The effect of controlled photopigments excitations on pupil aperture

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Several studies have shown that the pupil aperture responds to the spectrum of light. The underlying mechanism is subject to discussion. Five photopigments are present in the retina: L-cone, M-cone, S-cone and rod pigments, and the melanopsin recently identified in the body and dendrites of a few ganglion cells. The intrinsically photosensitive retinal ganglion cells (ipRGCs) are good candidates for controlling the tonic pupil aperture but their spectral sensitivity is close to rods and S-cones which are other candidates. Our study aims at identifying the stimulus for the pupil response when the luminance is maintained and the spectrum of light changes.
A light booth was equipped with five types of coloured light emitting diodes (LEDs): Blue, Cyan, Green, Orange and Red. The intensity of each LED type could be adjusted to control the light spectrum. Pairs of illuminations were prepared ensuring the exclusive change of excitation of one receptor type and silent substitution for others. Because the range of the possible controlled changes of excitation was narrow, we also prepared pairs of illuminations ensuring silent substitution for luminance rather than for L-cones and M-cones independently. Photographs of the observer's eyes were taken following one minute of adaptation to each illumination. The observer could view freely the illuminated field of view (150 degrees) until he was instructed to fixate a single target letter just above the camera when the photograph was taken. The pupil diameter and the iris diameter were measured on the digital pictures.
Preliminary results show that, at constant luminance, a change of pupil size is obtained with isolated melanopsin excitation, isolated S-cone excitation or isolated rod excitation but a clear pattern has not emerged yet.