits that the magnitude of the sequential effect depends on the reliability of both the previous and current stimuli, empirical support for this prediction remains lacking. In order to test this central prediction of the Bayesian framework, we systematically manipulated the perceptual noise of to-be timed stimuli by embedding them in dynamic visual noise. We found that reproduced durations were biased towards the duration of the preceding stimulus, confirming the presence of a sequential effect. Importantly, the magnitude of this effect was modulated by the reliability of both the previous and current stimuli, in a manner consistent with Bayesian predictions. Furthermore, by fitting a Bayesian computational model that updated prior expectations on a trial-by-trial basis, we demonstrated that manipulating the uncertainty of the current sensory input (likelihood variance) enabled the model to capture the observed reliability-dependent modulation of the sequential effect. These findings provide direct empirical evidence for reliability-based integration in human duration judgements and highlight the sequential effect as an adaptive mechanism that dynamically adjusts to sensory uncertainty.

Keywords: sequential effect, Bayesian modeling, duration reproduction, sensory reliability

Bach and Bayes: Prediction in Noisy Musical Sequences

*Akanksha Gupta[1], Alejandro Tabas[2,3]

1. INS, INSERM, Aix-Marseille University, Marseille, 2. Perceptual Inference Group, Basque Center on Cognition, Brain and Language, San Sebastian, 3. Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig

Information from the external environment is often uncertain and ambiguous, posing a challenge for the brain to accurately infer the state of the world. According to the predictive processing framework, prior knowledge pertinent to inference is compressed into predictions about imminent future states. These predictions are combined with sensory inputs using Bayesian belief updating. While this approach is optimal for inferring latent states in certain stochastic systems, it may not be useful when applied to more complex systems such as music or language. In this work, we examine whether neural networks trained to infer the current latent state in a musical sequence also develop a capacity to predict what comes next.

To investigate this hypothesis, we utilized tokenized Bach compositions corrupted with noise as sensory inputs and gated recurrent neural networks (GRUs) to model neural circuits. The training procedure involved two stages: first, to infer the current token, and then, to optimize a linear readout for predictions of the next token to see if the predictions are encoded in the network's internal states. Furthermore, we benchmarked the network's performance against an optimal Markovian model, which predicts the next token using only the current token. Our findings demonstrate that neural circuits fine-tuned for perceiving the current state can learn to predict future sensory input, suggesting that predictive capabilities emerge as a consequence of such optimization. This evidence strengthens the computational foundation of the predictive coding framework and offers insights into how biological systems may utilize prior knowledge to adaptively operate within uncertain environments.

Keywords: Predictive Processing, Bayesian Brain Hypothesis, Recurrent Neural Networks (RNNs), gated recurrent neural networks (GRUs)

Poster | Other

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Disentangling the effects of movement speed and travel distance on perceived traveled time

*Cindy Jagorska[1], Christopher Hilton[1], Martin Riemer[1] (1. Technical University Berlin (Germany))

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withdrawn

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[P2-03]
Impaired Temporal Perception Following Sight Restoration After Congenital Cataracts

*Abel Mewleddeg Legu[2], Gianluca Mariscano[1], David Melcher[1,4], Ehud Zohary[2,3] (1. Department of Psychology, New York University Abu Dhabi (United Arab Emirates), 2. Project Eyeopener (Ethiopia), 3. The Hebrew University of Jerusalem (Israel), 4. Center for Brain and Health, New York University Abu Dhabi (United Arab Emirates))

[P2-04]
Decoding the reproduction of durations in size-varying virtual environment

*Camille L. Grasso[1], Matthew Logie[1], Virginie van Wassenhove[1] (1. CEA/DRF/Inst. Joliot, NeuroSpin; INSERM, Cognitive Neuroimaging Unit; Université Paris-Saclay, Gif/Yvette, 91191 France (France))

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Maria Nogales[1], *Judit Castellà[1] (1. Autonomous University of Barcelona UAB (Spain))

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Electrophysiological signatures of post-interval activity in explicit and implicit timing

*Mariagrazia Capizzi[1], Cristina Narganes Pineda[1], Pom Charras[3], Giovanna Mioni[2], Antonino Visalli[4] (1. Mind, Brain and Behavior Research Center (CIMCYC), University of Granada; Department of Experimental Psychology, University of Granada, Granada, Spain (Spain), 2. Department of General Psychology, University of Padua, Padua (Italy), 3. Univ Paul Valéry Montpellier 3, EPSYLON EA 4556, F34000, Montpellier, France (France), 4. Department of Biomedical, Metabolic and Neural Sciences, University of Modena and Reggio Emilia (Italy))

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*Mildred Salgado-Menez[1], Ana Maria Malagon[1], Victor de Lafuente[1] (1. Universidad Nacional Autonoma de Mexico (Mexico))

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*Chika Goto[1], Naoya Tachibana[1], Shogo Sugiyama, Yuko Yotsumoto[1] (1. the University of Tokyo (Japan))

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Hand proximity enhances visual encoding via anticipatory processing

*Ankit Maurya[1,3], Tsukasa Kimura[2,3], Minto Hashimoto[4,3], Masamichi J. Hayashi[3,4], Tony Thomas[1] (1. Department of Humanities and Social Sciences, Indian Institute of Technology Roorkee, Roorkee (India), 2. Graduate School of Human Sciences, The University of Osaka, Suita (Japan), 3. Center for Information and Neural Networks (CiNeT), Advanced ICT Research Institute, National Institute of Information and Communications Technology, Suita (Japan), 4. Graduate School of Frontier Biosciences, The University of Osaka, Suita (Japan))

[P2-10]

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*Claire TERRAN[1], Laurence CASINI[1] (1. CRPN - Centre for Research in Psychology and Neuroscience, AMU, CRNS (France))

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*YUHUI ZHOU[1], Sae Kaneko[1] (1. Hokkaido University (Japan))

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*Ludovica Ortame[1,2], Michele Pellegrino[2], Joseph Glicksohn[3,4], Patrizio Paoletti[2], Fabio Marson[5], Stafno Lasaponara[1,6], Maria Sofia Romano[1], Fabrizio Doricchi[1,6], Filippo Carducci[1], Tal Dotan Ben-Soussan[2] (1. Sapienza University of Rome (Italy), 2. Research Institute of Neuroscience, Education and Didactics (RINED) (Italy), 3. Bar-Ilan University (Israel), 4. The Leslie and Susan Gonda (Goldschmied) Multidisciplinary Brain Research Center, Bar-Ilan University, Ramat Gan (Israel), 5. University of Milano-Bicocca (Italy), 6. RCCS Fondazione Santa Lucia (Italy))

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*Ikuya Murakami[1] (1. The University of Tokyo (Japan))

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Assessing Temporal Resolution in Amblyopic and Fellow Eyes Using the Two-Flash Fusion Paradigm

*Aysha Hamkari[1], Gianluca Marsicano[1], Katja Cundric[1], David Melcher[1] (1. New York University Abu Dhabi (United Arab Emirates))

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*Solène Leblond[1], Tutea Atger[1], Franck-Emmanuel Roux[1,2], Robin Baurès[1], Céline Cappe[1] (1. CerCo (Centre de Recherche Cerveau et Cognition), CNRS UMR 5549, University Toulouse (France), 2. Pôle neurochirurgie, CHU Purpan, Toulouse (France))

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Temporal Binding Across Timing Domains: Behavioural Evidence and a Protocol for Causal Manipulation via Transcranial Direct Current Stimulation

*Gustavo Brito de Azevedo[1], André Mascioli Cravo[2] (1. Graduate Program in Neuroscience and Cognition, Federal University of ABC (UFABC) (Brazil), 2. Center for Mathematics, Computing and Cognition, Federal University of ABC (UFABC) (Brazil))

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*Gabriel Cafeu Brandão[1], Gustavo Brito de Azevedo[1], Peter Maurice Erna Claessens[1], André Mascioli Cravo[1] (1. Center for Mathematics, Computing and Cognition, Federal University of ABC (UFABC) (Brazil))

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*Takuma Hashimoto[1,2], Yuko Yotsumoto[1] (1. The University of Tokyo (Japan), 2. Research Fellow of Japan Society for the Promotion of Science (Japan))

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Effects of attentional orienting on the production of temporal durations: an eye-tracking study

*Mariagrazia Ranzini[1], Sebastiano Cinetto[3], Sara Noacco[1], Zaira Romeo[2], Mario Bonato[4], Marco Zorzi[4], Giovanna Mioni[1] (1. Department of General Psychology (DPG), Univ. of Padova (Italy), 2. Neuroscience Institute, National Research Council, Padova (Italy), 3. Padova Neuroscience Center (PNC), Univ. of Padova (Italy), 4. Department of General Psychology (DPG) and Padova Neuroscience Center (PNC), Univ. of Padova (Italy))

[P2-20]

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*Florie MONIER[1], Michael DAMBRUN[1], Pierre-Michel LLORCA[2], Sylvie DROIT-VOLET[1] (1. Université Clermont-Auvergne (France), 2. Université Clermont-Auvergne, CHU clermont-ferrand (France))

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*Mai Sakuragi[1,2], Elisa M. Gallego Hiroyasu[1,2], Satoshi Umeda[1] (1. Keio University (Japan), 2. Japan Society for the Promotion of Science (Japan))

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*Yusuke Haruki[1], Keisuke Suzuki[2], Yuri Terasawa[3], Kenji Ogawa[4], Olaf Blanke[5], Yuko Yotsumoto[1] (1. Department of Life Sciences, The University of Tokyo (Japan), 2. Center for Human Intelligence, Artificial Intelligence, and Neuroscience, Hokkaido University (Japan), 3. Department of Psychology, Keio University (Japan), 4. Department of Psychology, Hokkaido University (Japan), 5. Laboratory of Cognitive Neuroscience, Ecole Polytechnique Federal de Lausanne (Switzerland))

[P2-23]

Distributional Variability Increases Uncertainty in Mean Duration Judgments

*Taku Otsuka[1,2], Hakan Karsilar[1], Hedderik van Rijn[1] (1. University of Groningen (Netherlands), 2. The University of Tokyo (Japan))

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*Marianna Lamprou Kokolaki[1], Virginie van Wassenhove[1] (1. CEA/DRF/Inst. Joliot, NeuroSpin; INSERM, Cognitive Neuroimaging Unit; Université Paris Saclay (France))

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*Jonathan Kirsh[1], Sharanya Badalera[1], John Rehner Iversen[1] (1. McMaster University (Canada))

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*April M Joyner[1], Martin Wiener[1] (1. George Mason University (United States of America))

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*Takahide Etani[1,2,3], Mitsuaki Takemi[4,5], Tomohiro Samma[6], Jun Nitta[7], Saki Homma[6,8], Kenta Ueda[6], Keigo Yoshida[9,6], Kenjun Hayashida[4,5], Tatsuro Fujimaki[4], Sotaro Kondoh[6,9,10], Kazutoshi Kudo[7], Shinya Fujii[9] (1. Keio Research Institute at SFC (Japan), 2. Keio Univ. Hospital (Japan), 3. Japanese Red Cross Ashikaga Hospital (Japan), 4. Graduate School of Science and Technology, Keio Univ. (Japan), 5. Graduate School of Advanced Science and Engineering, Hiroshima Univ. (Japan), 6. Graduate School of Media and Governance, Keio Univ. (Japan), 7. Graduate School of Arts and Sciences, The Univ. of Tokyo (Japan), 8. Department of Neuropsychiatry, Keio Univ. School of Medicine (Japan), 9. Faculty of Environment and Information Studies, Keio Univ. (Japan), 10. Japan Society for the Promotion of Science (Japan))

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Timing Difficulties in Developmental Language Disorder and Stuttering: A planned study on the Role of Dysfunctional Synchronization of Brain Rhythms

*Christian A. Kell[1], Lars Meyer[2], Joachim Gross[2], Katrin Neumann[2] (1. Goethe University (Germany), 2. Muenster University (Germany))

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Contributions of cognitive abilities and attention to Motor Timing in Parkinson’s Disease

*Elisa M. Gallego Hiroyasu[1], Yuko Yotsumoto[2], Giovanna Mioni[3] (1. Keio University (Japan), 2. The University of Tokyo (Japan), 3. Universita di Padova (Italy))

[P2-30]

Exploring the role of rhythmicity for infant word learning by entrainment of brain and behaviour in social contexts: A preliminary study

*Erica Flaten[1], Cristina Conati[2], Janet Werker[1] (1. Department of Psychology, University of British Columbia (Canada), 2. Department of Computer Science, University of British Columbia (Canada))

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Pre-motor and auditory processing for inner and overt speech

*Lachlan James Hall[1], Thomas J Whitford[2], Mike E Le Pelley[2], Bradley N Jack[1] (1. Australian National University (Australia), 2. University of New South Wales (Australia))

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Neural correlates of changes of mind and confidence in the judgement of elapsed time

*Chetan Desai[1], Martin Wiener[1] (1. George Mason University (United States of America))

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*Valdas Noreika[1], Stefano Arlaud[1] (1. Queen Mary University of London (UK))

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*Chiaki Hirata[1], Shun'ichi Kitahara[1] (1. Jumonji University (Japan))

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*Sayako Ueda[1,2] (1. Japan Women's University (Japan), 2. RIKEN CBS (Japan))

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*Julia Ayache[1], Malika Auvray[2], Anna Ciaunica[3,4] (1. EuroMov Digital Health in Motion, Univ. Montpellier IMT Mines Alès, Montpellier (France), 2. Institut des Systèmes Intelligents et de Robotique, Sorbonne Université, CNRS, Paris (France), 3. GAIPS INESC-ID, Instituto Superior Tecnico, University of Lisbon, Lisbon (Portugal), 4. Institute of Cognitive Neuroscience, University College London, London (UK))

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Recalibrating perceptual time through motor learning

*Nicola Binetti[1], Federico Mancinelli[3], Marco Zanon[2], Domenica Bueti[2] (1. Università degli studi di Roma Tor Vergata (Italy), 2. International School for Advanced Studies (Italy), 3. University of Bonn (Germany))

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Beyond Pacemaker Speed: A Planned Investigation into Atemporal Perceptual Processes Underlying Differences in Auditory-Visual Duration Judgments

*Valtteri Arstila[1], Jarno Tuominen[1] (1. University of Turku (Finland))

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Influence of turn-taking regularity on respiratory activity in human conversation

*Mirei Kin and Hiroki Koda (Graduate School of Arts and Sciences, The University of Tokyo)

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Female gibbons’ great calls change tempo in the presence of their offspring

*Yoichi Inoue[1], Waidi Sinun[2], Kazuo Okanoya[1] ([1]Teikyo University, [2]Research and Development Division, Yayasan Sabah Group)

Disentangling the effects of movement speed and travel distance on perceived traveled time

*Cindy Jagorska[1], Christopher Hilton[1], Martin Riemer[1]

1. Technical University Berlin

Perceived travel time is influenced by both the distance traveled and the speed of movement. While greater distances are typically associated with longer perceived travel time, higher movement speeds have been found to be associated with compressed time perception. Because distance, speed, and time are inherently interdependent, isolating their individual effects on perceived travel time remains a challenge.To investigate these effects, we are conducting a pre-registered experiment in which participants move through a virtual environment under varying combinations of travel distance and movement speed. After each movement, participants receive feedback about the distance they have traveled, presented via a landmark placed at one of three locations: closer than the actual distance (indicating a shorter distance), at the correct location, or farther than the actual distance (indicating a longer distance). This manipulation allows us to disentangle perceived distance from actual movement speed, while keeping travel time constant. Participants are then asked to reproduce the time of the movement based on their subjective experience.We expect that, when feedback about traveled distance is held constant while movement speed is changing, increased movement speed will lead to shorter reproduced travel time, highlighting the negative association between movement speed and perceived travel time. Conversely, when speed is held constant, but the landmark suggests a longer traveled distance, participants are expected to report longer perceived travel times, highlighting the positive association between travel distance and perceived travel time. The results of the experiment will contribute to understanding how movement speed and traveled distance respectively influence the perception of travel time.

Keywords: space-time interference, travel time, virtual reality

Does Semantic Modulation Induce Time Dilation? The Role of Flicker Frequency and Visual Saliency

*Takeya Oda[1], Amirmahmoud Houshmand Chatroudi[2], Yuko Yotsumoto[1]

1. The University of Tokyo, 2. Sony Computer Science Laboratories

Flicker-Induced Time Dilation (FITD) describes the phenomenon where the perceived duration of a stimulus is overestimated due to its flickering nature. Recent findings suggest that semantic content might also play a role in modulating perceived time. This study aimed to explore the contribution of ventral visual pathway activation to FITD. To this end, we utilized a variety of flickering stimuli whose frequencies were systematically modulated. Alongside scrutinizing the impact of semantic information, flicker frequency was parametrically manipulated to examine the interplay between stimulus saliency and the perception of time. The Semantic Wavelet-Induced Frequency Tagging (SWIFT) technique was employed to generate scrambled and semantic flicker stimuli. A critical aspect of these stimuli was the preservation of low-level visual characteristics across all frames for both flicker types. In the first experiment, standard stimuli comprised scrambled and semantic flickers presented at 2, 4, and 6 Hz. While both categories of flickers were designed to evoke minimal responses in early visual processing areas, the semantic variants were specifically intended to preferentially engage higher-level regions within the ventral visual pathway. The second experiment introduced luminance-based flickers (scramble/semantic) at identical frequencies to ensure robust activation of low-level visual regions. A consistent and strong influence of flicker frequency on perceived duration was evident across both experimental setups, a conclusion supported by inclusion Bayes factors of $BF_{incl} = 14.04$ in Experiment I and > 1000 in Experiment II, indicating strong to extreme evidence. In contrast, the type of stimulus (scramble/semantic) provided only anecdotal support for any discernible effect. These observations imply that higher rates of flicker reliably result in a greater degree of time dilation, whereas the semantic nature of the stimuli appears to have a minimal effect. The observed increase in time dilation as a function of frequency was notably amplified when early visual cortices were more intensely engaged. Future investigations will focus on elucidating the connection between subjective saliency and time dilation by behaviorally assessing the perceived salience of each type of flicker stimulus.

Keywords: time dilation, semantic flicker, SWIFT, saliency

Impaired Temporal Perception Following Sight Restoration After Congenital Cataracts

*Abel Mewleddeg Legu[2], Gianluca Mariscano[1], David Melcher[1,4], Ehud Zohary[2,3]

1. Department of Psychology, New York University Abu Dhabi, 2. Project Eyeopener, 3. The Hebrew University of Jerusalem, 4. Center for Brain and Health, New York University Abu Dhabi

Temporal integration is essential for understanding rapidly changing visual information, enabling us to perform visual functions such as motion perception and causal inference. While spatial aspects of visual recovery following sight restoration are well documented, far less is known about how temporal integration develops. Notably, individuals with a history of congenital cataracts often show reduced alpha activity, which has previously been linked to the resolution of temporal perception over short intervals (50- 100ms). We investigated temporal integration in 6 participants with congenital cataracts who had undergone cataract surgery, using both a two-flash fusion and a causality perception task. The first task involves judging between one or two flashes at varying inter-stimulus intervals (ISIs). Our results show that only one participant performed the task with a typical pattern, while the other 5 showed temporal integration thresholds that were over 3 times longer than what is typically reported in normally sighted individuals to see two distinct flashes. The second task involves judging whether one moving object caused the movement of another at varying temporal lags. While longer time lags typically result in reduced perception of causality, 5 out of 6 participants showed no systematic differences in causality perception at different time lags. Together, these findings suggest a potential critical window for the development of temporal integration mechanisms, with potential knock-on effects for higher-level temporal perception tasks like causality, and are consistent with previous electrophysiological studies showing reduced alpha activity for patients with bilateral congenital cataracts even following sight restoration.

Keywords: Temporal integration, Causality perception, Two-flash fusion, Congenital cataracts, Sight restoration

Decoding the reproduction of durations in size-varying virtual environment

*Camille L. Grasso[1], Matthew Logie[1], Virginie van Wassenhove[1]

1. CEA/DRF/Inst. Joliot, NeuroSpin; INSERM, Cognitive Neuroimaging Unit; Université Paris-Saclay, Gif/Yvette, 91191 France

When and how is duration encoded in the brain? In this EEG study, we investigated the cognitive and neural correlates of environmental constraints and production of durations. Previous works revealed that participants over-produce durations when immersed in larger virtual environments, relative to smaller ones (e.g., Delong et al., 1981; Ma et al., 2024; Riemer et al., 2018). A proposed explanation for these findings, derived from the action constraint theory, which suggests that larger environments involve longer possible movements (and consequently, more time). However, this working hypothesis remains untested, and the underlying cognitive and neural mechanisms unknown. To test this , we manipulated environmental constraints in virtual reality (i.e., room size, ceiling height) and combined behavioral measures of duration production (relative production time and error) with EEG recordings and multivariate pattern analyses (decoding). Behavioral results replicate and extend previous ones: participants produced longer durations in large environments, relative to smaller ones. Decoding analyses showed that it is possible to decode both the produced duration and the size of the environment, as early as the first button press. These results suggest that the effect of environmental constraints occurs at the early stages of duration production. This study provides a deeper understanding of how environmental constraints influence temporal cognition.

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Keywords: Temporal production, Decoding, Virtual environment , Environmental constraints, EEG

Ticking Forward or Counting Down: The Impact of Clock Format on Time Perception and Task Performance

Maria Nogales[1], *Judit Castellà[1]

1. Autonomous University of Barcelona UAB

The influence of time pressure on time perception and performance has been widely studied; however, no research to date has compared forward-counting clocks with countdown clocks. These two formats are believed to evoke different emotional connotations that may influence the intensity of perceived time pressure and its effects. This study aimed to examine how these clock formats impact performance on a mathematical task, as well as the perception of time duration and speed. A quasi-experimental within-subjects design with counterbalancing was employed with 26 university students, who were asked to solve multiplications of three-digit by two-digit numbers under both clock conditions. Results showed that performance and motivation were significantly higher in the forward-counting condition. While no significant differences in time perception were found between conditions, participants reported a greater sense of time acceleration and a shorter perceived duration with the forward-counting clock. These findings suggest that the forward-counting format may be associated with more positive emotional connotations and lower perceived time pressure, ultimately enhancing task performance.

Keywords: Time pressure, Countdown, Forward-counting, Performance, Time perception

Electrophysiological signatures of post-interval activity in explicit and implicit timing

*Mariagrazia Capizzi[1], Cristina Narganes Pineda[1], Pom Charras[3], Giovanna Mioni[2], Antonino Visalli[4]

1. Mind, Brain and Behavior Research Center (CIMCYC), University of Granada; Department of Experimental Psychology, University of Granada, Granada, Spain, 2. Department of General Psychology, University of Padua, Padua, 3. Univ Paul Valéry Montpellier 3, EPSYLON EA 4556, F34000, Montpellier, France, 4. Department of Biomedical, Metabolic and Neural Sciences, University of Modena and Reggio Emilia

The distinction between explicit and implicit timing in the processing of millisecond-to-second intervals is gaining attention in timing research. Explicit timing involves the deliberate estimation of time in tasks that require overt temporal judgments, whereas implicit timing occurs incidentally in tasks where time is not the primary focus, yet temporal processing still influences behavior. Whether explicit and implicit timing rely on shared or distinct neural mechanisms remains an open question. In the present study, we addressed this issue by directly comparing explicit and implicit timing tasks, paired with electrophysiological (EEG) recording. In the explicit timing task, participants judged whether a comparison interval was shorter or longer than a standard interval. In the implicit timing task, participants judged whether a comparison color was more reddish or yellowish than a standard color. Durations and colors were fully orthogonalised across the two tasks, ensuring that the only difference lay in the task instructions, which directed attention either to duration or to color. Event-related potentials (ERPs) were time-locked to the offset of the comparison intervals, either attended or unattended depending on the task. Behaviorally, we found that the color dimension was irrelevant for the temporal discrimination task. In contrast, the implicit temporal manipulation influenced color perception, with shorter durations leading participants to perceive colors as brighter. EEG results showed that temporal processing modulated early components over central scalp electrodes in a similar manner across both explicit and implicit tasks. In contrast, a sustained activity pattern with a frontal-posterior bipolar distribution emerged, indicating differential engagement depending on task demands. Overall, our results suggest that explicit and implicit timing shape behavior via both shared and distinct neural mechanisms.

Keywords: Time discrimination, Explicit processing, Implicit processing, ERPs

Time in the primate hippocampus during a metronome task

*Mildred Salgado-Menez[1], Ana Maria Malagon[1], Victor de Lafuente[1]

1. Universidad Nacional Autonoma de Mexico

We addressed how interval time is encoded in the non-human primate hippocampus. Are time-encoding hippocampal signals susceptible to contextual changes? And if they are, how are these signals dynamically adapted? (visual vs. non-visual). At the single cell level, we describe mixed selectivity to different task features, followed by a population analysis using PCA, where we report the geometry of abstract information representation in the hippocampus that accurately reflected the diverse tuning properties of individual cells that differed between visual and non-visual epochs of the task. We observed oscillatory activity at individual and population levels at the non-visual epoch of the timing task. The fact that some drift of the temporal and spatial information was being represented without any relevant visual input proves that this short-term memory function operates without the regular input that provides the reference position for a spatial view. These findings are evidence for the operation of an attractor that influences the activity of hippocampal pyramidal cells.

Keywords: hippocampus, visual task, interval timing, neural dynamics

Effects of simultaneity and arm posture on tactile time perception in young and older adults

*Chika Goto[1], Naoya Tachibana[1], Shogo Sugiyama, Yuko Yotsumoto[1]

1. the University of Tokyo

While age-related decline in basic sensory processing is well documented, its effects on higher-order tactile functions remain unclear. In particular, how aging affects tactile frequency discrimination has received limited attention. Prior research reported that frequency discrimination becomes more difficult when tactile stimuli are presented simultaneously (Kuroki et al., 2017), but the role of stimulus simultaneity in age-related decline has not been systematically examined.To address this gap, we conducted a vibrotactile frequency discrimination task with ten young adults (age range = 19–22; Mean = 19.0; SD = 1.29) and 30 older individuals (age range = 65–83; Mean = 74.0; SD = 3.93). Stimuli were presented either simultaneously or sequentially (with a 200 ms interval). Given that arm crossing could modulate task difficulty, experiments were conducted under both crossed and uncrossed arm conditions.Results showed a significant age-related decline in frequency discrimination performance, particularly during simultaneous presentation ($BF_{inclusion}$ = 3.452; $F(1, 28) = 27.25$, $p < .01$), suggesting difficulty in suppressing competing tactile information presented in close temporal proximity. Additionally, older adults exhibited a stronger arm-crossing effect ($BF_{inclusion}$ = 2.854; $F(1, 38) = 5.455$, $p < .02$), indicating increased vulnerability to interference from task-irrelevant spatial information. These findings highlight the impact of aging on higher-order tactile and spatial processing, potentially linked to declining inhibitory function in the secondary somatosensory cortex.

Keywords: frequency discrimination, vibrotactile perception, arm-crossing, aging, simultaneity

Hand proximity enhances visual encoding via anticipatory processing

*Ankit Maurya[1,3], Tsukasa Kimura[2,3], Minto Hashimoto[4,3], Masamichi J. Hayashi[3,4], Tony Thomas[1]

1. Department of Humanities and Social Sciences, Indian Institute of Technology Roorkee, Roorkee, 2. Graduate School of Human Sciences, The University of Osaka, Suita, 3. Center for Information and Neural Networks (CiNeT), Advanced ICT Research Institute, National Institute of Information and Communications Technology, Suita, 4. Graduate School of Frontier Biosciences, The University of Osaka, Suita

Precise encoding of physical properties of objects is essential for efficient reaching, grasping, and manipulating. Previous psychophysical studies have reported that perceived duration expands when a visual stimulus is presented near the hand (peri-hand space), suggesting the involvement of anticipatory mechanisms associated with peri-hand space. However, the neural evidence for anticipatory processing associated with peri-hand space remains scarce. In humans, contingent negative variation (CNV), a slow negative deflection in electroencephalography (EEG), has been proposed as a neural signature of anticipatory processing. Therefore, we hypothesized that the appearance of objects in peri-hand space modulates CNV, facilitating accurate encoding of the object’s properties. To test this hypothesis, we recorded EEG while participants performed a visual temporal bisection task (n = 40). Participants judged whether stimulus durations, ranging from 50 to 170 ms, were closer to which of the two reference intervals, Short’ (50 ms) or ‘Long’ (170 ms), that they acquired prior to the EEG recording. The distance between hands and the visual stimulus was manipulated by placing participant’s hands either on the sides of a monitor (Hand condition) or on their lap (No-hand condition), allowing the stimuli to appear inside or outside the graspable space. The results showed that the CNV amplitude building up toward the appearance of the visual stimulus was significantly larger in the Hand condition than in the No-hand condition. Moreover, although there was no significant difference in behavioral performance between the two conditions, participants who exhibited greater CNV amplitude demonstrated higher sensitivity in the bisection task in the Hand condition. These findings suggest that placing the hands near an object enhances anticipatory processing, which may facilitate the precise encoding of stimuli for efficient reaching, grasping, and manipulating.

Keywords: Temporal anticipation, Time perception, Near-hand space , Contingent Negative Variation

Role of Supplementary Motor Areas in temporal estimation using tDCS.

*Claire TERRAN[1], Laurence CASINI[1]

1. CRPN - Centre for Research in Psychology and Neuroscience, AMU, CRNS

Time is a fundamental aspect of life, orchestrating a wide array of behaviours in our daily activities. Multiple models explaining the mechanisms of temporal estimation coexist, attributing this function to different neural structures. A key distinction is often made between sub-second and supra-second intervals: durations under one second are thought to be prosessed primarly via a cortico-thalamo-cerebellar network, while longer intervals are believed to rely on a cortico-thalamo-striatal circuit. However, evidence also suggests the possibility of shared mechanisms across these time scales. We chose to anchor this study within the internal clock model, more specifically the pacemaker-accumulator framework, to investigate: (1) whether the supplementary motor areas (SMA) could serve as a substrate for the accumulation process and, (2) whether judgments of both short and long durations rely on an accumulation process. Using transcranial Direct Current Stimulation (tDCS), we modulated the activity of the SMA and subsequently assessed its role on temporal estimation using a temporal bisection task. Participants' performance provided insights into two key parameters of temporal estimation: precision and variability. Preliminary results reveal that SMA modulation affects temporal estimation differently depending on the duration range. Specifically, tDCS significantly impacted the variability of long-duration judgments, whereas it affected the accuracy of estimations in the short-duration range. Interpreted within the pacemaker-accumulator model, these findings support the hypothesis that the SMA may act as the neurobiological substrate for the accumulation process, one of the internal clock's critical components. Overall, this study enhances our understanding of the neural mechanisms underlying temporal estimation and highlights the pivotal role of the SMA in the estimation of both short and long durations.

Keywords: Timing, tDCS, SMA, Duration range, Bisection task

Duration Underestimation in Peripheral Visual Field

*YUHUI ZHOU[1], Sae Kaneko[1]

1. Hokkaido University

In recent years, there has been an increasing number of studies discussing the fundamental differences in perception between central and peripheral visual fields (form, color, and texture) (Baldwin et al., 2019; Cohen et al., 2020; Cohen et al., 2021). However, the results of prior studies on differences in time perception are contradictory (Long & Beaton, 1981; Kliegl & Huckauf, 2014; Bao et al., 2024). This study examines the differences in duration perception between the central and peripheral visual fields using static Gabors. In the experiment, two Gabor patches (10° of diameters, spatial frequency: 5cpd, 100 % contrast, with a randomized phase) were presented sequentially at two locations: the peripheral (10, 30, 50, 70°) and central (0°) visual field. Two standard stimulus durations (67/250ms) were consistently presented in the periphery, while the duration of the central Gabor was varied at nine steps. Participants were instructed to select which Gabor lasted longer. The results indicated that underestimation of duration occurred in the peripheral visual field. However, no significant differences in duration perception were observed between 10° and 70° for either standard duration. The fact that no significant differences in time perception were found in the 10 to 70° may suggest that time perception is relatively stable across different eccentricities, from the central to the periphery. This indicates that time perception may depend on a higher level of visual information processing stage.

Keywords: Time Perception, Central Visual Field, Peripheral Visual Field

Embodying the expanded moment: the role of bodily awareness in temporal production during meditation-like attentional states

*Ludovica Ortame[1,2], Michele Pellegrino[2], Joseph Glicksohn[3,4], Patrizio Paoletti[2], Fabio Marson[5], Stafno Lasaponara[1,6], Maria Sofia Romano[1], Fabrizio Doricchi[1,6], Filippo Carducci[1], Tal Dotan Ben-Soussan[2]

1. Sapienza University of Rome, 2. Research Institute of Neuroscience, Education and Didactics (RINED), 3. Bar-Ilan University, 4. The Leslie and Susan Gonda (Goldschmied) Multidisciplinary Brain Research Center, Bar-Ilan University, Ramat Gan, 5. University of Milano-Bicocca, 6. RCCS Fondazione Santa Lucia

In a world going at an increasingly faster pace, leading to higher attentional demands, there is a growing need to understand how attentional states influence time perception and how one can achieve a more self-regulated experience of time. The literature that suggests that meditation affect subjective time shows conflicting results (Morin & Grondin, 2024). This could be due to the challenge of investigating temporal tasks during meditation without interfering with the practice itself. In the current study we therefore examined temporal productions (TP) tasks during meditation-like attentional states. This study is, to our knowledge, the first to assess time perception during attentional states associated with contemplative practices without requiring actual meditation. Drawing on the Sphere Model of Consciousness (Paoletti & Ben-Soussan, 2019) and the hierarchy of meditation types (Laukkonen & Slagter, 2021), we hypothesized a gradual slowing down of TP across three conditions: (1) a simple TP; (2) focused attention on an external visual stimulus; and (3) longest TP in the stronger bodily condition. Participants (n=43) underwent the three conditions requiring to perform a TP task while a bistable figure (BF) appeared on the screen. During the (1) simple condition participants completed the TP task while just looking at the figure; (2) focused attention condition, they were additionally asked to focus on one feature of BF; (3) focused attention and monitoring condition, participants were divided into two groups based on additional requests: namely to furtherly focus on either their own breath or on rhythmic sounds. Results revealed progressively longer produced durations from the simple to more embodied condition, with stronger effects in breath group. These results highlight the role of bodily awareness when assessing TP, and suggest that more embodied states are associated with a slowing down of subjective time.

Keywords: Time, Attention, Awareness, Meditation, Interoception

Temporal unfolding contributes to interocular comparison for motion-in-depth perception in peripheral vision

*Ikuya Murakami[1]

1. The University of Tokyo

Time has often been considered as a confounder in stereoscopic depth perception. For example, the Pulfrich effect tells us that when one eye somehow requires longer latency, the visual system is ignorant of the actual cause of lags and ascribe them to spatial lags between eyes, hence fake binocular horizontal disparities producing illusory depths. However, recent studies have suggested that dynamic depth cues may help construct motion-in-depth perception. Due to their subtle efficacy and other geometrical constraints, most studies have been conducted around the fovea, and little is known about the characteristics in the periphery, where changing disparity over time (CDOT) may help construct dynamic scenes, but effects of another dynamic depth cue, interocular velocity difference (IOVD), are unknown. We aimed to examine whether motion-in-depth perception in peripheral vision is possible solely from the IOVD when fine grating patterns move oppositely between eyes. Gratings were chosen because they were compatible with a unitary grating object moving in depth in a real scene. Importantly, the spatial frequency of the gratings was set sufficiently high to maintain the maximally attainable disparity still below depth detection threshold at the tested eccentricity, making the CDOT useless. These gratings moved either leftward or rightward at a constant speed, forming four conditions that were consistent with four different motion percepts: receding, approaching, leftward, and rightward. Observers were asked to indicate perceived motion by three alternative forced response: receding, traversing, and approaching. If the grating in one eye tended to mask the grating in the other eye, the traversing responses would be a great majority irrespective of the conditions. Contrary to this prediction, the results indicated that observers well discriminated the conditions of non-zero IOVDs from the conditions of traversing, suggesting interocular comparison. Even though none of the component frames produce depth, their animation over time does.

Keywords: Motion in depth

Assessing Temporal Resolution in Amblyopic and Fellow Eyes Using the Two-Flash Fusion Paradigm

*Aysha Hamkari[1], Gianluca Marsicano[1], Katja Cundric[1], David Melcher[1]

1. New York University Abu Dhabi

Amblyopia, traditionally viewed as a monocular visual disorder, is increasingly understood as a neurodevelopmental condition that affects cortical-level visual processing. While its effects on spatial vision are well-documented, less is known about how amblyopia may disrupt temporal integration - the brain’s ability to combine information over time into coherent percepts. This study investigates temporal integration in patients with amblyopia by using the two-flash fusion (2FF) task, which varies the interstimulus interval required to perceive two flashes as distinct. We hypothesize that the amblyopic eye will exhibit higher 2FF thresholds compared to the non-amblyopic eye, indicating impaired temporal resolution. As part of this ongoing study, four amblyopic participants with corrected-to-normal vision have so far completed psychophysical testing under binocular and two counterbalanced monocular conditions using eye patching. Preliminary results suggest that in some cases, the amblyopic eye exhibits higher 2FF thresholds compared to the non-amblyopic eye, indicating potential delays in temporal resolution and hence longer integration window for the amblyopic eye. However, other participants show relatively similar thresholds across both eyes, pointing to individual variability. There are also preliminary indications of asymmetries in performance across visual fields. We also implemented a staircase procedure to estimate personalized thresholds for the amblyopic eye and tailor ISI ranges for subsequent testing.These early findings suggest that temporal integration deficits in amblyopia may vary across individuals, potentially reflecting different degrees of cortical adaptation. Ongoing recruitment and psychometric modeling will help clarify underlying neural mechanisms. This work may contribute to the identification of non-invasive perceptual biomarkers to aid early detection and intervention in amblyopia.

Keywords: amblyopia, temporal integration, visual perception, psychophysics

Neural Bases of the Audiovisual Temporal Binding Window Using TMS

*Solène Leblond[1], Tutea Atger[1], Franck-Emmanuel Roux[1,2], Robin Baurès[1], Céline Cappe[1]

1. CerCo (Centre de Recherche Cerveau et Cognition), CNRS UMR 5549, University Toulouse, 2. Pôle neurochirurgie, CHU Purpan, Toulouse

The temporal law, one of the main principles of multisensory integration (Stein & Meredith, 1993) stipulates that two stimuli from two distinct modalities must occur synchronously to be perceived as part of the same event. The temporal binding window (TBW) corresponds to the time interval within which auditory and visual stimuli are perceived as synchronous. Although the brain regions involved in audiovisual TBW have been identified, such as the superior temporal gyrus (STG), prefrontal cortex, and primary sensory areas (Zhou et al., 2020), most studies relied on correlational methods (Vaidya et al., 2019). Zmigrod & Zmigrod (2015) used tDCS to establish a causal link between the right posterior parietal cortex (rPPC) and TBW plasticity.
Our study aims to confirm the involvement of the STG and the intraparietal sulcus (IPS) in TBW using transcranial magnetic stimulation (TMS) guided by anatomical MRI. By applying single-pulse TMS at different time delay after stimulus presentation, we are also able to investigate the temporal dynamics of the neural processes underlying the TBW. Participants performed a simultaneity judgment task in which they were asked to determine whether two stimuli, one visual and one auditory, were synchronous. Single-pulse TMS was applied with six delays ranging from 50 to 300 ms post visual stimulus, over the IPS, STG, or vertex (control site).
Our results showed a temporal dynamics different involvement of the IPS and STG. First, the right STG is involved as early as 100ms. This is followed by the involvement of the left IPS (150 ms) and then a later the one of right and left STG (250 ms).
Our results partially confirm those of Zmigrod and Zmigrod (2015) by showing IPS involvement, though only in the left hemisphere at 150 ms post stimuli. TMS enabled us to reveal the timing of this activation, highlighting the left IPS’ s role at this latency. We also confirm the involvement of the STG at both early and later stages of the simultaneity judgment process. Early stimulation of these regions increased the perception of simultaneity, whereas later stimulation, mainly to the STG, increased asynchrony detection. These findings suggest that the IPS and STG belong to a broader cortical network supporting the TBW, with each region contributing at different stages of multisensory processing.

Keywords: Temporal Binding Window, Multisensory Integration, Transcranial Magnetic Stimulation, AudioVisual

Temporal Binding Across Timing Domains: Behavioural Evidence and a Protocol for Causal Manipulation via Transcranial Direct Current Stimulation

*Gustavo Brito de Azevedo[1], André Mascioli Cravo[2]

1. Graduate Program in Neuroscience and Cognition, Federal University of ABC (UFABC), 2. Center for Mathematics, Computing and Cognition, Federal University of ABC (UFABC)

Temporal binding - the perceived shortening of time between a cause and its effect - is typically assessed using tasks that tap into different timing processes: event timing (e.g., Libet Clock, Response Mapping) and interval timing (e.g., Temporal Estimation, Reproduction). This ongoing study examines whether temporal binding is consistent across these tasks and whether it varies by interval length. To date, fifteen participants completed two sessions, each involving four timing tasks under causal and non-causal conditions, with action-effect delays of 250 ms, 625 ms, and 1000 ms. Median responses were analysed using a 2 (Condition: causal vs. non-causal) ×2 (Session) ×3 (Interval) repeated-measures ANOVA. The Libet Clock task revealed a significant Condition ×Interval interaction ($F(2,28) = 4.63$, $p < .05$), with stronger temporal binding for causal trials at 250 ms ($t(14) = -3.16$, $p < .001$, mean diff. = 30.23 ms) and 1000 ms ($t(14) = -2.83$, $p < .05$, mean diff. = 18.14 ms). The Reproduction task similarly showed a Condition ×Interval interaction ($F(2,28) = 6.49$, $p < .01$), with greater under-reproduction for causal trials at 250 ms ($t(14) = -2.78$, $p < .05$, mean diff. = 95.72 ms) and 625 ms ($t(14) = -2.29$, $p < .05$, mean diff. = 86.04 ms). Response Mapping also exhibited a significant Condition ×Interval interaction ($F(2,28) = 12.25$, $p < .001$), with stronger binding at 1000 ms ($t(14) = -4.64$, $p < .001$, mean diff. = 49.50 ms), alongside trends at 250 ms ($t(14) = -2.02$, $p = .06$) and 625 ms ($t(14) = 1.87$, $p = .08$). The Estimation task showed neither a main effect of condition ($F(1,14) = 0.07$, $p = .79$) nor a significant Condition ×Interval interaction ($F(2,28) = 2.13$, $p = .14$). These findings suggest that temporal binding occurs across both event and interval timing tasks but is shaped by the specific task and interval used. We propose a follow-up study using transcranial direct current stimulation (tDCS) over the left angular gyrus to test whether event timing can be selectively disrupted without affecting interval timing.

Keywords: temporal binding, time perception, causality, tDCS

Modality-Specific Temporal Assimilation in a Bisection Task

*Gabriel Cafeu Brandão[1], Gustavo Brito de Azevedo[1], Peter Maurice Erna Claessens[1], André Mascioli Cravo[1]

1. Center for Mathematics, Computing and Cognition, Federal University of ABC (UFABC)

Time perception is fundamental to adaptive behavior, yet its neural mechanisms remain debated. While some models propose a centralized internal clock, others argue for distributed, modality-specific processing. This study tests these models by investigating whether the temporal assimilation effect, in which target intervals are underestimated after short distractors, generalizes across sensory modalities (auditory, visual, tactile). In Experiment 1 ($n = 20$), auditory targets paired with auditory or visual distractors revealed assimilation only when the distractor and target shared the same auditory modality. A significant main effect of distractor duration was found, $F(1, 19) = 15.8473$, $p < .05$, as well as a significant interaction effect, $F(1, 19) = 19.2034$, $p < .05$. In Experiment 2 ($n = 20$), auditory targets with frequency-varied auditory distractors (500Hz vs. 4000Hz) showed no significant modulation of assimilation. The distractor effect was present, $F(1, 17) = 5.2168$, $p < .05$, but no interaction, $F(1, 17) = 1.5918$, $p > .05$, indicating that modality, but not stimulus dissimilarity, modulated the effect. To test whether the modality effect in Experiment 1 was due to participants being able to inhibit visual processing, a novel tactile-vibratory device was developed and preliminarily validated through pilot testing ($n = 2$) to extend the paradigm to tactile-auditory pairings. We are recruiting 20 participants for a bisection task with tactile distractors (50- 217ms) and auditory targets. Data collection will test if assimilation persists cross-modally. If tactile distractors modulate auditory targets, this suggests supramodal temporal integration; the absence of this effect further supports the notion of distributed processing. Taken together, our findings raise questions about centralized models of time perception and suggest the possibility of modality-specific temporal encoding. The tactile extension may help clarify whether distributed timing mechanisms operate universally or vary across different sensory hierarchies.

Keywords: Time perception, Temporal bisection, Crossmodal integration, Distributed processing, Psychophysics

Serial dependence between duration and numerosity perception

*Takuma Hashimoto[1,2], Yuko Yotsumoto[1]

1. The University of Tokyo, 2. Research Fellow of Japan Society for the Promotion of Science

Serial dependence refers to the phenomenon where current perception is biased toward previous perception. This effect has been observed across various features, including magnitude dimensions such as numerosity. Converging evidence suggests overlapping mechanisms among magnitude dimensions, and cross-dimensional adaptation has been reported. However, whether cross-dimensional serial dependence occurs remains unclear. Togoli et al. (2021) investigated serial dependence between duration and numerosity perception but failed to observe such an effect. One possible cause is the absence of feature-based attention to the inducing feature (i.e., duration or numerosity). Therefore, the present study examines whether cross-dimensional serial dependence occurs under condition that require feature-based attention.In line with the previous study, we will recruit 28 participants. Participants will compare sequentially presented dot arrays and indicate which stimulus had a longer duration or a greater number of dots. The two tasks –duration comparison and numerosity comparison will be conducted on separate days. Inducer stimuli will be presented prior to the comparison task to influence the reference stimuli. To ensure feature-based attention to the inducing feature, we will include catch trials at unpredictable intervals. In these trials, participants will classify the inducer stimuli according to the dimension not used in the main task. For example, when the main task involves duration comparison, participants will classify the inducer as “few” or “many” in catch trial, and vice versa. If feature-based attention to the inducing feature is critical for cross-dimensional serial dependence, we expect to observe the effect. Such a finding would suggest that serial dependence occurs more broadly than previously thought and supports the view that higher-level cognitive processes contribute to serial dependence. It would also further support the idea of shared processing mechanisms for duration and numerosity. Conversely, if feature-based attention is not critical, or cross-dimensional serial dependence is inherently absent, the effect will not be observed.

Keywords: serial dependence, duration, numerosity, ATOM

Effects of attentional orienting on the production of temporal durations: an eye-tracking study

*Mariagrazia Ranzini[1], Sebastiano Cinetto[3], Sara Noacco[1], Zaira Romeo[2], Mario Bonato[4], Marco Zorzi[4], Giovanna Mioni[1]

1. Department of General Psychology (DPG), Univ. of Padova, 2. Neuroscience Institute, National Research Council, Padova, 3. Padova Neuroscience Center (PNC), Univ. of Padova, 4. Department of General Psychology (DPG) and Padova Neuroscience Center (PNC), Univ. of Padova

Many studies indicate the existence of a spatial representation for temporal durations: shorter durations are represented on the left, and longer duration are represented on the right of the temporal continuum (Bonato, Zorzi, & Umiltà, 2012). Evidence exists indicating that time-space associations are mediated by mechanisms of visuospatial attention, which orient attention along the temporal continuum (e.g., Di Bono et al., 2012). In this study, we analysed gaze shifts during a temporal production task to test the hypothesis that attentional orienting through eye movements could predict production duration. Forty-six healthy adults participated in the study. At each trial, the participant listened to an alert stimulus, pressed the spacebar, and held it for a duration of choice. During the execution of the task, eye movements were recorded. The trial-by-trial analysis of eye movements in function of the produced duration revealed evidence for time-space associations. Importantly, upwards gaze shifts in the first 100ms after the trial onset predicted the subsequent time production magnitude, with larger shifts predicting longer durations. Differently from what expected, leftwards or rightwards gaze shifts were not related to duration. Furthermore, exploratory analyses also revealed that participants producing briefer productions took longer preparation times. Overall, these findings indicate that the spatialisation of time along the horizontal axis is not systematic, while it appears reliable along the vertical axis. Also, this study highlights the usefulness of the used duration task to assess and investigate links between space and time. These results will be further discussed in light of embodied and grounded cognition theories.

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Keywords: Time Perception, Mental Time Line, Visuospatial Attention, Eye Movements, Eye-Tracking

Retrospective Passage of Time Judgments in a Population of Parkinson’ s Disease Patients: A Matter of Self-Projection in Time

*Florie MONIER[1], Michael DAMBRUN[1], Pierre-Michel LLORCA[2], Sylvie DROIT-VOLET[1]

1. Université Clermont-Auvergne , 2. Université Clermont-Auvergne, CHU clermont-ferrand

In this study, we examined retrospective judgments of the passage of time (PoT) in 56 patients with Parkinson’ s disease, compared to 53 age-matched healthy participants, to evaluate whether interoceptive perceptions or psychological representations of the self were responsible for these judgments. Participants rated their perception of the passage of time using 7-point Likert scales for distant life periods (5–10 years ago). They also compared their current feeling about the passage of time with how they remembered feeling during those past periods, and they evaluated their recent experience of time passing (over the past week, days, and months). Then, they completed short scales assessing their emotional states, perceived health, well-being, and feelings of happiness. Finally, they completed the Dambrun & Ricard (2001) scale assessing the psychological dimension of self-transcendence. Our results confirmed that the passage of time related to long past periods and the current feelings of PoT are two distinct dimensions of retrospective feelings about time. The former is related to the dimension of self-consciousness linked to self-projection across the lifespan. The latter depends on representations of bodily states and emerges from perceived health, present well-being, and emotional state. Finally, Parkinson’ s disease itself did not alter the judgment of PoT related to either the present self or the projected self. Self-transcendence strongly modulated the perception of both the present and future self, and significantly influenced PoT judgments in both patients and healthy participants.

Keywords: retrospective PoT, Parkinson’ s disease , Emotions, Self-transcendence

Cardiac Rhythms, Interoception and Temporal Counting: Dynamic Interactions across Time Ranges

*Mai Sakuragi[1,2], Elisa M. Gallego Hiroyasu[1,2], Satoshi Umeda[1]

1. Keio University, 2. Japan Society for the Promotion of Science

While previous research has established links between heart rate variability over fixed time periods and interoception (perception of bodily responses) with time perception, the relationship between beat-to-beat cardiac activity patterns and actual counting timing remains unexplored. This study investigated how individual heartbeat interval time-series relate to temporal counting intervals across different time ranges. Seventy healthy participants performed time estimation tasks for three durations (23, 40, and 56 seconds) while cardiac activity was monitored. Individual counting intervals were estimated from variability in task performance across trials. Trial-by-trial heart rate and Dynamic Time Warping (DTW) distances between heartbeat intervals and estimated temporal counting intervals were calculated. Additionally, interoceptive accuracy was assessed using the heartbeat counting task. Results revealed time condition-specific relationships between cardiac activity and time perception: in the 23-second condition, higher average heart rate was associated with reduced variability in temporal counting intervals. In the 56-second condition, larger DTW distances between cardiac and counting time-series predicted better timing accuracy, indicating that greater divergence between cardiac and temporal counting rhythms enhanced time perception performance. Interoceptive accuracy showed weak positive correlation trends with timing performance in shorter durations, but this trend weakened in the 56-second condition. These findings demonstrate that while bodily arousal, interoception and temporal regularity are closely linked in shorter time conditions, divergence between cardiac and temporal counting rhythms becomes advantageous for accurate time perception in longer durations. This beat-to-beat time-series analysis approach revealed that optimal relationships between cardiac activity and time perception adaptively change according to the estimated time length.

Keywords: Time Perception, Heart Rate, Interoception, Dynamic Time Warping

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When do we perceive our heartbeats? Exploring temporal dynamics in interoception

*Yusuke Haruki[1], Keisuke Suzuki[2], Yuri Terasawa[3], Kenji Ogawa[4], Olaf Blanke[5], Yuko Yotsumoto[1]

1. Department of Life Sciences, The University of Tokyo, 2. Center for Human Intelligence, Artificial Intelligence, and Neuroscience, Hokkaido University, 3. Department of Psychology, Keio University, 4. Department of Psychology, Hokkaido University, 5. Laboratory of Cognitive Neuroscience, Ecole Polytechnique Federal de Lausanne

Interoception refers to the process by which our nervous system detects, conveys, integrates, interprets, and utilises the vast array of sensations arising from within the body. Such processes are now recognised as playing critical roles in cognitive functions, including perception, emotion, decision-making, and so on. Cardiac signals and conscious access to them have been widely used to assess individual differences in perceptual ability related to interoception, reflecting how well individuals can detect internal bodily processes (i.e., their own heartbeats). However, previous methodologies have serious shortcomings in evaluating interoceptive ability, as some of them cannot exclude estimation strategies to count the heartbeats, are too difficult to perform, and crucially, all of them neglect the temporal aspect of heartbeat perception.Here, we developed a novel method called the “oneshot” heartbeat detection task, which allows us to examine the temporal dynamics of heartbeat perception. This approach enables us to identify the precise moments when individuals become aware of their heartbeat sensations or not in a trial-by-trial manner. Specifically, participants are instructed to press a button when they perceive their first heartbeat following a cue, while maintaining focus on internal sensations. After a number of heartbeats later (ranging from 1 to around 20), a word color is changed, timed either with their cardiac systole or diastole. Participants then answer a forced-choice question regarding the synchronicity of the heartbeat and color change. Using this task, we reveal characteristic patterns that distinguish individuals who are good at detecting heartbeat sensations from those who are not. Our findings provide new insights into the perceptual mechanisms underlying interoception, and further elucidate how multisensory interactions occur between interoceptive and exteroceptive modalities.

Keywords: heartbeat perception, interoception, temporal dynamics, signal detection theory

Distributional Variability Increases Uncertainty in Mean Duration Judgments

*Taku Otsuka[1,2], Hakan Karsilar[1], Hedderik van Rijn[1]

1. University of Groningen, 2. The University of Tokyo

Prior studies on contextual effects in duration perception have focused on how current perception is influenced by traces of past stimuli. However, real-world performance often requires extracting and retaining summary statistics, such as the mean and variance, of temporal distributions. For example, in baseball, it is advantageous for a batter to estimate the average speed of pitched balls and the variability around this mean to prepare for the next game. In order to investigate such summary representations in time perception, we explicitly instructed participants to estimate the mean duration of stimulus distributions. Critically, these distributions had identical means but differed in their variability. We found that the variability of participants' mean estimates increased with the variability of the distributions, even though the actual mean remained constant. We further examined how this variability-related effect was reflected in EEG signals during the task. The contingent negative variation (CNV) correlated not only with single-trial reaction times but also with the extent to which participants' mean estimates were influenced by the distributions' variability. Conversely, the post-interval P2 component was associated with the perceived duration of the current stimulus. These findings suggest that while humans can accurately estimate the mean of a temporal distribution, the uncertainty of this representation increases as distributional variability increases, as reflected in the preparation-related CNV during temporal judgments.

Keywords: distributional variability, contextual effect, Bayesian, EEG, contingent negative variation

Image Memorability Shapes the Temporal Structure of Memory

*Marianna Lamprou Kokolaki[1], Virginie van Wassenhove[1]

1. CEA/DRF/Inst. Joliot, NeuroSpin; INSERM, Cognitive Neuroimaging Unit; Université Paris Saclay

Remembering past events involves the ‘what’, the ‘where’ and the ‘when’ of memory. This suggests that we retain the temporal structure of episodes in memory, including detailed information about temporal distances between events. Stimulus properties, known to affect temporal judgments, may also shape this structure. For example, image memorability—an intrinsic property of visual stimuli linked to their likelihood of being remembered—is parametrically related to subjective duration distortions: the duration of presentation of highly memorable images is judged as longer than that of forgettable images (Ma et al., 2024). Herein we report an online study (n=33) in which participants actively viewed sequences of images varying in memorability and then reported the temporal distance between image pairs from each sequence using a Visual Analog Scale. We found that memorable images were systematically perceived as temporally closer in memory than forgettable images, suggesting that memorability also influences temporal memory. Additionally, we found that a transition between low and high memorability altered temporal distance judgments: pairs spanning a change in memorability were reported as further apart in time than pairs within the same memorability group. This suggests that a shift in memorability might act as a boundary, segmenting the sequence into two distinct events. Follow-up online studies revealed that participants are able to segment images into groups based on memorability—showing above-chance performance despite being unaware of the grouping criteria. Overall, these results indicate that stimulus manipulations which elicit online temporal distortions also influence the temporal organization of memory, supporting the view that context operates as a cognitive scaffold for encoding and retrieving episodic temporal information.

Keywords: Temporal distance, Memorability, Event segmentation, Duration distortion, Temporal memory

Effects of Network Topology and Goals on Interpersonal Synchronization in a Virtual ‘Rhythm Network’

*Jonathan Kirsh[1], Sharanya Badalera[1], John Rehner Iversen[1]

1. McMaster University

Drum circles provide a rich context for investigating interpersonal coordination and group timing dynamics. In real-world drum circles all participants can generally hear each other, enhancing group-level cooperative synchrony as group size increases (Dotov et al., 2022, eLife). But how does group synchronization behave in uncooperative, or reduced-information situations? We have developed a virtual drum circle paradigm to explore such challenging contexts, hypothesizing that individuals will display more diverse strategies when so challenged. In two pilot drum circles (N=6) we contrasted group synchronization in three conditions: all-all network topology with goals either to 1) maximize synchronization (all-sync) or 2) maximize desynchronization (all-desync), and 3) a ring topology with impoverished information flow across the group (ring-sync), which we hypothesize will force each individual to rely on an imagined collective goal and reveal different capacities to manage frustration with a seemingly uncooperative partner. In all-sync, the group successfully achieved high synchrony (Kuramoto order parameter $r \approx 1$), though, as often observed, with an acceleration of tempo. In all-desync, the order parameter remained between 0.25 and 0.5, suggesting difficulty in fully decoupling from one another. In ring-sync, each participant hears only their left neighbor, so any coordination occurs with a large delay, mediated through the entire group. This topology inverts traditional assumptions, predicting that group synchrony degrades as group size increases. For N=6 we observed dynamic behavior, with surprising periods of complete synchrony ($r \approx 1$) alternating with deep desynchronization ($r < 0.2$), suggesting that participants may rely on internal models of group intention. This flexible virtual ‘Rhythm Network’ paradigm offers possibilities to test models of group synchronization in extreme behavioral regimes and lays the foundation for future studies of inter-brain synchrony.

Keywords: Group Synchronization, Drum Circle, Network Topology, Simulation

EEG Correlates of Movement-Induced Enhancements of Beat Timing

*April M Joyner[1], Martin Wiener[1]

1. George Mason University

Previous work has shown that motor systems and rhythmic auditory processing are linked, such that motor system activation is coincident with auditory system activity while listening to music, suggesting an interaction between auditory and motor systems. Further, behavioral work has shown that inducing movement in a subject can lead to enhancement of auditory timing abilities. Yet, the neural correlates of this enhancement are not well understood. Here, we replicate and extend work by Manning and Schutz (2013) in which subjects tap along or passively listen to isochronous woodblock sequences, and then must detect if a final, delayed probe tone is aligned with the implied beat and explore the brain activity associated with this effect of movement using EEG. Preliminary data suggest stronger neural entrainment to the beat in the movement condition in comparison to no-movement. Further activity locked to the probe tone also demonstrated a larger amplitude P300 and N600 for the movement condition. For response-locked activity during choice, the movement condition exhibited a larger preceding negativity peaking higher and closer to the response as well as a positive potential following the response that is higher in amplitude compared to the no movement condition, suggesting greater certainty. Data collection will proceed to investigate the strength of these results and potential correlations related to these findings. Overall, these findings suggest an improvement in timing perception and processing, stronger entrainment to the beat, and faster target detection associated with movement.

Keywords: Beat Perception, Sensorimotor Integration, Rhythm, Movement

The effect of repetitive transcranial magnetic stimulation (rTMS) over the supplementary motor area on the groove experience

*Takahide Etani[1,2,3], Mitsuaki Takemi[4,5], Tomohiro Samma[6], Jun Nitta[7], Saki Homma[6,8], Kenta Ueda[6], Keigo Yoshida[9,6], Kenjun Hayashida[4,5], Tatsuro Fujimaki[4], Sotaro Kondoh[6,9,10], Kazutoshi Kudo[7], Shinya Fujii[9]

1. Keio Research Institute at SFC, 2. Keio Univ. Hospital, 3. Japanese Red Cross Ashikaga Hospital, 4. Graduate School of Science and Technology, Keio Univ., 5. Graduate School of Advanced Science and Engineering, Hiroshima Univ., 6. Graduate School of Media and Governance, Keio Univ., 7. Graduate School of Arts and Sciences, The Univ. of Tokyo, 8. Department of Neuropsychiatry, Keio Univ. School of Medicine, 9. Faculty of Environment and Information Studies, Keio Univ., 10. Japan Society for the Promotion of Science

The pleasurable urge to move along with the music is called "groove." This study aimed to examine whether activation of the supplementary motor area (SMA) is related to the groove experience using repetitive transcranial magnetic stimulation (rTMS). We hypothesized that excitatory stimulation would enhance, and inhibitory stimulation would decrease, the groove experience compared to the sham condition. Fifteen healthy individuals (mean age = 24.8±7.26 years; 9 females) participated in the study. Each underwent three rTMS conditions using an automated TMS robot system: SMA-iTBS (excitatory intermittent theta burst stimulation over the SMA), SMA-cTBS (inhibitory continuous theta burst stimulation over the SMA), and sham stimulation over the vertex. After each session, participants listened to ten musical excerpts (five high-groove and five low-groove) from a previous study (Janata et al., 2012) and rated their experienced groove ("urge to move" and "pleasure") using a visual analog scale (0–100). A two-way ANOVA (stimulation condition [SMA-iTBS, SMA-cTBS, and sham] x music type [high-groove and low-groove music]) revealed no significant main effect of stimulation condition on either rating. There was a significant main effect of music group on "pleasure" ratings ($F_{(1,28)} = 257.7$, $p < .001$), with high-groove music receiving higher ratings. Contrary to our hypothesis, SMA stimulation did not significantly affect the groove experience, suggesting that the SMA may not be directly involved in the groove experience.

References

Janata, P., Tomic, S. T., & Haberman, J. M. (2012). Sensorimotor coupling in music and the psychology of the groove. *Journal of Experimental Psychology. General*, *141*(1), 54–75. https://doi.org/10.1037/a0024208

Keywords: groove, pleasure, repetitive transcranial magnetic stimulation (rTMS), supplementary motor area (SMA), music

Timing Difficulties in Developmental Language Disorder and Stuttering: A planned study on the Role of Dysfunctional Synchronization of Brain Rhythms

*Christian A. Kell[1], Lars Meyer[2], Joachim Gross[2], Katrin Neumann[2]

1. Goethe University, 2. Muenster University

In this planned study we will characterize the neural underpinnings of timing difficulties in developmental language disorder (DLD) and developmental stuttering. Children suffering from DLD display receptive timing difficulties and misperceive temporal modulations, in particular at high rates. In contrast, children who stutter (CWS) show timing difficulties during actions, such as speech production.
We hypothesize that timing difficulties in DLD and stuttering arise from an underlying deficit in the synchronization of rhythmic brain activity. In DLD, we hypothesize dysfunctionalsynchronization with the external speech signal during perception. In contrast, CWS are hypothesized to display dysfunctional internal auditory–motor synchronization, which is particularly important for the processing of auditory feedback.
Children with DLD, children who stutter, and control children aged 10-15 (66 each) will participate in an MEG study at Muenster and Goethe university Frankfurt. We will investigate speech-brain synchronization, rhythmic deviance detection, and synchronization/ continuation tapping with and without feedback.
We will present and discuss the details of the study design.

Keywords: Developmental Stuttering, Developmental Language Disorder, Speech-Brain Alignment, Synchronization-Continuation Tapping Paradigm, Auditory-motor interactions, Magnetoencephalography

Contributions of cognitive abilities and attention to Motor Timing in Parkinson’ s Disease

*Elisa M. Gallego Hiroyasu[1], Yuko Yotsumoto[2], Giovanna Mioni[3]

1. Keio University, 2. The University of Tokyo , 3. Universita di Padova

Finger tapping tasks are often employed to measure the rhythm of the internal clock. These, however, are susceptible to influences from both motor symptoms and cognitive functions which makes interpreting results difficult. This study investigates the influence of specific cognitive functions on finger tapping in Parkinson’ s Disease (PD). In contrast to the widespread use of tools like the Mini-Mental State Examination (MMSE), our focus lies on specific cognitive domains crucial to finger tapping—Montreal Cognitive Assessment (MoCA) and Trail Making Test (TMT). PD patients engaged in spontaneous tapping and 1-second paced tapping tasks. Cognitive functions were assessed using the MoCA for general cognitive abilities and TMT-A for attention and processing speed. Bayesian model comparisons were employed to evaluate 12 different models predicting the interval between taps and variability of taps, for each task. The results confirmed previous findings of a faster tapping rate and increased variability in free tapping and 1-second tapping tasks among PD patients. Furthermore, distinct trends emerged concerning MoCA and TMT-A performance and their effect on tapping tasks, differentiating between PD patients and healthy controls.

Keywords: Parkinsons, Motor Timing

Exploring the role of rhythmicity for infant word learning by entrainment of brain and behaviour in social contexts: A preliminary study

*Erica Flaten[1], Cristina Conati[2], Janet Werker[1]

1. Department of Psychology, University of British Columbia, 2. Department of Computer Science, University of British Columbia

Infants learn words from caregivers labelling objects with their names. Such interactions involve infant-directed (ID) communication, which is inherently highly rhythmic. Infants attend more to, learn better from, and more strongly neurally track ID than adult-directed speech, however, whether this is specifically due to rhythmicity is currently unknown. We thus posit that rhythmicity in ID speech dynamically engages infants' cognitive processes in real time (such as measured via eye-tracking), which enhances word learning, and that such learning processes are anchored by underlying neural activity. We are currently testing this hypothesis while developing machine learning (ML) techniques to utilize infants' multiple signals together (e.g., eye-tracking and/or EEG, video of facial expressions) to predict learning outcomes. Specifically, 9- to 11-month-old infants (data collection is ongoing) from English-speaking homes were familiarized with two novel objects one at a time on a screen, each paired with a pseudoword (e.g., 'Bap' & 'Dit'). The word was spoken repeatedly over an intonation phrase, and these phrases were manipulated to be rhythmically regular (i.e., with regular inter-onset-intervals[IOIs] between word onsets) or irregular (e.g., jittered IOIs between words). During familiarization, infants' visual and neural signals were measured using eye-tracking and EEG, respectively. Following this, infants' associative word learning was then tested: infants heard the learned pseudowords one at a time while both objects appeared on the screen, and looking times to the correct vs. incorrect object was measured to index learning. We predict that infants' brains will more strongly track the regular compared to irregular phrases, and that this pattern will predict their word learning outcomes. Additionally, ML models will predict which infants learned best using the eye-tracking (and in the future, EEG and facial expression) data from the familiarization phase. This project is the first to directly manipulate rhythmic regularity in ID speech to investigate word learning, and additionally, to employ ML techniques to extract features from infants' multiple signals that predict learning outcomes. This work will better our understanding of the processes involved in early language acquisition.

Keywords: Word Learning, Infants, Neural Tracking, EEG, Eye-tracking

Pre-motor and auditory processing for inner and overt speech

*Lachlan James Hall[1], Thomas J Whitford[2], Mike E Le Pelley[2], Bradley N Jack[1]

1. Australian National University, 2. University of New South Wales

There is a long-standing debate as to whether the neural processes associated with inner speech –the silent production of words in one’ s mind –and overt speech –the audible production of words via movement of the articulator organs –are the same or different. Watson (1913) claimed that the only difference between them is that inner speech does not produce an audible sound, whereas Vygotsky (1934) argued that they are completely different. To distinguish between these possibilities in the context of pre-motor and auditory processing, we sought to investigate the similarities and differences in both the N1, an event-related potential (ERP) associated with auditory processing, and the slow negative wave, a negative-going deflection preceding the onset of a voluntary action. To elicit these potentials, participants were instructed to watch an animation which provided them with precise knowledge about when they should produce a sound (e.g., “cat”) in either inner or overt speech. At the same time, participants would hear an audible sound played through headphones that either matched (e.g., “cat”) or mismatched (e.g., “dog”) the sound they produced. The results and their implications for understanding the perception of inner and overt speech will be discussed.

Keywords: Inner Speech, EEG, Decoding, Overt Speech

Neural correlates of changes of mind and confidence in the judgement of elapsed time

*Chetan Desai[1], Martin Wiener[1]

1. George Mason University

The ability to monitor and correct errors is essential for accurate timing. Recently, investigators have started probing confidence in temporal decisions as a means of understanding temporal metacognition (Fu, et al. 2023). However, few studies have investigated the EEG correlates of metacognitive inferences in time perception (Kononowicz, et al. 2019; Kononowicz & van Wassenhove, 2019). Separately, perceptual decision-making studies have found that, when given the option, subjects will shift their decisions from one choice to another, so-called "changes of mind" (Resulaj, et al. 2009; van Den Berg, et al. 2016). We have found that changes-of-mind also exist for temporal decisions (Wiener, et al. 2019). Here, we probed the EEG correlates of these changes-of-mind and confidence estimates in a suprasecond auditory temporal bisection task. Our initial analysis revealed that the late positive component of timing (LPCt), an EEG signal associated with post-decisional evidence in timing tasks (Wiener & Thompson, 2015; Ofir & Landau, 2022), is significantly lower on trials in which subjects changed their minds about their decision. Additional analyses will examine the link between this shift in LPCt amplitude and decision confidence, both at the neural and behavioral level, as well as if changes-of-mind can be predicted by pre-decisional evidence accumulation.

Keywords: decision-making, changes-of-mind, temporal metacognition

Metacognition of Time Discrimination

*Valdas Noreika[1], Stefano Arlaud[1]

1. Queen Mary University of London

While the conscious sense of the passage of time is often assessed in the temporal orientation studies on the individual’s focus on the past, present and future, much less is known about metacognitive awareness of our perception of short time scales. In a series of time discrimination studies, we measured the sensitivity of time judgments (Level 1) and the metacognitive accuracy (Level 2) of the Level 1 responses. We found that different aspects of time judgment (threshold, slope) predict metacognitive awareness of time perception. In addition, participants showed systematic over- and under-estimation of sub-second vs. supra-second judgements, which was also reflected in the metacognitive processes. The results highlight the higher-level processing of time, which likely cannot be carried out without conscious awareness of time.

Keywords: Time discrimination, Metacognition, Sub-second vs. supra-second, Consciousness

Timing Control of Upper Body Movements in Playground Swing Pumping: The Role of External Forces

*Chiaki Hirata[1], Shun'ichi Kitahara[1]

1. Jumonji University

Playground swing pumping represents a coupled oscillator system consisting of the swing apparatus and the human swinger. Dynamic simulations using equations of motion reveal that for seated pumping, swing amplification requires synchronization between the swing's resonant frequency and the swinger's upper body movements. Furthermore, a progressive phase shift between the swing and upper body motion is essential for effective pumping. Specifically, when swing amplitude is small, maximum backward lean of the upper body should occur when the swing moves forward and the swing is at the vertical. As swing amplitude increases, the timing of maximum backward lean must shift earlier toward the swing's back extreme.
Motion capture analysis of 10 untrained participants pumping an in-lab playground swing showed that while one swing cycle lasted approximately 2.5 seconds, the phase shift advanced about 30 milliseconds per cycle. This precise phase control was consistent across all participants, suggesting it occurs without conscious intention.
Our hypothesis proposes that external forces—including inertial, fictitious, and centrifugal forces—acting on the swinger's upper body drive this phase shift. To test this hypothesis, we constructed a virtual reality swing environment consisting of a head-mounted display connected to a personal computer and a stationary bar stool with poles mimicking swing chains. The VR swing responds to upper body movements synchronized with swing motion, but critically, no external forces act on the swinger's body since the seat remains fixed to the ground.
Ten participants successfully pumped both VR swing. Importantly, during VR swing pumping, the phase relationship between the seat and upper body remained constant throughout the pumping process, contrasting with the progressive phase shift observed in physical swing pumping.
These findings demonstrate that external forces are crucial for the automatic phase shift that enables effective swing pumping. This research advances our understanding of how environmental constraints shape motor coordination in coupled oscillatory systems.

Keywords: phase shift, external forces, coupled oscillator system, playground swing

Social modulation of sense of responsibility and subjective time experience in semi-automated motor tasks

*Sayako Ueda[1,2]

1. Japan Women's University, 2. RIKEN CBS

Automation technologies increasingly assist or augment human motor functions in contexts such as driving, surgery, and rehabilitation. As such systems become more prevalent, it is essential to understand how they influence users' subjective experience, particularly in social settings where individuals may compare themselves with others using more or less capable systems. Previous research has shown that automation can modulate the sense of agency (SoA), responsibility, and time perception, but these effects have mostly been examined in non-social contexts. In this study, we examined how automation and social context shape users' sense of responsibility and temporal experience. Participants engaged in a continuous circle-tracing task using a trackpad-controlled cursor under two automation conditions: auto-correction and delay. In Experiment 1, participants performed the task alone. In Experiment 2, two social contexts were introduced: while observing another agent using the same system (social–matched), or a different system (social–mismatched). The results showed that the automation condition consistently influenced subjective control, performance, drawing speed and accuracy in both experiments, with better outcomes in the auto-correction condition. The social context had no effect on these indices. However, temporal reproduction and responsibility judgements exhibited different patterns in Experiment 2. Specifically, subjective time compression occurred in social conditions under delay, and responsibility ratings were highest when the observer used the same system, and lowest when they used a different one. These findings suggest that automation performance has a consistent influence on core aspects of task execution and self-evaluation, while social context selectively modulates higher-order, self-related experiences, such as responsibility attribution and time perception. These findings emphasize the importance of considering technological and social factors when evaluating user experience in semi-automated environments.

Keywords: sense of responsibility, subjective time perception, human–automation interaction, social context, sense of agency

When Time Stands Still: Altered spatiotemporal experiences in depersonalization

*Julia Ayache[1], Malika Auvray[2], Anna Ciaunica[3,4]

1. EuroMov Digital Health in Motion, Univ. Montpellier IMT Mines Alès, Montpellier, 2. Institut des Systèmes Intelligents et de Robotique, Sorbonne Université, CNRS, Paris, 3. GAIPS INESC-ID, Instituto Superior Tecnico, University of Lisbon, Lisbon, 4. Institute of Cognitive Neuroscience, University College London, London

Introduction. Depersonalization (DP) is a common condition characterized by distressing feelings of estrangement from the self and the external world. Unlike schizophrenia, peripersonal space is preserved in DP, yet altered time perception are also observed. This asymmetry needed to be further investigated by considering DP facets in spatiotemporal experiences.

Methods. An online study was conducted ($N = 1034$) investigating the association of HIGH DP traits measured by the Cambridge Depersonalization Scale (CDS score > 50) with altered subjective experiences of body, time, and space.

Results. The results demonstrated associations between DP scores and distorted experiences of time, body and space. When shared variance between CDS facets is considered, the facet "Anomalous Body Experience", appears as main predictor of spatiotemporal alterations, associated with subjective experience of time slowing down.

Conclusion. These results echo phenomenological experiences of spatiotemporal disruption in DP and suggest that these experiences may mainly come from estrangement experiences from the bodily self. Our work calls for further investigations linking DP to disruption of internal/external clock, in relation to active movements in the world.

Keywords: Depersonalization, Time Perception, Altered Self, Bodily Self

Recalibrating perceptual time through motor learning

*Nicola Binetti[1], Federico Mancinelli[3], Marco Zanon[2], Domenica Bueti[2]

1. Università degli studi di Roma Tor Vergata, 2. International School for Advanced Studies, 3. University of Bonn

Timing is central to human cognition and behaviour, underscoring people's ability of comprehending speech, playing instruments and competing in sports. Accumulating evidence supports a motoric basis of timing, whereby time processing is embedded in motor control neural circuits and perceptual time undergoes distortion in proximity of action. Yet, the dynamic interplay between timing and motor systems remains under-characterized, particularly in goal-directed contexts where control is refined through practice. In a first study, we investigated this interaction by asking participants to judge brief visual durations while preparing hand movements toward either specific (Cued) or unspecified (Non-cued) targets, or during equivalent intervals without movement (Sensory). Temporal judgments were biased toward expansion in the Cued condition, and both action conditions showed progressive time expansion across trials, paralleling motor learning as indexed by decreases in action latency. EEG data revealed that these perceptual distortions arise from biased temporal encoding and decoding processes, linked to action planning and broader aspects of motor system engagement respectively. We further examined within this setup how perceptual (explicit) and motoric (implicit) timing mechanisms interact. Using a nested design that assessed both processes on a trial-by-trial basis, participants judged stimulus durations while also intercepting a target presented after a predictable interval containing the judged stimulus. Results showed that while action planning distorted perceived duration, motor-based timing remained accurate for target interception, suggesting partial decoupling between perceptual and motor timers. However, the systems also interacted: trials with faster perceptual timing (shorter perceived durations) were associated with slower motor timing (delayed responses), hinting at information leak between implicit and implicit timers. Together these findings highlight a dynamic, learning-driven coupling between perceptual time and motor control processes, wherby temporal experience is recalibrated throughout goal-directed motor learning

Keywords: Motor control , Visual timing, Sensorimotor integration , Time encoding and decoding , Behavioural modelling, EEG

Beyond Pacemaker Speed: A Planned Investigation into Atemporal Perceptual Processes Underlying Differences in Auditory-Visual Duration Judgments

*Valtteri Arstila[1], Jarno Tuominen[1]

1. University of Turku

Research consistently shows that auditory stimuli are perceived as longer than visual stimuli of equivalent duration. Current explanations for this phenomenon are based on the internal clock model; no detailed explanation has been presented within alternative frameworks, such as oscillator-based models like the striatal beat frequency model. The internal clock model explanation attributes the effect to modality-specific pacemaker speeds. This could imply either that one pacemaker operates at different speeds for different sensory modalities or that each modality has its own pacemaker operating at different speeds. (Wearden and Jones 2021) However, this approach amounts to merely *explaining by naming*; within the context of the internal clock model, the explanation doesn't truly elucidate the phenomenon but rather describes it in a novel way. As long as the accumulator and the switch/gate function largely similarly for both auditory and visual stimuli—both reasonable assumptions—differences in duration estimations can only be attributed to differences in pacemaker speeds. Consequently, the phenomenon remains unaccounted for.

In this presentation, we share initial results from psychophysical experiments—which compare duration judgments between matched auditory and visual stimuli—aimed at exploring alternative explanations for the differences in judged durations. Rather than attributing the duration judgment differences to unexplained variations in pacemaker speed, we anticipate demonstrating that these effects arise from more general and partly domain-specific perceptual and neural processes. Should our results support this explanation, they will challenge the explanatory value of modality-specific pacemaker speeds and advance our understanding of time perception by aligning it more closely with other perceptual processes.

Wearden, J. H., & Jones, L. A. (2021). "Judgements of the Duration of Auditory and Visual Stimuli." Timing & Time Perception, 9(2), 199–224.

Keywords: Time perception, Auditory stimuli, Visual stimuli

Poster | Other

Sat. Oct 18, 2025 12:45 PM - 2:45 PM JST | Sat. Oct 18, 2025 3:45 AM - 5:45 AM UTC MM Hall (KOMCEE-B1)

[P2] Poster: Day 2

[P2-39] Influence of turn-taking regularity on respiratory activity in human conversation

*Mirei Kin and Hiroki Koda (Graduate School of Arts and Sciences, The University of Tokyo)
Keywords：respiratory activity; conversion; speech timing; temporal regularity; turn-taking

Human conversational communication is characterized by the dynamic alternation of speaker roles, known as turn-taking. The smooth coordination of turns requires individuals to predict the timing of their partner’s utterance onsets and offsets and to execute their own speech with precise motor timing. Since speech production depends on the voluntary control of respiration, it is plausible that respiratory activity plays a role not only in individual speech planning but also in the mutual regulation of conversational flow. Specifically, respiratory control may act as a physiological substrate for inter-individual coordination by enabling reciprocal influence between speakers’ breathing patterns. Such coordination may extend beyond vocal turn-taking and contribute to broader socio-psychological domain, including synchronization of autonomic nervous system activity. Despite its potential relevance, respiratory coupling in naturalistic conversation remains understudied. Here, we investigated how conversational context influences respiratory synchrony between two speakers. We recorded respiratory activity during dyadic conversations conducted under two conditions: face-to-face interaction and virtual interaction via video online system including unpredictable time delay. These settings allowed us to manipulate the physical co-presence of participants while keeping the conversational task comparable. The temporal aspects of dialogue, such as turn transition timing in relation to respiratory signals, were also examined following previous studies. Our preliminary analysis showed condition-dependent differences in respiratory synchronization. Our data partially suggested that synchronized breathing during smooth turns occurred more frequently in face-to-face conditions than in virtual interactions. Notably, simultaneous laughter emerged as a particularly salient event, during which participants’ respiratory rhythms temporarily aligned. These moments of affective synchronization might facilitate smoother turn transitions and more sustained conversational flow in subsequent exchanges. These findings suggest that respiration might serve not only as a substrate for speech production but also as a medium for inter-individual coordination during conversation.

Poster | Other

Sat. Oct 18, 2025 12:45 PM - 2:45 PM JST | Sat. Oct 18, 2025 3:45 AM - 5:45 AM UTC MM Hall (KOMCEE-B1)

[P2] Poster: Day 2

[P2-40] Female gibbons’ great calls change tempo in the presence of their offspring

*Yoichi Inoue[1], Waidi Sinun[2], Kazuo Okanoya[1] ([1]Teikyo University, [2]Research and Development Division, Yayasan Sabah Group)

Gibbons are small apes distributed throughout Southeast Asia known for their loud vocalizations (songs). Female gibbons produce a loud, elaborate, and stereotyped song known as the great call (GC). From 2009 to 2025, we observed four females in three groups of Northern Gray gibbons (Hylobates funereus) in northern Borneo and recorded their songs to investigate whether female GCs change before and after giving birth. Observations suggest that infant gibbons begin producing high-pitched vocalizations synchronized with their mother's GC from birth. By approximately 26 months of age, offspring begin to sing the initial portion of the GC in synchrony with their mother, gradually lengthening their contribution. We hypothesized that females may adapt their vocalizations to match their offspring’s developing song—similar to human motherese—by producing slower, shorter calls with higher pitch. To test this hypothesis, we analyzed the GC’s duration, number of notes, maximum and minimum frequencies, and note speed. The GC consists of a series of notes: the first half begins slowly and accelerates, while the second half maintains a steady tempo. Therefore, note speed was measured separately for the first 20 notes and for the 21st note onward. We compared these acoustic features before and after the birth of offspring. Although our overall findings did not support the hypothesis, we found that note speed in the first half of the GC was significantly faster after birth. This change may reflect hormonal effects related to lactation or heightened maternal arousal for offspring protection, but the underlying cause remains unclear. Further studies are needed to clarify the function and mechanisms of this vocal change (Work supported by JSPS 25H21984).

TRF

Sat. Oct 18, 2025 8:00 AM - 10:00 AM JST | Fri. Oct 17, 2025 11:00 PM - 1:00 AM UTC TCVB tour

[T04] TCVB tour @ Zazen Experience

TRF

Sat. Oct 18, 2025 5:45 PM - 8:30 PM JST | Sat. Oct 18, 2025 8:45 AM - 11:30 AM UTC Shibuya

[T05] Conference Dinner