Effect of flickering of led light on cognitive event-related potentials

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Purpose: It has been well established that light condition affected the brain function including cognitive processes. However, exact mechanisms of these effects have not been fully understood. Development of light-emitting diode (LED) allowed us to control light conditions in more detail. In this study, we examined the effects of LED light flicker on working memory by using event-related potential (ERP). Materials and Methods: Twenty-six healthy subjects participated in this study (mean age, 30.4 years; men 66.7%). Sixty-channel scalp EEG was recorded under two different conditions: control flicker (40%) light and flickerless (1%) light. Color temperature and brightness were set as 4,000 K and 500 lux in both conditions. Each light condition consisted of four blocks: 3 min in a dark condition (resting block), 4 min in one of the light condition (EEG block), 15min with working memory task (ERP block), and 3 min in a relaxed state (relaxation block). Data were epoched from 200ms prestimulus and 1,200ms poststimulus. We analyzed ERP component, time-frequency, functional connectivity data by using Matlab (MathWorks, USA). Results: Among ERP component, P2 component (from 160 ms to 200 ms) tended to increase in parietal and occipital areas under flickerless condition ($p = 0.038$ and 0.021, respectively). However, P3 component did not differ between two light conditions. Time-frequency analysis revealed no significant difference in all frequency bands. Regarding functional connectivity, flickerless light increased theta-band connectivity in both item 2 and 3 conditions ($F_{1,18} = 8.633$, $p = 0.009$). In addition, theta-band connectivity was significantly correlated with refreshing and comfort scores ($p = 0.012$ and 0.040, respectively). Conclusions: This ERP study demonstrated that flickerless light enhanced the theta-band functional connectivity during the working memory process compared to control flicker light.