2016 Meiji-NTU Neurobiology and Cognitive Neuroscience Exchange Program

Organizers: **Dr. Yumie Ono, Dr. Sotaro Shimada,**
Dr. Hiroyuki Kudo, Dr. Riichi Kajiwara (Meiji University)

謝辞 Acknowledgement

本プログラムは，明治大学国際連携本部
「2016 年度 国際学会・シンポジウム開催助成」
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This program was financially supported by
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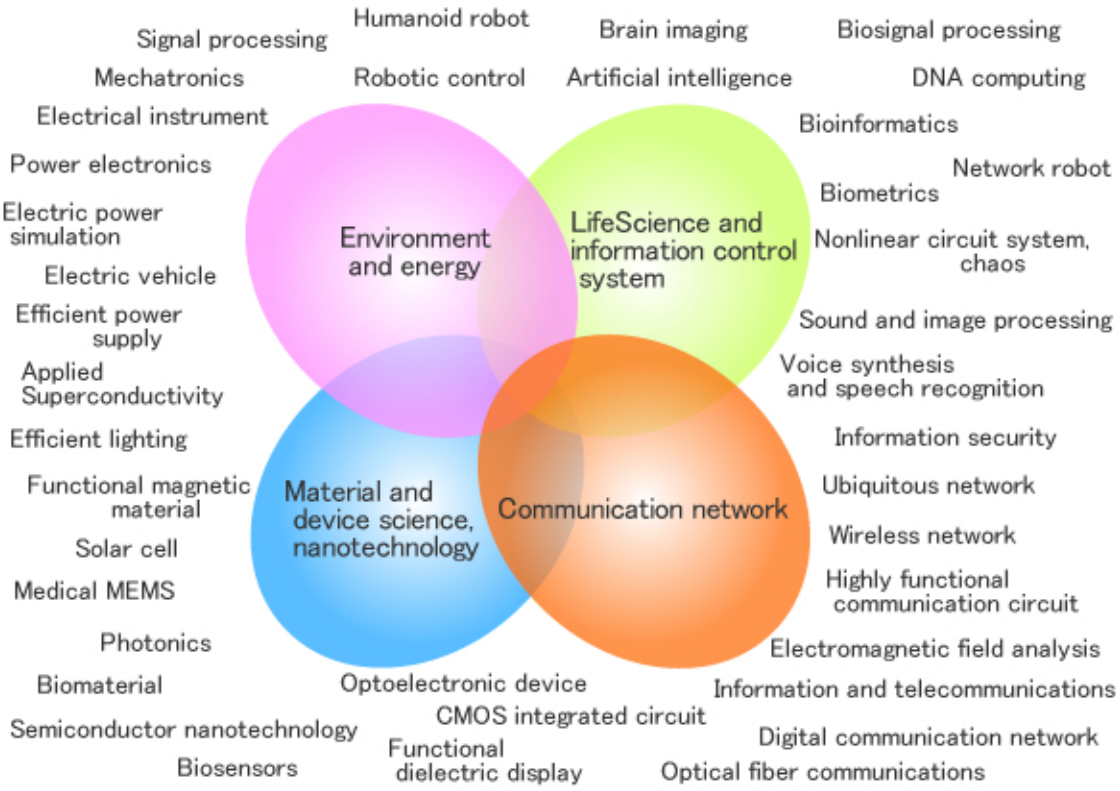
Welcome to Ikuta campus, Meiji University

A Garden Campus that Creates and Transmits Knowledge

The Ikuta Campus is a vast area situated in the Tama Hills. The campus has several advanced research facilities such as The High-Tech Research Center and Ikuta Structural Test Building to greenhouses and fields. Students from the School of Science and Technology and from the School of Agriculture, as well as graduate students, study in this rich natural environment. For students busy in experiments and research, facilities for daily life such as a cafeteria, shops and ATMs are available on campus. Also, our library is open on Sundays. Thus, the campus is planned to function for the convenience of students.

About Department of Electronics and Bioinformatics
at School of Science and Technology, Meiji University

The Department of Electronics and Bioinformatics has a unique character – we have interdisciplinary research fields of the traditional electrical, electronic and communication engineering integrated with life science and biotechnology. It has basic course concerning life science and biotechnology in addition to the conventional Electrical and Electronics Engineering, and the Electronics and Communication Engineering. The interdisciplinary research program includes integration of biotechnology and information technology (bioinformatics), nanotechnology and living system (nanobiotechnology), and biology and medical engineering (systems biology). The mission of this Department is to provide human resources who can contribute to not only the traditional electrical, electronic and communication engineering society, but also human healthcare and pharmaceutical industry. Currently 1,010 undergraduate students and 205 graduate students are studying with 27 faculty members under 26 independent laboratories.



Fields of Scholarship

Time Table

July 17th (Sun) Pre symposium Day

9:30 Registration @ 4th floor, Room A416/417 Presentation hall

9:50 Opening remark

10:00-11:45 Morning session: Technology to measure human cognitive function

Chair: Hiroyuki Kudo (Meiji University)

10:00 Professor Su-Ling Yeh (NTU)

"Investigating the limit of language processing under visual crowding"

10:30 Professor Yumie Ono (Meiji University)

"Source localization of mismatch negativity response of the auditory event-related potential in schizophrenia patients"

11:00 Professor Koichi Yokosawa (Hokkaido University)

"An Investigation of Brain Activity Using Magnetoencephalography During the Performance of a Sequential Memory Task"

11:30 Discussion

Move to Ikuta-Ryokuchi Park (optional hereinafter)

13:00 Soba noodle Lunch in Old Folk House "Shirakawa-go"

14:00-15:00 Japan Open-air Folk House Museum (English Guide Provided)

15:00 Take your own trip to nearby area

Suggestions: Kawasaki Municipal Science Museum, Taro Okamoto Museum of Art, Fujiko F Fujio Museum, Shopping in Shinjyuku etc…

July 18th (Mon) Symposium Day

9:00-9:30 Poster mounting @ 4th floor, Room A401/402, Pins provided

9:50 Welcome note @ Room A416/417 Presentation hall

Professor Hisao Kubota

Dean of Department of Science and Technology, Meiji University

10:00-11:40 Morning session: Imaging and evaluation of pain and motor function

Chair: Riichi Kajiwara (Meiji University)

10:00 Professor Fang-Chia Chang (NTU)

"Effects of acupuncture at Zusanli (ST36) on pain and pain-induced sleep disruption"

10:40 Professor Chen-Tung Yen (NTU)
"Visualize pain fiber and terminals directly in vivo and ex vivo in self-fluorescent mice"

11:20 Takuro Zama (Meiji University)
"Movement preparation-related cortical activity measured by a simultaneous EEG and near-infrared spectroscopy recording"

11:40-12:50 Lunch break and poster viewing @ Room A401/402

13:00-15:00 Student Poster Session

13:00 Guided poster viewing Chaired by NTU and Meiji Professors

13:30 Free Discussion

14:45 Vote for best poster

Tea break @ Room A416/417 Presentation hall

15:30-16:40 Afternoon session: Behavioral and emotional modulation of perception
Chair: Sotaro Shimada (Meiji University)

15:30 Professor Su-Ling Yeh (NTU)
"Multisensory perception: low-level and high-level factors"

16:10 Mohamad Arif Fahmi Bin Ismail (Meiji University)
"The effect of delayed visual feedback on `robot` hand illusion: a Near-Infrared Spectroscopy study"

16:30 Yuki Tsuji (Meiji University)
"The effect of socially anxious tendency in discrimination of emotional other's gaze"

16:50 Best poster award

17:00 Closing remark
Professor Minoru Onozuka
Faculty of Medical Science, Nippon Sport Science University

17:30 Get together party @ Dining Hall Square 21

Participant List

NTU Faculty

Chen-Tung Yen	PhD	嚴震東	Professor	Department of Life Science, NTU
Su-Ling Yeh	PhD	葉素玲	Professor	Department of Psychology, NTU
Fang-Chia Chang	PhD	張芳嘉	Professor	Department of Veterinary Medicine, NTU

Meiji Faculty

Yumie Ono	PhD	小野弓絵	Associate Professor	Department of Electronics and Bioinformatics
Riichi Kajiwara	PhD	梶原利一	Associate Professor	Department of Electronics and Bioinformatics
Hiroyuki Kudo	PhD	工藤寛之	Associate Professor	Department of Electronics and Bioinformatics
Sotaro Shimada	PhD	嶋田総太郎	Professor	Department of Electronics and Bioinformatics

NTU Students and Postdocs

Tzu-Hao Chao	趙子豪	PhD student	Yen lab
Bei-Xuan Lin	林蓓萱	MS student	Min lab
Chih-Hong Chi	紀志弘	PhD student	Pan lab
Wee-Shin Lim	林偉莘	MS student	Pan lab
Pey-Shyuan Chin	金佩璇	MS student	Chen lab
Nan-Fu Liou	劉南甫	MS student	Chen lab
Wen Tai	戴聞	MS student	Huang lab
Yung-Hao Yang	楊詠皓	Postdoc	Yeh lab
Ti-Fan Hung	洪迪凡	MS student	Yeh lab

Meiji Students

Yasuhiro Matsuda	松田康宏	PhD student	Ono lab
Kimiya Esaki	江崎公哉	MS student	Ono lab
Hidenori Kayanuma	栢沼一修	MS student	Ono lab
Yuki Komoriya	小森谷由貴	MS student	Ono lab
Miku Matsubara	松原未来	MS student	Ono lab
Naoto Seki	関　直人	MS student	Ono lab
Shohei Teramoto	寺本将平	MS student	Ono lab
Mikie Nakabayashi	中林実輝絵	MS student	Ono lab
Keisuke Matsumoto	松本圭佑	MS student	Ono lab
Shohei Morota	諸田翔平	MS student	Ono lab
Masaya Miyazaki	宮崎将也	BS student	Ono lab
Nursyairah Binti Azman	シャイラ	BS student	Ono lab
Kohei Okamoto	岡本亘平	MS student	Kajiwara lab
Shoto Kamada	鎌田翔仁	MS student	Kajiwara lab
Iori Sato	佐藤以織	MS student	Kajiwara lab
Kazumi Fujimoto	藤本和美	MS student	Kajiwara lab
Wakayama Yuka	和歌山ゆうか	MS student	Kajiwara lab
Tomohiro Iwasaki	岩崎智洋	BS student	Kajiwara lab
Katsuki Tsukamoto	塚本勝貴	BS student	Kajiwara lab
Michihiro Hyodo	兵藤道大	BS student	Kajiwara lab
Mari Morifuku	森福真里	BS student	Kajiwara lab
Yuta Yamada	山田悠太	BS student	Kajiwara lab
Jotaro Yuza	湯座丞太郎	BS student	Kajiwara lab

Meiji Students (continued)

Shuya Negishi	根岸周也	MS student	Kudo lab
Nozomi Kawai	河合　望	MS student	Kudo lab
Takuro ZAMA	座間拓郎	PhD student	Shimada lab
Yuki Tsuji	都地裕樹	PhD student	Shimada lab
Mohamad Arif Fahmi Bin Ismail	アリフ	PhD student	Shimada lab
Inoue Yu	井上　優	MS student	Shimada lab
Tadayoshi Koide	小出允善	MS student	Shimada lab
Aziem Athira Abdullah	アズィム	MS student	Shimada lab
Inamura Yuya	稲村雄也	MS student	Shimada lab
Takahashi Yoshiyuki	高橋芳幸	MS student	Shimada lab
Chen Zikun	陳子鵬	MS student	Shimada lab
Yusuke Hirako	平子祐亮	MS student	Shimada lab
Momokawa Tomoyuki	桃川智行	MS student	Shimada lab
Shohei Shimizu	清水翔平	BS student	Shimada lab
Mizuki Nakajima	中島瑞貴	BS student	Shimada lab
Atsushi Yumoto	湯本淳史	BS student	Shimada lab
Dai Yoshino	吉野　太	BS student	Shimada lab

Abstracts for Oral sessions

***Technology to measure human cognitive function 1*:**
July 17th (Sun), 10:00-10:25

Investigating the limit of language processing under visual crowding

Su-Ling Yeh
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Visual crowding is a phenomenon in which the ability to recognize a flanker-surrounded object in the visual periphery is drastically impaired; this effect is ubiquitous and occurs very often during the reading process. Several models have been put forth to explain the mechanism, with the *Pooling* Model and the *Substitution* Model as the most popular ones where both attribute crowding to a loss of signal integrity early in the visual pathway. However, as there are increasing reports of stimulus properties that could be processed under crowding, we investigated under the scope of language processing whether any *word* properties could survive. We first tested single word effect by presenting a prime word in the periphery that was either crowded or isolated, followed by a target that could be a word either related or unrelated to the prime, or a non-word. The participants had to perform LDT on the target, and a prime visibility check. We found that even when the prime was invisible, its semantic relatedness to the target influenced LDT performance (RT's) comparable to the magnitude in the visible condition. This result is also confirmed by ERP (N400's) and fMRI (BOLD responses) experiments. We then investigated whether temporally-segregated words could unconsciously integrate. We presented Chinese four-word idioms with either a congruent or incongruent ending word, or a non-word, one word at a time with the same suppression techniques, and asked participants to conduct the same tasks. Both behavioral and ERP results showed congruency effect in only the visible conditions. To ensure that the absence of a congruency effect was not due to presenting too many words within a trial, we conducted two-word studies in which the priming effect was also not found. Our finding thus suggests that even though temporal semantic integration might require conscious awareness, single word semantic processing does not. In terms of crowding mechanism, our results implicate that although our perception of a crowded stimulus might be a scramble, there potentially exists at least one pathway in our visual feedforward system where stimulus signals could maintain their integrity to be processed by the part of our brain that governs language.

***Technology to measure human cognitive function 2*:**
July 17th (Sun), 10:30-10:55

Source localization of mismatch negativity response of the auditory event-related potential in schizophrenia patients

Yumie Ono
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The auditory mismatch negativity (MMN) is a component of event-related potential (ERP) that corresponds to a response to an odd sound stimulus among a sequence of uniform stimuli. Auditory MMN is considered as an index of automatic context-dependent information processing and auditory sensory memory, and previous clinical studies reported deficit of MMN in schizophrenia patients. To further understand the difference in auditory signal processing between healthy controls and schizophrenia patients, we utilized Multiple Sparse Priors, an EEG/MEG source localization tool implemented in the generalized functional neuroimaging software SPM (version later than SPM8), to estimate cortical activities for the auditory MMN response. The advantage of using SPM in the analysis of MMN-ERP is that the reconstructed sources are represented in the normalized brain coordinates and thus it is available to statistically compare the volumetric cortical activities between participants. In our collaboration project with the Department of Psychiatry of National Taiwan University Hospital, we analyzed a duration-deviant MMN that were recorded from 38 schizophrenia patients and 42 age- and gender- matched healthy controls. To compensate the low spatial-resolution of the data recorded by conventional 32-channel EEG system, we limited the area of source locations around the predetermined possible MMN sources that were taken from previously published high-density EEG or fMRI studies. Results well differentiated the circuitries of bottom-up auditory processing in patients showing enhanced activity in the anterior prefrontal area and fusiform gyrus. Source localization technique could be utilized to more advanced analysis on the cortical network such as evaluating the time-course of electrical activities even in low-density EEG environment if the candidates of active source locations are given from different modalities.

***Technology to measure human cognitive function 3*:**
July 17th (Sun), 11:00-11:25

An Investigation of Brain Activity Using Magnetoencephalography During the Performance of a Sequential Memory Task

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The memory process consists of three stages, encoding, retention, and retrieval. Due to its high temporal and special resolution, magnetoencephalography (MEG) can record brain activity along the time course of the memory process and estimate representative brain regions. Utilizing sequential short-term memory tasks can also reveal various brain activity in accordance with memory targets. It is known that memory items at the beginning and ending of a presented sequence are memorized well, thereby causing the accuracy rate to present as a U-shape along the order of item presentation ("serial position effect" or "primacy and recency effects"). Here, the recency effect reflects immediate memory, while primacy effect may be related to working memory. By recording MEG during a sequential memory task, mechanisms of declining memory performance (e.g. those caused by aging), should be revealed. We therefore proposed a novel sequential memory task in which seven directional arrows (pointing up, down, left or right) were presented sequentially. Each participant memorized the arrow directions in the order presented and recalled the direction of the arrow corresponding to a recall number that was presented just after the final arrow in the sequence. The amplitude modulation of alpha-band rhythm during memory encoding and retrieval were recorded, and the representative brain regions were estimated. The chance level of a correct response for this task was only 25%, half that of the conventional Sternberg task, 50% (yes or no). This wider accuracy rate (25-100%) made it possible to analyze the relationship between the amplitude of alpha-band modulation and the accuracy rate. These results will be presented, along with the effects of mild cognitive impairment on memory performance.

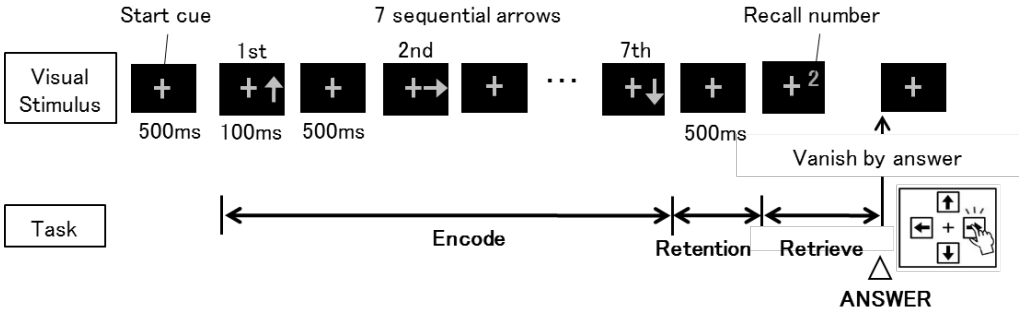

Figure. Schematic diagram of the time sequence of a single epoch

***Imaging and evaluation of pain and motor function 1*:**
July 18th (Mon), 10:00-10:30

Effects of acupuncture at Zusanli (ST36) on pain and pain-induced sleep disruption

Fang-Chia Chang
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Sleep problem is common comorbidity associated with chronic pain, and patients with primary insomnia are reported chronic pain at rates over 50%. Clinical studies demonstrate that sleep disturbance is improved after pain relief. In clinic, ST-36 (Zusanli) is one of commonly used acupoints for treating both pain and insomnia. The analgesic effect of acupuncture of ST-36 may be mediated by endogenous opioids in the nucleus tractus solitarii (NTS). This study investigated effects of acupuncture at ST-36 on pain and pain-induced sleep disturbance, and elucidated underlying mechanisms. Rats were surgically implanted with three electroencephalogram (EEG) screw electrodes for classifying the sleep-wake stages. Rats were also implanted a microinjection guide cannula directly into the NTS to determine the involvement of opioid receptors. A 30-minute manual acupuncture at ST-36 was performed before the dark period and then EEGs were recorded for 24 hours. The complete Freund's adjuvant (0.15 ml) was injected intradermally into the right hind paw to induce pain and the Von Frey hair was used for evaluating the pain threshold. The percentages of both rapid eye movement (REM) sleep and non-REM (NREM) sleep acquired after acupuncture was significantly higher than that obtained from the sham group. Naloxone administered into the NTS blocked sleep enhancement caused by acupuncture of ST36, suggesting the involvement of opioidergic system. Pain decreased NREM sleep and REM sleep and fragmented sleep architecture. Acupuncture of ST36 increased pain threshold and improved pain-induced sleep disruption, and administration of opioid receptor antagonist into the NTS block acupuncture's effects. In conclusion, these results indicated that acupuncture at ST-36 per se increased spontaneous NREM sleep and REM sleep, and opioids mediate the effects. Moreover, acupuncture of ST-36 exhibits analgesic effects and improves pain-induced sleep disturbance, and the effects of acupuncture are also mediated by opioid system in the NTS.

***Imaging and evaluation of pain and motor function 2*:**
July 18th (Mon), 10:40-11:10

Visualize pain fiber and terminals directly in vivo and ex vivo in self-fluorescent mice

Chen-Tung Yen
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Skin is the largest sensory organ in our body. There are numerous sensory endings in the skin that report to our somatosensory nervous system. Nociceptors (pain fibers) are the sensory fibers sensing noxious mechanical, thermal, and chemical stimuli. In normal subject, nociceptor activation produces painful sensation which helps us avoiding further injury and serves an important adaptive function. On the other hand, under disease conditions, patients suffer from chronic intractable spontaneous pain and evoked pains. Sensitization of the peripheral nociceptors may underlie many neuropathic pain conditions. In this talk, I will present our preliminary results on the use of two-photon microscopic methodologies to longitudinally following changes of nociceptor fibers and terminals under the skin of transgenic mice that express fluorescent reporters. The quantitatively measured results were compared with ex vivo imaging of the same fibers in situ in CLARITY cleared transparent tissue. We are utilizing harmonic microscopic methodologies to examine the same tissue of the mice. This may help us to see nerve fibers and endings in human subjects.

Movement preparation-related cortical activity measured by a simultaneous EEG and near-infrared spectroscopy recording

Takuro Zama[1] and Sotaro Shimada[2]
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[2]*Department of Electronics and Bioinformatics, School of Science and Engineering, Meiji University, Kanagawa, Japan*

Recent advances in functional neuroimaging have developed simultaneous multimodal recording. In particular, simultaneous measurement of electroencephalography (EEG) and near-infrared spectroscopy (NIRS) has a high applicability to naturalistic human motor control tasks because it has low motion-constraints on a subject. Previous studies have reported brain activity during motor preparation either by EEG or hemodynamic measurement: EEG studies have shown that the readiness potential (RP), which is the negative slow potential shift, precedes to a movement onset by about 1-2 s, while hemodynamic studies have reported the activity of premotor area during motor preparation. Nevertheless, the relationship between RP and the hemodynamic responses during motor preparation has not been fully investigated. In this study, we conducted EEG-NIRS simultaneous recordings over the sensorimotor area during motor preparation in a self-paced button press task. Participants were instructed to press a button at their own timing after a cue was shown. The result showed that the RP on C3 in the extended 10–20 system occurred about 1025 ± 153 ms (mean ± s.e.) before the movement onset. An increase in concentration of oxyhemoglobin (oxyHb) in the premotor cortex (BA6, MNI coordinate: [−41, 11, 60]) during motor preparation was also confirmed by NIRS, showing a significant correlation with the RP amplitude (Pearson's correlation $r = -0.48$, $p = 0.03$). Our study first showed that EEG-NIRS simultaneous recording can demonstrate the correlation between the RP and hemodynamic response in the premotor cortex contralateral to the performing hand. We will also discuss the possibility of EEG-NIRS simultaneous measurement technique to apply to single-trial based motor detection.

Behavioral and emotional modulation of perception 1:
July 18th (Mon), 15:00-15:30

Multisensory perception: low-level and high-level factors

Su-Ling Yeh
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Multiple sources of information provide the perceiver a more veridical view of the world; however, to perceive a unified percept, sensory inputs from different modalities must be integrated as a meaningful whole. In this talk, I will provide human behavioral evidence for the temporal and the spatial rules (multisensory events that occur close in time and space, respectively, tend to bind together) that have derived from animal studies, and show that consciousness is not necessary (while attention may be) in multisensory integration. Specifically, our investigations on the connection between cognitive aptitudes and the rubber hand illusion, semantics and grapheme-color synesthesia, as well as the correlation of temporal integration window with age and light exposure have yielded several clues about the kind of factors that may affect multisensory integration.

Behavioral and emotional modulation of perception 2:
July 18th (Mon), 15:40-16:00

The Effect Of Delayed Visual Feedback On `Robot` Hand Illusion: A Near-Infrared Spectroscopy Study

Mohamad Arif Fahmi Bin Ismail[1] and Sotaro Shimada[2]
[1]*Erectrical Engineering Program, Graduate School of Science and Technology, Meiji University, Kanagawa, Japan*
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[2]*Department of Electronics and Bioinformatics, School of Science and Engineering, Meiji University, Kanagawa, Japan*

Rubber hand illusion (RHI) is a subject's illusion of the self-ownership of a rubber hand that was touched synchronously with their own hand. While RHI is an illusion regarding visual and tactile integration and hence is about the sense of self-ownership, it is natural to consider a similar illusion regarding visual and motor integration. We may call this as "robot hand illusion" (RoHI), which is relevant to both the sense of self-ownership and the sense of self-agency. Our previous study, showed that the subject felt significantly greater RoHI effects with visuomotor temporal discrepancies of less than 200ms both in the sense of self-ownership and the sense of self-agency, while weaker RoHI effect, only in the sense of self-agency, was still observed even with temporal discrepancies of 300-500ms. Here we investigate the effect of RoHI with brain activity using near-infrared spectroscopy (NIRS). The result showed that a channel placed on the parietal region (angular gyrus) showed significant activation in the 100ms visual-feedback delay condition in the left angular gyrus. ANOVA showed that there are significant difference between the 100ms condition and larger delay conditions (400ms, $p<0.05$; 700ms, $p<0.1$). These results demonstrate that the activity in the angular gyrus was modulated by the delay between the motor command and the visual feedback of the hand movements. We suppose that the angular gyrus is essential for integrating motor and visual information to distinguish one's own body from others.

The effect of socially anxious tendency in discrimination of emotional other's gaze

Yuki Tsuji[1] and Sotaro Shimada[2]
[1]*Erectrical Engineering Program, Graduate School of Science and Technology, Meiji University, Kanagawa, Japan*
tsuji@meiji.ac.jp
[2]*Department of Electronics and Bioinformatics, School of Science and Engineering, Meiji University, Kanagawa, Japan*

Socially anxious tendency is considered as a potential for social anxiety disorder (SAD), which is characterized by excessive fear to a social situation associated with being evaluated or embarrassed by others. Especially, gaze of others is known to frequently induce social anxiety. Here we employed an other's gaze emotion discrimination task to examine the effect of socially anxious tendencies on social cognition. We generated emotionally ambiguous gazes by employing a morphing technique (neutral, disgust 10-100% in 10% steps, and happy 10-100% gazes). Subjects were required to judge whether the stimulus was positive or negative. Seventeen male adult subjects (aged 21.2 ± 1.35, mean ± SD) participated in the study. Two subjects were excluded from the analysis because they did not correctly perform the experiment. The participant's level of social anxiety was examined by means of the Japanese version of the Social Phobia Inventory (SPIN-J). The SPIN-J is a 17-item questionnaire, each rated on a 5-point Likert-type scale. The total score of SPIN-J ranges from 0 to 68, and the clinical cut-off point is at 30. The SPIN-J is designed to measure three symptom dimensions: fear, avoidance, and physiological arousal. The subjects were assigned to the high (HSA: n = 9) or low socially anxious tendency groups (LSA: n = 6) on the basis of clinical cut-off point. To examine the differences in judgment between the LSA and HSA groups, logistic curves were fitted to the subject's response function in the emotion discrimination task. We estimated the point of subjective equality (PSE), where positive and negative judgment probabilities are equal (50%), by fitting to a complexed curve of logistic and Gaussian functions. The mean PSE in the HSA group (disgust = 16 ± 10%, mean ± SE) was significantly smaller than that in the LSA group (disgust = 31 ± 14%) (Wilcoxon's Rank Sum Test: $Z = 1.71$, $p < 0.05$). We also found a negative correlation between the score of the avoidance, which is a subscale of SPIN-J, and PSE (correlation coefficient $\rho = -0.64$, $p < 0.01$). These results suggest that highly socially anxious subjects have a tendency to recognize ambiguous emotional gazes as negative.

Poster session guide

Poster list and guided tour subgroups

Group 1 Chaired by: Professor Riichi Kajiwara

1	Pey-Shyuan Chin	Mapping the retina-SCN functional circuitry
2	Iori Sato	Generation of a red-wavelength shifted membrane-potential sensitive protein for in-vivo brain analysis
3	Nan-Fu Liou	M1 ipRGCs regulate light adaptation through DAC by intra-retinal axon collateral
4	Shohei Morota	Effect of neurofeedback training of steady-state visual evoked potentials

Group 2 Chaired by: Professor Su-ling Yeh

5	Aziem Athira	Functional connectivity between dorsomedial prefrontal and motor cortices during being imitated by the other
6	Yu Inoue	EEG analysis of mirror system and reward system in vicarious reward
7	Naoto Seki	Appropriate timing for sensory feedback in ERD-BMI
8	Yung-Hao Yang	Temporal integration of semantic information with and without visual awareness: An fMRI study
9	Tomoyuki Momokawa	Neural Processing of Self-generated and Passively-presented Temporally-Deviant Auditory Stimulus

Group 3 Chaired by: Professor Hiroyuki Kudo

10	Chih-Hung Chi	CaM regulates the $Ca_V2.2$ protein expression level and localization in HEK293T
11	Nozomi Kawai	Development of Lactic Acid Biosensor for in-situ Monitoring of Mantle Cavity Fluid of *Venerupis philippinarum*
12	Shoto Kamada	Continuous Lactic Acid Monitoring System for various *ex vivo* Block Preparations
13	Shuya Negishi	Development of Lactic Acid Biosensor for *ex-vivo* Brain Monitoring
14	Mikie Nakabayashi	Detection of temperature-dependent blood flow changes at subcutaneous and muscle tissues using Diffuse Correlation Spectroscopy

Poster list and guided tour subgroups (continued)

Group 4 Chaired by: Professor Yumie Ono

15	Yuya Inamura	Hand Motion Brain-Machine Interface by Using EEG Signals and Support Vector Machine
16	Keisuke Matsumoto	Difference in prefrontal activity in response to occlusal discomfort given at different types of teeth
17	Tzu-Hao Chao	Plasticity changes of forebrain activity during neuropathic pain development in sciatic nerve injured rat
18	Kimiya Esaki	Decrease of blood flow velocity and reactive hyperemia response due to progression of capillary disorder in diabetic rats

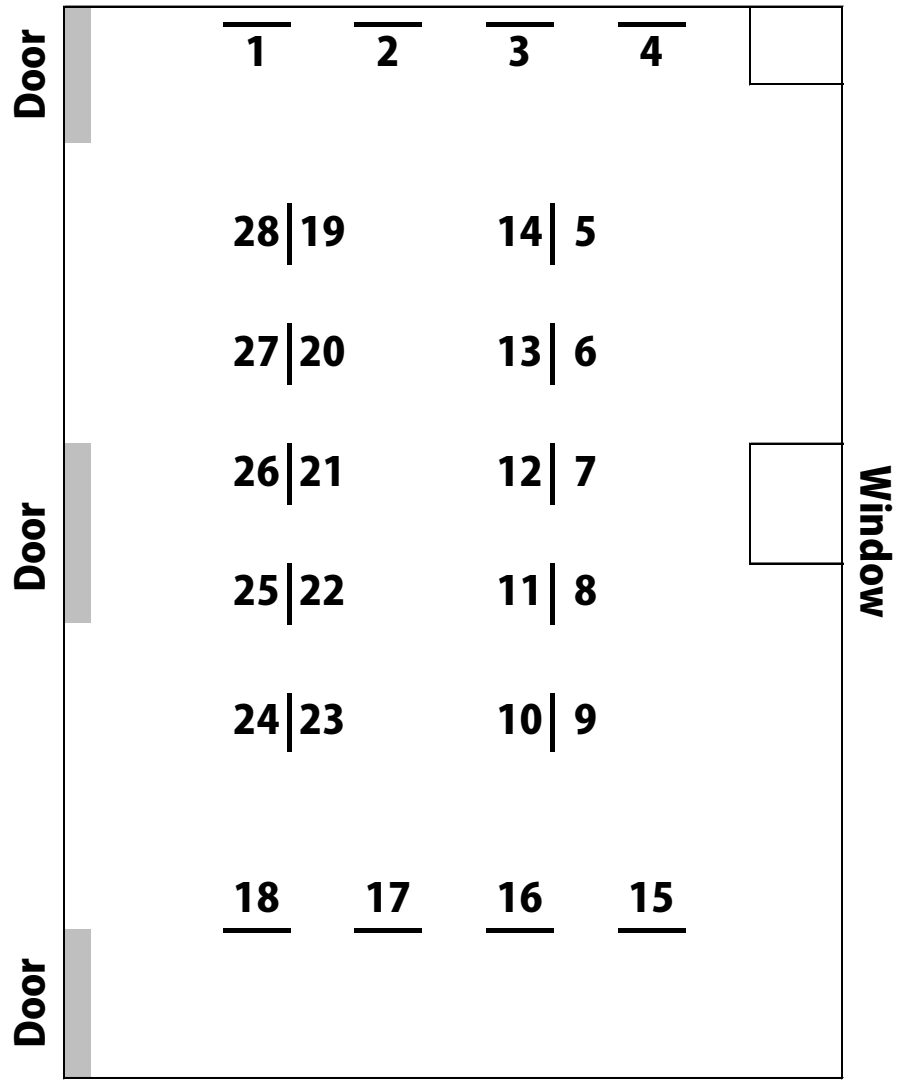
Group 5 Chaired by: Professor Chen-Tung Yen

19	Yuka Wakayama	Voltage-Sensitive Dye Imaging of the Neuronal Propagation between the Perirhinal and Entorhinal Cortices in Mice Brain Slices
20	Bei-Xuan Lin	Unbalanced Activation of Pyramidal Cells and GABAergic interneurons in Rostral Agranular Insular Cortex may Cause Hyperalgesia in Acid-Induced Muscle Pain Mice
21	Shohei Teramoto	Comparison of regional brain activity between successful and unsuccessful short-term memory formation using source localization of alpha-band EEG
22	Wen Tai	A Computational Model of Interactions between Statistical Summary Perception & Statistical Learning
23	Yusuke Hirako	Intersubject correlation analysis of students' brain activity during listening to teacher's explanation

Group 6 Chaired by: Professor Sotaro Shimada

24	Yoshiyuki Takahashi	Effect of the Visual Feedback Delay on Visually-guided Hand Movement and Self-body Recognition
25	Tadayoshi Koide	Effect of vicarious rewards on action selection during observation others action
26	Ti-Fan Hung	Blue light broadens the scope of attention: evidence from the Attention Network Task (ANT)
27	Yuki Komoriya	Emotion evaluation of young adults with autism spectrum disorder during aerobic dance exercise
28	Kohei Okamoto	Experimental Design for Investigating the Music Preference in Rats

Poster Room Plan (A401/402)



Instructions for Poster presenters:

- Please mount your poster by 9:30 AM on the symposium day (July 18th).
- Please meet at the first poster of your group at 1:00 PM.
- Guided Poster tour (30min) is chaired by Professors. Please take voting form from your chairperson.
- At the Guided Poster tour, please give a short (2 min) introduction of your work, followed by a few question & answers.
- Open discussion is available from 1:30 PM to 2:45 PM. Visit as many posters as you can.
- Please vote 3 best posters (select 1 from NTU students and 2 from Meiji students).
- Please remove your poster from 3:00 to 3:30 PM.
- Best posters will be awarded at the ceremony in the end of the symposium!

Abstracts for
Student poster sessions

Poster 1

Mapping the retina-SCN functional circuitry

Pey-shyuan Chin, Yiting Chang, Shih-kuo Chen
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In mammals, suprachiasmatic nucleus (SCN) located at the hypothalamus is the master clock to control daily activity pattern and influence many physiological functions. In mammalian retina, intrinsically photosensitive retinal ganglion cell (ipRGC) contributes to many light-induced non-image forming functions. They directly project to suprachiasmatic nuclei (SCN) for circadian photoentrainment. The SCN can be separated into several regions, such as the ventral lateral SCN (vlSCN), which contains VIP and GRP expressing neuron, and the dorsal medial SCN, which contains AVP neurons. Previous studies suggests that light input is only transmitted to VIP and GRP expressing neuron in the vlSCN, while the AVP expressing neurons in the dmSCN provide output from the SCN. However, our single cell tracing study indicated that ipRGCs innervate to whole SCN and make putative synaptic contact with VIP, GRP and AVP neuron. Furthermore, we found that each ipRGC preferentially innervates to a specific region of the SCN. In the retina, ipRGCs projecting to ventral part of the SCN are clustered together. To determine whether a specific chemo-attractive or repulsive cue is expressed in the SCN, we used immune-histochemistry method to stain axon guidance molecular in SCN coronal sections.

Poster 2

Generation of a red-wavelength shifted membrane-potential sensitive protein for in-vivo brain analysis

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Visualizing individual neural activity by using fluorescent proteins is quite informative for revealing neural circuit mechanism in intact brains. In addition, optogenetic approaches which control neural activity have been developed and have been applied to living animals. Therefore, both the regulation and the observation of neuronal activity simultaneously in the brain help to understand the processing mechanism in a certain neural circuit for brain functions. However, limited number of probes prevents us regulating and visualizing each neuronal-cell activity simultaneously. As for regulation of cellular activity, a photo-activated depolarizing protein Channelrhodopsin-2 (ChR2) enables neurons to activate freely, by the irradiation of excitation light (ex. 488nm). As for visualization, Ca2+ sensitive-fluorescent proteins have been widely used to visualize neural activities in vivo, however, the responses derived from those probes are not corresponding to real activity of the cell. On the other hands, genetically-encoded fluorescent voltage sensors (GeFVS) can also be used to directly visualize electrical activities of each neuronal cells in the brain. ArcLight, which is a recently-developed GeFVS, is a probe showing the largest optical dynamics ever reported. This protein is consisted of two-domains: the voltage-sensing domain derived from Ciona intestinalis voltage-sensitive phosphatase and super ecliptic pHluorin which is a derivative of pH-sensitive GFP. In this background, we are currently trying to develop a novel molecular probe for investigating neural activity by shuffling ArcLight and ChR-2. By using this novel probe, we hope that we can visualize activities of neuronal cells with simultaneously controlling their activities. In this presentation, we will show the specific expression patterns of ArcLight and ChR-2 in the Caenorhabditis elegans sensory neurons and discuss about the strategy to improve our novel visualization methods for in-vivo brain analysis.

Poster 3

M1 ipRGCs regulate light adaptation through DAC by intra-retinal axon collateral

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Ambient illuminance is a vital environmental information for us to maintain our physiology normal function, but its contribution to our retinal system is still under debate. Visual system was ever thought to function only through light contrast variation. However, the effect of environment illuminance is considered to be involved caused by the study of intrinsic photosensitive retina ganglion cell (ipRGC) which is the third type of photosensitive cell in retinas. IpRGCs express melanopsin for light sensing and transmit their signal to brains for circadian photo-entrainment, pupil reflex and sleep regulation. Previous study separated ipRGCs into at least five types according to their morphology and cell body size; besides (Schmidt et al., 2011), other study also showed that M1 type ipRGCs have intraretinal axons collateral innervating back into inner plexiform layer (IPL) (Joo et al., 2013). Moreover, our immunostaining images suggest that ipRGC axons collateral may form a putative synapse with dopamine amacrine cells (DACs). Since dopamine is important for the light adaptation function (Jackson et al., 2012), we operated electroretinogram to verify if M1-ipRGCs are involved in visual function through DACs. Interestingly, our study indicates that M1 ipRGCs can detect the background luminance level and project both to suprachiasmatic nucleus (SCN) for circadian function and back to DACs in IPL to modulate light adaptation and probably involve in higher complex visual function.

Poster 4

Effect of neurofeedback training of steady-state visual evoked potentials

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We investigated the change in the power of steady-state visual evoked potentials (SSVEP) through repetitive training with correct and timing-incorrect neurofeedback, to investigate whether neurofeedback training is effective to enhance SSVEP response. Ten young adults without vision problem participated in the study. Offline experiment was performed every experimental day to determine an individual threshold value of SSVEP power that was used in the following online training. In offline experiment, participants gazed at a fixation point (rest) and a visual stimulation flickering at 6 Hz (task) alternately for 10 s each for 4 times. Mean spectrum power around 6 Hz was derived from electroencephalography separately from rest (Pr) and task (Pt) periods and the power difference between task and rest ($\Delta P = Pt - Pr$) was calculated. The first threshold value in the feedback training was set to the power value of 150 % increase of SSVEP response ($Pt + 1.5\,\Delta P$), and the second threshold value was set to that of 80 % increase ($Pt + 0.8\Delta P$). Electrodes were placed in PO7, O1, Oz, O2, PO8 based on 10-10 system throughout the experiment. In online SSVEP training, auditory feedback was given to the participants when they achieved SSVEP power reaching to the first and the second threshold values. Half of the participants were given a correct feedback depending on their own ongoing SSVEP response, and the others were given an incorrect feedback depending on the SSVEP response of other participants that was recorded previously instead of their own response. Participants gazed at the visual stimulus for 20 s for each trial and completed 10 trials daily for consecutive 4 days. We used Fourier fast transform-based online analysis of SSVEP responses every 0.5 s to provide feedback. The recorded data were also offline analyzed using wavelet transform. Spectrum powers obtained at the fundamental and second harmonic frequencies were averaged both in online and offline analyzes. Participants in correct feedback group showed statistically significant increase in the mean SSVEP power after training but those in incorrect feedback group did not. Furthermore, the growth of SSVEP power through 4 days of training was significantly higher in correct feedback group compared to incorrect feedback group. These results suggest that our proposed neurofeedback system is useful if a proper feedback reflecting the user's neuronal responses is provided.

Poster 5

Functional connectivity between dorsomedial prefrontal and motor cortices during being imitated by the other

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Human beings tend to unconsciously imitate the behavior of others, and individual who was imitated tends to have a good impression towards the imitator, which is known as the chameleon effect. A recent study showed that the dorsomedial prefrontal cortex (dmPFC) is involved in social influence on preference change, although the role of dmPFC on positive consequences of being imitated has not been investigated yet. This study investigates the activity of dmPFC during being imitated of simple drawing movement by the other, using functional magnetic resonance imaging (fMRI). The results showed that the sensorimotor cortex was activated both during the participant was writing a letter and during the participant was watching the other writing the letter. Correspondingly we had identified these regions as the mirror neuron system. Furthermore, we also observed a significant positive correlation between the letter preference score and the right dmPFC during observation phase. We further investigate the regions that were strongly correlated with the dmPFC activation and found a significant functional connectivity with the primary sensorimotor cortex. Interestingly, the connectivity showed a significant positive correlation with the letter preference score. In conclusion, our results suggest that the dmPFC and the sensorimotor cortex were related to preference enhancement of the action being imitated by the other.

Poster 6

EEG analysis of mirror system and reward system in vicarious reward

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Mirror neuron system (MNS) is the brain regions that show activity as if an individual is acting when observing the behavior of others. A previous fMRI study has shown that the magnitude of MNS activity correlates with the reward system activity evoked by vicarious reward that was received by others whom the individual had cheered for [Shimada, S., Matsumoto, M., Takahashi, H., Yomogida, Y., & Matsumoto, K. (2016). Coordinated activation of premotor and ventromedial prefrontal cortices during vicarious reward. Social Cognitive and Affective Neuroscience, 11(3), 508-512.]. In the previous electroencephalography (EEG) studies, MNS activity was indexed by mu-suppression which is the attenuation in mu-band (8-13 Hz) power related with the motor activity. We investigated whether the magnitude of mu-suppression during observation of other's action was modulated before and after the vicarious reward. The experiment consisted of four sessions in the following order: i) 1st Observation session (ob1), ii) Cheering session, iii) 2nd Observation session (ob2), iv) Action session. In the ob1 and ob2 sessions, the subject observed the movie, in which one (blue or yellow) right hand performed a gesture of Rock-Paper-Scissors game (RPS). In the cheering session, the subject was instructed to cheer for a particular (blue or yellow) player in the two-player RPS game. In the Action session, the subject was instructed to perform a RPS gestures by themselves with his/her right hand. The magnitudes of mu-suppression in the ob1 and ob2 sessions were submitted to a 2 (before and after the cheering session) ×2 (player) repeated-measure ANOVA. The result showed that there was a statistically significant interaction between session and player in the left motor area (C3:$F(1, 10) = 8.44$, $p < 0.05$). There was no main effect in the two factors. Subsequent analyses (Tukey's honestly significant difference) revealed that the magnitude of mu-suppression for cheered-for player became larger after cheering than before, while that for non-cheered player was smaller after cheering than before ($p < 0.05$). The result suggests that the vicarious reward enhances the MNS activity, which is likely to underlie the sense of unity with the cheered-for others.

Poster 7

Appropriate timing for sensory feedback in ERD-BMI

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We are developing Digital Mirror Box (DMB), a BMI rehabilitation device for stroke patients operated by Event-Related Desynchronization (ERD) of hand motor imagery. In DMB, a successful motor imagery will give a user both somatosensory and visual feedbacks via exoskeleton robot that is attached to the user's hand and via tablet screen placed in front of the user's hand. We studied a time-course change in the rate of successful operation of DMB and the ERD strength in healthy volunteers and stroke patients when they received synchronous or delayed multimodal feedbacks during repetitive DMB operation. Sixteen young adults without paralysis in hand and 23 stroke patients with paralyzed hand participated in the experiment. All participants conducted online operation of the exoskeleton robotic hand for 12 times. EEG signals were recorded from 9 scalp electrodes placed over the motor area. They were divided into group A and B. Participants in group A received synchronous somatosensory and visual feedbacks while those in group B received somatosensory feedback 1 s after visual feedback upon their successful ERD generation. We divided the total 12 trials into 3 periods of the first, middle, and last one-thirds and analyzed the transition of successful operation rate and ERD strength. We calculated ERD strength from the decay ratio of the EEG mu band power between 0.7 s before and after motor imagery cue. Successful operation rate throughout the online experiment was 30-65 % in both groups and there was no statistically significant difference between participant profiles and feedback groups. Patients in group A maintained the successful operation rate with its slight increase through progress of 12 trials, while those in group B showed continuous decrease in operation rate which was significantly decreased in the third period compared to the first period. The operation rates in the second period was significantly lower in group B compared to group A. The transition of ERD strengths followed that of the success rates. ERD strength in the second period was also significantly lower in group B compared to group A. These result suggest that the effect of delayed feedback is larger in stroke patients than in healthy participants and therefore it is important to give sensory feedback that is synchronized with patients' own will for hand movement in the hand motor rehabilitation for stroke patients.

Poster 8

Temporal integration of semantic information with and without visual awareness: An *f*MRI study

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Previous studies have shown that semantic information can be extracted even without visual awareness. However, these studies mainly focused on unconscious processing of single words, and thus it remains unclear whether multiple words presented sequentially can be unconsciously integrated into higher-level semantic meaning. To address this issue, four Chinese characters were temporally presented to form either Chinese idioms or random sequence. We also manipulated these characters so that they would be perceived either consciously (the characters were presented to both eyes) or unconsciously (the characters were presented to one eye while they were interocularly suppressed by dynamic masks from the other eye). Neural activation was measured by functional magnetic resonance imaging (*f*MRI). In the conscious condition, *f*MRI data showed that Chinese idioms led to higher activation than random sequence in left parahippocampus, left caudate nucleus, right superior temporal gyrus (STG), and left thalamus. The same comparison under the unconscious condition revealed activation in bilateral inferior frontal gyrus (IFG). These results suggest that temporal integration of semantic information may occur unconsciously, and it involves distinct brain mechanisms from that of conscious processing of temporal semantic integration.

Poster 9

Neural Processing of Self-generated and Passively-presented Temporally-Deviant Auditory Stimulus

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Predicting the timing and occurrence of auditory stimulus is an important feature of auditory processing. Our previous studies showed that a delayed auditory feedback of self-action elicits the event-related potential (ERP) components named enhanced-P2 (EP2) and N300 (Toida, et al., 2016). To further investigate the characteristics of the delay detection ERP components (EP2 and N300), we examined weather these components were also elicited by a delayed auditory stimulus in the middle of periodical auditory stimulus trains. We employed an oddball paradigm with a non-delayed 1000-Hz pure tone as the standard stimulus and a delayed 1000-Hz pure tone as the deviant stimulus. Auditory stimulus was presented either in association with participants' mouse-click (action experiment), or passively (non-action experiment). We introduced four delay conditions (100, 200, 300, and 400 ms) and the control condition (non-delayed). Participants were told to silently count the number of trials in which they could detect the delayed auditory stimulus. The average number of deviant stimuli counted by the participants monotonically increased as the delay increased in both the action and non-action experiments. The N300 amplitude showed a main effect of the delay ($p < 0.01$) in both experiments. A post hoc analysis (Tukey's HSD test) showed that the amplitude of the N300 was significantly larger in the 300 and 400 ms conditions compared to the other conditions ($p < 0.01$). Although the N300 amplitude showed a significant correlation with the number of deviant stimuli counted by the participant in both experiment, the N300 amplitude was more enhanced in the action experiment than in the non-action experiment ($p < 0.01$).Our results demonstrated that the delayed auditory stimulus elicited the N300, which was more enhanced when the stimulus was generated by the participant's action than when presented passively.

Poster 10

CaM regulates the $Ca_V2.2$ protein expression level and localization in HEK293T

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Intracellular Ca^{2+} concentration change is an important signal for a wide spectrum of cell activities from short-term neurotransmitter release to long-term gene expression control. For synaptic transmission, Ca^{2+} influx through the voltage-gated Ca^{2+} channels play an important role in triggering neurotransmitter release and modulating synaptic plasticity. Calmodulin (CaM), which has 4 EF-hand Ca^{2+}-binding motifs, binds to the IQ motifs located at the intracellular C-terminals of several subtypes of voltage-gated Na^+ and Ca^{2+} channels to regulate the channel activity in a Ca^{2+}-dependent manner. In our previous study, we found that CaM_{12} (deficient of Ca^{2+}-binding ability at N-lobe) could enlarge the inward current of $Ca_V2.2$ in HEK293T. To verify the possibility that CaM_{12} increases the localization of $Ca_V2.2$ to the plasma membrane, we applied immunocytochemistry and surface biotinylation in HEK293T to characterize the surface expression of $Ca_V2.2$. In immunostaining experiments, the $Ca_V2.2$ locates at the plasma membrane and the cytosol; when coexpressed with CaM_{12}, the staining signal in the cytosol was enhanced. By biotin-labeling analysis, CaM_{12} increased the total protein expression level of $Ca_V2.2$, but not the plasma membrane ratio. Therefore, N-lobe of CaM does not only increase the current amplitude but enhance the expression level leading to have more $Ca_V2.2$ at plasma membrane.

Poster 11

Development of Lactic Acid Biosensor for *in-situ* Monitoring of Mantle Cavity Fluid of *Venerupis philippinarum*

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A flow injection analysis system for *in-situ* monitoring of lactic acid (LA) in metabolite of *Venerupis philippinarum* was fabricated and tested. *Venerupis philippinarum* is a kind of saltwater clam, so-called" Asari (in Japanese)", "Manila clam" or "Japanese littleneck", which has been popular food since ancient times to the Japanese.

The measurement system consists of two elements: a lactate oxidase (LOD) biosensor based on screen-printed carbon electrodes with a redox reaction of osmium wired horseradish peroxidase (Os-HRP) as an electron transfer mediator and micro-flow cell formed using Polymethyl methacrylate (PMMA). Owing to the Os-HRP redox reaction, the sensor is operated under the low potential of 0V vs silver / silver chloride electrode, which is possible to reduce the effect of interferences foreign substances. In addition, the LOD was transfer-coated onto the surface of working electrode. The sensor exhibited a relatively fast response (response was a time T_{95}=20sec to reach 95% of the stable value).

Using the monitoring system assessment of mantle cavity fluid of Asari LA was carried out. As a result, increase in LA value due to the change of metabolic status into anaerobic metabolism of Asari were observed during Asari was kept outside of the seawater.

Poster 12

Continuous Lactic Acid Monitoring System for various *ex vivo* Block Preparations

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Lactic acid accumulation is generally believed to be involved in muscle fatigue. In this regard, Nielsen et al. first suggested that lactic acid can improve excitability and function of depolarized muscles (Nielsen et al. 2001). Alternatively, the lactic acid is also paid attention as the substance which plays a fundamental role in brain energy metabolism, being the end product of glycolysis in the absence of oxygen (Sokoloff 1977). An important source of energy for the brain is thought to be glucose, but interestingly, recent report suggested that the brain prefers lactate over glucose as an energy substrate when both substrates are available (Wyss et al 2011). In the present study, the chamber for the ex vivo block preparations was constructed and utilized in continuous lactate and glucose monitoring. Our system consists of a microfluidic dual-analyte biosensor (lactate and glucose) and a moisture type chamber that is suitable for organ level experiment. By applying this system to the mouse muscle-nerve preparation, we confirmed that the lactic acid can be measured from the muscle by the electrical shock to the nerve. In addition, we measured the cerebral hemisphere of the mouse brain, and confirmed that the lactic acid level of the brain varies with the concentration of glucose in extracellular fluid (10 mM to 0mM). This result should reflect the reactions of glycolysis cycle of the brain preparation.

Poster 13

Development of Lactic Acid Biosensor for *ex-vivo* Brain Monitoring

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Lactic acid (LA) biosensor for assessment of lactic acid at organ levels was fabricated and tested. The system consists of a microfluidic dual-analyte biosensor (LA and glucose) and a brain chamber to maintain physiological activity of brain samples. The biosensor was fabricated by immobilizing enzyme on a carbon electrode modified with osmium wired horseradish peroxidase. The sensor showed sufficient sensitivity (LA: 0.01mM~, glucose: 0.01mM~) and selectivity for assessment of brain LA. Wide linear calibration range of lactate sensor from 0.1 mM to 1.0 mM was confirmed in both sensors. In addition, the microfluidic biosensor utilized an adhesive sheet made of polyvinyl chloride (PVC) as an interlayer between the electrode and the polydimethyl siloxane micro flow-channel. Using this interlayer, leakage of the sample flow around the electrode, resulted by the vacancy due to thickness of the carbon electrode, was reduced and thus response time was decreased from 60sec to 10sec.
Ex-vivo monitoring of brain LA was also carried out. As a result, extracellular LA and glucose in aCSF were successfully monitored in real-time. Details of fundamental characteristics of the biosensing system and the result of *ex-vivo* brain LA monitoring will be presented at the meeting.

Poster 14

Detection of temperature-dependent blood flow changes at subcutaneous and muscle tissues using Diffuse Correlation Spectroscopy

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Diffuse Correlation Spectroscopy (DCS) is an emerging optical technique to noninvasively measure the hemodynamics of the living tissue. Using emitter and detector optical probes attached to the body surface, DCS estimates the mean speed of the blood flow (Blood Flow Index: BFI) in the tissue through which the emitted near-infrared light propagated. The incident light can propagate into the tissue to approximately half the depth of the inter-probe distance. Therefore, the advantage of DCS is that the mean blood flow of the deeper tissue such as muscle layers can be measured noninvasively. To investigate the sensitivity of DCS in detecting the physiological changes of blood flow in deep and shallow tissues of healthy human subjects, we conducted DCS measurement of skin-temperature dependent reallocation of local blood flow. Skin temperature of 14 healthy subjects was maintained either at approximately 43°C (local warming), 25°C (room temperature), or 10°C (local cooling). Simultaneous DCS measurement was conducted with inter-probe intervals of 0.5 cm and 2.5 cm. Because the absolute values of the BFI are affected by the inter-probe distance, we normalized the BFI values obtained at 2.5 cm inter-probe interval by those obtained at 0.5 cm inter-probe interval to compare the allocation ratio of blood flow (deep tissue/ shallow tissue) among temperature conditions tested. Compared to the allocation ratio at the room temperature, it was decreased in local warming condition, indicating the increased and decreased local blood flow in shallow and deep tissues, respectively. Moreover, the allocation ratio was increased in local cooling condition possibly due to the preservation of blood flow in deeper layer of the tissue to prevent heat loss. We found a significant difference in the allocation ratios between conditions of 43°C and 10°C ($p<0.05$: Wilcoxon signed-rank test with Bonferroni correction). These results demonstrated that DCS can measure the differences in the physiological blood flow dynamics in deep and shallow tissues, suggesting the possible use of DCS to noninvasively quantify the microcirculation level in both shallow and deep tissue layers.

Poster 15

Hand Motion Brain-Machine Interface by Using EEG Signals and Support Vector Machine

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Brain-machine interface (BMI) is a system which transfers neural information to external devices (e.g. prosthetic arm), and people with disabilities can be aided by these devices. Although invasive neural signals have a high spatial resolution, noninvasive neural signals are still valuable for BMIs because they are recorded without surgery. In our study, we used electroencephalography (EEG) signals in order to develop a noninvasive BMI. We instructed subjects to make three hand motions (rock, paper and scissors) following a task cue presentation while recording their EEG signals and finger angles by using a data glove. We used 1.5 to 2.0 sec from the task cue for the movement duration and 1.0 sec to 1.5 sec from a fixation (rest) cue for the rest duration. We classified amplitude changes of EEG signals into four classes (three hand motions and rest) by using multi-class support vector machine (SVM). The result showed that the average of classification accuracy by applying 5-fold cross-validation was 48.97% (chance level 25%). This result suggests that EEG amplitude changes can be used for a feature for movement classification machine learning in BMI systems.

Poster 16

Difference in prefrontal activity in response to occlusal discomfort given at different types of teeth

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We used functional near-infrared spectroscopy (NIRS) to measure prefrontal brain activity accompanying the oral discomfort given at different type of teeth. We conducted two experiments. Both experiments employed eight healthy young adult volunteers. In the first experiment, participants grinded a metal strip with a pair of maxilla and mandibular teeth of central and lateral incisors, canines, first and second premolars, and first and second molars at their habitual occlusal side. Increasing the thickness of metal strips, we recorded the discomfort threshold, a thickness of metal strips at which participants have felt occlusal discomfort. We found that grinding at incisors showed larger discomfort threshold compared with that at canines, premolars, or molar teeth. Since the maxillary incisors overhang the mandibular incisors while the maxillary and mandibular molars contact each other with cusps, more vertical disposition was likely to be required to give enough contact and occlusal pressure to the incisors. In the second experiment, we measured prefrontal brain activity during grinding metal strips by NIRS. Participants used either the central incisors, first premolars, or the first molars to grind. The thickness of metal strips was set to 0 μm (no metal strips), the discomfort threshold, and 60 μm thicker than the discomfort thickness. The peak amplitude of the oxy-Hb concentration change was larger when participants grinded with incisors compared to other teeth. These results suggest that prefrontal brain activity is different depending on the tooth types, especially between incisors and molars.

Poster 17

Plasticity changes of forebrain activity during neuropathic pain development in sciatic nerve injured rat

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Peripheral nerve damage frequently induces ectopic discharge in injured nerve fibers, which causes central sensitization and the development of neuropathic pain. Although there are many brain imaging studies of well-established chronic neuropathy, the involvement of the forebrain areas in the chronification process in the initiation phase is less studied. We hypothesize that ectopic barrage from the peripheral may cause sustained activation in the forebrain to initiate the plasticity involved in chronic neuropathic pain development. In this study, we combined the advantages of different MRI methods, and demonstrated the transition of the brain activation changes during the neuropathic pain development in the spared nerve injury (SNI) model of the rat. We compared the brain activity during three different neuropathic pain development stage, including the moment of nerve injury using fMRI, and the 1st day and the 8th day after the neuropathic pain onset using manganese-enhanced magnetic resonance imaging (MEMRI). Our main findings were: (1) Insular cortex (IC) and cingulate cortex (CC) showed sustained activation immediately after the SNI surgery. These sustained activations maintained at least 5 minutes throughout the whole fMRI scanning. (2) During the following days after the SNI surgery, we found consistently increased activation in ipsilateral IC. (3) Plasticity change of functional connectivity between ipsilateral IC, contralateral S1 and bilateral rostral anterior IC (RAIC) was established under the neuropathic pain condition. These results imply that IC may play an important role in neuropathic pain chronification.

Poster 18

Decrease of blood flow velocity and reactive hyperemia response due to progression of capillary disorder in diabetic rats

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Diffuse correlation spectroscopy (DCS) is an optical measurement of a velocity of the capillary blood flow in the living tissue. To utilize DCS to diagnose peripheral artery diseases, we measured longitudinal changes in the peripheral blood flow velocity in diabetic model rats. Streptozotocin (STZ, 50mg/kg) was administered intraperitoneally to 7 male SD rats (6-7 weeks of age) to produce hyperglycemia state (blood glucose level more than 250 ml/dl). We measured the blood flow reactivity using a reactive hyperemia (RH) test with two optical probes attached to the hind limb, which is a frequent site of diabetic capillary disorder, of the anesthetized rats (2% Isoflurane, 1.5 L/min) at 1 week before and once in every week for 12 weeks after the STZ administration. The blood flow speed during the baseline period and the peripheral vasolidation reaction in RH test were gradually decreased after administration of STZ. The baseline blood flow in diabetic rats reached to the statistically significant decrease compared to control rats at 5 weeks after administration of STZ. Concurrently, the peak value of blood flow speed after releasing from the ischemia also decreased over time, and the duration from peak to baseline was prolonged. The gradual reduction of the baseline and the maximum blood flow speed after RH test in diabetic rats suggests the progression of capillary disorder under the influence of high blood glucose stress. Our current results demonstrated that DCS could successfully detect changes in microcirculation with prolonged hyperglycemic state. Further research would investigate the association between specific complication such as peripheral neuropathy and indices of RH test that are obtained from DCS.

Poster 19

Voltage-Sensitive Dye Imaging of the Neuronal Propagation between the Perirhinal and Entorhinal Cortices in Mice Brain Slices

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The perirhinal cortex (PC) communicates with the hippocampus (HP) via the entorhinal cortex(EC). Since the PC receives diverse inputs from unimodal and polymodal association cortices (Suzuki, 1996), the functional linkage between the PC and the entohrnial- hippocampal network is thought to be essential for the formation and recall of context-dependent memories. However, previous electrophysiological experiments in the rodents indicated that propagation of neural activity between PC and EC occurs with an extremely low probability (de Curtis and Pare, 2004). In relation to this phenomena, our voltage-sensitive dye (VSD) imaging study suggested that an impulse transmission from PC to EC neurons might be facilitated by the activation of the amygdala. The present study focuses on the question what kind of neuronal circuit in the boundary area of PC/EC cause such phenomenon. To reveal the functional dynamics of the PC/EC circuit which inhibit the neural transmission, we analyzed the propagation pattern of the perirhinal neural activity in the mice horizontal brain slices using VSD imaging technique. Here, we show the data about the neuronal network property of the PC neurons activated by the stimulation of the surface layer and the deep layer in PC, and discuss about the effect of various concentrations of the GABAA blocker bicuculline on the neural activity to the EC-HP network.

Poster 20

Unbalanced Activation of Pyramidal Cells and GABAergic interneurons in Rostral Agranular Insular Cortex may Cause Hyperalgesia in Acid-Induced Muscle Pain Mice

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It is believed that cortical modulation may contribute to chronic muscle pain symptoms such as fibromyalgia, while we know few about the neural mechanisms underlying the chronic pain formation. The rostral agranular insular cortex (RAIC) is one of the few cortical areas consistently activated by nociceptive stimuli, and changes in g-aminobutyric acid (GABA) neurotransmission in the RAIC can lead to analgesia or hyperalgesia. However, it remains unknown whether RAIC is necessary participant in chronic pain induction. As same as other cortice, intra-RAIC circuit is based on the network of pyramidal cells and interneurons. We wonder whether the interaction of pyramidal cell and interneuron play some roles during chronic pain developing. Here we performed acid-induced muscle pain animal model (AIMP model) in mice established by Sluka et al. (2001). Interestingly, immunohistochemistry in brain slices showed that specific expression of the phosphorylated extracellular signal-related kinase (pERK) in pyramidal cells not interneurons in RAIC from AIMP mice. The further hypothesis is that RAIC activation is necessary or sufficient to chronic pain induction. We aim to make remote manipulation on activity of pyramidal cells in RAIC to investigate the hypothetical status of RAIC during chronic pain development via behavior experiments. In addition, we compare the synaptic transmission underling the excitatory innervation on different cell types in RAIC by double whole-cell recording in acute brain slice. These findings might provide an indirect evidence that principle neurons in RAIC participate in the development of chronic pain.

Poster 21

Comparison of regional brain activity between successful and unsuccessful short-term memory formation using source localization of alpha-band EEG

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Using source-localization of EEG, we investigated the regional brain activity that is required for formation of short-term memory and its difference between successful and unsuccessful memory formation in healthy young adults. Eighteen participants performed a sequential fashion of visual Sternberg memory task. This task consisted of an encoding period in which 7 arrows were randomly presented in series followed by a retrieval period that presents a numerical cue (*n*). Participants were requested to press one of the 4 arrow keys on a keyboard whose direction corresponds to the *n*th arrow that was presented in the preceding sequence. The 32-channel EEG was continuously measured during participants performed two 70 trials of memory task and single 30 trials of control task. Control task was the same as the memory task but participants were asked to just observe the visual stimuli and not memorize the sequence of arrows without any button press response. The regional brain activity corresponding to the oscillatory EEG activity in the alpha band (8-13 Hz) during encoding period was analyzed by SPM8. We divided the data of all participants into 3 groups based on the accuracy rate (low, intermediate, and high group) using cluster analysis with dendrogram and analyzed differences in regional brain activity between trials in which participants answered correctly and incorrectly within each of the group. In memory task compared from control task, there was a significant activity in such brain regions related to working memory of Baddeley or visual cortex in the high group. When succeeding in memory task compared from failing , there was a further significant activity in the frontal area and temporal lobe compared from just trying to memory . It seems that the sites for storage worked specifically if the percentage of correct answers of the memory task is high. The more correct answers rate increase, the brain regions that has a significant activity is distribution. In other words, it seems that memory formation is likely to succeed if it can be simultaneously using various brain regions.

Poster 22

A Computational Model of Interactions between Statistical Summary Perception & Statistical Learning

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To efficiently process overwhelming information from viewing, human visual system can not only compute summary statistics of a scene (e.g., mean size of objects) but also learn statistical regularities in that scene. However, these two automatic, statistical processes have been reported to interfere each other (Zhao, Ngo, McKendrick, & Turk-Browne, 2011, Psychological Science) and the cause of such interference is not entirely clear yet. Here we propose that the observed interference is resulted from a conflict between relatively distributed spatial attention demanded by statistical summary perception and relatively localized spatial attention demanded by statistical learning. We implemented a computational model to illustrate that distributed attention for statistical summary perception could impair statistical learning of local regularities, which, once learned, could capture attention and thus bias estimates of global summary statistics incorrectly toward local statistics. Our computer simulations successfully replicated findings in the statistical learning literature and various mutual interference phenomena reported by Zhao et al. (2011). The proposed model offers insight into how attention may mediate both statistical processes and its prediction—no interference between statistical summary perception and statistical learning of global scene regularities—has been confirmed by our experiment.

Poster 23

Intersubject correlation analysis of students' brain activity during listening to teacher's explanation

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In this study, we investigated the mechanism of comprehending teacher's explanation by utilizing intersubject correlation (ISC) analysis of students' brain activity. ISC is calculated by utilizing general linear model (GLM) with one subject's brain activity as a model to see how similar the other subject's brain activity was.

Twenty-four right handed subjects participated in the experiment (one female, aged 21.3 ± 0.17 years, mean ± SD). Half of the subjects (N=12) listened to the explanation of a teacher about basic probability statistics in the recorded video. Another half listened to the equivalent explanation performed by another teacher in the recorded video. The hemodynamic responses in the bilateral cortical areas (9 x 9 square cm area each) were recorded by using 48-ch functional near-infrared spectroscopy (fNIRS) during explanation. The sampling frequency was 10 Hz. After the recording, the subject continuously (10 Hz) scored the rating of comprehensibility of the explanation by watching the movie again (0 – 100). The measured brain activity was analyzed by ISC analysis between two subjects who listened to the same teacher or different teachers. We also calculated Pearson's correlation between the ISC and the subjective rating of comprehensibility.

The ISC analysis showed significant ISCs in the right dorsolateral prefrontal cortex (DLPFC) (ch-38, BA9: $t(24) = 1.83$), the middle temporal gyrus (ch-46, BA21: $t(24)=3.70$), and the frontal eye field (ch-31, BA8: $t(24) = 1.71$). Among those, the right DLPFC showed a significant difference in ISCs between the subjects who listened to the same teacher and the subjects who listened to the different teachers (ch-38: $t(24) = 1.78$, $p<0.05$). The correlation analysis between the ISC and the subjective rating showed significant correlations at the left premotor cortex (ch-6, BA6: $r=0.24$, $p<0.05$) and the left angular gyrus (ch-21, BA39: $r=0.17$, $p<0.05$).

These results suggest that DLPFC is involved in comprehending teacher's explanation, by playing a role as working memory to translate verbal information into abstract numerical representation, which likely covariates among students who listened to the same teacher's explanation.

Poster 24

Effect of the Visual Feedback Delay on Visually-guided Hand Movement and Self-body Recognition

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Self-body recognition is the capacity to recognize one's body parts as one's own. Self-body recognition can be divided into two subjective senses of the self: the sense of self-ownership and the sense of self-agency. The sense of self-ownership is the sense that this body part belongs to me. The sense of self-agency is the sense that I am generating this movement. Previous study suggests that temporal congruency between the visual and tactile feedback is important for self-body recognition. It has been reported that during active self-body movement, the sense of self-agency decreases when the actual sensory feedback does not match with the predicted one. However, it is not clear how these senses are developed and relate to each other. In our study, by using delayed visual feedback paradigm and Structural Equation Modeling (SEM) analysis, we investigated how the senses of self are affected by the performance of visually-guided hand movement. The results suggest that task performance and the senses of self both attenuate between 200ms and 300ms delay condition. Also, the results of SEM analysis suggests that the sense of agency affects the sense of ownership.

Poster 25

Effect of vicarious rewards on action selection during observation others action

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Humans have the ability of observational learning that the observer learns the effectiveness of an action through observing other's actions and its outcome. Vicarious reward is the phenomenon in which the observer appreciates positive feeling by observing the other receiving reward or desirable outcome. In this study, we investigated the relationship between observational learning and vicarious reward during observation of action selection of others. Sixty-three right handed and one left handed subjects (age 22.1 ± 1.2, mean $\pm$ SD) participated in the experiment. Participants watched a movie clip in which a model played the competitive game (rock-paper-scissors: RPS) with cheering a particular player (wearing a blue or yellow glove) repeatedly six times, and then selected an RPS action by themselves (Fig. 1). Participants were assigned to one of three experimental groups (Rock condition: RC, Scissors condition: SC, Paper condition: PC), or the control group (CC), in which the certain action has a higher probability of winning (ex. the cheered-for player tended to win by rock in RC). We found that the subject tended to select the action that has a higher probability of winning of the cheered-for player in the observed game (Fig. 2). Our result suggests that observing an action of others with reward influenced the observer's action selection.

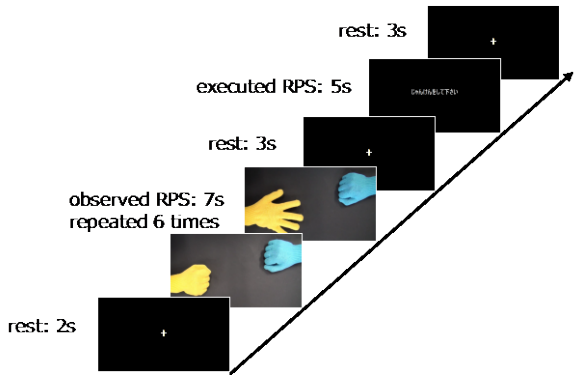

Fig. 1 The experimental design

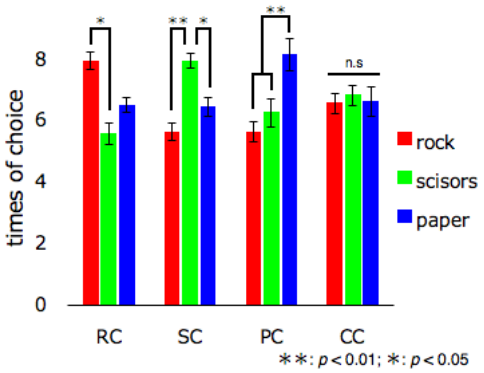

Fig. 2 Times of the observer's choice

Poster 26

Blue light broadens the scope of attention: evidence from the Attention Network Task (ANT)

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In the modern world nowadays, the living environment is virtually always full of artificial lights both during daytime and nighttime. This trend might have resulted from the love we have for the sense of sight that Aristotle had once claimed, for our vision is highly dependent on the presence of light. However, light is not only visually essential for human beings, but is also important for modulating non-visual functions. A small subset of retinal ganglion cells expressing melanopsin, named intrinsically photosensitive retinal ganglion cells (ipRGCs), are most sensitive to blue light wavelengths around 480 nanometers; hence the widespread use of LED light which is rich in blue light may affect the ipRGC neural circuitry and impact the timing of circadian rhythms and modulation of alertness and performance. Although some animal studies and fMRI researches have been done to investigate the effect of blue light, more studies are needed to probe the influence of blue light on human cognitive behavior. Therefore, this experiment aimed to investigate whether blue light affects visual attention. We used the Attention Network Task (ANT) to measure three visual components of visual attention (alertness, orienting, and executive control) when participants were under the exposure of blue or red light. The results of this study showed that blue light reduced the effect of executive control and induced faster reaction time, which suggests that blue light may broaden the scope of attention. Although more blue light studies on other modalities are definitely needed, the current finding may provide some insights for choosing appropriate light sources for different environments, such as offices or homes, in order to maximize our cognitive performance when we need it.

Poster 27

Emotion evaluation of young adults with autism spectrum disorder during aerobic dance exercise

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People with autism spectrum disorder (ASD) have difficulty to verbally express their feeling and therefore sometimes have problem in communicating with people around them. Our aim is to develop an aid device to quantitatively evaluate and express the feeling of people with ASD to others, utilizing cardiac autonomic nervous activities of heart rate variability (HRV). The current study focused on detecting the pleasant or unpleasant feeling when people with ASD performed aerobic exercise under their favorite or unfavorite music. Two young adults with ASD participated in the experiment. They performed predetermined aerobic dance exercise for 30 s with two types of background music. One background music is their favorite one to induce pleasant feeling and the other is the same music but was run in reverse to induce unpleasant feeling. The pleasant feeling and the performance level were self-evaluated by post-experiment questionnaire. The electrocardiogram was continuously measured through the experiment. We calculated the time-courses of heart rate and the indices of autonomic nervous activity of sympathetic and parasympathetic nervous activities from HRV. We observed continuous increase of heart rate when they performed with their favorite music. Specific motion seems to increase sympathetic activity when performer felt they could dance well. These results suggest that the HRV could be a possible tool to evaluate whether the aerobic dance player with ASD feels pleasant or not with their performance.

Poster 28

Experimental Design for Investigating the Music Preference in Rats

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How do we feel beauty for art or music? In humans, the objects that are considered beautiful have reinforcing properties for us. Also in nonhumans, artificial and non-biologically relevant sensory stimuli (e.g., switching on a lamp; give off a neutral odor, etc) as well as the reward stimuli have reinforcing effects on animals. However, only a few reports examined reinforcing stimulus property of “music” in rodents (Otsuka et al. 2009, Polston et al. 2011). For the purpose of investigating music preference in rats, we created an apparatus that gave instrumental control of musical choice to the rats themselves. Two speakers were embedded in the U-shape chamber placed in the sound shielding box. We developed a dedicated software on the LabVIEW platform, which can control the apparatus and analyze the activity of rats by image processing. By using this system, we tried to determine rats’ preferences for two contrasting sounds (white noise vs. kanon chord progression). After rats are conditioned with reward (sucrose solution) to each sounds, we exhibited each sound simultaneously from separate speakers located in another place in the chamber. As a result, one rat preferred kanon chord progression to white noise. This result indicated that our experimental setup can extract the music preference in rats, although we need to perform further experiments in another subjects.

Meijiro: our university owl