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Research report

Hyperthymic temperament and brightness judgment in healthy subjects: Involvement of left inferior orbitofrontal cortex

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ABSTRACT

Background: Hyperthymic temperament has been generally accepted as one of premorbid temperament of bipolar disorders. Since recent several studies indicate an association between illuminance and hyperthymic temperament, it can be hypothesized that more hyperthymic temperament subjects have a different threshold of brightness or darkness perception in comparison with less hyperthymic temperament subjects.
Methods: We compared the threshold of brightness and darkness judgment between more and less hyperthymic subjects, and by simultaneously using fMRI we compared activations of whole brain between these subjects by two sample *t*-test. Furthermore, the association between the activations and hyperthymic temperament scores was analyzed.
Results: Although there was no significant difference in the threshold of brightness or darkness judgment between more and less hyperthymic subjects, there was a significant difference in activations of the regions including left superior temporal gyrus, left inferior orbitofrontal cortex, left triangular inferior frontal gyrus and left insula between these subjects. Moreover, there was a significantly positive association between a cluster containing left inferior orbitofrontal cortex and hyperthymic temperament scores. The common activated region of these two analyses (categorical and continuous ones) was determined as left inferior orbitofrontal cortex.
Limitations: Limitation of the present study is a lack of brightness and darkness preference experiment between more and less hyperthymic subjects.
Conclusions: The present findings suggest that the threshold of brightness and darkness judgment is not different between more and less hyperthymic subjects, and that hyperthymic temperament may be associated with left inferior orbitofrontal cortex, which has been reported to be associated with bipolar disorder.

1. Introduction

A century ago, Kraepelin proposed four distinct temperamental types (depressive, hyperthymic, cyclothymic and irritable) as Grundzutaende, and he conceptualized these temperaments as subclinical manifestations of major affective states. Thereafter, Akiskal formulated the modern concept of affective temperaments that there is a continuum between certain types of affective disorders and affective temperaments, and he described the classic four temperaments and newly added anxious temperament (Gonda et al., 2011). Particularly, Akiskal and Pinto (1999) emphasized hyperthymic and cyclothymic temperaments and described two types of bipolar spectrum which are not associated with manic or hypomanic state. These are bipolar II1/2 (depression in those who have cyclothymic temperament) and bipolar IV (depression in those who have hyperthymic temperament). Goto et al. (2011) investigated patients with bipolar II1/2 and/or IV and showed that these patients on lithium were likely to be in remission whereas those patients on selective serotonergic inhibitors were unlikely to be in remission, supporting the validity of these concepts.

Moreover, Hoaki et al. (2011) comprehensively investigated biological aspects of hyperthymic temperament and showed that higher illuminance of daytime, greater fluctuation in sleep time, and lower central serotonergic function significantly and independently

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predicted hyperthymic temperament scores. This positive association between hyperthymic temperament and illuminance can contain several possibilities. One possibility is that high illuminance may maintain and enhance hyperthymic temperament such as light therapy for depression. To support this possibility, Kohno et al. (2012) showed that healthy residents at higher latitude (43°, Sapporo city in Japan) with lower illuminance had lower hyperthymic temperament scores than another healthy residents at lower latitude (33°, Oita city in Japan) with more illuminance.

Another possibility is that more hyperthymic temperament subjects feel darker than less hyperthymic temperament subjects at the same brightness and darkness and thereby seek more illuminance. Therefore, it can be hypothesized that more hyperthymic subjects have a higher threshold of brightness and/or a lower threshold of darkness judgment than less hyperthymic temperament subjects. Moreover, it seems possible that some regions may be activated during these judgments and that this activation may be different between more hyperthymic subjects and less hyperthymic subjects, suggesting that the differently activated region may be associated with hyperthymic temperament. In the present study, these hypothesis and possibility was investigated by using functional MRI.

2. Methods

2.1. Subjects

Thirty-four (21 men, 27.0 ± 5.3 of a mean age with range 21–41 years) healthy subjects participated in this experiment. None of the subjects had any current or lifetime history of psychiatric disorders, which were determined by Mini-International Neuropsychiatric Interview. They gave written informed consent to participate in this study according to procedures approved by the ethical committee at Oita University Faculty of Medicine.

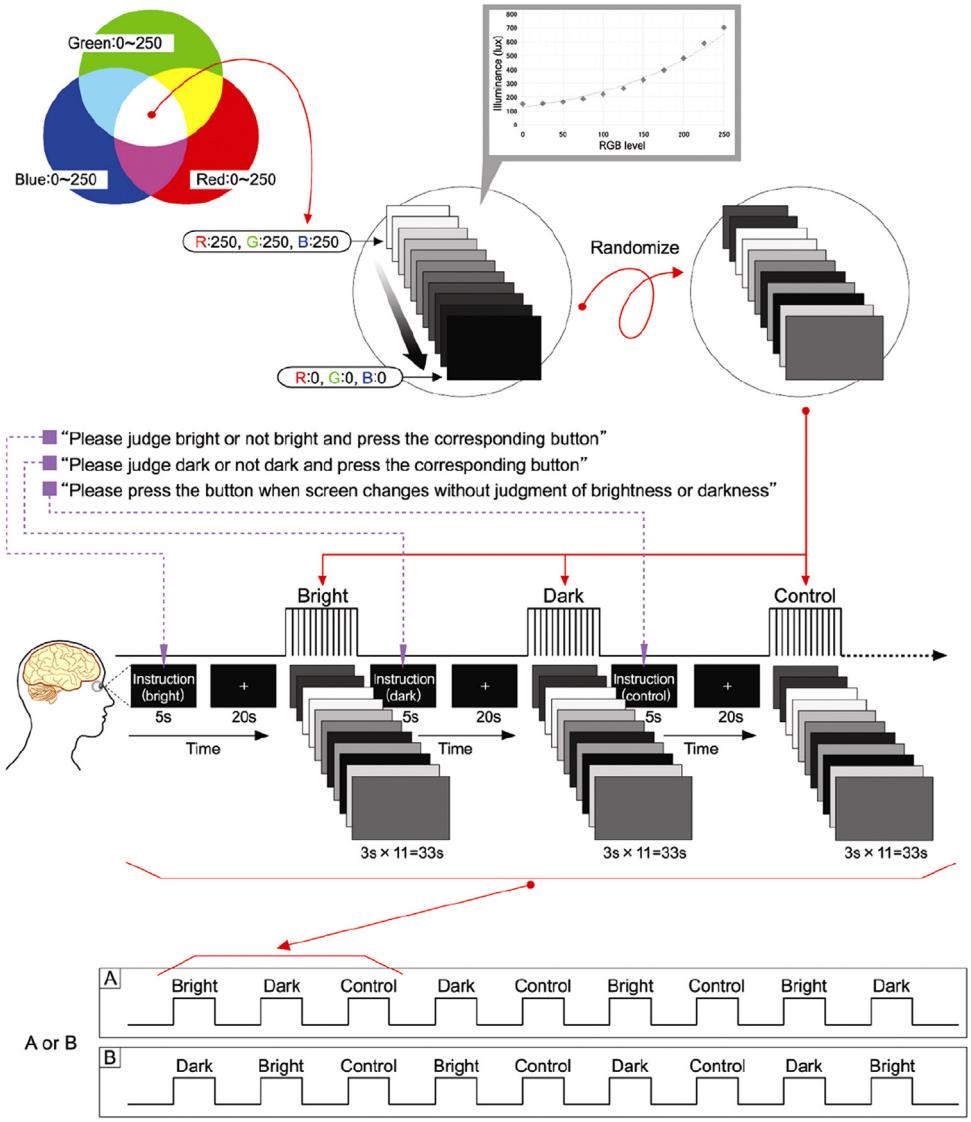

Fig. 1. Experiment protocol. All blocks consisted of a sequence of 11 blank screens adjusted by tristimulus value, each blank screen gradating from white to black by 25 tristimulus value. These kinds of blocks gradated blank screens were randomly arranged in each block. Three kinds of blocks were presented to the subjects in randomly allocated pattern of two balanced-order patterns which consisted of 9 blocks (A or B). Prior to each block, an instruction screen was presented for 5 s with fixation cross for 20 s. These visual stimuli were presented using Presentation (version 14.1) and projected via a forward projection system onto a translucent screen placed at the end of the magnet's gurney. Subjects viewed the screen through a mirror attached to the head coil. Prior to each block, an instruction screen was presented for 5 s with fixation cross for 20 s. Subjects were instructed as follows; "Please judge if the screen is bright or not bright by pressing the corresponding button" in brightness judgment, and; "Please judge if the screen is dark or not dark by pressing the corresponding button" in darkness judgment, and; "Please press the button when the screen changes without making a judgment of brightness or darkness" in control task.