【Grant-in-Aid for Scientific Research(S)】
Integrated Science and Innovative Science (Comprehensive fields)

Title of Project：Saliency detection by the "unconscious" visuo-motor system

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Research Area：Neuroscience

Keyword：awareness, superior colliculus, attention, saccade, blindsight

【Purpose and Background of the Research】

When the primary visual cortex (V1) is damaged, visual awareness in the affected visual field is impaired. However, it has been reported that some patients can localize the objects in the affected visual field either by reaching or saccadic eye movements when they are forced to do so. Such dissociation of visual awareness and ability of goal directed movements has been termed "blindsight" and attracted attention of wide variety of scientists, from clinician, physiologists to psychologists and philosophers. The midbrain structure superior colliculus (SC) has been supposed as the center of such "unconscious" visuo-motor system, however why and how the superior colliculus can detect salient visual stimuli is still elusive. In this project, we will clarify the neural mechanism of saliency detection in the unconscious visual system with behavioral neurophysiological experiments in a non-human primate model of blindsight and analysis of local circuit structure of the superior colliculus by using in-vitro slice preparations obtained either from the rodents or common marmosets.

【Research Methods】

①Saliency detection in a monkey model of blinsdsight---we have been studying the saccadic eye movements in macaque monkeys with unilateral lesion of the V1. In this project, we will combine the brain imaging with functional MRI and single unit recording and reversible pharmacological blockade to clarify the whole picture of the visual pathways for the visuo-motor processing after the V1 lesion. In addition to the SC, the pulvinar, the parietal cortex and frontal eye fields will be the primary targets of the study. We will also analyze the saliency detection under the free viewing condition based on the "saliency model" proposed by Itti and Koch (2000).

②Saliency detection mechanism in the local circuit of the superior colliculus---We have reported that in the horizontal slices of the superior colliculus which contains all the elements of the local structure for the spatial map that stimulation of a particular site induces typical center excitation and surround inhibition, which can be the basis for the winner-take-all type of saliency detection. We will study how the individual neurons in the local circuits, both excitatory and inhibitory neurons, behave to form the winner-take-all or vector summation activation field by applying Ca^{2+} imaging in the 2-photon laser microscopy and whole cell patch clamp recordings in *in vitro* slice preparation of the Sc obtained from the mouse and marmosets.

【Expected Research Achievements and Scientific Significance】

We may be able to clarify the whole picture of the saliency detection by the subconscious visual system, which might also be useful for designing the neuro-rehabilitational therapy for the patients with cortical blindness.

【Publications Relevant to the Project】

1. Weiskrantz L, Blindsight--a case study spanning 35 years and new developments. 2nd edition, Oxford Univ Press.
2. Yoshida M, Takaura K, Kato R, et al. (2008) Striate cortical lesions affect deliberate decision and control of saccade: implication for blindsight. *J Neurosci*, 28: 10517-10530.
3. Isa T, Hall WC (2009) Exploring the superior colliculus in vitro. *J Neurophysiol*, 102: 2581-2593 (review).
4. Isa T, Yoshida M. (2009) Saccade control after V1 lesion revisited. *Curr Opin Neurobiol,* 19: 608-614 (review).
5. Ikeda T, Yoshida M, Isa T. (2010) Functional differences between cortical and subcortical visual pathway in spatial attention: inhibition of return and attention capture. *J Cogn Neurosci, Online Early Access,*

【Term of Project】 FY2010-2014

【Budget Allocation】 160,000 Thousand Yen

【 Homepage Address and Other Contact Information】

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