MINI SYMPOSIUM

5th Mini-Symposium on Cognition, Decision-making and Social Function: In Memory of Kang Cheng

July 19 (Wednesday), 2017
13:30 – 17:30
1F Seminar Room, BSI Central Building

13:30-13:35 Opening

13:35-14:00
Metacognition in Value-based Decision-making
Dr. Xiaohong Wan (Beijing Normal University)

14:00-14:25
Influence of Simple Action on Subsequent Manual and Ocular Responses
Dr. Pei Sun (Tsinghua University)

14:25-14:50 Break

14:50-15:15
Mouse primary visual cortex is not part of the reverberant neural circuitry critical for visual perception
Dr. Masataka Watanabe (The University of Tokyo)

15:15-15:40
Imaging magnetic susceptibility with magnetic resonance: a tool to study neurodegeneration
Dr. Mauro Costagli (IMAGO7 Research Center)

15:40-16:05
Color representation in human visual cortex
Dr. Ichiro Kuriki (Tohoku University)

16:05-16:30 Break

16:30-16:55
Neural computations underlying social decision-making
Dr. Hiroyuki Nakahara (RIKEN)

16:55-17:20
Priors and heuristics in human visual perception
Dr. Justin L. Gardner (Stanford University)

17:20-17:30 Closing

Host:
Hiro Nakahara Lab for Integrated Theoretical Neuroscience
Keiji Tanaka Lab for Cognitive Brain Mapping

MINI SYMPOSIUM

Metacognition in Value-based Decision-making

Dr. Xiaohong Wan
Beijing Normal University

July 19 (Wednesday), 2017
13:35-14:00
1F Seminar Room, BSI Central Building

Value comparison is the key process of value-based decision-making. Dorsal anterior cingulate cortex (dACC) and ventromedial prefrontal cortex (vmPFC) have been suggested to be critically involved in value comparison, as their activities are correlated with the absolute value difference (AVD) of options. However, value-based decision-making is usually accompanied by uncertainty with the decisions; consequently, the metacognitive process of uncertainty monitoring is automatically elicited. We found that the vmPFC activity associated with AVD might be caused by negative regulation from dACC and its association network, which were indeed correlated with decision uncertainty (DUC), involved in uncertainty monitoring. Instead, we found that intra-parietal sulcus (IPS) and medial orbitofrontal cortex (mOFC) were associated with signed option value difference (OVD), suggesting involvement in value comparison. Thus, our findings suggest that the activities of dACC and vmPFC, as well as their association networks, correlating with AVD, may be irrelevant to value comparison, but associated with decision uncertainty monitoring.

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Influence of Simple Action on Subsequent Manual and Ocular Responses

Dr. Pei Sun
Tsinghua University

July 19 (Wednesday), 2017
14:00-14:25
1F Seminar Room, BSI Central Building

Recent investigations into how action affects perception have revealed an interesting 'action effect'—that is, simply acting upon an object enhances its processing in subsequent tasks. The previous studies, however, relied only on manual responses, allowing an alternative stimulus-response binding account of the effect. The current study examined whether the action effect occurs in the presence of changes in response modalities. In the experiment, participants completed a modified action effect paradigm, in which they first produced an arbitrary manual response to a shape and then performed a visual search task in which the previous shape was either a valid or invalid cue—responding with a manual or saccadic response. In line with previous studies, the visual search was faster when the shape was a valid cue but only if the shape had been acted upon. Critically, this action effect emerged similarly in both the manual and ocular response conditions, thus ruled out the stimulus response binding account. In the following experiments, the nature of this action effect was further investigated from the perspectives of attention and working memory.

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Mouse primary visual cortex is not part of the reverberant neural circuitry critical for visual perception

Dr. Masataka Watanabe
The University of Tokyo

July 19 (Wednesday), 2017
14:50 – 15:15
1F Seminar Room, BSI Central Building

The primary visual cortex (V1) is the main source of visual input to downstream cortical areas; it is a long-standing question, however, whether V1 activity is critical for conscious visual perception[1]. Previous studies have exploited visual illusions that render stimuli invisible, such as binocular rivalry (our own work that I will briefly introduce:[2]) or backward masking, but have provided conflicting results. Moreover, in these paradigms, the role of a candidate area in visual perception was often based on correlations between its neural activity and subjective reports of visibility. Mere correlations, however, may reflect spurious relationships, and ultimate answers about an area's contribution to perception will require methods demonstrating causality. Here we provide a causal test of V1's role in perception by porting the backward masking paradigm to the mouse model, where we combine behavior, electrophysiology, and optogenetic manipulations of neural activity. We first demonstrate that the behavioral signatures of visual backward masking known from humans and non-human primate are also present in the mouse. We then characterize a prolonged response component of V1 neurons, which is indeed correlated with the mouse's report of visibility. Despite this correlation, we find that this prolonged V1 response component is not causally linked to perception, because temporally precise suppression of it leaves behavioral performance fully intact. We conclude that V1 functions as an input source of visual information to later areas, but is not part of the circuitry critical for visual perception.

1. Crick, F. and C. Koch, Towards a neurobiological theory of consciousness. Seminars in Neuroscience Vol2, 1990: p. 263-275.
2. Watanabe, M., et al., Attention but not awareness modulates the BOLD signal in the human V1 during binocular suppression. Science, 2011. 334(6057): p. 829-31.

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MINI SYMPOSIUM

Imaging magnetic susceptibility with magnetic resonance: a tool to study neurodegeneration

Dr. Mauro Costagli
IMAGO7 Research Center

July 19 (Wednesday), 2017
15:15-15:40
1F Seminar Room, BSI Central Building

Magnetic susceptibility χ describes the response of a substance when it is placed in an external magnetic field. Conventional Magnetic Resonance Imaging (MRI) techniques, such as T2*-weighted imaging, offer valuable information that reflect the magnetic properties of biological tissues, as they provide imaging contrast weighted by local field homogeneity. More recent techniques, namely Susceptibility-Weighted Imaging, enhance this information by combining the conventional T2* signal amplitude with signal phase.
We have optimized Susceptibility-Weighted ANgiography (SWAN), a technique based on 3D gradient-recalled multi-echo acquisition, to target the mesencephalon on a 7T whole-body MRI system, and we described, with excellent anatomical detail in-vivo, a three-layered organization of the substantia nigra (SN). After training on the normal appearance of SN in eight healthy subjects, the SN anatomy was evaluated by two neuroradiologists, blinded to the clinical diagnosis of 30 subjects: 17 patients with Parkinson Disease (PD) and 13 healthy controls. The abnormal architecture of the SN allowed discriminating between PD patients and healthy subjects with sensitivity and specificity of 100% and 96.2%, respectively, suggesting that 7T susceptibility-weighted imaging could be used to accurately diagnose PD.
With a similar approach we targeted the primary motor cortex (M1) in patients with amyotrophic lateral sclerosis (ALS). Signal hypointensity of M1 deep layers correlated with clinical scales of upper motor neuron impairment ($r= -0.47$; $P< 0.001$) and with disease progression rate ($r= -0.60$; $P< 0.009$). We also implemented Quantitative Susceptibility Mapping (QSM), a novel MRI technique that allows the quantification of χ, and demonstrated that, in a group of 13 healthy subjects, the measured values of χ correlated with the expected concentration of iron in different regions of the cerebral cortex. In ALS patients, significant increases in magnetic susceptibility colocalized with T2* hypointensity observed in the deep layers of M1. The magnetic susceptibility, hence iron concentration, of the deep cortical layers of patients' M1 subregions corresponding to Penfield's areas of the hand and foot significantly correlated with the clinical scores of impairment of the corresponding limbs. QSM, which therefore appears to reflect the presence of iron deposits related to neuroinflammatory reaction and cortical microgliosis, might prove useful as a possible radiological sign of severe upper motor neuron burden in ALS patients.

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MINI SYMPOSIUM

Color representation in human visual cortex

Dr. Ichiro Kuriki
Tohoku University

July 19 (Wednesday), 2017
15:40-16:05
1F Seminar Room, BSI Central Building

Color is one of the fundamental aspects of visual information, but little is known about how color information is coded in human brains. We addressed to this issue by using a functional brain imaging technique with MRI scanner (fMRI). We first measured a histogram of hue selectivity in human visual cortex by using a modified method of phase encoding technique and we found abundant hue selective voxels in various hues. The results showed strong anisotropy in hue-selectivity population and individual differences. We have also tested that the hue selectivity in the intermediate hue is not a weighted sums of outputs from cone-opponent mechanisms by using a selective adaptation technique in fMRI. The result showed significant hue selectivity in V1-V4, which implies that the intermediate hue selectivity was not a spatial average of cone-opponent responses within the fMRI voxel. However, relations between these results and color perception, which is a subjective experience or appearance, is not shown. The unique hues are fundamental colors in color appearance, but are known to differ from hues that selectively stimulate cone opponent mechanisms. I would like to introduce the results of recent pilot study of comparing brain activity to unique hues.

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Neural computations underlying social decision-making

Dr. Hiroyuki Nakahara
RIKEN

July 19 (Wednesday), 2017
16:30-16:55
1F Seminar Room, BSI Central Building

I will present some of our works for developing a quantitative understanding of social decision-making, and here I highlight one study. A challenge in social cognition is elucidating how one decides with others, and what the underlying neural mechanisms are. In reinforcement learning, decisions are guided by an internal reward valuation process. These value-based neural signals comprise a self-oriented currency for decision-making. However, social signals also play a powerful role in shaping the value currency, suggesting a fundamental but poorly understood brain computation – the conversion of social into self reward values for decision-making. Using human behavior, modeling and fMRI, we will show that social value conversion requires a core neural circuit of three-stage computations for driving decision-making, and further their individual variability underlies different socio-behavioral phenotypes.

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Priors and heuristics in human visual perception

Dr. Justin L. Gardner
Stanford University

July 19 (Wednesday), 2017
16:55-17:20
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Human behavior from sensory perception to higher cognition, reasoning and language have all been productively modeled in Bayesian frameworks. Despite these successes of probabilistic modeling, it is not known how humans can compute the central computation in Bayesian inference; the multiplication of a prior and likelihood distributions to form a posterior. Certainly this computation is not done analytically or through typical computations that are used in computer programs that simulate statistical inference processes. We have documented a human behavior in a sensory estimation task which approximates Bayesian inference, not by multiplicatively integrating prior and likelihood, but switching between the two. This switching behavior suggest that humans can perform a simpler, more heuristic, operation that approximately achieves the computational goals of Bayesian inference while reducing the complexity of implementation of multiplying probability distributions.

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