Aging affects the impact of light on non-visual cognitive brain functions

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Introduction: Age-related change in non-visual cerebral light sensitivity may underlie modifications in sleep-wake cycle and circadian rhythms. Here, we investigated the acute impact of blue light exposure on non-visual cognitive brain activity as a function of age.

Methods: 16 young (22.8 ± 4 y.o.) and 14 older (60.9 ± 4.5 y.o.) individuals were alternatively maintained in complete darkness or exposed to short (45s) monochromatic blue (480nm) illuminations of three irradiance levels while performing an auditory working memory task in fMRI. Blue light irradiance levels were $7x10^{12}$, $3x10^{13}$ and 10^{14} photons/cm^2/s and pupil constriction was not inhibited. Data acquisition took place 1h after habitual sleep time. Data were normalized using state of the art techniques (Dartel in SPM8) to take into account morphological changes with age.

Results: Performance to the task was equally high in both age groups (>87%), was not significantly difference between light conditions, and showed no significant age x light intensity interaction ($p>0.05$), preventing behavioural bias of fMRI results. fMRI analyses revealed that, taking into account age-related differences in brain activity independent of the light condition, increasing irradiance enhanced brain responses to the task more

strongly in younger than older individuals (p corrected<0.05). These age-related differences in the impact of light irradiance on brain responses to the task were found in the thalamus, prefrontal cortex, hippocampus, and cerebellum.

Conclusion: These results show that the stimulating effect of blue light on non-visual cognitive brain function decreases with age in regions important for cognition (prefrontal cortex, hippocampus, thalamus) and alertness regulation (thalamus). Future research will determine if this decrease reflects age-related changes at the level of the brain, of the eye, or both.

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