

The 3rd National Taiwan University–Kyoto University International Symposium

Cognitive Neuroscience:

Socio-Cognitive Neuroscience on Understanding Self, Others, and Objects

9:00~17:30 March 17th (Sat.) 2018

North Hall 100, Department of Psychology, National Taiwan University.

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■ Programs

- 9:00~9:10 **Opening Ceremony & Remarks**
- 9:10~9:50 **Jun Saiki** (Kyoto U): PI of Meditation group
Effects of short-term mindfulness meditation on self-concept and emotion regulation
- 9:50~10:30 **Su-Ling Yeh** (NTU): PI of Synesthesia group
Cross-cultural comparison of grapheme color synesthesia of Kanji characters: Cases of Taiwan and Japan
- 10:30~10:50 *Tea Break*
- 10:50~11:30 **Chien-Chun Chen** (NTU): PI of Vision group
The local configuration effect on global percept
- 11:30~12:10 **Satoru Saito** (Kyoto U): PI of Statistical learning group
Statistical learning and perception: An integrated framework for visual and language domains
- 12:10~14:00 *Lunch & Poster session*
- 14:00~14:40 **Chien-Te Wu** (NTU): Co-PI of Aging group
A cross-country comparison of the correlation between resting-state brain connectivity and life styles: A preliminary study of older adults in Japan and Taiwan
- 14:40~15:20 **Nobuhito Abe** (Kyoto U): PI of Honesty group
A cognitive neuroscience approach to honesty
- 15:20~15:40 *Tea Break*
- 15:40~16:20 **Bo-Cheng Kuo** (NTU): PI of Visual working memory group
Neural correlates for location-shared and feature-bound representations in visual working memory: An MEG study
- 16:20~17:00 **Keng-Chen Liang** (NTU): PI of Social, cognitive, and biology group
Behavioral and brain mechanisms underlying social interaction: From animal to human
- 17:00~17:30 **General Discussion & Closing Remarks**

Talk Session Abstracts

Meditation group

Effects of short-term mindfulness meditation on self-concept and emotion regulation

Jun Saiki

Graduate School of Human and Environmental Studies, Kyoto University

Tifan Hung

Graduate Institute of Brain and Mind Sciences, National Taiwan University

Masahiro Fujino

Graduate School of Education, Kyoto University

The meditation group reports two studies on the effects of short Mindfulness-based interventions. The first study investigated the effects of short-intervention of Open Monitoring Meditation (OMM) on emotion regulation using attentional bias to facial expressions. After a 30-minute mindfulness exercise (either focused attention meditation (FAM), OMM, or control) participants performed a speeded discrimination of the orientation of “T” presented in the face picture with angry, neutral, or happy expression. Results showed that the reaction time was longer with angry faces in the control condition, whereas it was longer with happy faces after the OMM intervention, suggesting that OMM plays an important role in attentional bias toward happy expressions. The second study investigated the self-reference effect, a tendency of people to encode information according to the degree of self-participation. According to traditional Buddhism teaching, the insistence on the concept of a personal identity is disruptive. We examined the impact of different kinds of meditation practice, including FAM and loving-kindness meditation (LKM) on behavioral measures of self-referential processing to investigate the effect of the short interventions and the difference between FAM and LKM.

Synesthesia group

Cross-cultural comparison of grapheme color synesthesia of Kanji characters: Cases of Taiwan and Japan

Su-Ling Yeh

Department of Psychology, National Taiwan University

In grapheme color synesthesia, black-and-white characters are seen as colorful, usually one character paired with a particular color across space and time consistently. However, whether and to what extent learning experience play a role remains largely unexplored, especially for non-alphabetic writing scripts such as Chinese characters. We examined whether the perceived color among each individual synesthete was clustered or randomly distributed on the color space, and what factors determined the synesthetic color, mainly focused on the phonological aspects. Taiwanese and Japanese synesthetes were recruited and the same set of Kanji characters were used as stimuli. Global and local aspects of grapheme color synesthesia are revealed by comparing the results of the two groups of participants.

Cultural comparison between Taiwanese and Japanese of synesthetic colors distribution in the color space

Daisuke Hamada, Hiroki Yamamoto, and Jun Saiki

Graduate School of Human and Environmental Studies, Kyoto University, Japan

This study investigated distribution of synesthetic colors in the color space to understand perceptual properties of synesthetic colors for Taiwanese and Japanese. This analysis requires a large amount of data for a single synesthete. We therefore collected large samples of synesthetic colors associated with kanji characters shared between Taiwanese and Japanese. We obtained over 100 synesthetic colors for each of synesthete. We then analyzed the distribution pattern of synesthetic colors in the color space by using techniques of spatial statistics. The spatial statistical analysis revealed that synesthetic colors for both Taiwanese and Japanese are concentrated in multiple regions in the color space, that is, they form “synesthetic color clusters”. The

synesthetic color clusters indicate that generally synesthetic colors are not selected randomly from the color space, but specific colors preferentially become synesthetic colors for each synesthete.

Pronunciation similarity predicts synesthetic color similarity more in Japanese Kanji characters rather than Mandarin Chinese

Huan-Wei Lin and Su-Ling Yeh

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Although rule-based systems of color mappings between words and the synesthetic color were found in many languages, the influence of cultural difference still needs further investigation. Shared characters list with little shape difference between Japanese and Mandarin Chinese were chosen for further analysis. We calculated the synesthetic color similarity within character pairs which were selected according to same pronunciation for both Chinese and Japanese. The results showed in Japanese, 80 percent (4 out of 5) of Japanese synesthetes tended to see characters with the same pronunciation as similar colors, while only 14 percent (1 out of 9) of Taiwanese synesthetes showed the same tendency. The asymmetry of the proportion indicates that synesthetic colors of Japanese Kanji relied more on spelling or pronunciation than Chinese, even with similar shapes, and the result gives us hints about language processing and lexical accessing difference between Japanese and Chinese Kanji characters.

Vision group

The local configuration effect on global percept

Chien-Chun Chen

Department of Psychology, National Taiwan University

The standard model of biological motion perception requires an analysis of spatiotemporal variation of image properties, such as luminance or texture. Here, we used a series of experiments demonstrating a global motion phenomenon that does not depend on spatiotemporal variation of local elements but the spatial relationship between them. In Experiment 1, we showed that simply showing uncorrelated random dot images in sequence was enough to produce stable motion percept and that it is more likely to perceive concentric than any other types of motion. In Experiment 2, replacing dots with dipoles, the perceived motion direction tends to go from low to high contrasts, regardless luminance polarity. In Experiment 3, with tripoles, the perceived motion direction was determined by the relative, rather than absolute contrast of dot elements. Our results suggest visual motion mechanisms that can be activated just by the onset or offset of image elements. A sensitivity to concentric motion and an insensitive to luminance polarity suggests that these mechanisms may locate in hMST.

Statistical learning group

Statistical learning and perception: An integrated framework for visual and language domains

Satoru Saito

Graduate School of Education, Kyoto University

Yoshiyuki Ueda

Kokoro Research Center, Kyoto University

Tsung-Ren Huang

Department of Psychology, National Taiwan University

Su-Ling Yeh

Department of Psychology, National Taiwan University

Statistical learning refers to the ability to extract regularities from sensory inputs and to adjust behavioural, cognitive/perceptual, and neuronal processes to the statistical structure of the environment. Seminal studies had long been emphasizing the domain-general aspect of statistical learning rather than the domain-specific view that assumes an innate/built-in language acquisition capacity in humans. Later studies, with the development of a variety of paradigms, however, point to the presence of domain-specific constraints or mechanisms and to the multi-faceted characteristics of statistical learning. To elucidate domain-generality, domain-specificity, and their relationship in statistical learning, we employed one such paradigm - the Hebb repetition paradigm - in which participants are repeatedly presented with the same to-be-memorized list for immediate serial recall in every, e.g., fourth trial. The enhanced memory performance with the repetition is called the Hebb effect, which was initially reported in the verbal domain but later in the visuospatial domain, e.g., in serial order memory for spatial locations. In a series of experiments that we conducted searching for the Hebb effects, participants are required to remember four colour-location combinations and to reconstruct them immediately. The results indicated that in a certain situation, we may be able to detect distributional statistics (e.g., item occurrence frequency) in a similar manner in the verbal and visuospatial domains, whereas it is not the case for transitional or co-occurrence statistics (e.g., co-occurrence frequency of elements in a stream or in a visual array). This highlights the domain-generality and domain-specificity in the Hebb repetition paradigm and provides a clue to the development of an integrated framework for the multi-faceted statistical learning.

Aging group

A cross-country comparison of the correlation between resting-state brain connectivity and life styles: A preliminary study of older adults in Japan and Taiwan

Chien-Te Wu

Department of Psychology, National Taiwan University

Most countries in the world will be facing the challenge of super-aged society (more than 20% of population is 65 or older) in 5~10 years. Research has shown that aging is accompanied by declinations in physical and mental functions as well as structural and functional alterations in the brain. Research of effective approaches to 'successful aging' has therefore become an important issue. In line with the scaffolding theory of aging, few studies have shown that life participation (e.g., engaging in meaningful interaction with friends, capability of independently performing activity of daily living, etc.) may be a protective factor of cognitive aging. However, the neurophysiological basis underlying this implication is still unclear, and its understanding can be an essential step to establish an effective guideline for successful aging. In the current study, we aimed to investigate the interrelationship across the degrees of individual life participation (evaluated by Meaningful Activity Participant Assessment, or MAPA), health-related outcomes or wellbeing (evaluated by Montreal Cognitive Assessment, or MoCA, Short Form 36, or SF-36, and Geriatric Depression Scale, or GDS), and intrinsic functional brain connectivity (evaluated by resting-state fMRI) in elderly population. We used a cross-sectional research design and collected data from 41 elder participants in Taiwan and 36 elder participants in Japan. Our preliminary results revealed correlations between the quality and quantity of meaningful activity engagement (indexed by MAPA) and the resting-state connectivity patterns as well as mental wellbeing. Particularly, we found that the hippocampus is a key brain region that reflects a person's degree of life participation, where the number of brain regions showing significant interactions with the hippocampus is positively correlated with the MAPA score. Our next step is to establish the causal linkages between meaningful activity engagements, physical and mental wellbeing, and resting-state brain connectivity, by using mediation analyses.

Honesty group

A cognitive neuroscience approach to honesty

PI: Nobuhito Abe

Kokoro Research Center, Kyoto University

Co-PI: Tsung-Ren Huang

Department of Psychology, National Taiwan University

Chien-Te Wu

Department of Psychology, National Taiwan University

The neurocognitive mechanisms underlying honest and dishonest moral decisions have gradually been delineated. However, the individual differences in structural and functional neural networks associated with honesty have yet to be fully clarified. To address this issue, we have collected the data from over 200 subjects, using multi-modal neuroimaging techniques including T1-weighted structural scans, diffusion tensor imaging, and resting-state fMRI. We have also collected the data of honesty using a cognitive task, in which participants are given opportunities to gain extra reward by lying about their accuracy in an incentivized prediction task. Dishonest behavior was indexed by improbably high levels of self-reported accuracy. In this symposium, we will present preliminary results on a series of regression analyses of structural imaging, in which there was no regional brain volume and white matter integrity that can predict the individual differences in the frequency of dishonest behavior. Implications for personal factors that influence on honesty and dishonesty from a cognitive neuroscience perspective are discussed.

Visual working memory group

Neural correlates for location-shared and feature-bound representations in visual working memory: An MEG study

Ya-Ping Chen

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Jun Saiki

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Previous studies have shown that feature-integrated object representations are formed in visual working memory (WM). A recent study by Saiki (2016) suggests that these integrated representations are not bound to their locations. Whilst these findings highlight the importance of attention in feature binding in visual WM, the underlying neural substrates of location-shared and feature-bound representations in visual WM were not fully investigated. In this study, we address this issue using magnetoencephalography (MEG). Participants (N = 18) performed a WM task in which they viewed two types of feature (colors and letters) in a two-object memory display, following a short delay, and a single object probe. Their task was to respond whether the probe item contained any features of the memory display, regardless of its location. We manipulated the location and amount of feature matching between memory and probe. We tested for a hemispheric lateralisation of oscillatory activity in alpha band for each location-shared and location-unshared binding and feature condition during the probe in sensory-level analysis. We also localised the neural origins of the alpha activity using beamforming analysis in source-level analysis. In sum, this study will provide novel evidence for feature binding in visual WM.

Social, cognitive, and biology group

Behavioral and brain mechanisms underlying social interaction: From animal to human

Keng-Chen Liang and Chun-I Yeh

Department of Psychology, National Taiwan University

Progress was made for the social, cognitive and biology group in observation learning and its underlying neural substrates as well as on reaction of monkeys to inequity in the veil of ignorance experiment. K. C. Liang and colleagues extended his former findings in two other aversive learning tasks: conditioned fear potentiation of acoustic startle and inhibitory avoidance. The former task did replicate previous results that observing a demonstrator would induce saving in subsequent learning. The latter task found that an observing rat was more reluctant to enter and spent less time in a dark chamber where a demonstrator received electric shocks before. We also found that at the individual unit level, the shared-response units and the prosocial rescue units did not overlap substantially and might be distinct groups in the insular and anterior cingulate cortices. We did an fMRI study to assess BOLD activation during observation learning of pattern-reward association in human subjects. The results showed that observation learning with vicarious reward in contrast to real feedback learning with verbal reward involved certain brain regions. The thought experiment on veil of ignorance (VOI) is helpful in revealing how animals react to inequity. C. I. Yeh and colleagues study choices behind the VOI in Formosa macaques, attempting to shed light on how fairness may be determined. Monkeys appear more equal-minded behind the VOI than in a corresponding risky environment, suggesting the influence of other-regarding concerns. This higher tendency to be equal-minded behind the VOI correlates with the strength of disadvantageous other-regarding preference such as the aversion to fall behind, which further correlates with the body weight of the decision maker. These results suggest the importance of disadvantageous other-regarding preference in explaining more equal choices behind the VOI.

Poster Session Abstracts

Reduced limbic white matter integrity mediated age-related decline in the “When” memory component

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To examine age-related differences in the four memory components (i.e., who, when, where, and what) of verbal episodic memory, and to explore whether the difference is mediated by limbic white matter tract integrity. Two age groups completed the Logical Memory test of WMS-3 with a revised scoring method. Tract-specific analysis was performed to investigate the integrity of three limbic white matter tracts. The results revealed significant age-related differences in the learning condition of all four components, and age-related decline in the retention of the when component relative to other memory components. Furthermore, the immediate recall of when component was mediated by the integrity of the left fornix and the uncinate fasciculus, while the retention of when component was marginally mediated by the tract connecting left posterior cingulum and hippocampus. These findings suggest that age-related changes of left limbic white matter integrity mediated the relationship between age and verbal episodic memory.

ACKNOWLEDGEMENTS: This work was supported by the Taiwan Ministry of Science and Technology (grant numbers 1042628-H-002-001-MY3, 105-2420-H-002-003-MY2 to Y.L.C.).

Alterations in white matter microstructure mediate the deleterious effect of hypertension on cognitive performances in cognitively normal older adults

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The underlying pathophysiological mechanism of hypertension to cognitive declines remains uncertain. The current study aimed to examine the role of white matter integrity in hypertension-related cognitive detriments. The study recruited 66 cognitively normal older adults, comprising 41 hypertensive patients and 25 normotensive controls. All participants underwent a battery of neuropsychological tests and diffusion spectrum imaging. The mediating effects of the white matter integrity were assessed with structural equation modeling. The results revealed that alterations in white matter integrity, particularly in those tracts connecting frontal with posterior cerebral regions, underlay effects of hypertension on performances in multiple cognitive domains, including processing speed, executive function, memory encoding, and memory retrieval. Overall, this study suggests that hypertension might exert deleterious effects on multiple cognitive domains through undermining the white matter microstructure even in cognitively healthy older adults, thus supporting calls for monitoring vascular health to prevent cognitive declines.

Replication of the aging-related bias for striatum- over hippocampus-based spatial learning and memory in a Taiwanese sample: A pilot study

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Spatial learning and memory is subserved by striatal circuitry, which mainly relies on simple cue-location associations, and hippocampal circuitry, which involves more complex spatial information including boundaries. In Caucasian samples, it has repeatedly been shown that aging affects the relative prioritization of hippocampus- and striatum-dependent strategies during spatial navigation. However, it remains elusive whether the bias for striatum-dependent resources in older age can also be observed in different cultural contexts. In this study we used a desktop virtual reality-based spatial navigation task that differentiates hippocampus- versus striatum dependent spatial

learning and memory and tested 22 young and 20 older Taiwanese subjects. As with previous literature, older adults showed overall worse performance during spatial learning and relied more on striatum-dependent cue than hippocampus-dependent boundary information. In conclusion, our pilot results indicate aging-related changes in spatial learning and memory are rather unaffected by cultural influences when no additional cultural manipulation is applied.

Age-related alterations in resting state functional connectivity and verbal episodic memory performance

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Previous resting-state fMRI studies have documented its relationship with cognitive performance. The relationship between the hemispheric differences in the functional connectivity (FC) of the brain networks and cognitive performance, however, remains uncharacterized. The present study investigated age-related FC alterations, focusing on the hemisphere differences in the default mode network (DMN) and salience network (SN), and its association with verbal episodic memory performance in a sample of 61 healthy adults (young, $n=31$; old, $n=30$). The results revealed that the FCs in the left hemisphere were particularly vulnerable to aging effect compared to that in the right one. Moreover, increased FC strength within the right SN was associated with higher learning abilities, particularly in the old high performer. These findings suggest that asymmetric alterations of intrinsic FC in the two hemispheres were associated with age-related verbal memory changes, which was in line with evidences obtained in task f.

The neural mechanisms of mentalizing during social interaction in adults with autism spectrum disorders

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Mentalizing during social interaction is atypical in autism spectrum disorder (ASD) individuals. However, the neural mechanisms of mentalizing between ASD adults and healthy controls are unclear. We studied ASD and control adults by using a social animation task in fMRI. The Social responsiveness scale (SRS) and Autism Diagnostic Interview, Revised (ADI-R) were collected. The ASD group produced greater brain activation in the left precuneus, left inferior parietal lobule (IPL), right middle frontal gyrus, and right superior frontal gyrus than controls. For correlation analysis, there were marginally significant negative correlations between the right middle frontal/left precuneus activation and the SRS Social Awareness in controls, indicating that greater activation in these regions may be associated with better functions of social awareness. Moreover, greater IPL activation was positively correlated with the ADI-R Qualitative Communication Abnormalities in the ASD group, suggesting that greater activation in this region may be related to poor communication skills.

Keyword: mentalizing, social interaction, fMRI, autism spectrum disorder

Sex differences in adults with attention-deficit/hyperactivity disorder: a counting Stroop functional MRI study

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Emerging evidence in individuals with attention-deficit/hyperactivity disorder (ADHD) has reported executive functioning (EF) dysfunctions in the fronto-striato-parietal network. To date, the EF abnormalities in women with ADHD are less clear. Thus, we used functional magnetic resonance imaging (fMRI) to examine the sex differences in ADHD in a counting Stroop task that explored inhibitory control. The sample consisted of 53 adults with ADHD (27 men) and 52 age- and IQ matched healthy comparisons (26 men). In the counting Stroop task, participants were asked to judge the number of words (one to four) by pressing a button, regardless of the word meaning. Our results demonstrated a disrupted fronto-striato-parietal network for both sexes in ADHD. In addition, a significant group-by-sex interaction indicated that the comparison-versus-ADHD difference was greater for the women than for the men. In conclusion, this study revealed the distinctive neural activities between women and men with and without ADHD.

Semantic processing as an endophenotype in youths with autism spectrum disorder

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Autism spectrum disorder (ASD) is characterized as a highly heritable disorder, and aberrant semantic processing is one of common symptoms. However, little is known about heritable traits that were correlated with ASD in semantic processing. Therefore, this study adopted an endophenotype approach to investigate the differences in underlying neural mechanisms by comparing ASD youths, their unaffected siblings, and TD youths. Participants were instructed to judge whether two Chinese characters

were related in meaning in MRI scanner. The unaffected ASD siblings showed greater cuneus activation with ASD youths as compared to TD youths. Also, the ASD siblings showed intermediate inferior frontal gyrus (IFG) activation between TD and ASD youths. Our findings indicate that cuneus activation and weaker IFG activation may be candidate trait markers for semantic processing in ASD. Moreover, the unaffected siblings may adopt perception-based strategies to access semantic knowledge as ASD youths, and have poor retrieval of semantic knowledge.

Keywords: autism spectrum disorder (ASD), endophenotype, semantic processing, functional magnetic resonance imaging (fMRI)

Developmental changes in brain connectivity of semantic processing in youths with autism and typically developing youths

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Previous studies have found aberrant neural networks of meaning processing in autism spectrum disorders (ASD) adults. However, little is known about developmental differences in neural substrates of semantic processing in youths with ASD. We addressed this issue by recruiting ASD and typically developing (TD) groups, with each group divided into two age subgroups (child, adolescent). They were tested on a semantic judgement task within an MRI scanner. There were three main results. First, for the ASD children, a significant connection was found between the cuneus and right inferior parietal lobule (IPL), suggesting a visual-based processing during semantic judgments. Second, for the TD children, a significant connection was found between the cuneus and middle temporal gyrus (MTG), indicating a direct mapping between orthographic and semantic representations. Third, for the TD adolescents, a significant connection was found between the IFG and MTG, suggesting a top-down controlled process to retrieve semantic knowledge.

Keywords : semantic; functional connectivity; age; fMR

Fear conditioning altered BOLD signal and functional coupling in the sensory pathways

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In search of neural change altered by a learning process, task fMRI monitors whole brain activity during acquisition and resting state fMRI captures activity reverberating within brain network in the early phase of consolidation. We trained male Wistar rats to acquire light-shock association under dexmedetomidine sedation during imaging and assessed their memory in a normal awake state by fear potentiated startle task. Rats were categorized into good and poor learners based on their memory performance. Fear conditioning significantly enhanced the BOLD activity in the visual pathway and primary somatosensory cortex, and ROI analyses further reveal that the learning-induced signal increment was mainly present in the good learners. Moreover, this group showed stronger functional coupling between the visual and somatosensory pathways after learning. These results indicate that fear conditioning leaves memory trace in the sensory pathways, and the subsequent activity reverberation between sensory pathways is involved in consolidation.

Key words: rodent fMRI, memory acquisition, consolidation, fear potentiated startle, emotional memory

Repeated sensory stimulation enhanced the within-modality functional connectivity but decreases that of between-modalities

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Sensory stimulus can elicit unit activity even subjects are under deep anesthetic state, so in the present study we used fMRI to record the BOLD signal evoked by footshock and light, respectively, on dexmedetomidine-sedated rats. Resting state scans were inserted

before and after sensory stimulation to calculate the stimulation-elicited functional connectivity change. The forepaw stimulation evoked BOLD signal in the ventral posterior nucleus of thalamus and primary sensory cortex, while flash light elicited strong BOLD response in the visual pathway, including the lateral geniculus nucleus, superior colliculus, and primary visual cortex. Repeated sensory stimulation enhanced the functional connectivity within the stimulated circuit but decreased that between the visual and somatosensory pathways. In contrast to the stimulated groups, no consistent change pattern was found in the task-free control. These results serve as a baseline to be compared with the change by a learning event requiring association of light and shock.

Key words: rodent fMRI, forepaw stimulation, visual fMRI

Relieving other's pain by pressing a lever can serve an empathy based pro-social behavior in rats

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Pro-social behavior motivated by empathy once thought was unique in human. There are cumulative evidences showing that rodents have similar motivations to help others. To test this, we trained rats to avoid or escape a shock by pressing a lever during the conditioned cue or during shock delivering. Afterward, two rats were putting into two near by boxes. One as an active rat can access the lever but had no cue in its box. The other as passive rat cannot access the lever but had conditioned cue in its box. Active rat must observe other's cue as a signal to press the lever. A success response terminated shock delivering of both boxes. In last phase, two rats tested at the same time again. Active rat received no more shock, while passive rat still had. Subjects continued pressing the lever to terminate other's shock delivering. Our results were not conditioned or instinct behaviors because they extinguished faster when tested alone

without receiving shock. We argue that rats show pro-social behaviors motivated by conspecific's distress by pressing levers to relieve others' pain

The hippocampal brain waves of rats during the differential reinforcement of low rate task

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Obedience training refers to teaching dogs to respond to commands. Positive reinforcement such as giving treats, helps dogs to learn. The order, “wait before doing something”, is a very common command for training disobedience dogs. A psychological term-differential reinforcement of low rate (DRL) could apply to the above-mentioned order, i.e. giving treats whenever animal waits for a certain period of time before doing something. The functional changes in the brain are still unclear when comparing the brain electrical signals before and after animal acquired the DRL task. Thus, we implanted electrodes into the rats' hippocampus, a critical brain area for learning and memory, to record their brain waves until the subjects learned the DRL task. We found that the levels of cross-frequency coupling of theta and gamma waves during the DRL task are higher in the second half of training days. The results suggest that operant conditioning increase the modulation between theta phases and gamma amplitudes, which also supports the idea that learning enhances the hippocampal cross-frequency coupling. To date, the function of cross-frequency coupling is still unclear; however, our results shed some light on their role in learning DRL task.

Contrast dependency of Gestalt proximity grouping principles

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Luminance contrast may play a major role in perceptual grouping (Lin et al., 2017). The current study investigated contrast dependency of proximity law using tripole Glass patterns (tGPs). A tGP consists of randomly-distributed sets of three dots, or tripole. Each tripole contains one anchor dot and two context dots. A clockwise (CW) or counter-clockwise (CCW) spiral would be perceived by grouping the anchor with either context dots. We changed luminance contrast, between -30 and 0 dB, and anchor-context distance, between 9.5 and 27 min. The task were to report which spiral an observer perceived. For context dots with low contrast, the probability of judging a CW spiral increased when the distance of CW side decreased. However, for high luminance contrast, the results showed an opposite trend. These results suggested that the Gestalt proximity law is subject to contrast control. Our result can be well fit by a divisive inhibition model.

Synchronous firing of black-dominant and white-dominant cell pairs in macaque V1

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Previous studies have shown that black-dominant neurons outnumber white-dominant neurons in the primary visual cortex V1 in many species. The black-over-white bias may serve as the neural substrate for better and faster processing of black than white objects. We hypothesized that the strength of synchronous firing between black-dominant neurons

should be stronger. Here we used a multi-electrode matrix to simultaneously record from multiple neurons in different cortical layers of macaque V1. The receptive field measured with sparse noise by reverse correlation was used to determine a cell's response bias (black or white dominant, Yeh et al 2009). We quantified the strength of synchronous firing by cross-correlogram. For both black- and white-dominant cell pairs, the correlation strength was negatively correlated with the distance. Moreover, the strength of the synchronous firing is also modulated by the stimulus. In comparison with white-dominant cell pairs, the average correlation strength of black-dominant cell pairs tended to be smaller with sparse noise, but tended to be larger with dense noise (a binary white noise generated by m-sequence, Reid et al 1997).

The contextual effect of the preferred orientation in macaque V1 neurons

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Several studies have shown that receptive fields of many macaque V1 neurons are very different when measured with different artificial stimuli. Here we further studied this contextual effect by using natural-scene stimuli (a black and white movie recorded by a camera mounted on a cat's head, Einhäuser et al 2002). We investigated whether the preferred orientation of the receptive field mapped by natural stimuli might change if the movie was rotated by 90 degrees. About half of the V1 neurons showed changes for more than 30 degrees in their preferred orientations when mapped with both original and rotated natural stimuli. These neurons tended to have higher circular variances (more broadly tuned in orientation) and lower modulation ratios for drifting gratings (more 'complex'). Overall, these results indicate that V1 neurons are highly adaptive and may change their properties based on the statistical properties of visual scenes.

Spatial summation in noise

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We investigate the effect of background noise on visual spatial summation. We used a 2AFC paradigm to measure the contrast detection threshold of a Gabor target with or without the presence of a white noise mask in various luminance contrast. When the target size was small, the detection threshold decreased with target size with slope -1, and then with slope -1/2. The latter section defines the range of attentional summation (Tyler & Chen, 2001). The target threshold was constant for noise level up to -26dB to -18 dB, then increased linearly with noise contrast. Since the “elbow” of the target threshold vs. noise intensity function indicates the level of the equivalent internal noise, our result suggests that while the internal noise increases with target size in the full summation range up to 36' Half-Height Full-Width. The magnitude of internal noise is independent of target size in the attentional summation range.

Guided neuroplasticity of excitatory neurons in primary sensory cortex: a whisker model

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Hebb's rule has been studied in development, learning and memory. The spike-timing dependent plasticity (STDP) is a possible mechanism underlying neuroplasticity on the synaptic level, but the mechanisms in an in vivo neural ensemble remains unclear. Following these rules, we hypothesized that controlling the timing of neuronal activities could alter the neuron's tuning functions. We seek to alter a neurons' tuning function by manipulating the timing of physical stimulus and optogenetic stimulation of the neuron. The neuron's tuning was analyzed before and after the paired stimulations (100 pairs). In conditions when the whisker-induced activities preceded light-induced activities, the paired stimulations increased the neuron's firing rate to whisker stimulation. On the contrary, in conditions when the light-induced activities preceded whisker-induced

activities, the paired stimulations decreased the neuron's firing rate to whisker stimulation. Interestingly, both conditions showed changes in neurons' direction selectivity. We concluded that paired stimulation could alter a neuron's tuning function, proposing a feasible method to manipulate the neural circuits.

Inverse Relationship between Cognitive Flexibility and Interoceptive Accuracy

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Previous studies exclusively explained the individual difference of cognitive flexibility from a cognitive perspective involving executive functions. This research aimed to investigate cognitive flexibility from a more holistic view by experimentally testing task-switching (as measured by switch-cost) and inhibitory control (as measured by Stroop effect) as well as interoceptive accuracy (as measured by Mental Tracking Method). We collected data from 32 participants, and hierarchical regression revealed that participants with lower interoceptive accuracy and lower Stroop effect had lower switch cost. These results suggest that in order to mentally switch between two external tasks, participants should first attend to external environments, and then inhibit the urge to follow previous rule in order to switch between two tasks; therefore, we speculate that the tendency of an individual to focus inwards or outwards, and his/her ability to inhibit **irregular properties** in order to reach the goal, **would both influence his/her performance during task-switching.**

Multi-time points analysis: A time course analysis with functional near-infrared spectroscopy

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In functional near-infrared spectroscopy (fNIRS) data analysis, the mass univariate analysis is often performed when researchers consider examining the difference between conditions at each sampled time point. However, some issues, including assumptions of linearity, auto-correlation, and multiple comparison problems, impact statistical inferences while using the mass univariate analysis on fNIRS time course data. To address these issues, the present study proposed a novel perspective, Multi-Time Points Analysis (MTPA), to discriminate signal differences between conditions by combining temporal information from multiple time points in fNIRS. The MTPA adopted the random forest algorithm, followed by a series of cross validation procedures, providing reasonable power to detect significant time points and ensure the generalizability. Using a real dataset, the proposed MTPA outperformed the mass univariate analysis in detecting more time points showing significant differences between conditions. Finally, the MTPA can compare signal between different areas, providing additional theoretical implications in future studies. Keywords: fNIRS, time series, linear model, mass univariate analysis, random forest

“I know that *Kiki* is angular”: The metacognition underlying sound-shape correspondences

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We examined people's ability to evaluate their confidence when making perceptual judgments concerning a classic example of sound symbolism, namely *the Bouba/Kiki effect*: People typically match the sound "Bouba" to more rounded patterns whereas they match the sound "Kiki" to more angular patterns instead. For each visual pattern, individual participants were more confident about their own matching judgment when it happened to fall in line with the consensual response regarding whether the pattern was rated as Bouba or Kiki. Logit-regression analyses demonstrate that participants' confidence ratings and their matching judgments were predictable by similar regression functions of component features. This implies that the consensus and confidence underlying the Bouba/Kiki effect is underpinned by a common process whereby perceptual features in the patterns are extracted and then used to match the sound following rules of crossmodal correspondence. Combining both matching and confidence measures therefore allows the researcher to explore and quantify the strength of associations in human knowledge.

Enhanced dynamic visual acuity under blue light

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Exposure to blue light affects circadian rhythm and sleep via stimulation of intrinsically photosensitive retinal ganglion cells (ipRGCs), which are also sensitive to motion stimuli. However, whether blue light could affect dynamic vision is still unknown, and we aimed to examine this. Three randomly chosen numbers (0-9) moved sequentially in either upward or downward direction at the center of the display, and participants' task was to report the numbers under blue- or orange-background condition in two separated days. A staircase procedure was used to measure the speed sensitivity. Higher sensitivity was found under blue light than orange light, especially with downward motion.

Dynamic visual acuity can be enhanced under blue light, perhaps through motion sensitive ipRGCs.

Effects of blue light on visual search

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The effects of blue light on human physiological and cognitive functions, such as circadian rhythm and alertness, have been well studied. Recent brain image research reported that blue light could activate parietal lobe which is highly associative with the ability of visual search, but there was no direct behavioral evidence. The present study focused on the behavioral effect of blue light on visual search. Subjects performed visual search task with either blue or yellow-green background color under different levels of discriminability between the target and distractors. We compared the search slopes in different experimental conditions. The result showed that the search slope in blue-background condition was shallower than yellow-green background condition when the target discriminability was poor. It suggested that the performance in visual search task could be improved by blue light.

Unconscious semantic priming reflected by Gamma- and theta-band synchronization: an MEG study

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Previous studies found that an unrecognizable word due to visual crowding still generated semantic priming effect to the subsequent target. While temporal and frontal brain regions are related to process semantic information, the dynamics of these regions during unconscious semantic priming remains unclear. We investigated cross-frequency phase-phase coupling between theta and gamma oscillations with magnetoencephalography (MEG) as both frequencies related to lexical-semantic networks. By presenting an isolated or a crowded prime word, the subsequent target word was either semantically related or unrelated to the prime. We observed higher phase-phase coupling between right middle temporal gyrus (MTG) theta-band activity and left inferior frontal gyrus (IFG) gamma-band activity for related compared to unrelated conditions during 400-850 ms after target onset. This result was consistently observed in both isolated and crowded primes, implying the possibility that there exists a cross-hemisphere interaction when processing semantic information even when the prime was unrecognizable.

Semantic priming of Japanese Kanji characters under visual crowding

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Previous studies found that for Chinese characters, semantic priming survives visual crowding but not phonological priming. This suggests that semantic information can be extracted even with unrecognizable characters, but phonology depends on recognizable orthography. Japanese Kanji, although borrowed from Chinese characters, may involve different processes due to different learning experience and linguistic context, and thus provide an excellent contrast. Japanese kanji character pairs (semantically-related and semantically-unrelated) were chosen by free-recall and rating, and no semantic priming effect was found under visual crowding, but crowding effect (longer RTs to the isolated target for crowded prime than isolated prime) was still found. This suggests that Japanese processes semantic information of Kanji character differently, compared to Taiwanese.

Neurobiology and statistics for reflective minds in primates

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In everyday life, we do not only make decisions but also reflect our own decisions. How about animals? The authors found the behavioral correlates of reflective minds in the monkeys. In opt-out task, the monkeys chose the escape options with low risk and low return more frequently as decision difficulty increased. These monkeys' behaviors indicate the degree of confidence, which is a typical consequence of self-reflective mind.

By recording single-unit activities from the monkeys performing the above opt-out task, we found out the neural correlates of decision confidence in the pulvinar, a higher-order nucleus of the thalamus. Moreover, we performed the human psychophysics with six ratings of subjective confidence. The human's confidence scores showed the same patterns as the modulations of monkey's pulvinar activities. These data were well explained by a statistical framework of confidence. The findings suggest that monkeys and humans shared a common mechanism of the reflective minds.

Does the left-side bias occur during perceptual averaging also reveal in the eye movement pattern?

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Li and Yeh (2017) found a left-side bias when averaging the size of a group of spots and suggested a leftward attentional bias in perceptual averaging. This LSB effect on mean size averaging task was further investigated by monitoring participants' eye movements, using similar stimuli as in Li and Yeh (2017) but longer presentation durations (until response or up to 6s). Eye scanning pattern showed that in the left-side-larger condition, the left-side and right-side spots were equally scanned. In contrast, in the right-side-larger-condition, the proportion of first saccade, total fixation count, and total fixation duration at the right side was higher than those at the left side. Taken together with our previous study, perceptual mean size estimation triggers a faster leftward attentional bias, followed by a rightward eye movement bias.

Unconscious evaluative conditioning under continues flash suppression

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Whether awareness of CS-US contingency is needed during evaluative conditioning is currently a controversial topic, and answering the question can be crucial for clarifying if evaluative conditioning is a type of Pavlovian conditioning, which requires such contingency awareness. In the present work, both CS (neutral flag) and US (valence words) were shown subliminally by means of the continuous flash suppression paradigm

during the conditioning procedure, thus keeping the participants from being aware of the CS-US relationship. Results showed that flags paired with positive-valence words were rated more positively than those paired with negative-valence words. The finding that evaluative conditioning occurs for unconsciously perceived word-flag pairs suggest that such conditioning does not depend on awareness of the CS-US contingency and is therefore different from Pavlovian conditioning.

Keywords: attitude formation, association formation model, continuous flash suppression, contingency awareness, evaluative conditioning

Which comes first? An investigation of awareness to high- and low-calorie food

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Food digestion is indispensable in daily life. Previous studies have suggested that people could automatically process food-related stimuli and elicit emotion-related brain regions. In the present study, we examined whether high-calorie food possess priority to access consciousness over low-calorie food and breaking continuous flash suppression (b-CFS) paradigm was adopted to investigate this issue. Implicit association test (IAT) was also conducted to measure the relationships between high- calorie/low-calorie food and positive/negative emotion. We found that high-calorie food release from suppression faster than low-calorie food, and IAT results showed stronger connection between high-calorie food and positive affect. Taken together, the results indicate high-calorie food can access awareness earlier than low-calorie food, which might result from stronger positive emotion elicited by high-calorie food.

Keywords: calorie, continuous flash suppression, emotion

How psychological ownership affects the endowment effect?

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It remains unclear how loss aversion and psychological ownership are affecting the endowment effect, a tendency to value a good more when owning it. Here we studied the question by recruiting 30 subjects to make a series of two-alternative forced choices between an owned lottery and a new, which differed from the owned in both reward and reward probability. The degree of psychological ownership was determined by whether the owned was assigned or chosen. To the result, when the owned was riskier than the new, subjects made decisions based more on the difference in reward than on the difference in probability. The size of the effect increased with the degree of psychological ownership. In summary, psychological ownership increases the weighting of the dominant attribute (reward or probability) to cause endowment effect.

Psychological ownership enhances endowment effect on risk

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The endowment effect, a tendency to value a good more when owning it, has been attributed to loss aversion or the psychological ownership. We investigated how these two variables contribute to the endowment effect.

Thirty subjects chose the preferred lottery between the owned (endowment) and the new. We let subject to decide the owned lottery to enhance the psychological ownership and manipulated the property of the new that different from the owned in reward probability and expected value.

To the result, when the endowment was riskier (higher reward), subjects chose the lottery according to the difference in reward but reward probability. When the endowment was safer (higher reward probability), the difference in reward slightly affected the choosing

behavior. Furthermore, these influences were enhanced when the endowment was chosen. In summary, we found that a greater sense of ownership on an endowment increased its utility by weighting the advantaged attribute more.

Retrieval-induced forgetting in social contexts: A meta-analysis

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“Within-individual Retrieval-induced Forgetting” (WI-RIF) refers to the phenomenon that an individual’s selective retrieval of items often causes more forgetting of categorically related and yet unrehearsed items than categorically unrelated and unrehearsed items. This memory phenomenon has been also reported in social settings as “Socially-shared Retrieval-induced Forgetting” (SS-RIF). For example, when a group of people mention parts of their shared experience in a conversation, both speakers and listeners suffer from forgetting of related and yet unmentioned memory. Despite their surface similarities, SS-RIF and WI-RIF studies show quantitatively and qualitatively different characteristics in experiment data. In our meta-analysis of SS-RIF, we found that SS-RIF studies employing free conversations between participants showed overall larger effect sizes of retrieval-induced forgetting than those of WI-RIF studies. Moreover, in these SS-RIF studies the forgetting effects decreased as practice effects increased, which was opposite to the observed positive correlation between forgetting and practice effects in WI-RIF studies. These characteristic differences in effect sizes between WI-RIF and SS-RIF studies imply some mechanistic differences between the two memory paradigms, which will be discussed from a cognitive rather than a social perspective.