

Investigation of Optimal Illumination Color in Clinical Environment of Medicine

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ABSTRACT

We investigate the illumination condition in clinical environment of medicine that could rather boost the efficacy of medical care. Medical care measures a person with respect to the physical and mental performance in the first step that affects the entire process of medicine. Despite the performance is known to be affected by the environmental factors, research efforts are not enough for making it clear how to optimize the medical environment. We conducted an experiment where the subjects executed memory or calculation tasks under several illumination conditions that varied the illumination temperature and color to see how the performance was affected.

1. INTRODUCTION

Humans have nature for adopting to their environment and also keeping social balance with others by using all their senses, i.e., vision, auditory, olfactory, gustatory, and tactile. From a different point of view, the environment including other people that surround a person may change the way of affecting him or her so that he or she could extend the ability for doing tasks. Cheering at a sport event is one of the examples where the audience plays the role of surrounding environment of a sport player that could empower him or her by sending cheers. So is the case in the clinical environment of medicine.

Recent hospitals pay much attention to the environmental issues such as the color of clothes of medical staffs that to avoid threatening the clients by the scary stereotype of white clothes of medical doctors. The color of room wall, curtains, devices, the position of lights that avoid being too bright to the clients under them, to name a few. Although they appear much better than before, they almost base on the rule of thumb without any scientific evidence so far that is a problem[1]. This work aims at giving the evidence with regard to the illumination conditions in medical environment by experiments.

In this paper, we focus on the cognitive measurement that comes to the first place in medical process. The JIS illumination standard is the standard for illumination for a variety of tasks that gives how bright the illumination should be for each specific task. It, however, has no

standard for medical care[2]. We conducted an experiment where the subjects executed memory or calculation tasks under several illumination conditions that varied the illumination temperature and color to see how the performance was affected.

2. EXPERIMENTS

2.1 Memory task

Memorizing eight digits of numbers is commonly used for memory task[3] whose process is depicted in Fig.1. We change the illumination condition while the subject repeat the memory task by following the protocol shown in Table 1.

2.1.1 Illumination conditions

The subjects were set in front of a white screen with the size 2,400mm x 1,800mm in a room without window. The illumination was adjusted to 100 lx to be consistent with conventional research. Three illumination temperatures 2,700K, 3,500K, and 6,200K were switched between the sessions of memory task.

2.1.2 Evaluating the score of memory task

Together with counting the correct answers, we count the number and the timing of eye-blinking that is known to be an indicator of memory process in brain activity[4]. The correlative analysis between the score of memory task and the activity of eye-blinking was done.

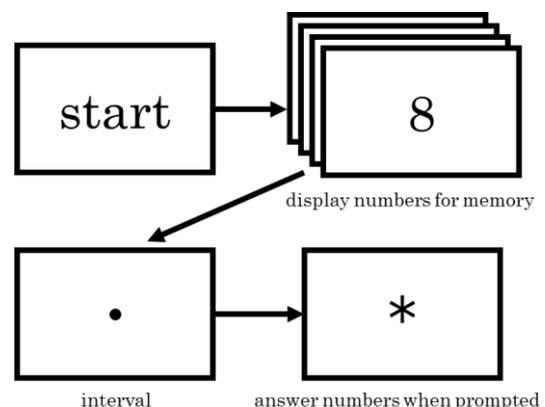


Fig. 1 Block diagram of memory task

Table 1 Protocol of the experiment on memory task.

time	description	To-do
0:00	enter room, agreement, and rest for 5 minutes	
0:05	memory task w/ color1	
0:05.1	interval for a second	
0:05.2	memorize numbers	8 numbers are displayed every second
0:05.10	interval for 3 seconds	
0:05.13	answer numbers	answer the displayed numbers in order every second
0:05.21	interval for 2 seconds	
repeat memory task 50 times		
0:24.31	rest for 5 minutes	
0:29.31	memory task w/ color2	
	rest	
	memory task w/ color3	
	rest	

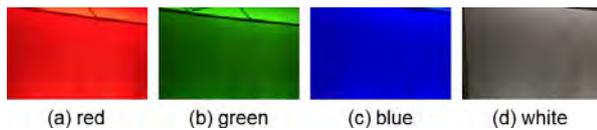


Fig. 2 Color conditions for calculation task.

2.2 Calculation task

The subjects calculate multiplication between two-digit numbers over and over while switching three different conditions of illumination. The protocol was similar to the memory task shown in Table 1.

2.2.1 Illumination conditions

The illumination was set as 100 lx with four colors of red, green, blue, and white (illumination temperature 3,500K) as shown in Fig.2. The order of the illumination conditions was randomized.

2.2.2 Subjective evaluation of calculation task

The subjects were asked to answer a questionnaire in terms of “sleepy”, “easy”, “focused”, “relieved”, “relaxed”, “comfortable”, and “bored” in five steps for rating.

2.2.3 Measuring biological metrics during the task

An electrocardiograph was measured during the calculation task using the myBeat sensor[5] which detected the heart-beat period as the parasympathetic activity excited for calculating the mental load of concentration[6].

3. CONCLUSION AND FUTURE WORK

We conducted two kinds of experiments that varied

illumination conditions while memory and calculation task where the task scores were analyzed with respect to the correlation with biological metrics of heart-beat rate and eye-blinking rate which both were known to be correlated with neural activities. The performance was also correlated with the subjective evaluation of those tasks using questionnaire.

Future work extends the results here that were obtained in the experimental setups to real clinical environments. One takes a communication task in the setting of clinical psychology, the other a preventive care for dementia in a regional private clinic.

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