Violet and blue light exposures elicit a broad range of CNS fMRI responses

G. Vandewalle[1], C. Schmidt[1], G. Albouy[1], V. Sterpenich[1], A. Darsaud[1], G. Rauchs[1], P-Y. Berken[2], E. Balteau[1], P. Maquet[1], D-J. Dijk[3].

1. Cyclotron Research Centre, University of Liège, Belgium; 2. Hololab, Department of Physics, University of Liège, Belgium. 3. Surrey Sleep Research Centre, University of Surrey, Guildford, UK.

Light elicits a wide range physiological and behavioral non-visual responses, such as acute effects on attention and arousal, and long term regulation of sleep/wake cycles. Responses are thought to be mediated by the recently discovered melanopsin-dependent and the classical photoreception system. However, the relative contribution of both photoreception systems, the brain mechanisms involved in these responses and their dynamics remain largely unknown.

In an fMRI protocol, we exposed 15 participants to short (50s) daytime light exposures of violet, blue and green monochromatic light (430-472-527nm) of equal photon flux (10^{13}photons/cm^2/s) while they were performing a cognitive task (2-back). Data were analyzed with SPM5. The analyses revealed that the hippocampus, amygdala, pulvinar and LGN mediate early responses to light, and are most sensitive to shorter wavelengths (violet and blue). Cortical areas, such as the intraparietal sulcus and insula, were initially very sensitive to green light but a shift to shorter wavelengths occurred over time. These effects were independent of the cognitive process involved because they were observed at light onset and during both task and rest periods. Our analyses also demonstrate that brain responses to light are influenced by the illumination context such that responses to an exposure of a given wavelength depend on the wavelength of the exposures previously received.

We conclude that very short light exposures induce dramatic changes in brain activity through a photoreception system that primarily recruits photoreceptors sensitive to violet and blue light such as S-cone and melanopsin ganglion cells.

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