Potential non-visual impact of light in the hypothalamus revealed with Ultra High Field (7-Tesla) fMRI

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In addition to vision, light can have many non-visual effects which are mainly mediated through intrinsically photosensitive Retinal Ganglion Cells (ipRGCs), recently-discovered retinal photoreceptors. IpRGC signal stimulates alertness, cognition and attention and regulates sleep and circadian rhythmicity. The hypothalamus and particularly, the suprachiasmatic nucleus (SCN), which is the site of the main circadian clock, is one of the key projection targets of ipRGCs. Up to now, the resolution of 3-Tesla MRI was insufficient to observe in detail this subcortical part of the brain, which receives the first non-visual light information from the retina. Here, we investigated the potential of ultra-high-field (UHF) (7-Tesla) MRI to provide high resolution insight on the subcortical mechanisms that regulate the non-visual impact of light, including at the level of the hypothalamus.

We recorded 15 healthy young participants (22-30y; 10 women) with 7T functional MRI while there were asked to perform an auditory working memory task (N-back) under different light conditions including blue-enriched light (100.200 and 400 microWatt/cm^2; recruiting ipRGCs) and monochromatic orange light (10^{13} photons/cm/s; as control light, close to undetected by ipRGCs).

Preliminary results reveal a statistically significant (uncorrected $p<.001$) increase in executive brain response (difference between 2-back and 0-back tasks) during blue-enriched light compared to orange light in small anterior and suprachiasmatic part of the hypothalamus compatible with the SCN. Response estimates confirm that this significant change is due to the higher response during the blue-enriched-light condition.

To our knowledge, this is the first UHF 7T MRI study that suggests that a few seconds of blue-enriched light exposure (30-45 seconds) can induce significant changes in subcortical areas involved in non-visual effects such as SCN. These preliminary results show the potential of 7-Tesla MRI in better understanding the involvement of small subcortical regions in non-visual effects of light.

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