Fri. Oct 17, 2025

Invited | Timing & Time Perception

Fri. Oct 17, 2025 11:00 AM - 12:00 PM JST | Fri. Oct 17, 2025 2:00 AM - 3:00 AM UTC Room 1(Mathematical Science Building)

[K1] Keynote : Kalanit Grill-Spector

Chair:Domenica Bueti(International School for Advanced Studies (SISSA))

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

[K1-01]

Understanding cognitive processing in the human visual system using spatiotemporal population receptive fields

*Kalanit Grill-Spector[1] (1. Stanford University (United States of America))

Symposium | Mammalian Brain

Fri. Oct 17, 2025 9:00 AM - 10:30 AM JST | Fri. Oct 17, 2025 12:00 AM - 1:30 AM UTC Room 1(Mathematical Science Building)

[S1] Symposium 1 :Time and Rhythm in the Mammalian Brain

Chair:Sonja Kotz(Maastricht University), Teresa Raimondi (Sapienza University of Rome)

9:00 AM - 9:30 AM JST | 12:00 AM - 12:30 AM UTC

[S1-01]

Time and Rhythm in the Mammalian Brain

*Sonja A Kotz[1], Teresa Raimondi[2] (1. Maastricht University (Netherlands), 2. Sapienza University of Rome (Italy))

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

[S1-02]

Tick-Tock Across Species: Comparative timing in audition

*Sonja A Kotz[1] (1. Maastricht University (Netherlands))

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

[S1-03]

When reward is right, macaques can have rhythm

*Hugo Merchant[1], Ameyaltzin Castillo-Almazán[1], Pablo Márquez[1], Vani Rajendran[1] (1. Instituto de Neurobiologia, UNAM, campus Juriquilla (Mexico))

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

[S1-04]

Rhythmic synchronization ability of rats

*Reo Wada[1], Hiroki Koda[1] (1. The University of Tokyo (Japan))

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

[S1-05]

Emergence of rhythm during sequential tapping in chimpanzees and humans

*Yuko Hattori[1] (1. Kyoto University (Japan))

Symposium | Healthy and Pathological Aging

Fri. Oct 17, 2025 5:15 PM - 6:45 PM JST | Fri. Oct 17, 2025 8:15 AM - 9:45 AM UTC Room 3(East B1)

[S3] Symposium 3: Towards a comprehensive understanding of time processing changes in healthy and pathological aging

Chair:Thomas Hinault(INSERM)

5:15 PM - 5:30 PM JST | 8:15 AM - 8:30 AM UTC

[S3-01]

Towards a comprehensive understanding of time processing changes in healthy and pathological aging

*Thomas Thierry Hinault[1] (1. U1077 Inserm (France))

5:30 PM - 5:45 PM JST | 8:30 AM - 8:45 AM UTC

[S3-02]

Aging effects on the neural bases of temporal processing

*Thomas Thierry Hinault[1] (1. U1077 Inserm (France))

5:45 PM - 6:00 PM JST | 8:45 AM - 9:00 AM UTC

[S3-03]

Electrophysiological signature of explicit and implicit timing in young and older adults

*Giovanna Mioni[1], Fiorella del Popolo Cristaldi[1], Luigi Micillo[1], Nicola Cellini[1] (1. Department of General Psychology, University of Padova (Italy))

6:00 PM - 6:15 PM JST | 9:00 AM - 9:15 AM UTC

[S3-04]

Time processing in prodromal stages of Alzheimer’s Disease

*Alice Teghil[1] (1. Sapienza University of Rome (Italy))

6:15 PM - 6:30 PM JST | 9:15 AM - 9:30 AM UTC

[S3-05]

Temporal processing disturbances in the dementias – from mechanisms to management

*Muireann Irish[1] (1. The University of Sydney (Australia))

Symposium | Temporal Metacognition

Fri. Oct 17, 2025 9:00 AM - 10:30 AM JST | Fri. Oct 17, 2025 12:00 AM - 1:30 AM UTC Room 2(West B1)

[S2] Symposium 2: Watching the Clock Err: Different Levels of Explanation for Temporal Metacognition

Chair:Tutku Oztel(George Mason University)

9:00 AM - 9:30 AM JST | 12:00 AM - 12:30 AM UTC

[S2-01]

Watching the Clock Err: Different Levels of Explanation for Temporal Metacognition

*Tutku Oztel[1] (1. George Mason University (United States of America))

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

[S2-02]

Cognitive Architecture Through Methodological Lenses: Understanding Temporal Error Monitoring

*Tutku Oztel[1] (1. George Mason University (United States of America))

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

[S2-03]

“Catching yourself trip” on timing errors

*Fuat Balci[1] (1. University of Manitoba (Canada))

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

[S2-04]

Exploring the Domain-Generality of Temporal Metacognition: From introspective reaction time to confidence in explicit timing

*Nathalie Pavailler[1] (1. CEA/DRF/Inst. Joliot, NeuroSpin; INSERM, Cognitive Neuroimaging Unit; Université Paris-Saclay, Gif/Yvette, 91191 France (France))

Symposium | Temporal Experience

Fri. Oct 17, 2025 5:15 PM - 6:45 PM JST | Fri. Oct 17, 2025 8:15 AM - 9:45 AM UTC Room 2(West B1)

[S4] Symposium 4: The Varieties of Temporal Experience: The Past, Present, and Future of Time Perception Research

Chair:Martin Wiener(George Mason University)

5:15 PM - 5:30 PM JST | 8:15 AM - 8:30 AM UTC

[S4-01]

The Varieties of Temporal Experience: The Past, Present, and Future of Time Perception Research

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

5:30 PM - 5:45 PM JST | 8:30 AM - 8:45 AM UTC

[S4-02]

Is Time Special?

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

5:45 PM - 6:00 PM JST | 8:45 AM - 9:00 AM UTC

[S4-03]

Of time and memory in cognitive neurosciences: how the observer flaws our understanding of time

*Virginie van Wassenhove[1] (1. CEA NeuroSpin; INSERM Unicog; Univ. Paris-Saclay (France))

6:00 PM - 6:15 PM JST | 9:00 AM - 9:15 AM UTC

[S4-04]

Temporality and the brain: the long and winding emergence of time in cognitive neuroscience

*Ayelet N Landau[1,2] (1. Hebrew University of Jerusalem (Israel), 2. University College London (UK))

6:15 PM - 6:30 PM JST | 9:15 AM - 9:30 AM UTC

[S4-05]

Measuring the neural clocks: fifteen years of timing neurophysiology

*Hugo Merchant[1], Germán Mendoza[1], Oswaldo Pérez[1] (1. Instituto de Neurobiologia, UNAM, campus Juriquilla (Mexico))

Oral | Timing & Time Perception

Fri. Oct 17, 2025 1:00 PM - 2:30 PM JST | Fri. Oct 17, 2025 4:00 AM - 5:30 AM UTC Room 3(East B1)

[O1] Oral 1: Timing & Time Perception

Chair:Nedim Goktepe(INM- Leibniz Institute for New Materials)

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

[O1-01]

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 (Brazil), 2. Center for Mathematics, Computing and Cognition, Federal University of ABC (UFABC), São Paulo, Brazil (Brazil))

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

[O1-02]

Causality Judgments and temporal order in individuals with Schizophrenia: a new case of time re-ordering

*Anne Giersch[1,2], Brice Martin[4,3], Cristina Rusu[1,2], Hager Guendouze[1,2] (1. INSERM (France), 2. University of Strasbourg (France), 3. Hôpital du Vinatier, Lyon (France), 4. Centre Hospitalier Drôme Vivarais (France))

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

[O1-03]

The human propensity for regularity extraction requires us to reconsider how we construct randomly timed stimuli

*Jelle van der Werff[1], Tommaso Tufarelli[1], Laura Verga[1], Andrea Ravignani[1] (1. Sapienza University of Rome (Italy))

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

[O1-04]

Moments or Continuum? Testing the Temporal Resolution of Human Anticipation

*GEORGIOS MICHALAREAS[1,2,3], David Poeppel[4], Matthias Grabenhorst[3,2] (1. Cooperative Brain Imaging Center (CoBIC), Goethe University Frankfurt (Germany), 2. Max-Planck-Institute for Empirical Aesthetics, Frankfurt (Germany), 3. Ernst Strüngmann Institute for Neuroscience in Cooperation with Max Planck Society, Frankfurt (Germany), 4. New York University (United States of America))

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

[O1-05]

Spatial tool use modulates time perception in near and far space

*Amir Jahanian-Najafabadi[1], Argiro Vatakis[2], Christoph Kayser[1] (1. Department of Cognitive Neuroscience, Bielefeld University (Germany), 2. Department of Psychology, Panteion University of Social and Political Sciences (Greece))

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

[O1-06]

Generalizing temporal perception in humans: learning transfer across interval categorization and interval identification tasks

*German Mendoza[1], Hugo Rey Andrade-Hernandez[2], Hugo Merchant[1] (1. Instituto de Neurobiología, UNAM (Mexico), 2. Maestría en Ciencias (Neurobiologĺa), UNAM. (Mexico))

Oral | Development, Clinical

Fri. Oct 17, 2025 3:30 PM - 5:00 PM JST | Fri. Oct 17, 2025 6:30 AM - 8:00 AM UTC Room 3(East B1)

[O2] Oral 2: Decelopment, Clinical

Chair:Rafael Román-Caballero(Universidad de Granada & McMaster University)

3:30 PM - 3:45 PM JST | 6:30 AM - 6:45 AM UTC

[O2-01]

“Past is Present, and Present is Past for Me": A case report of a 21-year-old female with autism spectrum disorder and enhanced episodic memory

*Ryuta Ochi[1,2], Shigeru Kitazawa[3], Mitsuru Kawamura[2] (1. Department of Psychology, Graduate School of Letters, CHUO University (Japan), 2. Division of Neurology, Department of Internal Medicine, School of Medicine, Showa Medical University (Japan), 3. Dynamic Brain Network Laboratory, Graduate School of Frontier Biosciences, The University of Osaka (Japan))

3:45 PM - 4:00 PM JST | 6:45 AM - 7:00 AM UTC

[O2-02]

Time attitudes and psychological distress: Exploring the interface between temporal representation and affect

*Thiago Bonifácio[1], André Mascioli Cravo[1] (1. Federal University of ABC (Brazil))

4:00 PM - 4:15 PM JST | 7:00 AM - 7:15 AM UTC

[O2-03]

Victims living in the now: A developmental glimpse on time perspectives through a criminological lense

*Sebastian L. Kübel[1,2,3] (1. University of Bern (Switzerland), 2. Max Planck Institute for the Study of Crime, Security and Law (Germany), 3. University of Leiden (Netherlands))

4:15 PM - 4:30 PM JST | 7:15 AM - 7:30 AM UTC

[O2-04]

Visual attention of infants in early interactions: Comparing early processing of music and language

*Rafael Román-Caballero[1,2], Maya Psaris[2], Betania Y. Georlette[3], Mohammadreza Edalati[3], Barbara Tillmann[4], Sahar Moghimi[3], Gabriel (Naiqi) Xiao[2], Laurel J. Trainor[2], Juan Lupiáñez[1] (1. Universidad de Granada (Spain), 2. McMaster University (Canada), 3. Université de Picardie (France), 4. Université de Bourgogne (France))

4:30 PM - 4:45 PM JST | 7:30 AM - 7:45 AM UTC

[O2-05]

Visual causality detection capabilities in individuals treated for prolonged early-onset blindness

*Marin Vogelsang[1], Lukas Vogelsang[1], Priti Gupta[2], Stutee Narang[2], Purva Sethi[2], Suma Ganesh[2], Pawan Sinha[1] (1. MIT (United States of America), 2. Dr Shroff’s Charity Eye Hospital (India))

4:45 PM - 5:00 PM JST | 7:45 AM - 8:00 AM UTC

[O2-06]

Performance of late-sighted children on the temporal order judgement task

*Lukas Vogelsang[1], Priti Gupta[2], Marin Vogelsang[1], Naviya Lall[2], Manvi Jain[2], Chetan Ralekar[1], Suma Ganesh[2], Pawan Sinha[1] (1. MIT (United States of America), 2. Dr Shroff’s Charity Eye Hospital (India))

Oral | Attention, Multisensory, Time Perception

Fri. Oct 17, 2025 3:30 PM - 5:00 PM JST | Fri. Oct 17, 2025 6:30 AM - 8:00 AM UTC Room 2(West B1)

[O3] Oral 3: Attention, Multisensory, Time Perception

Chair:Yuki Murai(National Institute of Information and Communications Technology)

3:30 PM - 3:45 PM JST | 6:30 AM - 6:45 AM UTC

[O3-01]

Discrete vs. continuous timer bars: How visual segmentation shapes the perception of time "running out"

*Jasmindeep Kaur[1], Jiaying Zhao[1], Joan Danielle Ongchoco[1] (1. The University of British Columbia (Canada))

3:45 PM - 4:00 PM JST | 6:45 AM - 7:00 AM UTC

[O3-02]

Neural Dynamics of Motor-Induced Attention during the Encoding and Retention of Temporal Intervals

*Lorenzo Guarnieri[1], Ayelet Nina Landau[1,2] (1. Hebrew University of Jerusalem (Israel), 2. University College London (UK))

4:00 PM - 4:15 PM JST | 7:00 AM - 7:15 AM UTC

[O3-03]

The priority accumulation framework – attention in time and space

*Mor Sasi[1], Daniel Toledano[1], Shlomit Yuval-Greenberg[1,2], Dominique Lamy[1,2] (1. Tel Aviv University (Israel), 2. Sagol school of neuroscience (Israel))

4:15 PM - 4:30 PM JST | 7:15 AM - 7:30 AM UTC

[O3-04]

Multisensory Integration and Delay Adaptation in Sensorimotor Timing

*Lingyue Chen[1], Loes C.J. van Dam[1], Zhuanghua Shi[2] (1. Technische Universität Darmstadt (Germany), 2. Ludwig-Maximilians-Universität München (Germany))

4:30 PM - 4:45 PM JST | 7:30 AM - 7:45 AM UTC

[O3-05]

Memory encoding for new information, not autobiographical memory load, predicts age-related acceleration in subjective time passage over the last decade

*Alice Teghil[1,2], Sebastian Wittmann[3], Adele Lifrieri[1], Sophia Saad[3], Maddalena Boccia[1,2], Marc Wittmann[3] (1. Department of Psychology, Sapienza University of Rome (Italy), 2. Cognitive and Motor Rehabilitation and Neuroimaging Unit, IRCCS Fondazione Santa Lucia, Rome (Italy), 3. Institute for Frontier Areas of Psychology and Mental Health, Freiburg (Germany))

4:45 PM - 5:00 PM JST | 7:45 AM - 8:00 AM UTC

[O3-06]

Interference between time and space in advanced age

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

Poster | Other

Fri. Oct 17, 2025 12:45 PM - 2:45 PM JST | Fri. Oct 17, 2025 3:45 AM - 5:45 AM UTC MM Hall (KOMCEE-B1)

[P1] Poster: Day 1

[P1-01]

Development of the Japanese Version of the Adult Hyperfocus Questionnaire and Examination of Its Reliability and Validity (in progress)

*Kazutoshi Tamura[1], Akira Midorikawa[2] (1. Department of Psychology, Graduate School of Letters, Chuo University (Japan), 2. Department of psychology, Faculty of Letters, Chuo University (Japan))

[P1-02]

Timing alterations in ADHD: Combining a scoping review with a planned empirical study of Temporal Binding

*Veronica Casagrande[1], Grace Isaura Durkin[2], Vanessa de Andrade[3], Tiemi Thais Tomonaga[3], Patricia Cibelle Pinto de Oliveira[3], Lucas Correia Signorini[3], Claudia Berlim de Mello[4], Gustavo Melo de Andrade Lima[3], André Mascioli Cravo[5] (1. Graduate Program in Neuroscience and Cognition, Federal University of ABC (UFABC), São Paulo, Brazil (Brazil), 2. Graduate Program in Psychobiology, Federal University of São Paulo (UNIFESP), São Paulo, Brazil (Brazil), 3. Center for Education and Research on Brain Aging, Federal University of São Paulo (UNIFESP), São Paulo, Brazil (Brazil), 4. Psychobiology Department, Federal University of São Paulo (UNIFESP), São Paulo, Brazil (Brazil), 5. Center for Mathematics, Computing and Cognition, Federal University of ABC (UFABC), São Paulo, Brazil (Brazil))

[P1-03]

Interval timing in children with ADHD: Pilot study on timing differences

*Kateřina Dörflová[1,2], Veronika Rudolfová[3,2], Kristýna Malenínská[2], Tereza Nekovářová[2,3] (1. Third Faculty of Medicine, Charles University, Neurosciences (Czech Republic), 2. National Institute of Mental Health in Czechia (Czech Republic), 3. Faculty of Science, Charles University, Department of Zoology (Czech Republic))

[P1-04]

Neuronal signals in the primate cerebellum underlying the detection of rhythmic deviations

*Masashi Kameda[1], Masaki Tanaka[1] (1. Hokkaido university graduate school of medicine (Japan))

[P1-05]

Temporally distorted cortical neural dynamics of explicit timing following cerebellar dysfunction

*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))

[P1-06]

Entrainment of periodic neural activity for rhythmic temporal prediction may involve cerebellar learning

*Ken-ichi Okada[1], Masaki Tanaka[1] (1. Hokkaido Univ. (Japan))

[P1-07]

Disentangling spatiotemporal correlates of time cognition: an ongoing investigation of the effects of cognitive aging and depressive symptoms

*Giulia Buzi[1], Florentine Fricker[1], Laura Masson[1], Francis Eustache[1], Thomas Hinault[1] (1. (1)Normandy Univ, UNICAEN, PSL Université Paris, EPHE, Inserm, U1077, CHU de Caen, Centre Cyceron, Neuropsychologie et Imagerie de la Mémoire Humaine, 14000 Caen, France. (France))

[P1-08]

Comparing Neural Oscillations During Cued and Uncued Rhythmic Movement Using Simultaneous Intracranial Basal Ganglia and Cortical Recordings: An Ongoing Study

*Bar Yosef[1], Jingtong Lin[1], Ausaf Bari[1], Kathryn Cross[1] (1. University of California, Los Angeles (United States of America))

[P1-09]

Temporal Expectation and Dopamine: Insights from Omission Oddball Paradigm in Rats

*Riko Iizuka[1], Ryotaro Yamaki [1], Tomoyo Shiramatsu-Isoguchi[1], Shota Morikawa [2], Yuji Ikegaya [3], Hirokazu Takahashi [1] (1. Graduate School of Information Science and Technology, The University of Tokyo (Japan), 2. Graduate School of Science and Faculty of Science, University of Tokyo (Japan), 3. Graduate School of Pharmaceutical Sciences & Faculty of Pharmaceutical Sciences, The University of Tokyo (Japan))

[P1-10]

Effects of voluntary actions on temporal preparation in different temporal contexts: an ongoing study.

*Alexandre de Pontes Nobre[1], André Mascioli Cravo[1] (1. Center for Mathematics, Computing and Cognition, Federal University of ABC. (Brazil))

[P1-11]

Time, space and Temporal momentum: an online replication and beyond

*Mario Bonato[1], Manuel Vencato[1], Mariagrazia Ranzini[1], Marco Zorzi[1,2] (1. Department of General Psychology, University of Padua, Italy (Italy), 2. IRCCS San Camillo Hospital, Lido Venice (Italy))

[P1-12]

Temporal competition and temporal promotion effects of visual arousal on visual search task

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

[P1-13]

Emotional Modulation of Time: The Role of Arousal, Valence, and Subjective Activation in an Immersive VR

*Luigi Micillo[1], Nicola Cellini[1], Jacopo Barbiero[1], Fiorella Del Popolo Cristaldi[1], Giovanna Mioni[1] (1. Department of General Psychology - University of Padova (Italy))

[P1-14]

Aggression May Accelerate Passage of Time Regardless of Physiological Arousal

*Ryohei Mimura[1,2], Makoto Ichikawa[1] (1. Chiba University (Japan), 2. Hyogo prefectural police H.Q. (Japan))

[P1-15]

Learning to feel vibrations: Associatively learned boredom but not stress modulates time perception

*Müge Cavdan[1], Bora Celebi[1], Knut Drewing[1] (1. Justus Liebig University Giessen (Germany))

[P1-16]

Behavioral Evidence for Precision-Weighted Prediction Updating in the Sub-Second Range: A Pilot Study

*Maki Uraguchi[1], Hideki Ohira[1] (1. Nagoya University (Japan))

[P1-17]

Investigating the Modulation of Prior Formation in a Multisensory 2AFC Temporal Judgment Task

*Natsuki Ueda[1], Mitsunari Abe[1] (1. National Center of Neurology and Psychiatry (Japan))

[P1-18]

Modelling timing processes in motor imagery

*Ladislas Nalborczyk[1], Camille Grasso[2] (1. Aix Marseille Univ, CNRS, LPL (France), 2. Cognitive Neuroimaging Unit, CEA DRF/I2BM, INSERM, Université Paris-Sud, Université Paris-Saclay, NeuroSpin Center, Gif/Yvette (France))

[P1-19]

Characterising the spatial and temporal neural dynamics of temporal predictions in audition

*Clara Driaï-Allègre[1,2], Sophie Herbst[1] (1. Cognitive Neuroimaging Unit, INSERM, CEA, NeuroSpin (France), 2. Université Paris-Saclay (France))

[P1-20]

Beyond probability: Temporal prediction error shapes performance across development

*LOUIS-CLÉMENT DA COSTA[1], Sylvie Droit-Volet[2], Katherine Johnson[3], Jennifer T Coull[1] (1. CRPN, CNRS and AMU, UMR 7077, Marseille (France), 2. CNRS and Université Clermont Auvergne, UMR 6024, Clermont-Ferrand (France), 3. Melbourne School of Psychological Sciences, Melbourne (Australia))

[P1-21]

Interaction between timing, stimulus control of light and sound, and its effects on anticipatory responses in multiple and mixed fixed interval schedules in rats (Preliminary Results)

*Paulina Citlali Montoya Barragán[1], Heber Zapata[2], Jonathan Buriticá[1] (1. CEIC, UDG (Mexico), 2. UACH (Mexico))

[P1-22]

How ensemble temporal statistics influence duration perception of visual events

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

[P1-23]

Temporal Reward Prediction in the Visual Corticostriatal Circuit

*Rebekah Yidan Zhang[1,2], Lianne Saussy[1], Marshall Hussain Shuler[1,2] (1. Johns Hopkins University (United States of America), 2. Kavli Neuroscience Discovery Institute (United States of America))

[P1-24]

Exploring the effects of rhythmic vibratory stimuli on time perception

*Yoshihiko Watanabe[1], Sae Kaneko[2] (1. Graduate School of Humanities and Human sciences, Hokkaido University (Japan), 2. Faculty of Humanities and Human Sciences, Hokkaido University (Japan))

[P1-25]

How facial features affect time perception: from the perspective of race and eye contact.

*Yuki Ogawa[1], Yusuke Moriguchi[2], Mitsuhiko Ishikawa[1] (1. Hitotsubashi University (Japan), 2. Kyoto University (Japan))

[P1-26]

Seeking the internal clock: Does the modality effect exist in retrospective timing and if so, is it multiplicative as in prospective timing?

*Ruoyu Zhang[1], Luke Jones[1], Ellen Poliakoff[1] (1. the University of Manchester (UK))

[P1-27]

The Interaction Between Timing, Impulsive Choice, and Risk Taking in Children with ADHD: Exploring the Role of Pharmacological Treatment

*Gloria Ochoa-Zendejas[1], Ivette Vargas-de la Cruz[2], Cristiano Valerio dos Santos[3], Jonathan Buriticá[1] (1. Lab. of Cognition and Comparative Learning, Univ. of Guadalajara-CEIC, Guadalajara. (Mexico), 2. Universidad de Guadalajara, Departamento de Neurociencias, Centro Universitario de Ciencias de la Salud (Mexico), 3. Universidad de Guadalajara, Centro de Estudios e Investigaciones en Comportamiento (Mexico))

[P1-28]

Assessing domain-generality of temporal metacognition: behavioral and electrophysiological insights

*Nathalie Pavailler[1], Antoine Vaglio[1], Nathan Faivre[3], Tadeusz Kononowicz[2], Virginie van Wassenhove[1] (1. CEA/DRF/Inst. Joliot, NeuroSpin; INSERM, Cognitive Neuroimaging Unit; Université Paris-Saclay, Gif/Yvette, 91191 (France), 2. Université Paris-Saclay, CNRS, Institut des Neurosciences Paris-Saclay (NeuroPSI), 91400 Saclay (France), 3. Université Grenoble Alpes, Université Savoie Mont Blanc, CNRS, LPNC, Grenoble (France))

[P1-29]

Retrieving sequence of duration(s) from working memory

*Yunyun SHEN[1], Sophie K Herbst[1], Virginie van Wassenhove[1] (1. CEA, DRF/Joliot, NeuroSpin; INSERM, Cognitive Neuroimaging Unit; CNRS; Université Paris-Saclay, F-91191 Gif/Yvette, France (France))

[P1-30]

Investigating heart–eye coupling during active visual search in early infancy: a planned study

*Akane Hisada[1], Tomoko Isomura[1] (1. Nagoya University (Japan))

[P1-31]

Temporal Binding and Sense of Agency in Oculomotor Control

*Lynn Huestegge[1], Julian Gutzeit[1] (1. University of Wuerzburg (Germany))

[P1-32]

What’s the difference between a premature and a timed anticipatory movement ?

*Marcus Missal[1], Dominika Drazyk[1] (1. Université catholique de Louvain, Institute of Neuroscience (Belgium))

[P1-33]

Revealing rhythm categorization in human brain activity

*Tomas Lenc[1,2], Francesca M. Barbero[2], Nori Jacoby[3,4], Rainer Polak[5,6], Manuel Varlet[7], Nicola Molinaro[1,8], Sylvie Nozaradan[2,9] (1. Basque Center on Cognition, Brain and Language (BCBL), Donostia-San Sebastian (Spain), 2. Institute of Neuroscience (IoNS), University of Louvain (UCLouvain), 1348 Louvain-la-Neuve (Belgium), 3. Computational Auditory Perception Group, Max Planck Institute for Empirical Aesthetics, Grüneburgweg 14, 60322 Frankfurt am Main (Germany), 4. Department of Psychology, Cornell University, Ithaca, NY 14853 (United States of America), 5. RITMO Centre for Interdisciplinary Studies in Rhythm, Time and Motion, University of Oslo (Norway), 6. Department of Musicology, University of Oslo (Norway), 7. The MARCS Institute for Brain, Behaviour & Development, Western Sydney University, Sydney (Australia), 8. Ikerbasque, Basque Foundation for Science, 48009 Bilbao (Spain), 9. International Laboratory for Brain, Music and Sound Research (BRAMS), Montreal (Canada))

[P1-34]

Memory traces of duration and location in the right intraparietal sulcus

*Martin Riemer[1], Thomas Wolbers[2], Hedderik van Rijn[3] (1. Technical University Berlin (Germany), 2. DZNE Magdeburg (Germany), 3. University of Groningen (Netherlands))

[P1-35]

Neural Correlates of Perceptual Biases in Visual Duration Estimation

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

[P1-36]

Uncovering the neuroanatomical substrates of impulsive behaviour induced by the temporal predictability of events: an fMRI-EMG investigation

*Inga Korolczuk[1,2], Boris Burle[2], Bruno Nazarian[3], Marion Royer D'Halluin[2,4,5], Franck Vidal[4], Jennifer T Coull[2] (1. Department of Psychology, Medical University of Lublin (Poland), 2. Centre for Research in Psychology and Neuroscience (UMR7077), Aix-Marseille University & CNRS (France), 3. Aix-Marseille Université, UMR 7289 CNRS, Institut de Neurosciences de la Timone, Marseille, Provence-Alpes-Côte d'Azur, 13005, France (France), 4. CHU Sainte-Justine Research Center, Montréal, Québec, Canada (Canada), 5. Department of Neurosciences, Université de Montréal, Montréal, Québec, Canada (Canada))

[P1-37]

Basic mechanism underlying the audio-visual temporal recalibration for the long stimuli

*Yaru Wang[1], Makoto Ichikawa[1] (1. Chiba University (Japan))

[P1-38]

Understanding Discomfort Caused by Audiovisual Temporal Asynchrony: Insights from Egg Cracking and Grissini Breaking Videos

*Mayuka Hayashi[1], Waka Fujisaki[1] (1. Japan Women's Univ. (Japan))

[P1-39]

Unconscious motor–visual temporal recalibration occurs in both active and passive movements

*Masaki Tsujita (Faculty of Child Studies, Kamakura Women's University)

[P1-40]

The sound octave equivalence in a songbird as shown by the event-related brain potentials and the operant behavior.

*Rin Ito[1], Yukino Shibata[1,2], Kazuo Okanoya[1] (1. Teikyo University, 2. Hokkaido University)

TRF

Fri. Oct 17, 2025 1:20 PM - 5:00 PM JST | Fri. Oct 17, 2025 4:20 AM - 8:00 AM UTC TCVB tour

[T03] Tokyo River Cruise & Hamarikyu Gardens

TRF | Other

Fri. Oct 17, 2025 10:45 AM - 11:00 AM JST | Fri. Oct 17, 2025 1:45 AM - 2:00 AM UTC Room 1(Mathematical Science Building)

[T00] Opening Remarks

Yuko Yotsumoto

Invited | Timing & Time Perception

Fri. Oct 17, 2025 11:00 AM - 12:00 PM JST | Fri. Oct 17, 2025 2:00 AM - 3:00 AM UTC Room 1(Mathematical Science Building)

[K1] Keynote : Kalanit Grill-Spector

Chair:Domenica Bueti(International School for Advanced Studies (SISSA))

A key goal of cognitive neuroscience is to generate an understanding of the functional neuroanatomy of cortical systems. fMRI and computational modeling have transformed our understanding of the human brain. In the visual system, modeling population receptive fields (pRF) led to discoveries of multiple maps of pRF eccentricity, polar angle, and size as well as explained cognitive phenomena like spatial attention and the face inversion effect. However, due to the low temporal resolution of fMRI and the low spatial resolution of EEG/MEG it is unknown what is the nature of spatiotemporal computations in the human brain
Using computational encoding models and the visual system as a model system, I will describe recent empirical and computational innovations that have advanced understanding of key cognitive neuroscience questions. Specifically, I will describe a new empirical and computational framework for estimating from fMRI data the spatiotemporal population receptive field (st-pRF) of each voxel in the visual system in units of visual degrees and milliseconds. I will start by showing how we tested and validated the sp-pRF framework vs. ground truth data. Then, we use this framework to elucidate the spatiotemporal computations across the human visual system for the first time, finding that spatial and temporal windows as well as compressive nonlinearities increases systematically across the visual hierarchy. With this understanding in hand, we then assess how simple, bottom-up computations by st-pRFs may affect visual capacity and explain elusive phenomena like why neural responses are suppressed when multiple visual stimuli are presented at once compared to one after the other in sequence. I will end by the discussing the relevance of this powerful spatiotemporal pRF framework for understanding other sensory and cognitive systems in the brain.

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

[K1-01]

Understanding cognitive processing in the human visual system using spatiotemporal population receptive fields

*Kalanit Grill-Spector[1] (1. Stanford University (United States of America))

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*Kalanit Grill-Spector[1]

1. Stanford University

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Keywords: Computational Modeling, Human Visual System, Spatiotemporal Population Receptive Fields

Symposium | Mammalian Brain

Fri. Oct 17, 2025 9:00 AM - 10:30 AM JST | Fri. Oct 17, 2025 12:00 AM - 1:30 AM UTC Room 1(Mathematical Science Building)

[S1] Symposium 1 :Time and Rhythm in the Mammalian Brain

Chair:Sonja Kotz(Maastricht University), Teresa Raimondi (Sapienza University of Rome)

Time and rhythm, the structured recurrence of events in time, orchestrate multiple functions in animal and human life, from oscillations in physiology, to gait patterning and social interaction. Despite their central role, the biological roots and evolution of time and rhythmicity remain only partially understood. This symposium will illuminate time and rhythm's multifaceted nature through an integrative, comparative framework, bridging proximate mechanisms and evolutionary explanations.
A central premise is that time and rhythm are not unitary phenomena but units of dissociable behavioral and neural modules. A comparative approach can dissect time and rhythm into components and trace their presence across taxa. Identifying homologies and analogies in temporal and rhythmic behavior allows reconstruction of their phylogenetic history and evolutionary significance.
However, isolated top-down (neurobiological) and bottom-up approaches have limitations. Top-down approaches identify brain modules enabling time and rhythm but are often ecologically limited and invasive. Bottom-up approaches detail observable output and ecological relevance but are a "black box" regarding proximate evolutionary causes, challenging phylogenetic tracing.
This symposium advocates for an integrative approach synthesizing both perspectives. Non-human animal models can reveal proximate neural and physiological mechanisms and ultimate causes (e.g., ecological pressures, communication, social dynamics) shaping the evolution of time and rhythm. Rodents and primates offer insights into convergent and divergent temporal and rhythmic behavior via phylogenetic and ethological proximity, respectively.
With this symposium, we pursue the following key objectives:
1. Fostering Interdisciplinary Dialogue: To bring together leading researchers from diverse fields including cognitive neuroscience, neurophysiology, comparative psychology, and ethology in a dialogue between mechanistic and evolutionary viewpoints.
2. Reviewing Current Advances: To provide a comprehensive overview of the most recent and innovative advances in experimental paradigms that link observed behavior to underlying brain activity across a wide range of species.
3. Catalyzing Future Research: To identify and catalyze promising new research directions and methodologies by highlighting both the conserved and unique aspects of timing and rhythmicity across different species.
4. Constructing a Comprehensive Framework: To collaboratively construct a more comprehensive and biologically grounded framework for understanding time and rhythm by recognizing their inherent architecture, remarkable evolutionary plasticity in response to diverse selective pressures, and fundamental role in coordinating the lives of animals, including humans.

9:00 AM - 9:30 AM JST | 12:00 AM - 12:30 AM UTC

[S1-01]

Time and Rhythm in the Mammalian Brain

*Sonja A Kotz[1], Teresa Raimondi[2] (1. Maastricht University (Netherlands), 2. Sapienza University of Rome (Italy))

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

[S1-02]

Tick-Tock Across Species: Comparative timing in audition

*Sonja A Kotz[1] (1. Maastricht University (Netherlands))

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

[S1-03]

When reward is right, macaques can have rhythm

*Hugo Merchant[1], Ameyaltzin Castillo-Almazán[1], Pablo Márquez[1], Vani Rajendran[1] (1. Instituto de Neurobiologia, UNAM, campus Juriquilla (Mexico))

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

[S1-04]

Rhythmic synchronization ability of rats

*Reo Wada[1], Hiroki Koda[1] (1. The University of Tokyo (Japan))

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

[S1-05]

Emergence of rhythm during sequential tapping in chimpanzees and humans

*Yuko Hattori[1] (1. Kyoto University (Japan))

Time and Rhythm in the Mammalian Brain

*Sonja A Kotz[1], Teresa Raimondi[2]

1. Maastricht University, 2. Sapienza University of Rome

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Keywords: Time, Rhythm, Synchronization, Oscillation, Evolution

Tick-Tock Across Species: Comparative timing in audition

*Sonja A Kotz[1]

1. Maastricht University

Exploring basic timing and subjective rhythms comparatively is crucial for understanding the neural mechanisms underlying auditory processing and cognition. Our studies reveal that even at a fundamental level (auditory thalamus, MGB), the processing of temporal regularity aligns in rats and humans, highlighting the MGB’ s importance in adaptive auditory filtering of spectrotemporal signal quality. Furthermore, comparative research between macaques and humans demonstrates shared neural oscillations for tracking, anticipating, and attending to temporal regularities, suggesting a conserved evolutionary basis for this ability. Investigating these basic timing mechanisms and their potential link to subjective rhythmic experiences therefore can illuminate the evolution of complex cognitive functions related to temporal processing across species.

Keywords: evolution

When reward is right, macaques can have rhythm

*Hugo Merchant[1], Ameyaltzin Castillo-Almazán[1], Pablo Márquez[1], Vani Rajendran[1]

1. Instituto de Neurobiologia, UNAM, campus Juriquilla

A large set of new behavioral and electrophysiological studies support the notion that monkeys are not only able to perceive and synchronize to an isochronous metronome but also to more complex inputs. EEG studies in the Rhesus monkey have shown that macaques produce evoked potentials linked to subjectively accented 1:2 and 1:3 rhythms from auditory metronomes. In addition, monkeys trained on tapping tasks can flexibly and predictively produce periodic intervals in synchrony with auditory and visual metronomes, can continue tapping without sensory cues, and can even consistently tap to the subjective beat of music excerpts.
Hence, macaques extract a rhythm from a continuous stream of sensory events, generate an internal rhythmic signal that predicts future beat events, and produce anticipatory motor commands such that movements slightly anticipate the next rhythm. Crucially, reward is a fundamental element so that monkeys can properly drive their predictive abilities within these tasks.

Keywords: rhythm, macaques

Rhythmic synchronization ability of rats

*Reo Wada[1], Hiroki Koda[1]

1. The University of Tokyo

Studying how animals perceive and respond to rhythm is important for understanding the evolutionary origins of musical abilities. Rhythmic synchronization, where animals coordinate their movements with a rhythmic stimulus, is one way to examine rhythmic cognition and is thought to be accompanied by vocal learning ability. Recent studies suggest possible rhythmic synchronization in rats, a non-vocal learning animal, but different tasks and limited findings make species comparisons difficult. Here, we employed an approach similar to that for other species and investigated whether rats also spontaneously synchronize their tapping with a rhythmic auditory stimulus. The results showed that rats responded synchronously to stimulus presentation in the fast-tempo condition. This finding suggests that non-vocal learning species, such as rats, can synchronize external rhythm only when the tempo of the rhythm is close to the tempo of their movement.

Keywords: Rhythmic synchronization, rats

Emergence of rhythm during sequential tapping in chimpanzees and humans

*Yuko Hattori[1]

1. Kyoto University

Both humans and non-human animals are known to spontaneously generate motor rhythms when controlling temporally sequential movements, such as walking or speaking. However, most previous studies on motor-related rhythms have primarily focused on externally guided synchronization, leaving the properties of rhythms that emerge spontaneously during motor learning, especially in non-human animals, largely unexplored.
In this study, I examined the spontaneous generation of motor rhythms in chimpanzees and humans as they learned to perform sequential key-tapping tasks. By comparing the rhythmic characteristics between the two species, I aim to shed light on the evolutionary pathway of rhythm generation abilities during motor learning and explore uniquely human mechanisms underlying this capacity.

Keywords: chimpanzees, tapping

Symposium | Healthy and Pathological Aging

Fri. Oct 17, 2025 5:15 PM - 6:45 PM JST | Fri. Oct 17, 2025 8:15 AM - 9:45 AM UTC Room 3(East B1)

[S3] Symposium 3: Towards a comprehensive understanding of time processing changes in healthy and pathological aging

Chair:Thomas Hinault(INSERM)

Time processing, the ability to process and memorize temporal information, is essential for cognitive functioning and supports the seamless execution of many of life’s daily tasks. While cognitive aging is typically associated with changes in attention and memory, mounting evidence indicates distinct alterations in time processing in older age. These changes in time processing are exacerbated in pathological aging, including neurodegenerative conditions such as Alzheimer’s disease and semantic dementia.
Research exploring interindividual differences in time processing with advancing age, and their underlying neural substrates, are crucial to inform our understanding of trajectories of healthy aging, as well as to improve the early detection of neurodegenerative disorders. Moreover, understanding the cognitive mechanisms driving age-related changes in time processing has the potential to improve our capacity to intervene and support older individuals to live well. In turn, investigating healthy and pathological aging trajectories can inform current neurocognitive models of time processing.
To address these questions, this symposium brings together a panel of diverse speakers from three different countries who will discuss recent developments in the cognitive neuroscience of time processing. Our objective is to provide a comprehensive overview of the neurocognitive mechanisms underpinning altered time processing in healthy and pathological aging, and to promote multidisciplinary collaboration to inspire new directions for future research.

5:15 PM - 5:30 PM JST | 8:15 AM - 8:30 AM UTC

[S3-01]

Towards a comprehensive understanding of time processing changes in healthy and pathological aging

*Thomas Thierry Hinault[1] (1. U1077 Inserm (France))

5:30 PM - 5:45 PM JST | 8:30 AM - 8:45 AM UTC

[S3-02]

Aging effects on the neural bases of temporal processing

*Thomas Thierry Hinault[1] (1. U1077 Inserm (France))

5:45 PM - 6:00 PM JST | 8:45 AM - 9:00 AM UTC

[S3-03]

Electrophysiological signature of explicit and implicit timing in young and older adults

*Giovanna Mioni[1], Fiorella del Popolo Cristaldi[1], Luigi Micillo[1], Nicola Cellini[1] (1. Department of General Psychology, University of Padova (Italy))

6:00 PM - 6:15 PM JST | 9:00 AM - 9:15 AM UTC

[S3-04]

Time processing in prodromal stages of Alzheimer’s Disease

*Alice Teghil[1] (1. Sapienza University of Rome (Italy))

6:15 PM - 6:30 PM JST | 9:15 AM - 9:30 AM UTC

[S3-05]

Temporal processing disturbances in the dementias – from mechanisms to management

*Muireann Irish[1] (1. The University of Sydney (Australia))

Towards a comprehensive understanding of time processing changes in healthy and pathological aging

*Thomas Thierry Hinault[1]

1. U1077 Inserm

Time processing, the ability to process and memorize temporal information, is essential for cognitive functioning and supports the seamless execution of many of life’s daily tasks. While cognitive aging is typically associated with changes in attention and memory, mounting evidence indicates distinct alterations in time processing in older age. These changes in time processing are exacerbated in pathological aging, including neurodegenerative conditions such as Alzheimer’s disease and semantic dementia.

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Keywords: Cognitive Aging, Alzheimer’s disease, Mental time travel, Duration Processing, EEG

Aging effects on the neural bases of temporal processing

*Thomas Thierry Hinault[1]

1. U1077 Inserm

While behavioral studies have been conducted to specify age-related changes of time perception and the temporal structuration of memory content, the neural bases underlying these changes remain unknown. The TIMES project is currently investigating age-related changes in the neural mechanisms underlying temporal processing using simultaneous electroencephalography and functional magnetic resonance imaging (EEG-fMRI), in healthy young (20-35 years) and healthy older participants (60-75 years). In this talk, I will present preliminary results showing that individual levels of fronto-parietal theta-gamma synchrony are associated with the activity of the striatum and fronto-striatal functional connectivity couplings. These fronto-parietal theta-gamma couplings show a greater variability as a function of decreased striatal activity in older adults. By applying multiscale modelling to investigate network dynamics association with temporal processing, new insights can be obtained on both the evolution of the neural bases of temporal processing with advancing age and the heterogeneity of aging trajectories across individuals.

Keywords: aging

Electrophysiological signature of explicit and implicit timing in young and older adults

*Giovanna Mioni[1], Fiorella del Popolo Cristaldi[1], Luigi Micillo[1], Nicola Cellini[1]

1. Department of General Psychology, University of Padova

Age-related changes in temporal processing are widely reported, but it remains debated whether they result from a slowing of temporal processing or reduced cognitive functioning in older adults. This study examined electrophysiological signatures of explicit and implicit timing using EEG, focusing on CNV, N1/P2 amplitude, and beta band modulation. Young and older adults (N = 26) completed time bisection (explicit) and foreperiod (implicit) tasks. Results showed no significant CNV or N1/P2 differences between tasks in older adults. However, younger adults exhibited larger CNV amplitudes than older adults for supra-second intervals in the explicit task and for all intervals in the implicit task.
Additionally, younger participants showed greater beta desynchronization for all intervals in the implicit task. These findings suggest age-related differences in temporal processing, with younger adults displaying stronger neural engagement, particularly in implicit timing.

Keywords: aging, EEG

Time processing in prodromal stages of Alzheimer’ s Disease

*Alice Teghil[1]

1. Sapienza University of Rome

While impaired time processing is common in Alzheimer’ s Disease (AD), research on duration perception in early disease stages, such as Mild Cognitive Impairment (MCI), has yielded mixed results.
In this talk, I will present evidence that subtle alterations in duration processing may occur early in AD, as reduced performance in retrospective timing and temporal learning tasks already emerges in MCI. Differences in timing performance relative to healthy older adults are also found in Subjective Cognitive Decline (SCD), a preclinical phase of AD characterized by a self-perceived change in cognitive performance not revealed by neuropsychological tests. Recent results show that changes in duration processing in SCD are further modulated by the level of cognitive complaint, and are paralleled by time-dependent alterations in autobiographical memory. Findings shed light on factors underlying altered time perception in prodromal AD, and on the contribution of duration processing to episodic features of memory.

Keywords: Alzheimer’ s Disease

Temporal processing disturbances in the dementias –from mechanisms to management

*Muireann Irish[1]

1. The University of Sydney

Humans possess the remarkable capacity to navigate mentally through extended periods of subjective time. This capacity bestows immense flexibility in our thinking, enabling us to revisit events from the past via autobiographical memory, or to project oneself into the future via episodic foresight. There is now abundant evidence to indicate that these temporally extended voyages across past and future contexts are compromised in neurodegenerative disorders, reflecting the breakdown of large-scale brain networks implicated in memory, planning, and executive function. In this talk, I will provide an overview of mental time travel disturbances in frontotemporal dementia, semantic dementia, and Alzheimer’s disease, paying particular attention to their respective underlying neurocognitive mechanisms. I will demonstrate how mental time travel disturbances likely represent a transdiagnostic feature of dementia, and how we can use this information to support many of the behavioural and functional impairments experienced by patients in their daily lives.

Keywords: Alzheimer’s disease

Symposium | Temporal Metacognition

Fri. Oct 17, 2025 9:00 AM - 10:30 AM JST | Fri. Oct 17, 2025 12:00 AM - 1:30 AM UTC Room 2(West B1)

[S2] Symposium 2: Watching the Clock Err: Different Levels of Explanation for Temporal Metacognition

Chair:Tutku Oztel(George Mason University)

Recent studies have demonstrated that the scope of the metacognitive abilities can be expanded to time and other metric domains, reflected in a trial-by-trial match between timing errors and error monitoring components. This reveals a robust temporal error monitoring ability that can also be observed in numerosity and spatial forms. The symposium aims at providing an extensive discussion on different levels of explanation of temporal error monitoring by bringing together speakers that employ diverse methodologies in humans, rodents, and computational modeling.

The first speaker will discuss how different methodological approaches can capture differential cognitive/phenomenological aspects of the metric error monitoring ability and shed light into our understanding of it at the cognitive level. The second speaker will discuss how this ability takes place at the computational level along with providing insights on its manifestation in mouse behavior. The last speaker will discuss how domain generality of temporal error monitoring can be investigated with motor action taking along with its physiological markers. While aiming at providing different methodological and theoretical approaches for the study of temporal error monitoring, this symposium series would be of particular interest for all researchers who aim to study time perception and magnitude representations at the consciousness level.

9:00 AM - 9:30 AM JST | 12:00 AM - 12:30 AM UTC

[S2-01]

Watching the Clock Err: Different Levels of Explanation for Temporal Metacognition

*Tutku Oztel[1] (1. George Mason University (United States of America))

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

[S2-02]

Cognitive Architecture Through Methodological Lenses: Understanding Temporal Error Monitoring

*Tutku Oztel[1] (1. George Mason University (United States of America))

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

[S2-03]

“Catching yourself trip” on timing errors

*Fuat Balci[1] (1. University of Manitoba (Canada))

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

[S2-04]

Exploring the Domain-Generality of Temporal Metacognition: From introspective reaction time to confidence in explicit timing

*Nathalie Pavailler[1] (1. CEA/DRF/Inst. Joliot, NeuroSpin; INSERM, Cognitive Neuroimaging Unit; Université Paris-Saclay, Gif/Yvette, 91191 France (France))

Watching the Clock Err: Different Levels of Explanation for Temporal Metacognition

*Tutku Oztel[1]

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Keywords: Temporal Error Monitoring, Metacognition, Time Perception, Levels of Processing

Cognitive Architecture Through Methodological Lenses: Understanding Temporal Error Monitoring

*Tutku Oztel[1]

1. George Mason University

Recent research indicates that error monitoring abilities extend to the metric domains of time, space, and number. In this talk, I will discuss our current understanding of metric/temporal error monitoring (TEM) by elucidating how diverse methodologies shape it.
First, I will focus on explicit measures of assessing TEM, delineating online and offline measurement. I will first discuss the discovery of phenomenological dissociation of timing error magnitude and direction within online measures. I will then identify key factors for monitoring cumulative timing errors within offline measures. Next, I will elaborate on TEM's application to non-motor timing, discussing how non-motor temporal biases are represented on a hypothetical mental timeline in temporal order judgment and why contextual temporal biases are exempt from metacognitive monitoring. Finally, I will address implicit indications of TEM through Bayesian integration of social cues in numerosity estimation. I will conclude by discussing implications for future investigations of TEM.

Keywords: Temporal Error Monitoring

“Catching yourself trip” on timing errors

*Fuat Balci[1]

1. University of Manitoba

Recent evidence shows that humans and rats can monitor their timing errors, namely “temporal error monitoring”. In the first part of this talk, I will present new evidence corroborating these observations in two mice studies. First study shows monitoring of temporal control, forming a rudimentary temporal error monitoring. The second study demonstrates a refined magnitude-based error monitoring. Together, these results demonstrate the nested architecture of temporal awareness. Next, I will present two drift-diffusion models of temporal error monitoring. First model affords the etrospective detection of timing errors, whereas the second model reads out and anticipates timing errors. Notably, second model affords the translation of real-time error signals into improved timing without violating psychophysical features of timing behavior. Finally, the task representation dependency of the refinement element accounts for the widely reported reward-rate maximizing timing behavior. Ultimately, this talk signifies the maturing empirical and theoretical scenery in temporal error monitoring research.

Keywords: Temporal Error Monitoring

Exploring the Domain-Generality of Temporal Metacognition: From introspective reaction time to confidence in explicit timing

*Nathalie Pavailler[1]

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

Temporal metacognition refers to the ability to monitor and evaluate timing-related processes but whether this type of metacognition is domain-general or domain-specific is unknown. To address this question, I will present two different lines of work. In the first one, we investigated introspective reaction time (iRT) judgments and showed their reliance on multiple sources of information combining direct readouts of mental operations and inferential processes (Pavailler et al, 2025). iRT is postulated to be linked to a generic performance monitoring system, as reflected by the Error-Related Negativity recorded with EEG (Pavailler et al., in prep).
In a second line of work, we used metaperception and developed a confidence forced-choice paradigm (de Gardelle & Mamassian, 2014, 2016) contrasting temporal and visual bisection tasks. I will discuss how these two approaches contribute to a better understanding of whether temporal metacognition relies on specialized or shared cognitive and neural mechanisms.

Keywords: temporal metacognition

Symposium | Temporal Experience

Fri. Oct 17, 2025 5:15 PM - 6:45 PM JST | Fri. Oct 17, 2025 8:15 AM - 9:45 AM UTC Room 2(West B1)

[S4] Symposium 4: The Varieties of Temporal Experience: The Past, Present, and Future of Time Perception Research

Chair:Martin Wiener(George Mason University)

Time is experienced in myriad ways, between periods of high stability and instability, governing the ways in which we experience everyday moments, encode memories, make decisions, plan and organize our thoughts. The time perception researcher is thus faced with a challenge unlike other domains: whence to begin?
At the TRF2 meeting, we held a special event dedicated to the near-term goals of time perception research – the timing "moonshot"; in this symposium, we will bidirectionally extend this horizon to provide an overview of the past, the present, and the future of time perception research. That is, what does the history and emergence of timing research tell us about where it may be headed? What are the challenges, both common to other disciplines and unique to our own, in studying "time"? What answers have we achieved, with the advent of new technologies and recording techniques, and what remains unknown, or unknowable? Each of the four speakers will thus provide their own unique perspective on these questions. Unlike other symposia, the talks will be shorter in length and will be followed by a panel discussion among the speakers with a moderator and questions. The intended audience is early career scientists and students, with the goal being to help guide future inquiries and enable success, whether continuing in time perception research or exploring other domains.

5:15 PM - 5:30 PM JST | 8:15 AM - 8:30 AM UTC

[S4-01]

The Varieties of Temporal Experience: The Past, Present, and Future of Time Perception Research

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

5:30 PM - 5:45 PM JST | 8:30 AM - 8:45 AM UTC

[S4-02]

Is Time Special?

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

5:45 PM - 6:00 PM JST | 8:45 AM - 9:00 AM UTC

[S4-03]

Of time and memory in cognitive neurosciences: how the observer flaws our understanding of time

*Virginie van Wassenhove[1] (1. CEA NeuroSpin; INSERM Unicog; Univ. Paris-Saclay (France))

6:00 PM - 6:15 PM JST | 9:00 AM - 9:15 AM UTC

[S4-04]

Temporality and the brain: the long and winding emergence of time in cognitive neuroscience

*Ayelet N Landau[1,2] (1. Hebrew University of Jerusalem (Israel), 2. University College London (UK))

6:15 PM - 6:30 PM JST | 9:15 AM - 9:30 AM UTC

[S4-05]

Measuring the neural clocks: fifteen years of timing neurophysiology

*Hugo Merchant[1], Germán Mendoza[1], Oswaldo Pérez[1] (1. Instituto de Neurobiologia, UNAM, campus Juriquilla (Mexico))

The Varieties of Temporal Experience: The Past, Present, and Future of Time Perception Research

*Martin Wiener[1]

1. George Mason University

Time is experienced in myriad ways, between periods of high stability and instability, governing the ways in which we experience everyday moments, encode memories, make decisions, plan and organize our thoughts. The time perception researcher is thus faced with a challenge unlike other domains: whence to begin?
At the TRF2 meeting, we held a special event dedicated to the near-term goals of time perception research –the timing “moonshot”; in this symposium, we will bidirectionally extend this horizon to provide an overview of the past, the present, and the future of time perception research. That is, what does the history and emergence of timing research tell us about where it may be headed? What are the challenges, both common to other disciplines and unique to our own, in studying “time”? What answers have we achieved, with the advent of new technologies and recording techniques, and what remains unknown, or unknowable? Each of the four speakers will thus provide their own unique perspective on these questions. Unlike other symposia, the talks will be shorter in length and will be followed by a panel discussion among the speakers with a moderator and questions. The intended audience is early career scientists and students, with the goal being to help guide future inquiries and enable success, whether continuing in time perception research or exploring other domains.

Keywords: Time Perception, Cognitive Neuroscience, History of Timing, Philosophy of Timing

Is Time Special?

*Martin Wiener[1]

1. George Mason University

Is “time” special? The answer to this question may seem obvious to a group of timing researchers at a timing conference, but the importance of a thing can be obscured by its closeness. In this talk, I will provide a reasoned argument for why the study of time is, in fact, special and why researchers can and should focus their attention to how the brain processes and perceives intervals of time. The title of the talk also reflects the internal conflict that many researchers studying time must face: since time is such an omnipresent feature of consciousness, of what use is there in studying it at all? Are we really studying “time”, or are we using temporal behavior to study other phenomena? This talk will lay out that argument and then proceed to counter it with the alternative view that time is, in fact, special.

Keywords: time

Of time and memory in cognitive neurosciences: how the observer flaws our understanding of time

*Virginie van Wassenhove[1]

1. CEA NeuroSpin; INSERM Unicog; Univ. Paris-Saclay

We segment time into past, present, and future, and scale temporal phenomenologies to “now”, a lifetime or universal times. This operationalization provides a practical approach to the study of temporal cognition, but it also suggests that neural systems process information differently when it is available in the present than when it is not. In cognitive neuroscience, this operationalization also divides the study of time into timing research, which focuses on online time perception (the integration of past experiences and prior knowledge to inform expectations and future predictions) and memory research, centered on the reconstruction of past events and foresight or imagination. Interestingly, both approaches require a temporal coordinate system or reference frame for time to enable the flexible mapping of information. Yet neither domain directly tackles the issue. The physical realization of a mental time axis in the brain currently eludes existing frameworks.

Keywords: time perception

Temporality and the brain: the long and winding emergence of time in cognitive neuroscience

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Understanding how our sensory systems generate coherent experiences of the world has been an outstanding quest for centuries. Throughout history, philosophers, biologists, psychologists, and –in the past few decades - cognitive neuroscientists have sought answers to how our brain generates thinking and feeling, behavior, and consciousness. Among the most fundamental aspects of conscious experience is the perception of time. In this talk I will discuss a bias that has characterized this quest: a spatial approach to understanding the neural mechanisms of cognition. I will critically assess this emphasis, offer a historical account, and point to its tacit assumptions and limitations. I will highlight key moments when opportunities to incorporate temporal principles were overlooked. Drawing on recent examples, I will discuss the potential of integrating the temporal domain into our understanding of the brain. Finally, I will show how a temporal prism can illuminate the study of mechanisms of time perception.

Keywords: cognitive neuroscience

Measuring the neural clocks: fifteen years of timing neurophysiology

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During the last fifteen-years many laboratories across the globe have recorded the neural activity of different brain areas during timing tasks, including perceptual or motor paradigms that require processing single intervals or rhythmic sequences. A handful of time-varying signals in the discharge rate of neurons have been identified as potential neural clocks. Here, we show how the neural populations of cells in the medial premotor areas and the putamen encode different timing features during a set of timing tasks, strongly suggesting that neural sequences and state space neural trajectories are the substrate of timing and that these signals are interacting dynamically with other sensory and motor execution neural responses of the timing tasks. We are also discussing how this interval timing information needs to be integrated with the incoming neural signals of primary sensory areas to generate efficient loops, especially in rhythmic tasks.

Keywords: neural correlates

Oral | Timing & Time Perception

Fri. Oct 17, 2025 1:00 PM - 2:30 PM JST | Fri. Oct 17, 2025 4:00 AM - 5:30 AM UTC Room 3(East B1)

[O1] Oral 1: Timing & Time Perception

Chair:Nedim Goktepe(INM- Leibniz Institute for New Materials)

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

[O1-01]

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 (Brazil), 2. Center for Mathematics, Computing and Cognition, Federal University of ABC (UFABC), São Paulo, Brazil (Brazil))

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

[O1-02]

Causality Judgments and temporal order in individuals with Schizophrenia: a new case of time re-ordering

*Anne Giersch[1,2], Brice Martin[4,3], Cristina Rusu[1,2], Hager Guendouze[1,2] (1. INSERM (France), 2. University of Strasbourg (France), 3. Hôpital du Vinatier, Lyon (France), 4. Centre Hospitalier Drôme Vivarais (France))

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

[O1-03]

The human propensity for regularity extraction requires us to reconsider how we construct randomly timed stimuli

*Jelle van der Werff[1], Tommaso Tufarelli[1], Laura Verga[1], Andrea Ravignani[1] (1. Sapienza University of Rome (Italy))

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

[O1-04]

Moments or Continuum? Testing the Temporal Resolution of Human Anticipation

*GEORGIOS MICHALAREAS[1,2,3], David Poeppel[4], Matthias Grabenhorst[3,2] (1. Cooperative Brain Imaging Center (CoBIC), Goethe University Frankfurt (Germany), 2. Max-Planck-Institute for Empirical Aesthetics, Frankfurt (Germany), 3. Ernst Strüngmann Institute for Neuroscience in Cooperation with Max Planck Society, Frankfurt (Germany), 4. New York University (United States of America))

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

[O1-05]

Spatial tool use modulates time perception in near and far space

*Amir Jahanian-Najafabadi[1], Argiro Vatakis[2], Christoph Kayser[1] (1. Department of Cognitive Neuroscience, Bielefeld University (Germany), 2. Department of Psychology, Panteion University of Social and Political Sciences (Greece))

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

[O1-06]

Generalizing temporal perception in humans: learning transfer across interval categorization and interval identification tasks

*German Mendoza[1], Hugo Rey Andrade-Hernandez[2], Hugo Merchant[1] (1. Instituto de Neurobiología, UNAM (Mexico), 2. Maestría en Ciencias (Neurobiología), UNAM. (Mexico))

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, 2. Tübingen University

Temporal prediction is essential for efficient interaction with our continuously changing environment, but previous research has focused on deterministic contexts such as isochronous rhythms, linking it to Oscillatory Entrainment (OE). However, real-world continuous streams typically lack deterministic temporal regularities (e.g. speech). Temporal prediction in uncertain environments was mostly studied for isolated intervals, supporting a Distributional Learning (DL) process. Whether and how OE or DL mechanisms drive temporal prediction in non-deterministic continuous streams remains unclear. To address this, we combined computational modeling of OE, using a simple harmonic coupled oscillator, and DL, using ideal Bayesian observer, with human behavioral experiments. Model simulations showed that in non-deterministic environments, the greater the temporal variability, the more the predictions and prediction certainties of the two models were differentiated. We designed continuous streams with low (25%) and high (50%) degrees of variability (mean rate = 1.25 Hz), for which the two models led to different predicted timepoints. In a speeded response task, we presented these streams to participants with the targets occurring at either of these predicted timepoints, an intermediate timepoint, or a late timepoint to account for hazard effects. We observed a general reduction in reaction times for later targets (hazard effect), and, critically, additional reduction in the 25% relative to 50% condition, but only for targets presented at the OE-predicted timepoint. This pattern was replicated in a second experiment in which the mean rate of the stream varied between trials (1 or 1.66 Hz), ruling out learning across trials. Overall, our findings highlight the inherent differences between the two mechanisms in handling uncertainty, and reveal the flexibility of OE in adapting to partial irregularities, and its independence from Bayesian DL.

Keywords: Temporal Prediciton, Oscillatory Entrainment, Bayesian Learning, Computational Modelling, Behavioral Study

Causality Judgments and temporal order in individuals with Schizophrenia: a new case of time re-ordering

*Anne Giersch[1,2], Brice Martin[4,3], Cristina Rusu[1,2], Hager Guendouze[1,2]

1. INSERM, 2. University of Strasbourg, 3. Hôpital du Vinatier, Lyon, 4. Centre Hospitalier Drôme Vivarais

Temporal order (TO) helps to establish causal relationships between events, but can also be reversed to match perceived causality. We explored whether mechanisms related with conscious causality-inference can induce TO reversal, by studying the relation between temporal order and causality in both neurotypicals and patients with schizophrenia (SZ). Those patients have difficulties to order events in time and often emit aberrant causality judgements. We adapted our task from the Michotte paradigm to impose distinct causality judgements.
The tasks all entailed the same trials, but different judgements. On each trial a square moved towards a second static square, which was displayed at various delays before or after the stop of the moving square (-512 ms to +512 ms). In one block participants judged to which amount the static square stopped the moving square. In another block participants judged whether the moving square caused the appearance of the static square. In a last temporal order judgement task participants pressed to the side of the first event: the stop of the moving square or the onset of the static square.
Patients with SZ (28 vs. 21 controls) were impaired at judging temporal order. In addition, neurotypicals, but not individuals with SZ, were biased to answer that the onset of the static square was the first event. Follow-up experiments in 54 neurotypicals showed this (large) bias to occur only after decisions about the static square stopping the moving one. Additional data showed the persistence of the bias after one week.

This study confirms a difficulty in temporal order processing in SZ. Most importantly, neurotypicals, but not patients with SZ, adjusted temporal order perception to causality. Given (1) the robustness of this effect, (2) the task-imposed causality (rather than causality emerging naturally), and (3) known impairments in schizophrenia, we suggest that an active re-organization of information in vision leads to temporal re-ordering.

Keywords: Temporal order judgement, causality, visual organization, schizophrenia

The human propensity for regularity extraction requires us to reconsider how we construct randomly timed stimuli

*Jelle van der Werff[1], Tommaso Tufarelli, Laura Verga, Andrea Ravignani[1]

1. Sapienza University of Rome

Rhythm as a concept is notoriously hard to define, yet all definitions seem to presuppose a categorical distinction between rhythm and its converse, temporal randomness. The two are commonly juxtaposed as separate conditions in experiments, where it is sometimes assumed that the conditions are maximally contrastive. However, different methods exist for creating temporal randomness, and so we asked: can humans distinguish between the resulting different types of randomness? And can we mathematically model how they do it?

In a finger-tapping experiment we tested humans' synchronization performance for two types of highly irregular sequences that differed only in the amount of autocorrelation between adjacent intervals. Autocorrelations are often—and sometimes unwittingly—introduced in random sequences as a result of the jittering (i.e. offsetting) of event onsets. To avoid this, one can randomly sample the intervals between event onsets, which does not result in correlated intervals.

Subjects tapped closer to the sequence tempo for event-jittered (autocorrelated) sequences than for interval-sampled (uncorrelated) ones. They also tapped more regularly in response to them. However, they did not tap more accurately for either type. The subjects thus seemed to regularize their taps towards the sequence tempo, leveraging the autocorrelations to improve their tempo estimate.

We then modelled how tempo estimation of random sequences might work for both types of sequences. Using linear statistical estimators we were able to show that the statistical advantage that the autocorrelated intervals brings when estimating tempo occurs after only two or three intervals, and that this advantage stabilizes after that.

When designing experiments, we may need to more carefully consider how temporal randomness is constructed, as temporal randomness does not seem to be unitary entity. Rather, it is a fuzzy set created by artificial methodological choices.

Keywords: temporal randomness, rhythmicity, time perception

Moments or Continuum? Testing the Temporal Resolution of Human Anticipation

*GEORGIOS MICHALAREAS[1,2,3], David Poeppel[4], Matthias Grabenhorst[3,2]

1. Cooperative Brain Imaging Center (CoBIC), Goethe University Frankfurt, 2. Max-Planck-Institute for Empirical Aesthetics, Frankfurt, 3. Ernst Strüngmann Institute for Neuroscience in Cooperation with Max Planck Society, Frankfurt, 4. New York University

When we predict *when* something will occur, do we sweep a continuous timeline or focus on a handful of privileged instants? We addressed this question in a Set-Go paradigm that orthogonally manipulated two factors. First, we shaped the time-to-event (Go-time) probability over a 0.4–1.4s time interval so that it rose linearly, fell linearly, or remained flat. Second, we discretised this time interval into 3, 5, 9, or 15 Go-time sampling points, parameterising temporal granularity from coarse to fine.

Because humans rapidly internalise a probability-density function (PDF)[1] we expected all participants to learn the rising, falling, or flat probability trend. Against this backdrop, three rival hypotheses were tested by the different sampling resolutions.First, according to the **"selective-gain hypothesis"**, widely spaced Go-times—beyond the scalar noise of interval timing (≈10 % of the interval)[2]—allow the brain to spotlight individual time points, yielding faster responses there. In contrast, the **"chunking-cost hypothesis"** suggests that sparse Go-times lead to discrete attentional episodes[3]. Transitioning between these episodes adds cognitive load and slows down responses. Finally, the **"resolution-invariant hypothesis"** proposes that the brain relies solely on the continuous PDF, regardless of sampling resolution[3].

We tested the effect of temporal granularity in both visual and auditory modalities. The results showed that Reaction Times were highly similar across sampling conditions—arguing against selective-gain or chunking processes, in the case of a small number of sampling points. Temporal anticipation was primarily driven by the event probability distribution, highlighting the importance of the macroscale characteristics of event probabilities over their temporal microstructure.

References
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4. A.C. Nobre, F. van Ede, *Nat. Rev. Neurosci.* **19**, 34–48 (2018).

Keywords: Temporal resolution, Anticipation, Event probability, Sampling, Interval timing

Spatial tool use modulates time perception in near and far space

*Amir Jahanian-Najafabadi[1], Argiro Vatakis[2], Christoph Kayser[1]

1. Department of Cognitive Neuroscience, Bielefeld University, 2. Department of Psychology, Panteion University of Social and Political Sciences

In our recent research, we found that time estimation is mildly influenced by spatial distance and tool-use training in both young and older adults, using a visual time reproduction task. These findings supported the notion that time perception is linked to spatial processing and sensorimotor interactions within and beyond the peripersonal space, with effects that appear to be age-dependent. In the present study, we aimed to replicate and extend these findings by investigating whether spatial influences on time perception are task-specific and sensitive to stimulus duration. Twenty young adults performed two temporal judgment tasks (time reproduction, time bisection) before and after tool-use training. During training, participants used a mechanical grabber to grasp and move 100 objects located at a distance of 120 cm toward their body. Time stimuli, consisting of eight durations (2100–2900 ms), were presented at three distances from the body: 60 cm, 120 cm, and 240 cm. In the reproduction task, participants reproduced the durations; in the bisection task, they judged whether durations were shorter or longer than a learned standard. The results revealed consistent underestimation of intervals presented at 60 cm (near space), indicated by a reduced proportion of "long" responses compared to the 120 cm and 240 cm (far space) conditions. This suggests a distance-dependent modulation of perceived time, with time appearing to be perceived as shorter in near space. Notably, tool-use training shifted these baseline biases, indicating that sensorimotor experience can influence temporal judgments across space. These findings reinforce the idea that time perception is not purely internal but is shaped by the spatial context of sensory events and by our capacity to interact with objects in space, suggesting the plasticity of time perception in response to action and space around us.

Keywords: time perception, spatial distance, tool-use training, peripersonal space, action-perception coupling

Generalizing temporal perception in humans: learning transfer across interval categorization and interval identification tasks

*German Mendoza[1], Hugo Rey Andrade-Hernandez[2], Hugo Merchant[1]

1. Instituto de Neurobiología, UNAM, 2. Maestría en Ciencias (Neurobiología), UNAM.

Perceiving the elapse of time in the sub-second to second range is an essential ability of humans and other animal species, yet its neural bases are not well known. Some experimental paradigms have been designed to understand this cognitive function, including interval categorization and identification. The former requires assigning the intervals of a test set to short- or long-duration categories. The latter requires differentiating all the intervals based on their different durations. An intuitive idea is that the brain uses the same neural mechanism to measure time elapsed to solve both tasks. Nevertheless, some neurophysiological observations, including ours, suggest this is not the case. To analyze this possibility, we designed a learning transfer paradigm. One group of participants was intensively trained in identifying each of eight different intervals. Then, it was tested by categorizing the same intervals as short or long before and after the training. Another group was intensively trained in categorizing the intervals and was tested in identifying them before and after the training. We found that participants showed statistical trends and significant changes in performance, reaction time, accuracy, and sensitivity to certain intervals depending on the trained task. The asymmetrical effects suggested differences in the neural mechanisms recruited to categorize and identify intervals. Based on these observations and previous neurophysiological findings in humans and non-human primates, we propose neural mechanisms for interval categorization and identification.

Keywords: timing, categorization, identification, learning transfer, human psychophysics

Oral | Development, Clinical

Fri. Oct 17, 2025 3:30 PM - 5:00 PM JST | Fri. Oct 17, 2025 6:30 AM - 8:00 AM UTC Room 3(East B1)

[O2] Oral 2: Decelopment, Clinical

Chair:Rafael Román-Caballero(Universidad de Granada & McMaster University)

3:30 PM - 3:45 PM JST | 6:30 AM - 6:45 AM UTC

[O2-01]

“Past is Present, and Present is Past for Me": A case report of a 21-year-old female with autism spectrum disorder and enhanced episodic memory

*Ryuta Ochi[1,2], Shigeru Kitazawa[3], Mitsuru Kawamura[2] (1. Department of Psychology, Graduate School of Letters, CHUO University (Japan), 2. Division of Neurology, Department of Internal Medicine, School of Medicine, Showa Medical University (Japan), 3. Dynamic Brain Network Laboratory, Graduate School of Frontier Biosciences, The University of Osaka (Japan))

3:45 PM - 4:00 PM JST | 6:45 AM - 7:00 AM UTC

[O2-02]

Time attitudes and psychological distress: Exploring the interface between temporal representation and affect

*Thiago Bonifácio[1], André Mascioli Cravo[1] (1. Federal University of ABC (Brazil))

4:00 PM - 4:15 PM JST | 7:00 AM - 7:15 AM UTC

[O2-03]

Victims living in the now: A developmental glimpse on time perspectives through a criminological lense

*Sebastian L. Kübel[1,2,3] (1. University of Bern (Switzerland), 2. Max Planck Institute for the Study of Crime, Security and Law (Germany), 3. University of Leiden (Netherlands))

4:15 PM - 4:30 PM JST | 7:15 AM - 7:30 AM UTC

[O2-04]

Visual attention of infants in early interactions: Comparing early processing of music and language

*Rafael Román-Caballero[1,2], Maya Psaris[2], Betania Y. Georlette[3], Mohammadreza Edalati[3], Barbara Tillmann[4], Sahar Moghimi[3], Gabriel (Naiqi) Xiao[2], Laurel J. Trainor[2], Juan Lupiáñez[1] (1. Universidad de Granada (Spain), 2. McMaster University (Canada), 3. Université de Picardie (France), 4. Université de Bourgogne (France))

4:30 PM - 4:45 PM JST | 7:30 AM - 7:45 AM UTC

[O2-05]

Visual causality detection capabilities in individuals treated for prolonged early-onset blindness

*Marin Vogelsang[1], Lukas Vogelsang[1], Priti Gupta[2], Stutee Narang[2], Purva Sethi[2], Suma Ganesh[2], Pawan Sinha[1] (1. MIT (United States of America), 2. Dr Shroff's Charity Eye Hospital (India))

4:45 PM - 5:00 PM JST | 7:45 AM - 8:00 AM UTC

[O2-06]

Performance of late-sighted children on the temporal order judgement task

*Lukas Vogelsang[1], Priti Gupta[2], Marin Vogelsang[1], Naviya Lall[2], Manvi Jain[2], Chetan Ralekar[1], Suma Ganesh[2], Pawan Sinha[1] (1. MIT (United States of America), 2. Dr Shroff's Charity Eye

Hospital (India))

“Past is Present, and Present is Past for Me": A case report of a 21-year-old female with autism spectrum disorder and enhanced episodic memory

*Ryuta Ochi[1,2], Shigeru Kitazawa[3], Mitsuru Kawamura[2]

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Introduction:
Some individuals with Autism Spectrum Disorder (ASD) experience sudden recall of past events, known as the “time-slip phenomenon." This phenomenon has been reported in individuals with ASD who show preserved intellectual function and exceptional memory abilities (Sugiyama 1994, 2016). Here, we report the case of a 21-year-old female with ASD and enhanced episodic memory who exhibited a unique perception of time passage.
Case Information:
The patient was a 21-year-old right-handed university student. She had a history of eating disorders since age 16 and was diagnosed with ASD at 21. Since high school, she had noticed her time perception differed from others. She described two main features: 1) past events appeared as discrete, isolated episodes, not as a continuous flow; and 2) past events felt as if they were occurring in the “present.' She also experienced involuntary, immersive recollections, as if reliving those scenes. Results: Neuropsychological testing revealed above-average intelligence on the WAIS-IV (Full IQ: 136, VCI: 122, PRI: 118, WMI: 131, PSI: 149) and above-average memory performance on the WMS-R (General Memory: 128, Verbal Memory: 128, Visual Memory: 112, Attention: 116, Delayed Recall: 125). In a task requiring memorization of numbers randomly placed in 52 squares (Luria 1968), she encoded them within ten minutes and recalled 85% after one month. In a McTaggart’s A series task (Tang et al. 2021; Futamura et al. under review), she correctly recognized tense differences but classified both past and future sentences as close to the "present," disregarding temporal distance. Discussions:
The patient had difficulty sensing the flow of time and distinguishing past from present. Her strong episodic memory suggests that insufficient forgetting—potentially associated with persistent focus on outdated memories and reduced adaptability (Awasthi et al., 2019)—may also disrupt the normal perception of time passage from past to present.

Keywords: perception of time passage, autism spectrum disorder, episodic memory

Time attitudes and psychological distress: Exploring the interface between temporal representation and affect

*Thiago Bonifácio[1], André Mascioli Cravo[1]

1. Federal University of ABC

This study explored the relationships between time-related attitudes, emotion regulation strategies, and psychological distress in a Brazilian sample (N = 625) using online self-report measures. Participants completed the Adolescent and Adult Time Attitudes Scale, Time Meaning and Metaphors Questionnaires, Regulation of Emotion Systems Survey, and the Depression, Anxiety, and Stress Scale (DASS-21). Bootstrapped correlation analyses showed strong positive associations between negative time attitudes, rumination, and psychological distress, especially depression. Present-negative attitudes were most strongly linked to depressive symptoms ($r = 0.62$, $p < .05$), along with general negative views of time (Meaning: $r = 0.48$; Metaphors: $r = 0.33$; $ps < .05$). In contrast, positive time attitudes correlated negatively with distress and positively with cognitive reappraisal ($r = 0.28$, $p < .05$). Random Forest regression analyses predicted psychological outcomes with modest accuracy: $R^2 = 0.24$ for anxiety (RMSE = 3.57), 0.50 for depression (RMSE = 3.91), and 0.27 for stress (RMSE = 3.46), all outperforming baseline models. Feature importance analyses identified key predictors: For anxiety: past-negative attitudes, age, and negative time metaphors. For depression: present-negative and present-positive attitudes, and general affective time evaluations. For stress: present-negative attitudes, affective time evaluations, and rumination. These results highlight the relevance of time attitudes, especially those related to the present, in the psychological well-being of adults. We suggest that time attitudes likely reflect rather than cause distress. Based on our findings, we propose two hypotheses: (1) the early marker hypothesis, where negative time attitudes may precede other symptoms; and (2) the open-window hypothesis, where time-related attitudes or beliefs offer a less stigmatizing path to early mental health interventions.

Keywords: Time attitudes, Psychological distress, Emotion regulation, Mental health

Victims living in the now: A developmental glimpse on time perspectives through a criminological lense

*Sebastian L. Kübel[1,2,3]

1. University of Bern, 2. Max Planck Institute for the Study of Crime, Security and Law, 3. University of Leiden

The prioritization of the present has for long been considered in Criminology as the most important individual-level predictor of crime. However, time perspectives were proposed as a relatively stable personality trait. Therefore, the discipline has neglected the investigation of factors that shape such a present orientation.

Inspired by current developments in psychology, this work set out to identify environmental factors that contribute to increases in present orientation. This is done using longitudinal data from a big representative sample of Swiss adolescents.

The results identify that victims of violent crimes report more present orientation and decreased future orientation. Mediation analyses show that these changes in time perspective in response to victimization are, in turn, associated with an increased risk to commit crime.

The prioritization of the present can thus explain the prominent criminological observation that victims are more likely to offend themselves. Peer processes following victimization appear to promote the increased focus on the present. Revealing these mechanisms in the development of time perspectives that contribute to crime can inform practical interventions to reduce crime.

Keywords: time perspective, present orientation, development, crime, person-environment interactions, longitudinal structural equation models

Visual attention of infants in early interactions: Comparing early processing of music and language

*Rafael Román-Caballero[1,2], Maya Psaris[2], Betania Y. Georlette[3], Mohammadreza Edalati[3], Barbara Tillmann[4], Sahar Moghimi[3], Gabriel (Naiqi) Xiao[2], Laurel J. Trainor[2], Juan Lupiáñez[1]

1. Universidad de Granada, 2. McMaster University, 3. Université de Picardie, 4. Université de Bourgogne

Given the immature cognitive development of newborns, caregivers naturally engage with them using distinctive ways of speaking and singing, with modified acoustic characteristics compared to adult-directed productions. These early interactions play a crucial role in building emotional and social connections and language development, although the core aspects of such interactions between infants and caregivers remain understudied. Recent evidence suggests that the rhythm of infant-directed (ID) songs helps guide infants' attention to emotionally and socially relevant facial regions. In fact, infants are more likely to look at the caregiver's eyes at the time of the strong beats of the song. In the present longitudinal study, we examined the extension of this phenomenon to ID speech and ID songs in native and non-native languages with different rhythmic patterns (stress-timed vs. syllable-timed languages; e.g., English and Spanish) throughout the first year of life (at 4, 6, and 12 months of age). Eye tracking while infants watched videos of ID speaking and singing revealed that four-month-olds' eye movements were entrained to temporal regularities in both ID songs and ID speech, in native and non-native languages. Time histograms showed that infants were more likely to look at the eyes during the beat/stressed vowels. In addition, we observed oculomotor tracking of the ID productions with time response function models. We are now examining how this rhythm tracking changes when infants are 6 and 12 months old, and how it relates to electroencephalography measures of auditory rhythm tracking. This study contributes to our understanding of the role of auditory and visual rhythmic entrainment in early language acquisition and social-affective skills.

Keywords: infant-directed singing, infant-directed speech, rhythm, visual attention, eye-tracking

Visual causality detection capabilities in individuals treated for prolonged early-onset blindness

*Marin Vogelsang[1], Lukas Vogelsang[1], Priti Gupta[2], Stutee Narang[2], Purva Sethi[2], Suma Ganesh[2], Pawan Sinha[1]

1. MIT, 2. Dr Shroff's Charity Eye Hospital

The ability to identify causal relationships between visual objects critically depends on the detection of temporal regularities in the environment. Albert Michotte's pioneering studies demonstrated that certain relationships between visual events lead observers to perceive them as causally linked. The ability to attribute causality in such displays emerges early in development. This raises important questions about the roots of this proficiency. Specifically, does this capacity depend on early visual experience with inter-object interactions, or is it resilient to prolonged early-onset visual deprivation? Here, we studied a unique group of children from rural India who were born blind and received sight-restoring surgeries late in childhood. These children viewed animations akin to Michotte's, designed to assess their ability to discriminate causal from non-causal interactions. Stimuli included one causal event ("direct launching", where one moving disk hits another, causing it to immediately continue along the same trajectory) and three non-causal events, introducing a spatial gap, a temporal gap, or both between the disks. Participants viewed one causal and one non-causal animation and selected the sequence depicting the causal interaction. Results reveal low performance immediately post-surgery but rapid and marked improvements within the first postoperative month. Interestingly, a similar trajectory of rapid improvement was observed in a separate experiment conducted with the same children, probing their sensitivity to the Gestalt principle of common fate, in which they judged the direction of visual elements moving together. To sum, these findings highlight the resilience of visual causality detection based on temporal regularities to early-onset visual deprivation, underscore the remarkable plasticity of the visual system into late childhood, and suggest a possible role for temporal processing in facilitating rapid visual development post-surgery.

Keywords: causality detection, spatiotemporal processing, late sight onset, congenital blindness

Performance of late-sighted children on the temporal order judgement task

*Lukas Vogelsang[1], Priti Gupta[2], Marin Vogelsang[1], Naviya Lall[2], Manvi Jain[2], Chetan Ralekar[1], Suma Ganesh[2], Pawan Sinha[1]

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Determining whether visual events occur simultaneously or sequentially critically impacts perceptual inference. Simultaneity has been shown to aid object discovery, a capacity essential for newborns in making sense of their sensory environment. Here, we examined whether early visual experience is necessary to acquire temporal order judgment capabilities in the visual domain. To this end, we studied individuals with prolonged visual deprivation due to congenital cataracts who received sight-restoring surgeries later in childhood. We examined two groups: 15 late-sighted individuals assessed several years after surgery, and 13 tested pre-operatively, then one week and one month post-operatively. Additionally, 22 normally sighted, approximately blur-matched controls completed the same experiment. Participants indicated which of two briefly presented visual bars appeared first, with temporal gaps between 17 and 500ms. The results reveal that, several years post-surgery, late-sighted participants performed comparably to controls. However, performance one week and one month following surgery was indistinguishable from pre-operative levels and remained significantly below that of the long-term follow-up group. Thus, proficiency in temporal judgments develops gradually with continued visual exposure. The data also suggest that the mechanism of time-based binding may contribute to the visual learning that the late-sighted undergo. Taken together, these findings reveal that early experience is not critical for acquiring temporal order judgment capabilities and highlight the feasibility of acquiring such capabilities despite early-onset, prolonged visual deprivation. This indicates that neural plasticity for developing this ability remains available into late childhood, with important implications for understanding temporal processing, perceptual organization, and rehabilitation prospects for children treated for early blindness.

Keywords: temporal order judgements, simultaneity, late sight onset, congenital blindness, temporal processing

Oral | Attention, Multisensory, Time Perception

Fri. Oct 17, 2025 3:30 PM - 5:00 PM JST | Fri. Oct 17, 2025 6:30 AM - 8:00 AM UTC Room 2(West B1)

[O3] Oral 3: Attention, Multisensory, Time Perception

Chair:Yuki Murai(National Institute of Information and Communications Technology)

3:30 PM - 3:45 PM JST | 6:30 AM - 6:45 AM UTC

[O3-01]

Discrete vs. continuous timer bars: How visual segmentation shapes the perception of time "running out"

*Jasmindeep Kaur[1], Jiaying Zhao[1], Joan Danielle Ongchoco[1] (1. The University of British Columbia (Canada))

3:45 PM - 4:00 PM JST | 6:45 AM - 7:00 AM UTC

[O3-02]

Neural Dynamics of Motor-Induced Attention during the Encoding and Retention of Temporal Intervals

*Lorenzo Guarnieri[1], Ayelet Nina Landau[1,2] (1. Hebrew University of Jerusalem (Israel), 2. University College London (UK))

4:00 PM - 4:15 PM JST | 7:00 AM - 7:15 AM UTC

[O3-03]

The priority accumulation framework – attention in time and space

*Mor Sasi[1], Daniel Toledano[1], Shlomit Yuval-Greenberg[1,2], Dominique Lamy[1,2] (1. Tel Aviv University (Israel), 2. Sagol school of neuroscience (Israel))

4:15 PM - 4:30 PM JST | 7:15 AM - 7:30 AM UTC

[O3-04]

Multisensory Integration and Delay Adaptation in Sensorimotor Timing

*Lingyue Chen[1], Loes C.J. van Dam[1], Zhuanghua Shi[2] (1. Technische Universität Darmstadt (Germany), 2. Ludwig-Maximilians-Universität München (Germany))

4:30 PM - 4:45 PM JST | 7:30 AM - 7:45 AM UTC

[O3-05]

Memory encoding for new information, not autobiographical memory load, predicts age-related acceleration in subjective time passage over the last decade

*Alice Teghil[1,2], Sebastian Wittmann[3], Adele Lifrieri[1], Sophia Saad[3], Maddalena Boccia[1,2], Marc Wittmann[3] (1. Department of Psychology, Sapienza University of Rome (Italy), 2. Cognitive and Motor Rehabilitation and Neuroimaging Unit, IRCCS Fondazione Santa Lucia, Rome (Italy), 3. Institute for Frontier Areas of Psychology and Mental Health, Freiburg (Germany))

4:45 PM - 5:00 PM JST | 7:45 AM - 8:00 AM UTC

[O3-06]

Interference between time and space in advanced age

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

Discrete vs. continuous timer bars: How visual segmentation shapes the perception of time "running out"

*Jasmindeep Kaur[1], Jiaying Zhao[1], Joan Danielle Ongchoco[1]

1. The University of British Columbia

Our lives are flooded with visual reminders of time slipping away —from ticking clocks to countdowns timers, that all depict a sense of time "running out". In time perception, the same duration can feel longer or shorter as a function of various factors (e.g., attention, predictability) —but we know less about the factors that influence the perception of how much time is left. In visual processing, a key discovery is that while sensory input may be a continuous wash of light, what we experience —what the mind parses —are discrete objects and events. Here we explored how discreteness structures our sense of time running out. Observers completed a multi-item localization (MILO) task, where they clicked on multiple targets in a sequence. In every trial, there was a black-bordered rectangular 'timer-bar' initially filled with a color that emptied over a period (e.g., 3 seconds) to visually depict the passage of time. The color diminished either *continuously*, gradually and evenly depleting throughout, or *discretely*, in which the bar was segmented into discrete chunks that disappeared at regular intervals. To measure perceived urgency of time 'running out', we examined inter-click latencies (i.e., the time between clicks). Results revealed longer inter-click latencies for discrete (compared to continuous) timer-bars, suggesting greater urgency in the continuous case. This difference disappeared in a separate experiment, where the bar was instead filled over time continuously or discretely, with a reliable interaction between experiments —suggesting that effects could not simply have been a function of one condition being more distracting than another. Thus, discreteness may have distinct effects on our sense of time running out versus time accumulating. Segmentation in visual depictions of time depletion may make time feel more "manageable," altering our sense of urgency in time-sensitive tasks.

Keywords: event perception, time scarcity

Neural Dynamics of Motor-Induced Attention during the Encoding and Retention of Temporal Intervals

*Lorenzo Guarnieri[1], Ayelet Nina Landau[1,2]

1. Hebrew University of Jerusalem, 2. University College London

Accurate timing is essential for perception, decision-making, and action. Theories ranging from pacemaker-accumulator models to population dynamics converge on a key role for attention in modulating time perception. For instance, the Attentional Gate Theory (Zakay & Block, 1994) proposes that perceived duration increases with attentional allocation. Yet, how attention operates across encoding and retention phases, especially under momentary motor demands, remains less understood. To investigate this, we used a time reproduction paradigm while recording EEG, manipulating attentional load through continuous force exertion. Participants reproduced three interval durations (2, 3, or 4 seconds) under both force and no-force conditions. Linear mixed-effects modeling revealed that reproduced durations scaled with interval length ($p < .001$), indicating accurate encoding. However, reproductions were overall shorter under force ($p < .001$), especially at longer intervals (interaction $p = .002$), suggesting under-reproduction due to heightened attentional load. Variability increased with interval length ($p < .001$), in line with Weber's Law, but was not modulated by force. EEG analyses showed that alpha (8–12 Hz) desynchronization increased with interval length, peaking just before interval offset ($p < .0001$), consistent with temporal anticipation (Rohenkohl & Nobre, 2011). Crucially, alpha desynchronization during both encoding and retention predicted the reproduced durations, particularly for longer intervals ($p < .001$). Moreover, encoding under force elicited greater alpha desynchronization in EEG channels ipsilateral to the effector hand ($p < .01$). These findings suggest that alpha oscillations mark temporal attention and support the encoding and maintenance of time across both visual and motor regions. Our results extend timing theories by showing that sustained alpha desynchronization under motor load reflects the dynamic allocation of attentional resources during temporal processing.

Keywords: Timing, Memory, Alpha desynchronization, Force exertion, EEG

The priority accumulation framework –attention in time and space

*Mor Sasi[1], Daniel Toledano[1], Shlomit Yuval-Greenberg[1,2], Dominique Lamy[1,2]

1. Tel Aviv University, 2. Sagol school of neuroscience

Most visual-search theories assume that our attention is automatically allocated to the location with the highest priority at any given moment. The Priority Accumulation Framework (PAF) challenges this assumption. It suggests that attention-guiding factors determine both when and where attention is deployed. Accordingly, some events are more likely to trigger shifts of attention (“when” dimension), and the spatial distribution of these shifts depends on the priority weights that have accumulated at each location based on past and present events.
In four experiments, we tested the predictions of this hypothesis against competing accounts. We examined overt attention by recording first saccades in a free-viewing spatial cueing task. We manipulated search difficulty, cue salience, spatially specific vs. non-specific events, as well as the time interval between events.
Consistent with PAF’s predictions, only a minority of first saccades occurred early in response to the irrelevant event (attentional capture), and most occurred later, in response to the action-relevant event. In addition, we showed that for all types of events, the spatial distribution of first saccades depended on the priority accumulated at each location from previous and current events (e.g., previous target locations, cue, target-distractor similarity), with the weight of previous events increasing with search difficulty.
Our findings provide strong support for the critical predictions of PAF. By offering a mechanistic account of how visual attention is allocated in space and in time, PAF provides an integrative and parsimonious account of attentional behavior that resolves enduring controversies about the factors that guide our attention.

Keywords: Visual-search, Eye-tracking, Attention, Capture

Multisensory Integration and Delay Adaptation in Sensorimotor Timing

*Lingyue Chen[1], Loes C.J. van Dam[1], Zhuanghua Shi[2]

1. Technische Universität Darmstadt, 2. Ludwig-Maximilians-Universität München

Subjective time perception can shift based on how the brain integrates sensory and motor signals. When temporal discrepancies occur between an action and its sensory feedback, the brain adjusts to maintain a coherent temporal experience. Using an adaptation-test paradigm, we investigated how humans adapt to delays between actions and feedback (visual or tactile), and how the brain weights these inputs in unimodal and bimodal contexts.
Across six experiments, we introduced delays between a button press and the resulting feedback. In the adaptation phase, participants experienced either no delay or a fixed 150 ms delay. In Experiment 1 and 2, the test phase tested the after-effect with 0ms delay trials, while in Experiment 3 to 6, the delay in the test trials varied from 0 to 150 ms. We manipulated whether feedback was visual, tactile, or both. Experiments 1 and 2 investigated uni-modal adaptation to visual delays and showed that participants implicitly incorporated 40% of the 150 ms visual delay into their reproduction. Experiments 3 and 4 focussed on uni-modal tactile or visual delays and participants incorporated 69% of the delay for tactile adaptation and 48% for visual adaptation. This demonstrates a greater reliance on tactile than visual feedback in the time domain. Experiments 5 and 6 extended these findings to a bimodal visuotactile context. Here, tactile feedback again dominated when a temporal conflict was introduced between tactile and visual feedback: participants adjusted to tactile delays even when visual feedback was synchronized with the action, and vice versa no adjustment to visual delays was observed when tactile feedback was synchronized with the action.
These results suggest that delay adaptation is partial and modality-dependent, with stronger reliance on tactile feedback in both uni- and bimodal contexts. These findings indicate an integration mechanism where the brain prioritizes tactile over visual input in sensorimotor timing.

Keywords: Multisensory Integration, Delay Adaptation, Sensorimotor Timing

Memory encoding for new information, not autobiographical memory load, predicts age-related acceleration in subjective time passage over the last decade

*Alice Teghil[1,2], Sebastian Wittmann[3], Adele Lifrieri[1], Sophia Saad[3], Maddalena Boccia[1,2], Marc Wittmann[3]

1. Department of Psychology, Sapienza University of Rome, 2. Cognitive and Motor Rehabilitation and Neuroimaging Unit, IRCCS Fondazione Santa Lucia, Rome, 3. Institute for Frontier Areas of Psychology and Mental Health, Freiburg

The widely observed phenomenon that the perceived speed of time passage over the past decade increases with chronological age has been consistently replicated across several studies in different countries. The present study aimed to investigate potential mechanisms underlying this effect, examining the role of autobiographical memory and cognitive functioning. A sample of 120 individuals aged 20-91 was assessed on subjective time perception for the preceding year and decade, the quantity and significance of autobiographical memories from those periods, and overall cognitive status. Results confirmed the age-related increase in perceived temporal acceleration over the past decade. However, no significant association was found between perceived time passage and the number or subjective value of retrieved autobiographical memories. Contrary to prevailing assumptions, older adults reported more vivid and personally meaningful recollections. Instead, reduced cognitive functioning, and specifically lower ability to form new memories as assessed through delayed memory recall, emerged as a significant mediator of accelerated time perception with age. Findings suggest that age-related cognitive decline leading to reduced ability to encode novel memories, rather than diminished autobiographical memory content, is a critical factor in the subjective experience of time compression in older adults.

Keywords: Time perception, Passage of time, Age, Cognitive functioning, Autobiographical memory

Interference between time and space in advanced age

*Cindy Jagorska[1], Isa Steinecker[1], Martin Riemer[1]

1. Technical University Berlin

Perceptual interference between time and space has been reported in neonates, infants, children and young adults, but to date it is unknown how space-time interference develops in advanced age. This is unfortunate, because aging is accompanied by cognitive decline, typically encompassing spatial as well as temporal processing. Moreover, changes in temporal as well as spatial perception have been associated with pathological aging. However, as primary deficits in time and space perception could be concealed by substitution strategies, space-time interference provides an indirect way for detecting these deficits. To bridge this research gap, we conducted an experiment by testing these interference effects in older (60+) and younger (18-35) participants. For that, we asked our participants to reproduce the temporal duration or the spatial size of realistic 3D stimuli and of abstract 2D stimuli. The results show that space judgments of older versus younger adults are more affected by irrelevant temporal information (time-on-space effect), whereas the reverse space-on-time effect was not significantly different between age groups. Together, our findings provide first knowledge on the healthy development of space-time interference in advanced age.

Keywords: space-time interference, aging, virtual reality

Poster | Other

Fri. Oct 17, 2025 12:45 PM - 2:45 PM JST | Fri. Oct 17, 2025 3:45 AM - 5:45 AM UTC MM Hall (KOMCEE-B1)

[P1] Poster: Day 1

[P1-01]

Development of the Japanese Version of the Adult Hyperfocus Questionnaire and Examination of Its Reliability and Validity (in progress)

*Kazutoshi Tamura[1], Akira Midorikawa[2] (1. Department of Psychology, Graduate School of Letters, Chuo University (Japan), 2. Department of psychology, Faculty of Letters, Chuo University (Japan))

[P1-02]

Timing alterations in ADHD: Combining a scoping review with a planned empirical study of Temporal Binding

*Veronica Casagrande[1], Grace Isaura Durkin[2], Vanessa de Andrade[3], Tiemi Thais Tomonaga[3], Patricia Cibelle Pinto de Oliveira[3], Lucas Correia Signorini[3], Claudia Berlim de Mello[4], Gustavo Melo de Andrade Lima[3], André Mascioli Cravo[5] (1. Graduate Program in Neuroscience and Cognition, Federal University of ABC (UFABC), São Paulo, Brazil (Brazil), 2. Graduate Program in Psychobiology, Federal University of São Paulo (UNIFESP), São Paulo, Brazil (Brazil), 3. Center for Education and Research on Brain Aging, Federal University of São Paulo (UNIFESP), São Paulo, Brazil (Brazil), 4. Psychobiology Department, Federal University of São Paulo (UNIFESP), São Paulo, Brazil (Brazil), 5. Center for Mathematics, Computing and Cognition, Federal University of ABC (UFABC), São Paulo, Brazil (Brazil))

[P1-03]

Interval timing in children with ADHD: Pilot study on timing differences

*Kateřina Dörflová[1,2], Veronika Rudolfová[3,2], Kristýna Malenínská[2], Tereza Nekovářová[2,3] (1. Third Faculty of Medicine, Charles University, Neurosciences (Czech Republic), 2. National Institute of Mental Health in Czechia (Czech Republic), 3. Faculty of Science, Charles University, Department of Zoology (Czech Republic))

[P1-04]

Neuronal signals in the primate cerebellum underlying the detection of rhythmic deviations

*Masashi Kameda[1], Masaki Tanaka[1] (1. Hokkaido university graduate school of medicine (Japan))

[P1-05]

Temporally distorted cortical neural dynamics of explicit timing following cerebellar dysfunction

*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))

[P1-06]

Entrainment of periodic neural activity for rhythmic temporal prediction may involve cerebellar learning

*Ken-ichi Okada[1], Masaki Tanaka[1] (1. Hokkaido Univ. (Japan))

[P1-07]

Disentangling spatiotemporal correlates of time cognition: an ongoing investigation of the effects of cognitive aging and depressive symptoms

*Giulia Buzi[1], Florentine Fricker[1], Laura Masson[1], Francis Eustache[1], Thomas Hinault[1] (1. (1)Normandy Univ, UNICAEN, PSL Université Paris, EPHE, Inserm, U1077, CHU de Caen, Centre Cyceron, Neuropsychologie et Imagerie de la Mémoire Humaine, 14000 Caen, France. (France))

[P1-08]

Comparing Neural Oscillations During Cued and Uncued Rhythmic Movement Using Simultaneous Intracranial Basal Ganglia and Cortical Recordings: An Ongoing Study

*Bar Yosef[1], Jingtong Lin[1], Ausaf Bari[1], Kathryn Cross[1] (1. University of California, Los Angeles (United States of America))

[P1-09]

Temporal Expectation and Dopamine: Insights from Omission Oddball Paradigm in Rats

*Riko Iizuka[1], Ryotaro Yamaki [1], Tomoyo Shiramatsu-Isoguchi[1], Shota Morikawa [2], Yuji Ikegaya [3], Hirokazu Takahashi [1] (1. Graduate School of Information Science and Technology, The University of Tokyo (Japan), 2. Graduate School of Science and Faculty of Science, University of Tokyo (Japan), 3. Graduate School of Pharmaceutical Sciences & Faculty of Pharmaceutical Sciences, The University of Tokyo (Japan))

[P1-10]

Effects of voluntary actions on temporal preparation in different temporal contexts: an ongoing study.

*Alexandre de Pontes Nobre[1], André Mascioli Cravo[1] (1. Center for Mathematics, Computing and Cognition, Federal University of ABC. (Brazil))

[P1-11]

Time, space and Temporal momentum: an online replication and beyond

*Mario Bonato[1], Manuel Vencato[1], Mariagrazia Ranzini[1], Marco Zorzi[1,2] (1. Department of General Psychology, University of Padua, Italy (Italy), 2. IRCCS San Camillo Hospital, Lido Venice (Italy))

[P1-12]

Temporal competition and temporal promotion effects of visual arousal on visual search task

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

[P1-13]

Emotional Modulation of Time: The Role of Arousal, Valence, and Subjective Activation in an Immersive VR

*Luigi Micillo[1], Nicola Cellini[1], Jacopo Barbiero[1], Fiorella Del Popolo Cristaldi[1], Giovanna Mioni[1] (1. Department of General Psychology - University of Padova (Italy))

[P1-14]

Aggression May Accelerate Passage of Time Regardless of Physiological Arousal

*Ryohei Mimura[1,2], Makoto Ichikawa[1] (1. Chiba University (Japan), 2. Hyogo prefectural police H.Q. (Japan))

[P1-15]

Learning to feel vibrations: Associatively learned boredom but not stress modulates time perception

*Müge Cavdan[1], Bora Celebi[1], Knut Drewing[1] (1. Justus Liebig University Giessen (Germany))

[P1-16]

Behavioral Evidence for Precision-Weighted Prediction Updating in the Sub-Second Range: A Pilot Study

*Maki Uraguchi[1], Hideki Ohira[1] (1. Nagoya University (Japan))

[P1-17]

Investigating the Modulation of Prior Formation in a Multisensory 2AFC Temporal Judgment Task

*Natsuki Ueda[1], Mitsunari Abe[1] (1. National Center of Neurology and Psychiatry (Japan))

[P1-18]

Modelling timing processes in motor imagery

*Ladislas Nalborczyk[1], Camille Grasso[2] (1. Aix Marseille Univ, CNRS, LPL (France), 2. Cognitive Neuroimaging Unit, CEA DRF/I2BM, INSERM, Université Paris-Sud, Université Paris-Saclay, NeuroSpin Center, Gif/Yvette (France))

[P1-19]

Characterising the spatial and temporal neural dynamics of temporal predictions in audition

*Clara Driaï-Allègre[1,2], Sophie Herbst[1] (1. Cognitive Neuroimaging Unit, INSERM, CEA, NeuroSpin (France), 2. Université Paris-Saclay (France))

[P1-20]

Beyond probability: Temporal prediction error shapes performance across development

*LOUIS-CLÉMENT DA COSTA[1], Sylvie Droit-Volet[2], Katherine Johnson[3], Jennifer T Coull[1] (1. CRPN, CNRS and AMU, UMR 7077, Marseille (France), 2. CNRS and Université Clermont Auvergne, UMR 6024, Clermont-Ferrand (France), 3. Melbourne School of Psychological Sciences, Melbourne (Australia))

[P1-21]

Interaction between timing, stimulus control of light and sound, and its effects on anticipatory responses in multiple and mixed fixed interval schedules in rats (Preliminary Results)

*Paulina Citlali Montoya Barragán[1], Heber Zapata[2], Jonathan Buriticá[1] (1. CEIC, UDG (Mexico), 2. UACH (Mexico))

[P1-22]

How ensemble temporal statistics influence duration perception of visual events

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

[P1-23]

Temporal Reward Prediction in the Visual Corticostriatal Circuit

*Rebekah Yidan Zhang[1,2], Lianne Saussy[1], Marshall Hussain Shuler[1,2] (1. Johns Hopkins University (United States of America), 2. Kavli Neuroscience Discovery Institute (United States of America))

[P1-24]

Exploring the effects of rhythmic vibratory stimuli on time perception

*Yoshihiko Watanabe[1], Sae Kaneko[2] (1. Graduate School of Humanities and Human sciences, Hokkaido University (Japan), 2. Faculty of Humanities and Human Sciences, Hokkaido University (Japan))

[P1-25]

How facial features affect time perception: from the perspective of race and eye contact.

*Yuki Ogawa[1], Yusuke Moriguchi[2], Mitsuhiko Ishikawa[1] (1. Hitotsubashi University (Japan), 2. Kyoto University (Japan))

[P1-26]

Seeking the internal clock: Does the modality effect exist in retrospective timing and if so, is it multiplicative as in prospective timing?

*Ruoyu Zhang[1], Luke Jones[1], Ellen Poliakoff[1] (1. the University of Manchester (UK))

[P1-27]

The Interaction Between Timing, Impulsive Choice, and Risk Taking in Children with ADHD: Exploring the Role of Pharmacological Treatment

*Gloria Ochoa-Zendejas[1], Ivette Vargas-de la Cruz[2], Cristiano Valerio dos Santos[3], Jonathan Buriticá[1] (1. Lab. of Cognition and Comparative Learning, Univ. of Guadalajara-CEIC, Guadalajara. (Mexico), 2. Universidad de Guadalajara, Departamento de Neurociencias, Centro Universitario de Ciencias de la Salud (Mexico), 3. Universidad de Guadalajara, Centro de Estudios e Investigaciones en Comportamiento (Mexico))

[P1-28]

Assessing domain-generality of temporal metacognition: behavioral and electrophysiological insights

*Nathalie Pavailler[1], Antoine Vaglio[1], Nathan Faivre[3], Tadeusz Kononowicz[2], Virginie van Wassenhove[1] (1. CEA/DRF/Inst. Joliot, NeuroSpin; INSERM, Cognitive Neuroimaging Unit; Université Paris-Saclay, Gif/Yvette, 91191 (France), 2. Université Paris-Saclay, CNRS, Institut des Neurosciences Paris-Saclay (NeuroPSI), 91400 Saclay (France), 3. Université Grenoble Alpes, Université Savoie Mont Blanc, CNRS, LPNC, Grenoble (France))

[P1-29]

Retrieving sequence of duration(s) from working memory

*Yunyun SHEN[1], Sophie K Herbst[1], Virginie van Wassenhove[1] (1. CEA, DRF/Joliot, NeuroSpin; INSERM, Cognitive Neuroimaging Unit; CNRS; Université Paris-Saclay, F-91191 Gif/Yvette, France (France))

[P1-30]

Investigating heart–eye coupling during active visual search in early infancy: a planned study

*Akane Hisada[1], Tomoko Isomura[1] (1. Nagoya University (Japan))

[P1-31]

Temporal Binding and Sense of Agency in Oculomotor Control

*Lynn Huestegge[1], Julian Gutzeit[1] (1. University of Wuerzburg (Germany))

[P1-32]

What’s the difference between a premature and a timed anticipatory movement ?

*Marcus Missal[1], Dominika Drazyk[1] (1. Université catholique de Louvain, Institute of Neuroscience (Belgium))

[P1-33]

Revealing rhythm categorization in human brain activity

*Tomas Lenc[1,2], Francesca M. Barbero[2], Nori Jacoby[3,4], Rainer Polak[5,6], Manuel Varlet[7], Nicola Molinaro[1,8], Sylvie Nozaradan[2,9] (1. Basque Center on Cognition, Brain and Language (BCBL), Donostia-San Sebastian (Spain), 2. Institute of Neuroscience (IoNS), University of Louvain (UCLouvain), 1348 Louvain-la-Neuve (Belgium), 3. Computational Auditory Perception Group, Max Planck Institute for Empirical Aesthetics, Grüneburgweg 14, 60322 Frankfurt am Main (Germany), 4. Department of Psychology, Cornell University, Ithaca, NY 14853 (United States of America), 5. RITMO Centre for Interdisciplinary Studies in Rhythm, Time and Motion, University of Oslo (Norway), 6. Department of Musicology, University of Oslo (Norway), 7. The MARCS Institute for Brain, Behaviour & Development, Western Sydney University, Sydney (Australia), 8. Ikerbasque, Basque Foundation for Science, 48009 Bilbao (Spain), 9. International Laboratory for Brain, Music and Sound Research (BRAMS), Montreal (Canada))

[P1-34]

Memory traces of duration and location in the right intraparietal sulcus

*Martin Riemer[1], Thomas Wolbers[2], Hedderik van Rijn[3] (1. Technical University Berlin (Germany), 2. DZNE Magdeburg (Germany), 3. University of Groningen (Netherlands))

[P1-35]

Neural Correlates of Perceptual Biases in Visual Duration Estimation

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

[P1-36]

Uncovering the neuroanatomical substrates of impulsive behaviour induced by the temporal predictability of events: an fMRI-EMG investigation

*Inga Korolczuk[1,2], Boris Burle[2], Bruno Nazarian[3], Marion Royer D'Halluin[2,4,5], Franck Vidal[4], Jennifer T Coull[2] (1. Department of Psychology, Medical University of Lublin (Poland), 2. Centre for Research in Psychology and Neuroscience (UMR7077), Aix-Marseille University & CNRS (France), 3. Aix-Marseille Université, UMR 7289 CNRS, Institut de Neurosciences de la Timone, Marseille, Provence-Alpes-Côte d'Azur, 13005, France (France), 4. CHU Sainte-Justine Research Center, Montréal, Québec, Canada (Canada), 5. Department of Neurosciences, Université de Montréal, Montréal, Québec, Canada (Canada))

[P1-37]

Basic mechanism underlying the audio-visual temporal recalibration for the long stimuli

*Yaru Wang[1], Makoto Ichikawa[1] (1. Chiba University (Japan))

[P1-38]

Understanding Discomfort Caused by Audiovisual Temporal Asynchrony: Insights from Egg Cracking and Grissini Breaking Videos

*Mayuka Hayashi[1], Waka Fujisaki[1] (1. Japan Women's Univ. (Japan))

[P1-39]

Unconscious motor–visual temporal recalibration occurs in both active and passive movements

*Masaki Tsujita (Faculty of Child Studies, Kamakura Women's University)

[P1-40]

The sound octave equivalence in a songbird as shown by the event-related brain potentials and the operant behavior.

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Development of the Japanese Version of the Adult Hyperfocus Questionnaire and Examination of Its Reliability and Validity (in progress)

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Background: Adults with Attention-Deficit/Hyperactivity Disorder (ADHD) occasionally experience "hyperfocus", a state of intense and sustained concentration that causes them to lose track of time. Hupfeld et al. (2019) developed the Adult Hyperfocus Questionnaire (AHQ), which comprehensively assesses each of the three hyperfocus settings (school, hobbies, screen time) and six hyperfocus dimensions (losing track of time, failing to notice the world around you, failing to attend to personal needs, difficulty stopping and moving on to a new task, feeling totally engrossed in the task, and getting "stuck" on small details). In the same study, Hupfeld et al. (2019) demonstrated that individuals with higher ADHD symptomatology reported more frequent experiences of hyperfocus. However, no reliable and valid scale to assess hyperfocus has yet to be developed in Japan. **Aims:** The aim of this study is to develop a Japanese version of the AHQ and to validate reliability and validity. Furthermore, this study aims to investigate the relationship between ADHD and hyperfocus in Japan. **Methods:** With the original author's permission, we translated the original version of AHQ into Japanese and the Japanese version was confirmed by back-translation. We plan to conduct a questionnaire survey of 500 Japanese adults. In this study, we will use the Japanese version of AHQ and Adult ADHD Self-Report Scale (ASRS) to evaluate ADHD symptoms. We also plan to include scales for flow and internet addiction to examine whether hyperfocus is a distinct construct from these related behaviors. This study is currently in the planning stage. Data collection is scheduled to take place between June and July 2025.**References:** Hupfeld, K. E., Abagis, T. R., & Shah, P.(2019). Living "in the zone": hyperfocus in adult ADHD. *ADHD Attention Deficit and Hyperactivity Disorders*, *11*, 191-208.

Keywords: Hyperfocus, ADHD, Flow, Internet Addiction, Time Blindness

Timing alterations in ADHD: Combining a scoping review with a planned empirical study of Temporal Binding

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Time perception involves two distinct abilities: duration estimation (interval timing) and temporal order processing (sequencing). While temporal order deficits are well-documented in clinical conditions like schizophrenia (Coull & Giersch, 2022), individuals with Attention-Deficit/Hyperactivity Disorder (ADHD) also show impaired time perception compared to neurotypical controls (Metcalfe et al., 2024). However, it remains unclear which specific aspects of time perception are affected in ADHD. This study addresses that gap through a two-part approach: (1) a scoping review of existing literature on duration and temporal order processing in ADHD, and (2) an planned empirical investigation of Temporal Binding—the perceived compression between cause and effect (Hoerl et al., 2020)—in adults with ADHD. Participants will complete two tasks: a temporal order task using the Libet Clock (Haggard et al., 2002) and an interval estimation task (Humphreys & Buehner, 2009). This design allows us to assess both timing and causality judgments. Our findings aim to clarify how time perception is altered in ADHD and contribute to a broader understanding of how neurological differences shape temporal experience.

Keywords: ADHD, Time perception, Temporal Binding, Duration estimation, Temporal order processing

Interval timing in children with ADHD: Pilot study on timing differences

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Attention-Deficit/Hyperactivity Disorder (ADHD) is a neurodevelopmental disorder often associated with significant deficits in time perception. However, the precise mechanisms underlying these temporal impairments remain unclear. This pilot study investigated interval timing in 17 children with ADHD (mean age 8.9 years) and 16 age-matched neurotypical children (mean age 8.8 years) to explore group differences, the effect of age, and connections to particular cognitive domains. Participants completed a battery of cognitive tasks (assessing attention, working memory, and executive functions) alongside three distinct temporal tasks: time reproduction (1200 ms; 3000 ms; 4200 ms; 5500 ms; 7000 ms), a bisection task (short/long anchors 1200 ms; 7000 ms), and a finger-tapping task (400 ms; 1200 ms, spontaneous tempo). Our findings revealed a significant group difference exclusively in the reproduction of the 3000 ms interval (Mann-Whitney U test: $p = 0.046$; Cohen’s $d = 0.184$), where children with ADHD were less accurate and consistently underestimated the duration. This observation aligns with the hypothesis of a faster internal clock in individuals with ADHD. Notably, no other significant group differences were observed across the temporal tasks, nor were there significant age-related differences in timing performance. Distinct underlying mechanisms might be involved in processing various interval lengths, as we generally found no correlation between accuracy and precision across different temporal tasks. However, a correlation was observed within the finger-tapping task, between 400 ms and spontaneous tempo ($p = 0.033$). Despite the preliminary nature and small sample size, this pilot study provides insights into the timing deficits often registered in ADHD. It underscores the importance of continued research with larger cohorts to resolve existing inconsistencies in this field of study.

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Keywords: ADHD, children, time perception, interval timing

Neuronal signals in the primate cerebellum underlying the detection of rhythmic deviations

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When we are feeling the rhythm, we often notice any subtle deviation. This ability relies on accurate prediction of periodic event timing. The cerebellum, known for its role in motor control, is also implicated in sensory timing prediction. Previous studies in our lab showed that neurons in the cerebellar dentate nucleus (DN) exhibit periodic firing modulation during the missing oddball detection task, in which animals were required to detect omissions of regularly presented visual stimuli (Ohmae et al., 2013). These neurons also showed greater directional modulation by stimulus location, suggesting a role in sensory rather than motor processing (Kameda et al., 2023). However, it remains unclear whether they contribute to the detection of subtle rhythmic deviations independently of movement.To address this point, we trained monkeys to detect slight changes in rhythm and examined the relationship between their behavioral performance and the activity of DN neurons. In the modified oddball detection task, a slightly longer interstimulus interval was introduced within a series of visual stimuli presented at regular 400-ms intervals. Monkeys were rewarded for responding with a hand movement to either a delayed stimulus (Hit) or subsequent omission (Miss). During recording sessions in two monkeys, we presented delays of 60–160 ms and compared neuronal activity between Hit and Miss trials. The firing rate immediately before the delayed stimulus was significantly greater in Hit than Miss trials (paired t-test; $p < 10^{-7}$, $n = 37$), while the activity at the time of the preceding stimulus showed no difference ($p = 0.65$). We also optogenetically manipulated neuronal activity in the DN to elucidate its causal role in behavior. After expressing ChR2 specifically in Purkinje cells of the cerebellar clus lobules, we illuminated their terminals within the DN to suppress neuronal activity. Optical stimulation immediately before the delayed stimulus significantly reduced Hit rate for delays that originally produced a Hit rate between 30% and 70% ($p < 0.05$, $n = 23$). These findings suggest that periodic neuronal activity in the DN encodes sensory timing predictions and contributes to the detectability of rhythmic deviations.

Keywords: Rhythm, Prediction, Non-human primate, Cerebellum

Temporally distorted cortical neural dynamics of explicit timing following cerebellar dysfunction

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The ability to quantify temporal intervals, known as explicit timing, relies on a distributed brain network, with the cerebellum playing a key role, as suggested by brain stimulation and neuropsychology studies. Yet, how the cerebellum impacts cortical dynamics of explicit timing, and at which stage of temporal information processing, remains unexplored. Here, we addressed this using scalp electroencephalography (EEG) in cerebellar ataxia (CA) patients (N=15) and healthy controls (N=10) performing a temporal discrimination task. In separate blocks, participants judged whether the duration of a fixed standard (700ms or 1200ms) matched or differed from that of a subsequent comparison spanning between the short and long standard durations. This design allowed us to dissociate comparison judgments anchored to the standard from those anchored to the comparison set's bisection point (BP). Behaviorally, temporal sensitivity was reduced in patients, replicating previous studies. Neurally, during the comparison interval, the contingent negative variation (CNV) potential failed to show adjusted ramping based on the standard interval in both groups. Instead, the CNV in controls peaked at the BP and resolved afterwards, in line with a BP mechanism. Conversely, in CA patients, it continued ramping negatively beyond the BP, indicating a lack of sensitivity to this anchor. Analysis of delta-band activity (0.54-2.18Hz) phase dynamics in the same time period revealed increased phase alignment before the earliest possible comparison in both groups. However, this was stronger in controls than in patients, consistent with previous findings in implicit timing. Importantly, evoked responses to standard onset were comparable between groups, ruling out group differences due to noisy or generally reduced brain responsivity in patients. Overall, these results uncover the cerebellar role in shaping cortical dynamics of explicit timing, specifically through the adjustment of anchor-dependent anticipatory activity

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

Entrainment of periodic neural activity for rhythmic temporal prediction may involve cerebellar learning

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The cerebellum plays a pivotal role in rhythmic movement and rhythmic perception. We previously showed that neurons in the cerebellar dentate nucleus gradually synchronize their activity in response to periodically presented visual stimuli in the absence of movement. Given that the dentate nucleus receives GABAergic projections from Purkinje cells (PCs) in the cerebellar cortex, and the interaction between simple spikes (SSs) and complex spikes (CSs) in PCs is central to cerebellar learning, we examined PC activity to understand how rhythmic neuronal activity is generated. Animals were trained to respond to the omission or color change of isochronically presented visual stimulus, depending on the color of the fixation point. Detection of stimulus omission required temporal prediction, whereas that of color change did not. The periodic activity of 112 well-isolated PCs has been recorded from the crus lobules in 3 monkeys. Neurons were classified into 3 groups based on the time course of SS and CS activities in trials with a 400-ms interstimulus interval. Cluster #1 (32%, n = 36) showed a SS peak around 300 ms following each stimulus and a transient CS for repetitive visual stimulus but not for the omission. Cluster #2 (40%, n = 45) showed an early SS peak and exhibited predictive CS around the time of the repetitive visual stimulus, which was sometimes enhanced following stimulus omission. Cluster #3 (28%, n = 31) showed a clear SS peak, but no evident CS response was observed. In all clusters, the magnitude of periodic SS activity was greatly diminished in the color change condition, indicating that neuronal activity reflects temporal prediction. Importantly, CS in Clusters #1 and 2 also decreased during color detection, indicating that CS occurrence is highly context-dependent. As expected, CS-triggered averaging of SS activity revealed a transient pause in SS in all PCs. Clusters #1 and 2 showed two additional decreases in SS activity, one occurring just before the CS and the other after the stimulus cycle. Contrary to the prevailing negative feedback model of the cerebellum, our results suggest the presence of a positive feedback circuit that amplifies a time-specific decrease in SS activity. This cerebellar learning mechanism may contribute to entrain SS activity to rhythm through the context-dependent occurrence of CSs.

Keywords: nonhuman primate, rhythm perception

Disentangling spatiotemporal correlates of time cognition: an ongoing investigation of the effects of cognitive aging and depressive symptoms

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Processing temporal information is a fundamental feature of our brain and cognitive functions. Timing capacities are known to become less precise and more variable with advancing age, yet not homogenously across individuals. One of the factors explaining this inter-individual variability could be the presence of depressive symptoms, which could hasten cognitive decline but also impact prospective timing of short durations. To investigate the interweaving between cognitive aging, brain temporal processing and depressive symptoms, we are enrolling 50 younger and 80 older adults to assess their cognitive abilities and quantify their depressive symptoms. While undergoing simultaneous EEG-fMRI recording, participants perform a temporal generalization task (e.g., 600, 900, 1250, 1750, 2400 ms) to a reference duration (1500ms). The Full Width at the Half Maximum (FWHM) of the generalization gradient of the OA group (n= 5, M_{age} = 67.2) was found to be larger ($FWHM_{OA}$ = 2160.36 ms) compared to its younger counterpart (n=5, M_{age}= 23.8, $FWHM_{YA =}$ 1252.38 ms), suggesting a reduced temporal precision in older adults. Time/Frequency source maps of the difference between the two groups, showed lower Theta (5-7 Hz) magnitude in cingulate (t=-7.105, p<0.001) and Insular cortices (t = -4.970, p<0.001), together with higher gamma (30-59 Hz) rhythms in parietal (t= 6,0086, p<.005), frontal (t=5.019, p<0.05), and cingulate gyrus (t=4.547, p<0.005) in older adults. Although this oscillatory imbalance in frontal-parietal network hubs has previously been linked to disruptions of top-down attention and working memory in aging, we hypothesize that it could reflect an inefficient compensatory mechanism in sub and supra-seconds timing tasks. Further investigation on links between cognitive performance, depressive symptom’s intensity and dissimilarity matrices of the theta-gamma Phase Amplitude Coupling and fMRI connectivity maps, as well as dynamic network modes (DyNeMo) of the fronto-parietal network time series, would help disentangle the spatiotemporal dynamics temporal processing changes with aging.

Keywords: Time cognition, Temporal processing , Cognitive aging , Subclinical depression, EEG-fMRI

Comparing Neural Oscillations During Cued and Uncued Rhythmic Movement Using Simultaneous Intracranial Basal Ganglia and Cortical Recordings: An Ongoing Study

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Rhythmic auditory stimulation (RAS) is a promising therapy for improving gait in Parkinson’s Disease (PD) patients. By providing external rhythmic cues, such as metronomes or music, RAS may compensate for impaired internal timing and improve motor coordination. However, the electrophysiological mechanisms underlying RAS remain unclear. Rhythmic cues may facilitate the impaired basal ganglia-cortical loop in PD or engage alternative compensatory circuits. Beta-band activity (13–30 Hz), which is linked to movement and might be modulated by rhythmic auditory stimuli, particularly in motor cortical areas, may play a key role. We hypothesize that auditory cues facilitate movement-related beta modulation in the basal ganglia-cortical loop. In the current study, we simultaneously recorded local field potentials from the globus pallidus internus (GPi) and cortex using subdural electrodes (ECoG) in 10 PD patients undergoing deep brain stimulation surgery. Patients performed a rhythmic tapping task with auditory tones presented at isochronous subsecond intervals under three conditions: passive listening (tones only), cued tapping (tones with tapping), and uncued tapping (tapping without ongoing auditory cues). Preliminary analyses show canonical movement-related beta suppression in the motor cortex during tapping compared to passive listening, confirming prior evidence that these signals are movement driven. However, auditory cues during tapping did not affect trial-averaged beta power in the GPi or motor cortex at the group level. Interestingly, auditory cues did affect average beta power in patients with ECoG over prefrontal and auditory cortices, suggesting that these regions may differentially engage in processing rhythmic cues versus internally generated timing. We are conducting ongoing analyses to assess finer temporal dynamics by examining tap-locked beta changes over time and evaluating whether auditory cueing is associated with changes in GPi-cortical connectivity. Understanding how rhythmic cues modulate brain dynamics in PD may reveal compensatory mechanisms beyond the motor system and inform the development of more personalized, neurophysiologically-targeted RAS therapies.

Keywords: rhythmic movement, Parkinson's disease, intracranial electrophysiology, auditory cueing, basal ganglia

Temporal Expectation and Dopamine: Insights from Omission Oddball Paradigm in Rats

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Dopamine plays a crucial role in perceiving time, with evidence suggesting that increases or decreases in dopamine levels can speed up or slow down the internal clock. Alongside its apparent influence on time perception, dopamine encodes reward, punishment, and motivation. This multifaceted nature makes it challenging to fully understand how dopamine affects time perception in different contexts. Furthermore, dopamine responds to neutral stimuli, such as white noise, that do not have positive or negative valence. Given that many time perception studies used neutral stimuli to investigate how each sensory modality perceives time, it is important to examine dopamine's response to these stimuli for accurate interpretation of previous research.

We focused on the effects of auditory stimuli's temporal expectations on dopamine. White noise was presented to rats, and dopamine was measured in vivo with high temporal resolution using fibre photometry. The omission oddball paradigm was used to manipulate temporal expectation. It has been suggested that neural activity during omission reflects a prediction error, as the standard stimuli create a temporal expectation for stimulus input.

Our results showed that dopamine increased phasically immediately after the sound onset, followed by a decrease, forming a wave pattern without repetition-induced suppression. When stimuli were omitted at unexpected timings, dopamine showed a gradual tendency to increase. Notably, with the typical oddball paradigm of standard and deviant defined by the frequency of stimuli, the amplitude of dopamine response was more significant in deviant stimuli. This phenomenon supports the theory that dopamine influences time perception and aligns with the previous reports of duration dilation for unpredictable stimuli. Furthermore, the fact that dopamine is affected by manipulating temporal expectancies, even for non-rewarding sensory stimuli, supports the view that time perception and dopamine are tightly involved.

Keywords: Dopamine, Oddball, In Vivo

Effects of voluntary actions on temporal preparation in different temporal contexts: an ongoing study.

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Temporal preparation is shaped by the temporal context of preparatory intervals (foreperiods), as reflected in differences in the slopes of foreperiod durations ×reaction time (RT) curves under distinct distributions of foreperiod durations. Recently, it has been shown that initiating foreperiods with voluntary actions influences temporal preparation. In this study, we investigate whether the effect of actions on preparation is related to differences in how foreperiod distributions are learned when intervals are self-initiated. We are conducting a choice-RT experiment using a variable foreperiod design. Participants indicate the orientation of a Gabor presented after a foreperiod of 0.6, 1.2, or 1.8 s. Participants are assigned to one of two conditions. In the action condition, foreperiods are initiated with a voluntary keypress. In the external condition, they are initiated automatically after a random interval. Across eight blocks, we manipulate the distributions of foreperiods. In the uniform distribution, all three foreperiod durations occur with equal frequency; in the exponential distribution, frequency decreases with duration; in the flipped exponential distribution, frequency increases with duration. Exponential and flipped exponential blocks are intermixed with uniform blocks. To examine whether the effect of actions on temporal preparation is related to the temporal context of foreperiods, we will compare slopes of RT curves between conditions for each distribution. Additionally, to investigate if actions influence learning of different distributions across blocks, we will compare transfer effects —operationalized as the slopes of RT curves in uniform blocks preceded by exponential blocks compared to uniform blocks preceded by flipped exponential blocks —between conditions. The results will contribute to the understanding of how voluntary actions influence timing and temporal preparation.

Keywords: Temporal preparation, Voluntary actions, Foreperiod, Temporal learning

Time, space and Temporal momentum: an online replication and beyond

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Performing mental arithmetic on brief temporal durations has been recently shown to induce operation-specific distortions. In a time reproduction task the request to add short durations resulted in longer responses while subtraction resulted in shorter responses than the correct, purely mathematical, outcome (Bonato et al., 2021, Cognition). This effect has been named "temporal momentum" in analogy with the representational momentum found when representing the position of moving objects as it mirrors the operational momentum charactering mental arithmetic. It suggests that our representation of time includes some features resembling closely those involved in spatial processing. In Experiment 1 we assessed the reliability of the temporal momentum effect in the first direct replication of Bonato et al.'s temporal arithmetic task by using an online procedure for data collection. In Experiment 2 we also tested whether the under-estimation found in subtraction is due to a longer operand being always presented first in the original study. The results showed a reliable temporal momentum effect that was virtually indistinguishable from previous, laboratory-based, experiments. Moreover, in Experiment 2 under-estimation in subtraction was still present when participants had to compute an order-independent difference between two operands, thereby excluding that the temporal momentum in subtraction is due to the specific ordering of stimuli used. This new evidence coming from a pre-registered study further demonstrates that the temporal momentum effect is a robust and reliable marker of manipulation in the domain of temporal durations.

Keywords: Temporal momentum, Operational momentum, Time-space interaction, Duration, Time reproduction

Temporal competition and temporal promotion effects of visual arousal on visual search task

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We investigated the temporal characteristics of the effect of emotional responses on performance in visual search task. Previous studies have shown that interfering effects of emotional responses evoked by viewing emotional picture on cognitive processing (temporal competition effect) would be strongest immediately after the presentation of the emotional picture, and it will decay within a short period. However, no systematic studies with various temporal conditions for stimuli have examined how the emotional response would affect the performance of the visual search task. In the present study, we presented the emotional pictures (neutral, or fearful) for 500 ms to evoke the emotional response, and then presented the stimulus for the visual search task. We prepared five conditions for the ISI between the emotional picture and stimulus for the visual search task (0, 120, 240, 360 and 480 ms), and three conditions for the duration of the visual search stimulus (100, 300, and 500 ms). In each trial, 45 participants conducted the visual search task after viewing the emotional pictures. In addition, they observed the same emotional pictures, and rated their emotional valence and arousal. Participants were divided equally into three groups in terms of their ratings for the arousal scale in viewing the fearful pictures. We found that the performance of the visual search task dropped with the ISI of 0 ms and 120 ms for the participant group who rated the fearful pictures as highly arousal while it significantly elevated with the ISI of 0 ms, 120 ms, and 480 ms for the participant groups who rated the fearful pictures as lowly arousal. These results suggest that there are two directions of effects of emotional response on the visual search (interfering, or promotion), and that the direction of effects would be determined by the individual emotional sensitivity.

Keywords: selective attention, emotional sensitivity, Individual Differences, ISI, accuracy

Emotional Modulation of Time: The Role of Arousal, Valence, and Subjective Activation in an Immersive VR

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Temporal ability and human existence are closely intertwined. Yet, temporal processing is a delicate function, susceptible to various influences. One notable example is the way emotional experiences can distort our perception of time—an effect traditionally attributed to arousal. However, a clear understanding of this relationship remains elusive. The present study aims to deepen this knowledge by examining the specific contributions of physiological arousal, perceived activation, and emotional valence to temporal distortions. To this end, 41 participants (mean age = 22.93, SD = 1.82) completed three temporal tasks—free tapping, time production, and retrospective judgment—while viewing three emotional videos (negative, neutral, and positive) presented in an immersive virtual reality environment. To assess emotional valence and perceived activation, we employed the Self-Assessment Manikin (SAM), while physiological arousal was measured using electrocardiography (ECG) and electrodermal activity (EDA). The results showed that emotional videos significantly affected valence ratings but not perceived activation. Nonetheless, physiological data revealed sustained sympathetic activation during both emotional conditions, as indicated by elevated skin conductance levels (SCL). Regarding temporal performance, no significant effects were observed for the retrospective judgment or free tapping tasks. However, in the time production task, participants tended to overestimate durations during negative videos and underestimate them during positive ones—an effect modulated by the order of video presentation. Taken together, these findings highlight the importance of considering both subjective and physiological factors in understanding how emotionally induced arousal influences time perception.

Keywords: Time Perception, Valence, Emotions, Physiological Arousal, Perception of Activation

Aggression May Accelerate Passage of Time Regardless of Physiological Arousal

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Impulsive and aggressive individuals tend to perceive time more quickly than it actually passes (Dougherty et al., 2007; Gorlyn et al., 2005). However, the mechanisms underlying such timing distortions remain unclear. Previous research suggested that higher levels of aggression were associated with lower resting physiological arousal (Scarpa et al., 2000) and increased arousal during tasks (Armstrong et al., 2019). Moreover, increased arousal levels accelerate subjective time perception (Droit-Volet & Meck, 2007; Gibbon et al., 1984; Treisman, 1963; Zakay & Block, 1997). This study investigated whether higher aggression levels would accelerate the subjective time passage, and whether the relationship between the aggression and subjective time passage could be mediated by physiological arousal. Participants completed the Japanese version of the Buss-Perry Aggression Questionnaire and subsequently performed a time estimation task. In each of the 10 trials, they estimated one of five randomly presented target durations (10, 20, 40, 60, or 90 seconds). Participants were instructed to count the target duration and press a key when they believed the time had passed. Heart rate, as an index of physiological arousal, was continuously recorded from the end of the questionnaire until the conclusion of the task. Results show that the more aggressive the participants were, the shorter they estimated the elapsed time. A mediation analysis, with aggression as the independent variable, physiological arousal as the mediator, and estimated time as the dependent variable, revealed that higher aggression levels accelerated the subjective time passage regardless of physiological arousal. These findings suggest that mechanisms other than arousal-related factors contribute to the effect of aggression on time perception. We are proposing that cognitive, affective, or motivational factors specific to aggressive traits may contribute to time perception.

Keywords: Aggression, Time Perception, Physiological Arousal

Learning to feel vibrations: Associatively learned boredom but not stress modulates time perception

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Emotional states influence our perception of time; for instance; time feels shorter when we are stressed about meeting a deadline but drags when we are bored, such as while waiting in a doctor’ s office. Associative learning allows pairing emotional states with a neutral stimulus through repeated exposure. Here, in the context of time perception, we investigated whether neutral stimuli such as vibrations acquire emotional value when linked with stress or boredom, potentially influencing the experience of time presented alone. First, we ascertained the efficiency of stress (multitask framework, public speech with counting) and boredom (peg turning and video from Markey et al., 2014) induction tasks. In the main experiment using a within-subjects design, individuals underwent stress learning, boredom learning, and no learning sessions across three days. During the learning phase, individuals performed either boredom or stress tasks while exposed to a neutral vibration pattern every 5 seconds via a custom multimodal haptic vest (Celebi et al., 2023). After the tasks, participants completed questionnaires on their anxiety and boredom (State-Trait-Anxiety-Inventory and short version of State-Boredom-Scale). Following a 1-hour break, participants performed a temporal bisection task. They first familiarized to discriminate between anchor durations of dots –400 ms (short) and 700 ms (long). Subsequently, they judged whether the duration of a dot on the screen, lasting 400-700 ms, resembled the previously learned short or long one while the associated vibration patterns were presented. Boredom-associated vibration patterns made time feel longer, while the stress-associated vibration pattern had no significant effect on time perception.

Keywords: haptic perception, associative learning, time perception , timing, boredom

Behavioral Evidence for Precision-Weighted Prediction Updating in the Sub-Second Range: A Pilot Study

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Predictive processing theory posits that perception involves continuously updating internal models to minimize prediction error, with the rate of updating depending on the relative precision of predictions and sensory inputs. When predictions are highly precise, they are more resistant to change. This study aimed to provide behavioral evidence for this precision-weighted updating hypothesis. We hypothesized that repeated exposure to the standard would enhance the precision of temporal predictions, thereby reducing prediction updating. Participants (120 adults) performed a temporal generalization task using 500 Hz pure tones. After memorizing a 600 ms standard, participants judged whether comparison intervals (420–780 ms) matched the standard. During the learning phase, half of the participants (repetition group) received three additional presentations of the standard, while the rest (control group) encountered it only at the beginning. In the subsequently administered test phase, the longest stimulus was presented more frequently in both groups, encouraging prediction updating toward longer durations. The repetition group exhibited smaller shifts in the weighted mean of the generalization gradient compared to the control group, indicating reduced updating of the internal standard. This supports the idea that greater prediction precision dampens updating, consistent with the principle of precision-weighted inference. We also examined response entropy during the learning phase as a potential marker of prediction uncertainty. The repetition group showed a higher group-mean entropy for the 660 ms stimulus compared to the control group. While this may reflect increased response variability due to a limited number of trials, it could also indicate a dynamic adjustment process—where participants were actively refining their predictions in response to repeated exposure. These findings raise the possibility that entropy may capture transitional stages in the formation of high-precision predictions, though further validation is needed.

Keywords: predictive processing, precision-weighted updating, temporal generalization task

Investigating the Modulation of Prior Formation in a Multisensory 2AFC Temporal Judgment Task

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The human brain integrates uncertain sensory inputs with prior expectations to enable efficient interaction with the environment. Previous studies showed that, in a temporal reproduction task, a single prior tends to be formed across different sensory modalities, while distinct priors emerge when stimuli are associated with different motor responses. This suggests that the structure of prior formation may depend more on motor output than on sensory modality. This study aims to investigate whether similar principles apply to perceptual decision tasks using a two-alternative forced choice (2AFC) paradigm. Participants will judge which of two sequentially presented stimuli is longer in duration. We will manipulate sensory modality (vision vs. audition) and response mode (button press vs. vocal response), along with the statistical distribution of stimulus durations (short-centered vs. long-centered), to examine how priors are formed and generalized across conditions. This research will clarify whether prior representations in temporal perception are structured based on sensory input, motor output, or both. By using a perceptual comparison task with minimal motor demands, this study provides novel insights into the sensorimotor organization of prediction.

Keywords: Prediction, Sensorimotor organization, Multi modal integration

Modelling timing processes in motor imagery

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Behavioural, electrophysiological, and neuroimaging evidence suggests that the motor system is involved in simulating execution during motor imagery. Perhaps not surprisingly then, mental chronometry data revealed that the timing of imagined actions follows the timing of executed actions. However, the timing of imagined actions also conforms to timing laws such as the central tendency effect or the scalar property, according to which the (trial-to-trial) variability of imagined movement times grows linearly with the average movement times. What could account for both the motor and timing properties of imagined actions? We recently developed an algorithmic model of motor imagery, which provides a simplified overarching description of the involvement of the motor system over time during motor imagery and predicts the onset and duration of imagined actions. We previously showed that this model provides an excellent fit to extant data and reliable parameter estimates. Here, we ask whether it can reproduce and account for the timing properties of motor imagery. Using various simulations, we show that the scalar property of motor imagery can be explained by assuming that the onset and duration of imagined actions are gated by a noisy threshold to conscious access. In other words, trial-to-trial variability in *when* and for *how long* motor imagery accesses consciousness suffices to account for the scalar property of motor imagery. In addition to providing an excellent fit to data, this model generates several novel predictions, thus opening new research avenues on the neural and cognitive mechanisms underlying the timing of motor imagery.

Keywords: motor imagery, scalar property, algorithmic modelling

Characterising the spatial and temporal neural dynamics of temporal predictions in audition

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Predicting *when* future events will happen helps us focus and respond effectively, especially when our attentional capacity is limited. Here, I will present results from two studies (one finished, one with data acquisition in progress) that investigate the neural dynamics of temporal prediction for auditory perception using a statistical learning approach. To characterise how temporal regularities are internalised, we employ Bayesian observer models to capture the learning process over trials. In a recent EEG study (n=27), we were able to demonstrate that humans learn temporal statistics in a Bayesian manner. Specifically, target-evoked responses (P3) reflected Bayesian surprise as measured by Shannon's information. Furthermore, we will present preliminary results from an ongoing study using fMRI and MEG (acquisitions in progress). Participants perform a simple reaction time task in a foreperiod paradigm, in two separate sessions, one for fMRI and one for MEG (1-3 weeks apart), and we manipulate the mean and dispersion of the foreperiod distributions. Bayesian observer models will be fitted to reaction times to quantify participants' temporal predictions per trial. By combining these two modalities, and informing the analyses with the information-theoretic parameters obtained from the Bayesian model (prediction error, surprise), we aim to uncover the spatial and temporal dynamics of the neural processes involved, particularly how learning to anticipate temporal probabilities enhances attentional focus over time, and how prediction error and surprise contribute to refining temporal predictions on subsequent trials. The combined fMRI-MEG approach allows us to consider cortical and subcortical brain areas, including the cerebellum, for which prior evidence suggests an implication in timing and predictive processing. By integrating neural and computational approaches, this work seeks to advance our understanding of how the brain encodes and utilises temporal statistical regularities.

Keywords: temporal prediction, Bayesian observer, fMRI, MEG, temporal statistics

Beyond probability: Temporal prediction error shapes performance across development

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We have previously shown that although children are significantly less precise than adults in explicit timing tasks, their performance is equivalent to adults in implicit timing tasks. However, the dynamic way in which the temporal prior is constructed in implicit timing tasks may nevertheless be subject to developmental change. Here, we adopted a more fine-grained analytical approach by tracking changes in temporal probabilities across trials and using a Bayesian learning algorithm to capture the emergence of the temporal prior throughout the session.
Speeded reaction times (RTs) were recorded in 47 young children (5-7 years), 58 older children (7-11 years), and 48 adults during a variable foreperiod (FP) paradigm (240-960ms FPs). The 600ms FP was much more probable (~36% of trials) than the six other shorter or longer FPs, which were themselves equiprobable (~9% each). We also included catch trials (~9%) to mitigate the effects of the hazard function on performance. For each participant, we calculated dynamic changes in FP probability (Pb) and temporal prediction error (pE) across trials. The pE was defined as the absolute difference between the FP predicted by a Bayesian learner (i.e. the moment at which the prior was maximal) and the actual FP of that trial.
We analysed the influence of FP duration, Pb and pE on RTs to the target. Performance varied as a function of FP duration and all three groups responded fastest to targets appearing after the most probable FP. Strikingly, RTs showed a U-shaped profile, getting gradually slower as FP duration got increasingly shorter or longer than 600ms, even though these FPs were all equally probable. Indeed, linear mixed-model analyses showed a significant main effect of pE on RTs, indicating that performance is guided by the temporal distance between the prior and the actual FP, rather than FP probability per se. Nevertheless, the influence of pE on performance emerged gradually during childhood, with younger children having a less temporally precise prior than older children.
These findings confirm that all participants demonstrated temporal statistical learning, and that temporal prediction error plays a key role in explaining implicit timing performance across development.

Keywords: temporal attention, implicit timing, foreperiod, prediction error, expectation, children

Interaction between timing, stimulus control of light and sound, and its effects on anticipatory responses in multiple and mixed fixed interval schedules in rats (Preliminary Results)

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The post-reinforcement pause has been studied using fixed-ratios in mixed and multiple schedules. The results showed long pauses in the multiple schedule with the long component and short pauses in the mixed schedule for both components, suggesting that the pause is a function of the upcoming ratio. This study aimed to analyze timing in rats under mixed and multiple fixed-interval (FI) reinforcement schedules with short and long intervals, using the same methodology of the fixed ratio comparisons, to replicate that pauses are anticipatory in the FI schedules as well and to collect evidence about how the behavioral patterns under control of the stimuli may facilitate timing. In Experiment 1, four rats underwent four phases of 20 sessions, alternating between mixed and multiple schedules. One component in each schedule was FI-60 s (short) and the other FI-240 s (long), presented in a semi-random sequence. The reinforcement was 5 seconds of access to water. Experiment 2 followed a similar procedure with five rats, using FI-30 s (short) and FI-120 s (long). The sessions were recorded for analysis. Additionally, two phases with peak trials were included. The results suggest differences in response rate between FIs, as well as between schedules and components. Stimulus control was observed in the multiple schedule (by the interaction of time and sound/light) and mixed schedules (by time). Furthermore, the pause's duration increased with the interval's length. It is concluded that the pause is an anticipatory phenomenon and that the rats use elapsed time as a signal to anticipate the delivery of the reinforcer; they combine such information with the stimulus to more effectively time appropriate durations. Additionally, videos were automatically analyzed using a deep learning model to track behavioral patterns. The results and conclusions of this study are preliminary.

Keywords: post-reinforcement pause, fixed intervals, discriminative stimuli, timing, rats

How ensemble temporal statistics influence duration perception of visual events

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The human ability to reproduce the duration of brief sensory events is shaped by the statistical distribution of recently experienced durations, referred to as the temporal context. For example, when the same physical duration is presented within different duration ranges, its reproduction tends to be systematically biased toward the mean of the respective range, leading to different reproductions across contexts. Temporal context also changes when we are exposed to a fixed set of durations that vary in their frequency of occurrence, though the effects of such context remain less well understood. At the neural level, functional MRI (fMRI) studies have shown that the processing of brief visual durations is supported by tuning mechanisms that change across the cortical hierarchy—from monotonic tuning in early visual areas to unimodal tuning in downstream regions. However, it remains unclear how and where these tuning properties adapt to contextual biases. In this study, 30 participants reproduced 8 visual durations presented under either a uniform or a positively skewed distribution. To investigate the neural underpinnings of this contextual manipulation, a separate group of 15 participants performed the same task while undergoing ultra-high-field (7T) fMRI. Behavioral data showed that, under the skewed condition, all durations were reproduced as longer, suggesting a repulsive effect of temporal statistics on behavioral responses. Representational similarity analysis further revealed a systematic forward shift in reproductions: responses under the skewed condition became more similar to those of the next longer duration in the uniform condition, indicating a fine-grained adjustment of timing performance driven by temporal statistics. For the neural data, we plan to use neuronal model-based analysis to estimate monotonic and unimodal responses to durations. This approach will be instrumental in characterizing tuning differences between statistical conditions and linking them to behavioral outcomes. Overall, this work may advance our understanding of the neural mechanisms underlying context-driven temporal distortions.

Keywords: temporal context, duration tuning, 7T-fMRI

Temporal Reward Prediction in the Visual Corticostriatal Circuit

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Accurate prediction of reward timing is critical for adaptive decision-making, yet the neural mechanisms underlying temporal reward expectations remain poorly understood. We investigate how the visual corticostriatal circuit (VC>DS) encodes and transmits reward timing signals to guide time-investment behavior. While the visual cortex (VC) traditionally is regarded to simply processes sensory information, a growing body of work demonstrates its role in encoding both reward timing and action timing. Complementing this, the dorsal striatum (DS) is known to integrate motor timing and action valuation. We propose that VC transforms sensory cues into temporal reward predictions, which DS then translates into timed behavioral policies.To test this hypothesis, we developed a novel behavioral paradigm where head-fixed mice optimize waiting durations to maximize reward rates. Mice were divided into two groups and trained with different reward regimes of distinct background delays (1s vs. 5s), requiring strategic adjustment of wait times. Behavioral data reveal precise adaptation, with mice waiting significantly longer under longer background delays (3.84s vs. 1.95s; n=26 mice; 604,837 trials; p-value < 10e-28). Simultaneous neural recordings using Neuropixels 1.0 probes identified DS and VC neurons exhibiting wait time-dependent firing patterns, with peak activity prior to decision to end waiting scaling either positively or negatively with wait duration.Current findings support a model where VC computes reward timing expectations that DS utilizes to guide action selection. Future work will employ circuit-specific perturbations to test the causal role of VC>DS projections in timing behavior. This study provides mechanistic insights into how sensory-motor circuits integrate temporal information to guide decisions—a process impaired in Parkinson’s disease and addiction. By elucidating computational principles of the VC>DS circuit, we advance our understanding of predictive timing in adaptive behavior.

Keywords: Reward timing, Corticalstriatal circuit, Neuropixels, Decision making, Reinforcement learning

Exploring the effects of rhythmic vibratory stimuli on time perception

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This study examined whether the time perception can be manipulated by presenting periodic tactile vibration. Previous research suggested that the vibration frequency (at around 1 Hz) applied while people are sitting passively distorts the perceived speed of time; higher frequencies make us perceive the passage of time faster than lower frequencies. (Iizuka & Yotsumoto, 2019). In this study, we presented vibration while participants were actively engaged in a task. After engaging in a task for 7.5 min, participants reported the subjective speed of the time passed, the amount of boredom during the task, and the estimated length of the time using a visual-analogue scale. In Experiment 1, participants solved arithmetic problems. Subjects were randomly assigned to one of three vibration conditions: none (control), 54 beats per minute (BPM), or 66 BPM. In Experiment 2, to investigate whether the effect of vibration stimuli is influenced by attention, participants counted the number of vibrations, with 54 BPM and 66 BPM assigned between subjects. In both experiments, significant negative correlation was found between perceived duration of time and the amount of boredom, replicating Witowska et al. (2020). However, neither perceived duration nor the subjective speed of time differed across vibration conditions, indicating no detectable effect of the tactile stimulation. These findings suggest that vibration-based modulation of time perception operates only under restricted circumstances. Future work should vary cognitive load and stimulus characteristics to clarify the detailed conditions under which external periodic stimulation influences human time perception.

Keywords: Time Perception, Tactile perception, Vibration Stimuli, Time distortion, Time judgement

How facial features affect time perception: from the perspective of race and eye contact.

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Previous studies have shown that eye contact alters time perception. However, inconsistent findings have been reported regarding whether eye contact leads to an underestimation (Burra & Kerzel. 2021) or overestimation of time (Ren et al. 2023). One possible reason for these discrepancies is the variation in facial stimuli and participants' racial backgrounds across studies. The current study investigated how the race of facial stimuli influences time perception during eye contact among Japanese university students.In Experiment 1, participants completed a temporal bisection task using static images of Japanese and Caucasian faces with either direct or averted gaze. The results showed no significant effect of gaze direction but a significant effect of race: participants perceived the duration of Japanese faces as shorter. This suggests that static direct gaze alone is insufficient to induce an eye-contact effect on time perception.In Experiment 2, we created a pseudo eye-contact situation by dynamically presenting sequential face images with different gaze directions. In this presentation method, the sequence of an averted gaze followed by a direct gaze and then another averted gaze made the eye movement more salient, enhancing the perception of eye contact. The results revealed that participants were more likely to perceive time as longer when the gaze was directed toward them, indicating a clear eye-contact effect.These findings suggest that the method of facial image presentation influences time perception. While static direct gaze may direct attention to overall facial features, leading to a stronger racial effect, dynamic gaze shifts may enhance the perception of eye contact, thereby modulating time perception. This study highlights the role of facial race and stimulus presentation methods in shaping time perception during eye contact.

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Burra & Kerzel 2021 *Cognit.*, 212, 104734.Ren et al. 2023 *Frontier in Psycho*l., 13, 967603.

Keywords: Time perception, Gaze direction, Race, Attention

Seeking the internal clock: Does the modality effect exist in retrospective timing and if so, is it multiplicative as in prospective timing?

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Time duration judgements are typically categorised into prospective, and retrospective time judgements. Solid evidence supports the internal clock model as a mainstream mechanism for prospective timing. The Storage Size Model proposed that retrospective timing judgement is instead based on the amount of information processed, but inconsistent experiment results have questioned the validity or purity of this underlying mechanism. A possible explanation of this inconsistency is that both types of time judgement are based on the internal clock, but they differ in the amount of attention allocated to timing the event. In the current study, we conducted two experiments with different stimuli durations in both the visual and auditory modalities to test the potential modality effect in a retrospective timing condition. The 'verbal estimation of duration' task was used. The two experiments differed only in the range of durations used. Experiment 1 used a range from 281 - 909 ms, and Experiment 2 used a range of 595 - 3107 ms. Results of both experiments revealed a significant longer verbal estimation of duration for auditory stimuli than that for visual stimuli, which suggests a modality effect. The regression analysis found a significant intercept effect between modalities, but no slope effect. The problem of the division of types of time judgement are also discussed in the article. This large scale investigation involved over 600 participants and represents the first investigation of the possibility of a modality effect in retrospective timing.

Keywords: Retrospective time judgement, Time duration perception, Internal-clock model, Slope effect

The Interaction Between Timing, Impulsive Choice, and Risk Taking in Children with ADHD: Exploring the Role of Pharmacological Treatment

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Impulsive choice is choosing a smaller, immediate reward over a larger, delayed one, even when the delayed option is objectively optimal. Research in animal models evidences interaction between impulsive choice and timing precision (Smith et al., 2015), consistent withs studies with human adults suggesting a relationship between impulsivity, time perception, and risk-taking behavior (Baumann & Odum, 2012). It has been proposed that precise temporal estimation might underlie reductions in impulsive behavior, particularly in intervention studies with animals. However, this hypothesis remains untested. Individuals diagnosed with Attention-Deficit/Hyperactivity Disorder (ADHD) often display heightened impulsive choice, perceive time as passing quickly, and show less precision in estimating temporal durations. Despite this, few studies have examined how these processes relate in children with ADHD, or how pharmacological treatment may influence them. This study aims to evaluate the performance of children with ADHD on tasks assessing impulsive choice, temporal bisection, time reproduction, and risk-taking, and to explore how pharmacological treatment may impact behavior in such tasks. Participants will be children aged 8 to 10 years with a confirmed ADHD diagnosis by a neurologist. The procedure will include three phases. In the pre-test, conducted before starting medication, participants will complete four tasks: temporal bisection, time reproduction, temporal discounting, and probability discounting, two weeks later, caregivers will complete a short telephone survey about medication adherence. Approximately one month after the initial assessment, participants will repeat the same set of tasks. This study is currently underway. We anticipate the results will contribute to a better understanding of the interaction between timing, impulsive choice, and risk-taking in children with ADHD, and will provide insights into the potential role of medication in modulating these behaviors. These findings may inform the development of more effective intervention strategies.

Keywords: Timing, ADHD, Impulsive Choice, Risk Taking, Pharmacological Treatment

Assessing domain-generality of temporal metacognition: behavioral and electrophysiological insights

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Temporal metacognition, the ability to evaluate one’ s own timing performance, remains a relatively understudied aspect of self-monitoring. Recent findings from temporal reproduction tasks in both humans and rodents (Oztel & Balci, 2024) suggest that individuals can access information about the magnitude and direction of their timing errors, pointing to a capacity for metacognitive evaluation in the temporal domain. However, it remains unknown whether temporal metacognition is supported by shared mechanisms also contributing to other perceptual and cognitive tasks or whether it is highly specific to the time domain. This question builds on a broader debate in the metacognition literature: does metacognitive monitoring rely on domain-general or domain-specific mechanisms? Prior research has primarily addressed this by comparing metacognitive performance across sensory modalities or between domains such as perception and memory, yielding mixed evidence for both shared and distinct processes (Rouault et al., 2018). To extend this line of inquiry into the temporal domain, we adapted a confidence forced-choice paradigm (de Gardelle & Mamassian, 2014, 2016) to compare metacognitive judgments across a temporal and a visual bisection task. Participants performed pairs of trials and indicated which response they felt more confident about. Preliminary results show an increase in psychophysical sensitivity for trials selected as more confident, in both tasks. Moreover, participants were able to compare confidence across domains, suggesting the presence of a domain-general format for confidence. To investigate the underlying cerebral mechanisms, EEG recordings are being conducted in a second study. We hypothesize that temporal metacognition might involve domain-general readout mechanisms acting on task-specific network dynamics. This work aims to provide new insights into whether temporal metacognition is integrated within a unified self-monitoring system or operates independently from other domains.

Keywords: Temporal metacognition , Confidence, Domain-generality, EEG

Retrieving sequence of duration(s) from working memory

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Cognition critically relies on both, working memory (WM) and temporal information. However, how our brain processes temporal information in WM remains largely unresolved. Previous studies have shown that WM load, but not attention, affects the reproduction of time intervals (Church, 1984; Herbst et al., 2025; Teki et al., 2014). Herein, we used a delayed n-item reproduction task in which participants hear a sequence of empty time intervals that they have to reproduce after a retention period. We asked (1) how the length of the retention period affects the reproduction of a stored duration, and (2) whether multiple durations (sequence) interfere with each other in WM.In the first experiment, we manipulated the ratio between the time interval to be reproduced and the retention period. Our data showed that both the retention period and the ratio of the time interval and retention affected WM performance. In the second experiment, we explored the interference between the durations in the sequence by adding a cue indicating whether one interval in the sequence (first or second) or the full sequence of intervals had to be reproduced. The cue could be presented before (pro-cueing) or after (retro-cueing) the retention period. We found that a primacy effect on reproduction precision only occurs when retro-cueing for a long duration: the reproduced long duration was more precise in the first position. Additionally, our results show that participants initiated their reproduction faster for the first interval in the sequence than for the second one, independently of their durations. Overall, our study suggests that both the retention period and interference with other remembered intervals can affect the representation of duration in working memory.

Keywords: time perception, duration, order, working memory, precision

Investigating heart–eye coupling during active visual search in early infancy: a planned study

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Humans actively explore and perceive their environment. Recent studies suggest that the timing of exploratory movements and subsequent sensory processing is regulated by a predictive mechanism tied to the cardiac cycle, whereby the central nervous system uses internally generated baroreceptor signals conveying blood-pressure information to modulate external sensory processing (Galvez-Pol et al., 2020). In our recent study, using eye movements as a proxy for exploratory and perceptual behavior, we found that rapid eye movements for exploration (saccades) tend to occur immediately after a heartbeat (during systole), whereas sustained fixations associated with perception predominantly occur during the subsequent diastolic phase (Hisada & Isomura, in prep).

To investigates the developmental emergence of this heart–eye coupling, we adapted our adult task into an infant-friendly, non-verbal visual search task. Infants were presented with an attractive image that was initially covered with a black mask, and spontaneously uncovered it by directing their gaze to masked region, revealing the underlying image. We simultaneously recorded the infants’ electrocardiogram (ECG) during the task. We hypothesize that heart-eye coupling emerges in parallel with the development of primitive self-processing in the first year of life. Data collection with early infants is ongoing, and will be complete by the time of the conference. We will present the results of circular-phase analyses of eye-movement timing relative to the cardiac cycle, and discuss our findings in terms of baroreceptor-mediated self-related processing.

Keywords: Eye movements, Cardiac cycle, Baroreceptor, Systole, Saccades

Temporal Binding and Sense of Agency in Oculomotor Control

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We investigated sense of agency (SoA) for saccades using explicit and implicit agency measures, including temporal binding. Participants moved their eyes towards on-screen stimuli that subsequently changed color. Participants then either reproduced the temporal interval between saccade and color-change or reported the time points of these events via an auditory Libet clock to measure temporal binding. Crucially, participants were either made to believe to exert control over the color change or not, thereby establishing an agency manipulation. Explicit ratings indicated that the manipulation of causal beliefs and hence agency was successful. However, temporal binding was only evident for caused effects, and only when a sufficiently sensitive procedure was used, that is, an auditory Libet clock. This suggests a feebler connection between temporal judgements and SoA than previously assumed. The results also provide evidence in favor of a fast acquisition of sense of agency for previously never experienced types of action-effect associations. Oculomotor temporal effect binding as addressed in the present study is theoretically informative given the lower degree of voluntariness involved in eye movement control as compared to more standard effector systems (e.g., manual) typically utilized in temporal binding research.

Keywords: Sense of Agency, Eye Movements, Temporal Binding

What's the difference between a premature and a timed anticipatory movement ?

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Imagine yourself in a car race waiting for the traffic light to go green. Impulsivity could push you to accelerate prematurely when the light is red, causing a false start. In contrast, cognitively driven anticipation could lead you to accelerate right at the time the traffic light goes green and give you some advantage. Whether these two types of responses interact or are independent is an open question. Independent neural processes could be reflected in different characteristics like latency distribution, velocity and/or amplitude of the movement.The independence hypothesis was tested using an oculomotor task with a constant delay between a warning and an imperative visual stimuli. Delay duration was either 400, 900, 1400 or 1900 ms in blocks of 120 trials. Through repetition, subjects (n=27) implicitly learn the timing of the imperative stimulus. On average, 10% of experimental trials were associated with a response before the 'go' signal. The latency distribution of eye saccades during the delay before the 'go' signal was composed of two modes. With increasing delay duration, we found that: 1) The number of 1st mode saccadic responses decreased whereas the number of 2nd mode responses remained approximately constant; 2) The variance of 1st mode response latencies remained constant whereas the variance of 2nd mode responses increased; 3) The maximum velocity of 1st mode responses remained constant whereas it decreased for 2nd mode responses.These results show that collectively referring to movements before the 'go' stimulus as 'anticipatory' is inaccurate. There are probably two independent processes taking place before the 'go' stimulus: an unintentional release of inhibition evoking a premature saccade and an anticipatory process temporally guided. Premature saccades could be subcortically initiated whereas anticipatory saccades could be under the dependence of the cortical eye fields.

Keywords: Temporal preparation, Eye movements, Anticipation, Impulsivity

Revealing rhythm categorization in human brain activity

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Human experience of musical rhythm is fundamentally determined by the ability to map the infinite variety of possible rhythmic sensory inputs onto a finite set of internal rhythm categories. However, the underlying nature and neural mechanisms of rhythm categorization are still not well understood. Here, we present a novel approach allowing to reveal rhythm categories from brain activity using scalp electroencephalography (EEG) combined with frequency-domain and representational similarity analysis (fRSA).

Using this approach, we provide first direct evidence for neural categorization of rhythm in humans. We show that EEG activity elicited by a set of two-interval rhythms goes beyond mere tracking of acoustic temporal features and, instead, reflects two discrete categories that encompass small integer ratio rhythms reported in prior behavioral work. Importantly, we show that these neural categories are remarkably similar to the categorical structure captured in sensorimotor reproduction of the same stimuli, yet they can emerge automatically, without a related explicit task, thus independently from motor, instructional or decisional biases.

To go a step further, we investigated whether the automaticity of this phenomenon could be related to an early emergence of rhythm categories in the subcortical auditory regions based on lower-level physiological properties of neural assemblies. To test this, we used a functional localizer allowing to isolate EEG activity originating from higher-level cortical vs. subcortical auditory sources. Preliminary results indicate that while the categorical representations observed at the cortical level cannot be fully explained by subcortical responses, rudiments of rhythm categorization might already emerge in the early stages of the ascending auditory pathway.

Together, these results and methodological advances constitute a critical step towards elucidating the fundamental constituents and biological substrates of musical rhythm, particularly the interplay between universal neurobiological constraints shared across individuals and species, and the plasticity of categorization processes developing through life experience.

Keywords: Musical behavior, Representational similarity analysis, Perceptual categorization, Rhythm perception and production, Electroencephalography

Memory traces of duration and location in the right intraparietal sulcus

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Time and space form an integral part of every human experience, and for the neuronal representation of these perceptual dimensions, previous studies point to the involvement of the right-hemispheric intraparietal sulcus and structures in the medial temporal lobe. Here we used multi-voxel pattern analysis (MVPA) to investigate long-term memory traces for temporal and spatial stimulus features in those areas. Participants were trained on four images associated with short versus long durations and with left versus right locations. Our results demonstrate stable representations of both temporal and spatial information in the right posterior intraparietal sulcus. Building upon previous findings of stable neuronal codes for directly perceived durations and locations, these results show that the reactivation of long-term memory traces for temporal and spatial features can be decoded from neuronal activation patterns in the right parietal cortex.

Keywords: space-time interference, spatial cognition, intraparietal sulcus, MVPA, fMRI

Neural Correlates of Perceptual Biases in Visual Duration Estimation

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Our perception of stimulus duration expands and compresses under the influence of multiple factors such as stimulus features, our physiological state or attentional focus. However, the neuronal mechanisms underlying temporal distortions are not yet well characterized. In the visual system, processing of stimulus duration is supported by distinct tuning profiles: early visual areas exhibit monotonic responses that scale with stimulus duration, whereas downstream cortical regions show unimodal tuning, whereby brain responses peak at preferred durations. In this study, we sought to identify how changes in these tuning profiles relate to biases in duration estimation. Using ultra-high field fMRI, we recorded brain activity of 15 participants engaged in a duration discrimination task under two experimental manipulations known to induce biases in duration judgements. In one session, we modulated perceived duration by altering stimulus speed, which is known to expand the perceived duration of faster stimuli. In a separate session, we employed a duration adaptation protocol, where repeated exposure to a short duration led participants to overestimate the duration of subsequently presented stimuli. Critically, although both manipulations produced similar perceptual biases, they are hypothesized to affect different stages of the neural tuning hierarchy: speed-driven biases are expected to modulate tuning in early visual areas, while adaptation-induced biases are more likely to impact duration tuning in higher-order regions. Using neuronal model-based analysis we aim to identify commonalities and differences in how our experimental manipulations shape duration tuning and its topographical organization. Preliminary results suggest that the two experimental manipulations differentially modulate duration tuning across distinct stages of duration processing within the cortical hierarchy. Overall, our findings might provide new insights into the flexible nature of the neural mechanism underlying our subjective experience of stimulus duration.

Keywords: duration perception, duration tuning, 7T-fMRI

Uncovering the neuroanatomical substrates of impulsive behaviour induced by the temporal predictability of events: an fMRI-EMG investigation

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Previous research has revealed that the temporal predictability of events enhances response speed but exacerbates impulsive responses during conflict tasks. We used fMRI coupled with EMG to investigate the neuroanatomical correlates underlying this impulsivity 24 healthy participants performed a temporally cued Simon conflict task. Temporal predictability was manipulated by visual pre-cues that either indicated (temporal cue) or not (neutral cue) target onset time. Participants responded to target shape (+/x) with left- or right-hand responses. Critically, the spatial location of the targets (left/right) was either compatible or incompatible with the required response hand, inducing response conflict. Behavioural data replicated previous findings: temporal cues increased the number of fast impulsive errors to incompatible targets. FMRI analysis revealed that temporal predictability, activated left inferior parietal cortex (IPC) and left premotor cortex irrespective of response hand laterality or target (in)compatibility. Conversely, response incompatibility activated right putamen and right premotor cortex, independent of cue type. Notably, an interaction effect—reflecting increased impulsivity to temporally predictable targets—was associated with enhanced activation in left IPC. This region is implicated in temporal attention and sensorimotor integration, and may accelerate motor preparation based on temporal expectations, boosting activation of both correct and incorrect responses. This anticipatory mechanism likely sharpens readiness but also leaves the system vulnerable to prepotent, task-irrelevant activations. Indeed, behavioural errors represent only part of the underlying impulsive processes during conflict. EMG recordings revealed that 16% of correct responses to incompatible targets were preceded by subthreshold EMG bursts in the incorrect response hand—so-called 'partial errors' - which are rapidly suppressed. Temporal predictability heightened this covert motor activation, with partial errors occurring more often after temporal cues than neutral ones. Our next steps include identifying brain regions linked to these partial errors to understand how temporal predictability affects the neural circuits modulating covert impulsive actions.

Keywords: Temporal predictability, Impulsivity, EMG, fMRI, Response conflict

Basic mechanism underlying the audio-visual temporal recalibration for the long stimuli

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When audio-visual stimuli are presented with a consistent temporal asynchrony for a few minutes, the perceived asynchrony between the stimuli would be reduced (audio-visual temporal recalibration). The present study aims to examine the mechanism underlying the audio-visual temporal recalibration for the stimuli whose onsets are distinguishable from their offsets. In Experiment 1, we investigated the responsibility of the onset-offset channel, which independently processes the onset and offset of stimuli, for the audio-visual temporal recalibration. Participants were exposed to either asynchronous onsets or offsets with a constant temporal lag (±240ms; negative lag means that the visual stimulus followed the audio stimulus) in the adaptation phase, and then made temporal order judgments for the offsets in the test phase. We found no temporal recalibration. In Experiment 2, we investigated the responsibility of the subject binding between the onset (offset) of the audio stimulus and the offset (onset) of the visual stimulus, for the audio-visual temporal recalibration. Participants were exposed to asynchronous onsets and offsets with a constant temporal lag (0, ±240ms; the audiovisual stimuli overlapped with each other only in the negative lag condition) in the adaptation phase, and then made temporal order judgments for the offset and onset of audio-visual stimuli in the test phase. We found the temporal recalibration only for the -240ms condition. In Experiment 3, we investigated the necessity of overlap between the audio-visual stimuli, for the audio-visual temporal recalibration. Participants were exposed to synchronous onsets and offsets with a constant temporal lag (-240ms) in the adaptation phase, and then made temporal order judgments for the offset and onset of the stimuli in the test phase. We found no temporal recalibration. These results suggest that the audio-visual temporal recalibration depends upon subjective binding between the onset and offset of audio-visual stimuli.

Keywords: Multiple sensory processing, Audio-visual stimuli, Temporal order judgement, Temporal lag, Awareness

Understanding Discomfort Caused by Audiovisual Temporal Asynchrony: Insights from Egg Cracking and Grissini Breaking Videos

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1. Japan Women's Univ.

This study investigated how a sense of discomfort may be triggered by a time lag between visual and auditory stimuli under conditions that resemble everyday experiences. We conducted a psychophysical experiment using videos in which audio-visual time lags were manipulated across seven levels (±0 ms, ±133 ms, ±266 ms, ±400 ms). Participants (N = 15) were asked to judge whether the auditory and visual stimuli were simultaneous (simultaneity judgment) and whether they felt discomfort (discomfort judgment), using a two-alternative forced choice (2 AFC) method. The stimuli featured two everyday actions: cracking an egg and breaking a breadstick (grissini).

We proposed three hypotheses to explain the emergence of discomfort. Hypothesis 1 suggested that discomfort and simultaneity judgments yield identical psychometric functions, implying that discomfort results directly from perceived asynchrony. Hypothesis 2 posited that the psychometric function is narrower for discomfort than for simultaneity, indicating that even without conscious awareness of asynchrony, subtle temporal discrepancies may still be subconsciously perceived, eliciting discomfort. Hypothesis 3 predicted the opposite—that the discomfort function is broader than the simultaneity function—implying that a certain degree of asynchrony is perceptible but not necessarily unpleasant. The study's results support hypothesis 3. The temporal window is wider for discomfort judgments than for simultaneity judgments, suggesting that audiovisual asynchrony can be detected without causing discomfort. This finding aligns with Fujisaki et al. (2004), who identified a perceptual category of "not simultaneous but related" using a three-alternative simultaneity task. Adaptation effects were also observed within this category. The similarity between our discomfort window and Fujisaki's "related" window suggests that the perception of cross-modal relatedness, rather than synchrony alone, plays a key role in the emergence of audiovisual discomfort.

Keywords: Audiovisual temporal asynchrony, simultaneity judgment, discomfort judgment, temporal window, psychophysical experiment

Poster | Other

Fri. Oct 17, 2025 12:45 PM - 2:45 PM JST | Fri. Oct 17, 2025 3:45 AM - 5:45 AM UTC MM Hall (KOMCEE-B1)

[P1] Poster: Day 1

[P1-39] Unconscious motor–visual temporal recalibration occurs in both active and passive movements

*Masaki Tsujita (Faculty of Child Studies, Kamakura Women’s University)

Keywords：temporal lag adaptation、sensorimotor adaptation、method of constant stimuli、Arduino、cerebellum

Simultaneity judgments between motor actions and visual flashes are adaptively recalibrated after repeated exposure to a motor–visual temporal lag. It remains unclear whether this recalibration is specifically attributed to the temporal processing of an intersensory pair (e.g. tactile–visual) or to the temporal processing of the causal relationship between active movements and sensory outcomes. A previous study reported that motor–visual simultaneity judgments are recalibrated even when observers are unaware of the adapted temporal lag. We examined whether this unconscious temporal recalibration also occurs in passive movements. Given that self-generated sensory outcomes are automatically distinguished from externally generated sensory events on the basis of the temporal prediction by an efference copy, we predicted that unconscious temporal recalibration would require active movements. Participants were randomly assigned to either of two groups: in the active movement group, participants actively pressed a key; in the passive movement group, a DC solenoid moved their finger up and down as if pressing a key. Adaptation flashes were presented with a 0 ms lag in the first half and a 150 ms lag in the second half of the session. After the experiment, participants were asked whether they were aware of the temporal lag in the second half. Contrary to our prediction, among participants who were unaware of the temporal lag, the point of subjective simultaneity between movements and visual flashes shifted significantly in response to the adapted temporal lag, regardless of whether the movements were active or passive. These results suggest that an automatic temporal recalibration system is implemented in the temporal processing of both intersensory pairs and action–outcome relationships.

Poster | Other

Fri. Oct 17, 2025 12:45 PM - 2:45 PM JST | Fri. Oct 17, 2025 3:45 AM - 5:45 AM UTC MM Hall (KOMCEE-B1)

[P1] Poster: Day 1

[P1-40] The sound octave equivalence in a songbird as shown by the event-related brain potentials and the operant behavior.

*Rin Ito[1], Yukino Shibata[1,2], Kazuo Okanoya[1] (1. Teikyo University, 2. Hokkaido University)
Keywords：songbirds、octave、operant conditioning、event-related potentials

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Octave equivalence is a psychological phenomenon in which two sounds that have the relation of doubling of wavelength are perceiving as being similar to each other. This is one of the fundamentals in music perception related with timing and pitch. We asked whether a species of songbirds, the Bengalese finch, perceives such relations in sounds. Because Bengalese finches sing complex songs with multiple syllables comprising of harmonics, we hypothesized they might possess such perceptual mechanisms. We tackled the question by the event-related brain potentials and the operant behavior. We first measured local field potentials from the higher order auditory area of the finches. We used the oddball task in obtaining the miss-match negativities (MMNs) from novel sounds over familiar sounds. We used the latencies and the negative voltages of the MMNs to construct a cross-correlation matrix and then analyzed it by a hierarchical clustering. We found birds placed sounds in the octave relations in proximity than the one with 1/2 octave relation, suggesting the possibility that they are perceiving the octave equivalence. We then trained the finches to respond discriminate between sounds with different pitches, and then tested whether a novel sounds with octave high or low might be perceived as being similar with the original sound. This behavioral experiment is ongoing and we will be able to show the results in the conference. The study will show whether or not a species of the songbirds, with similar usage of sound signals with our music, perceives octave equivalence. (Work supported by JSPS 24H05160 and 23H05428 to KO).

TRF

Fri. Oct 17, 2025 1:20 PM - 5:00 PM JST | Fri. Oct 17, 2025 4:20 AM - 8:00 AM UTC TCVB tour

[T03] Tokyo River Cruise & Hamarikyu Gardens

TRF | Other

Fri. Oct 17, 2025 10:45 AM - 11:00 AM JST | Fri. Oct 17, 2025 1:45 AM - 2:00 AM UTC Room 1(Mathematical Science Building)

[T00] Opening Remarks

Yuko Yotsumoto