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The role of the locus coeruleus-noradrenaline system in attention on visual change detection: a pupillometric study

Hijiri Kodama[1], Ken Kihara[1], Sakuichi Ohtsuka[1]

Abstract

Humans sometimes fail to notice obvious changes in objects in the field of view when the changes are unexpected. Failure to discern the change occurs because the object was not being attended to. This phenomenon is known as change blindness (Fig.1A). It is suggested that the activity of the locus coeruleus-noradrenaline (LC-NA) system is involved in regulating attention [1]. Therefore, in this study, we investigated the temporal dynamics of LC-NA system activity in attention during the periods before and after change detection.

We used a change detection task. Stimuli changes in 15 seconds. We repeatedly presented stimulus until participant could detect the change at a maximum of 10 attempts. Participants press the key as quickly as possible when they detect a change. This study uses measured pupil diameter during change detection task, because pupil changes directly reflect LC neuron activity [2]. We presented two types of stimuli, because we investigate influence on change detection by the context. Experiment 1 was change detection of natural scenes, and experiment 2 was change detection of geometric figures.

As a result, Pupil dilation was observed before the detection of the change (Fig.1B). We also found that the results of experiment 2 using geometric figures replicated those of experiment 1 using natural scenes.

These results suggest that the activity of the LC-NA system mediates attentional orientation to changing visual objects before awareness of the changes (Fig.1C). Firstly, pre attentive visual processing can find a changing area roughly by comparing past scene with present scene. Next, LC-NA system is activated, which enhances and orients attention to the location of the change. We then consciously detect the change. The activation of the LC-NA system for the change detection does not depend on types of the changing object.

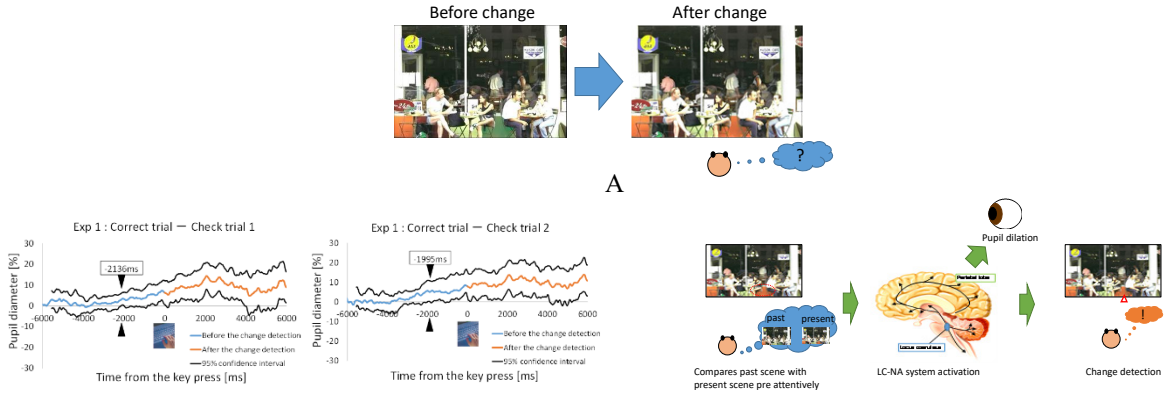

Figure.1 Figures used in the poster.

References

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2. Gary Aston-Janes, Jonathan D. Cohen, “An Integrative Theory of Locus Coeruleus-Norepinephrine Function: Adaptive Gain and Optimal Performance”, Annu. Rev. Neurosci., vol. 28, pp.403-450, 2005.

[1] Department of Science and Engineering, Kagoshima University, 890-0065, Kagoshima, Japan