修士論文要旨

睡眠前の青色光と赤色光が主観的睡眠感および睡眠構造に与える影響

Effects of Blue and Red Lights before Bedtime on Subjective Sleep Evaluations and Polygraphic Sleep Structures

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Introduction

Recently, an investigation has examined the relationship between bedroom color and the sleep and reported that sleeping in a blue bedroom is better for a good night’ s sleep than sleeping in a red bedroom (Travelodge, 2013). Supporting this conclusion, some studies have reported that red psychologically represents arousal, whereas blue produces a calming effect. However, on the chronobiolo-

gical side, blue light is not an ideal stimulus for high-quality sleep. Exposure to blue light during the biological night contributes to suppression of melatonin, phase delay of the melatonin rhythm, lower subjective sleepiness ratings et al. which are not beneficial to sleep (Wright & Lack, 2001). Therefore, the question still remains which is stronger between the psychological effect and the chronobiological effect of lights on sleep.

In present study, direct effects of nocturnal exposure to blue and red light before bedtime on both subjective sleep evaluations and polygraphic sleep structures were examined.

Preliminary study (omitted)

Experiment of main study

1. Subjects. 9 subjects (5 M & 4 F) (24.56±5.15 yrs).

2. Stimulus. Dim light condition: polychromatic LED (<10 lx). Blue light condition: blue LED (1500 lx). Red light condition: red LED (1500 lx).

3. Protocol. (Fig. 1)

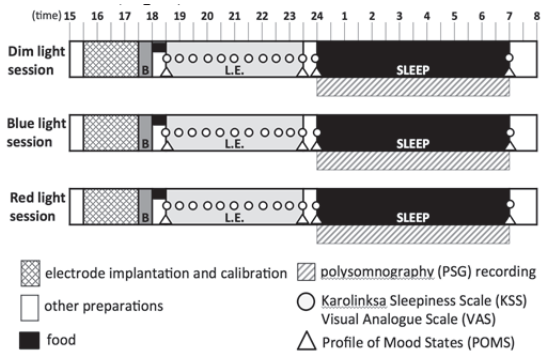

Fig. 1 Overview of the protocol design of 3-day experimental period.

4. Polysomngraphy (PSG) recording. EEG electrodes were placed on F3, C3, C4, O1 according to the International 10-20 system.

5. Results. a). *Questionnaires results.* No significant change of sleepiness caused by three light conditions was found in KSS result, VAS result or POMS result. However, subjective sleepiness, the eagerness level for lying down, the physical fatigue and the mental fatigue significantly increased causing by time passing. (p<.05). The impression of the blue room was significantly worse than dark room at 19:00, 19:30 and 21:30 (p<.05).

b). *PSG results.* No significant change was found in any sleep parameter after exposure to dim light, blue light or red light.

c). *Sleep cycle analysis results.* As for NREM and REM sleep, the percentage of NREM in the third NREM-REM cycle after blue light exposure was significantly larger than that under dim light condition (Fig. 2). Moreover, the percentage of REM in same cycle under blue light exposure was significantly smaller compared to that under dim light condition (Fig. 3). However, no significant change was found in the time length of each NREM-REM cycle, nor was Stage N1-N3.

Discussion and Conclusion

As for the psychological effects of blue and red light, subjective sleepiness, physical and mental fatigue increased significantly caused by time passing rather than different light conditions.

Considering the chronobiological effect, compared to dim light and red light, 5-hour exposure to blue light before bedtime reduced the duration of REM sleep during the third NREM-REM cycle, which was an unnatural alteration from normal sleep pattern. Conversely, increase the duration of NREM sleep in the same cycle. Although the reason why REM sleep pattern altered after blue light exposure is still unclear, it suggests that the blue light exposure affects distribution of NREM and REM sleep durations. Further studies are required to increase the experimental days and the population of subjects in order to apply the experimental conclusion to the daily life.

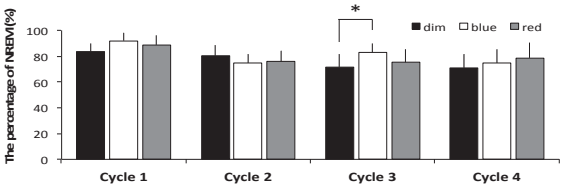

Fig. 2　The percentage of NREM sleep in each NREM-REM cycle.

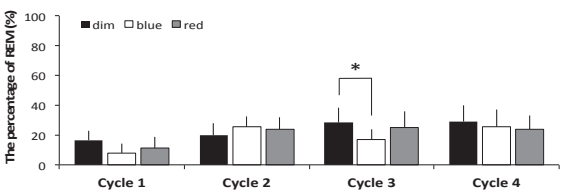

Fig. 3　The percentage of REM sleep in each NREM-REM cycle.