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Psychophysiological Effects of Colored Light Used in Healing

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Abstract: Chromotherapy uses colored light for healing. The present study assessed the physiological effects of blue and red light in normal volunteers, as these colors were believed to have opposite physiological effects. Fifteen male volunteers (age range 17 to 29 years) were studied in two sessions each. Each session lasted for 40 min, with a test period of 30 min, preceded and followed by two 5-min periods without colored light. Throughout both sessions, subjects lay supine with eyes closed. The room was illuminated with ordinary light during the pre and post periods of both sessions. During the test period, blue light was used for one session, while red light was used for the other. The heart rate, skin resistance, finger plethysmogram amplitude, breath rate, blood pressure and electroencephalogram (EEG) were measured. There was a significant reduction in the breath rate during exposure to blue light and the diastolic blood pressure reduced immediately after exposure to blue light, compared to the preceding period (t-test for paired data). The results suggest that blue light reduces physiological arousal, supporting the claim that blue light can be used to induce physiological rest. Red light did not have a stimulating effect in this study.

Key words: Colored light・respiration・blood pressure・physiological rest

INTRODUCTION

Chromotherapy or color therapy uses color (usually in the form of colored light) to produce beneficial or healing effect [1]. It is well established that color may be used to help people feel physically and emotionally more comfortable in their surroundings [2]. There have been reports that the mean anxiety and stress scores were higher for subjects who remained in an office with red walls, whereas the mean depression score was higher for subjects who stayed in an office with blue walls [3]. It was also shown that following exposure to red color, there was a reduction in skin resistance [4], suggesting increased sympathetic activity. In contrast, blue or violet colored rooms were correlated with lowest and most stable blood pressure readings [3].

The reports cited above discussed the effects of colors when the subject was viewing them. In chromotherapy, colored lights are used while the subjects' eyes are closed [5]. Light transmission through the eyelids has been estimated with a visual threshold response and was found to vary according to the wavelength [6]. Estimated light transmission was different for different colors, viz., 0.3% for blue, 0.3% for green and 5.6% for red light. The present study was designed to assess the physiological effects of exposure to colored light when the subjects' eyes were closed, as used in chromotherapy. Blue and red light were specifically selected, as they are believed to have opposite physiological effects. Based on this assumption blue light is used to manage insomnia, while red light is used for depression [1].

MATERIALS AND METHODS

Subjects: Fifteen healthy male volunteers between 17.0 and 29.0 years of age (group average age±SD., 23.8±2.8 years) participated in the study.

Design of the study: Recordings were done on consecutive days. The total period of assessment was 40 min, with a 30-min test period preceded and followed by two 5-min periods. During these two 5-min periods the room was illuminated with white light. For both days of assessment the two 5-min periods were the same, while the test periods were different. For randomization, subjects' names were drawn out in the form of a lottery, to assign the subjects to two groups. The first group of subjects was exposed to blue light during the test period of Day 1 (BL session) and red light during the test period of Day 2 (RD session). For the subjects of the second group the order of the BL and RD sessions was reversed.

Recording conditions: Recordings were done in a sound attenuated cabin (4.0 m x 2.5 m x 3.2 m). Subjects were asked to lie with eyes closed, on a bed which was illuminated by red or blue light using four incandescent, focusing, color bulbs

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of 40 W each, at a fixed distance of 1.4 m from the subject. During the control periods a single, 60 W, incandescent, white bulb, illuminated the room.

Assessments: The electrocardiogram (EKG), respiratory rate, finger plethysmogram, skin resistance and electroencephalogram (EEG) were recorded using a 10-channel polygraph (Polyrite, Recorders and Medicare, Chandigarh, India). The EKG was recorded using standard limb lead I configuration and an AC bio-amplifier with 1.5 Hz high pass and 75 Hz low pass filter settings. Respiratory rate was monitored with a thermistor worn as a clip at the nostril. To assess the digit pulse volume (DPV), a photoplethysmogram was placed on the left thumb at the junction of the nail and the skin. Skin resistance was recorded using Ag/AgCl disc electrodes attached to the volar surfaces of the distal phalanges of the right index and middle fingers. Electrode gel (Medicon, Chennai, India) was used and a constant current of 10 microamperes was passed between the electrodes. The signal was processed through a DC preamplifier. The EEG was recorded with Ag/AgCl disk electrodes placed at O1 and O2 positions, according to the standard 10-20 system for electrode placement [7], as a bipolar recording. The blood pressure (BP) was recorded at the beginning and end of the test periods using a standard mercury sphygmomanometer, auscultating over the right brachial artery. The diastolic pressure was noted as the reading at which the Korotkoff sounds appeared muffled.

Data extraction and analysis: The heart rate in beats per minute was obtained by continuously counting the QRS complexes in successive 60-second periods. The rate of respiration was similarly calculated by counting the number of respiratory waves also in successive 60-second epochs continuously and noting the respiratory rate as cycles per minute. The skin resistance trace was sampled every 20 seconds. The amplitude of the digit pulse volume was sampled from the peak of the pulse wave at 20-second intervals [8]. The EEG record was visually assessed to detect sleep episodes.

For both the blue and red light sessions, the data of the test and the post periods were compared with those of the respective preceding periods using the t-test for paired data.

RESULTS

There was a significant reduction in the breath rate during the test period of the BL session, compared to the preceding white light period ($p<0.001$). The diastolic blood pressure value was significantly lower immediately after exposure to blue light ($p<0.001$). The digit pulse volume was significantly reduced in the post period of the BL session ($p<0.001$) and also in the post period of the RD session ($p<0.001$). Visual assessment of the EEG did not show any differences between the BL and RD sessions. Also, there were no sleep episodes during any of the sessions. The group mean values±SD are provided in Table 1.

Table 1: Heart rate in beats per minute (bpm), breath rate in cycles per minute (cpm), Skin resistance (SR, kiloOhms), digit pulse volume (DPV, cm), systolic and diastolic BP (mmHg). Values are group mean±SD

Sessions	Heart rate (bpm)	Breath rate (cpm)	SR (kiloOhms)	DPV (cm)	Systolic BP (mmHg)	Diastolic BP (mmHg)
Blue light						
Before	72.4	19.8	141.0	1.05	111.8	71.3
	±6.8	±2.5	±90.5	±0.5	±8.4	±6.3
During	71.0	18.4**	146.2	1.14	#	#
	±5.6	±2.1	±84.8	±0.45	#	#
After	72.6	18.9	122.1	0.59**	109.5	68.1**
	±6.7	±2.6	±62.8	±0.4	±6.6	±4.3
Red light						
Before	72.4	19.3	132.5	1.06	111.3	70.3
	±6.9	±2.3	±64.8	±0.52	±9.2	±7.0
During	71.1	19.1	139.8	1.15	#	#
	±7.1	±2.9	±72.9	±0.62	#	#
After	71.6	19.0	132.8	0.66**	112.9	71.9
	±7.9	±2.7	±66.8	±0.51	±8.6	±7.8

**p<0.001 t-test for paired data, comparison with pre: # data not taken

DISCUSSION

In the present study there was a significant decrease in the rate of respiration when subjects were exposed to blue light and it remained lower in the subsequent period. The diastolic blood pressure was also significantly lower immediately after exposure to blue light. There were no changes during the exposure to red light. There was a significant decrease in the digit pulse volume in the control period after exposure to both blue and red light.

In chromotherapyz blue light is used in the management of insomnia, as it is believed to reduce physiological arousal [1]. The present results (decreased breath rate and diastolic blood pressure) support this idea. The results also show similar trends to those reported in previous studies which described the effects of blue color when the subject was looking at it (i.e., increased skin resistance, reduced BP). Hence though it was shown that the estimated light transmission through the eyelids is greater for red (5.6%) than for blue light (0.3%), significant effects were seen following eyes closed exposure to blue light in the present study [6].

The digit pulse volume reflects blood flow through the skin. A reduction in digit pulse volume suggests narrowing of cutaneous blood vessels. Reduced skin blood flow was shown to occur when subjects were alert, as while solving arithmetic problems mentally [9] and also in response to alerting stimuli [10]. The change that occurred during the control periods after exposure to both blue and red light, suggested that the subjects were more alert during the post periods of both sessions compared to the respective baseline. The decrease in the digit pulse volume suggests peripheral vasoconstriction and hence an increase in peripheral vascular resistance. It is known that increases in peripheral resistance increase the diastolic blood pressure [11]. However these results are not contradictory to the decrease in the diastolic blood pressure immediately after exposure to blue light, as the changes in digit pulse volume occurred in the control period while being exposed to white light.

In summary, the results suggest that blue light reduces physiological arousal, whereas red light does not have this effect. While the exact mechanism by which color can influence physiological functions is not known, it is thought that following cortical interpretation of the stimulus, the affective response determines the autonomic change [12]. The results support the claim that blue light can be used to induce physiological rest, but they do not support the idea that red light has a stimulating effect.

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