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Paper Title: Investigating the Effects of Color Light on Brain Activity Using NIRS:
Implications for Emotion Regulation and Cognitive Function

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Abstract

Light contains different wavelengths of the spectrum that are detected and received by photoreceptor cells (rod and cone cells) in the retina. However, light serves non-visual functions in human perception, such as emotion regulation, cognitive performance, sleep cycle, and hormone production. These functions increase brain activity and oxygen consumption in the brain. Our objective was to investigate the effect of light on brain activity using NIRS. Ten subjects (8 males, 2 females) with normal color vision were exposed to achromatic light (white and gray) or chromatic light (blue, green, yellow, and red) for 20 seconds in random order, followed by 30 seconds of rest (dim light). This stimulation-rest cycle was repeated 4 times (total time = 20.30 minutes). NIRS was used to measure Oxy-Hb, Deoxy-Hb, and Total-Hb levels in the frontal lobe of the brain during stimulation. After light stimulation, participants were assessed using the BRUMS and a color effectiveness test. The results indicated that the z-score of Oxy-Hb significantly increased in response to gray light compared to white light. Red and blue light led to a greater increase in Oxy-Hb than green and yellow light. However, there was no significant increase in Deoxy-Hb during both achromatic and chromatic light exposure. Gray light induced feelings of depression and confusion, while red light affected tension and anger. Red and green light promoted feelings of vigor. Fatigue did not show a significant difference between achromatic and chromatic light. Additionally, long wavelengths had a more positive effect compared to short wavelengths. These findings suggest potential applications in neuro-therapeutic interventions to activate brain activity in cases of cognitive impairment, or in the architectural design of lighting for buildings and interiors to influence emotion regulation.
