Spectral properties of Melanopsin

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All mammals including humans were previously thought to only possess outer retina rod and cone photoreceptors that have evolved from an ancestral “ciliary” photoreceptor cell. In addition to rods and cones, a third class of photoreceptive cells expressing the photopigment melanopsin has recently been described in the inner retinal mammalian ganglion cells. Melanopsin shows amino acid sequence homology and signal transduction mechanisms similar to the “rhabdomeric” photoreceptors found in invertebrates such as the fly. In line with this hypothesis, melanopsin has recently been shown to display in vitro bistable properties in which light drives both the photosensory response and photopigment regeneration, enabling a sustained response to light and resistance to bleaching. Using a strategy of spectral stimulations originally designed to demonstrate bistability in invertebrate photopigments, we show that previous light exposure can alter subsequent responses to light and that the obtained response functions are typical of invertebrate rather than vertebrate photopigments. This bistable properties, first demonstrated in different physiological and behavioral assays in the mouse, also translate to human melanopsin dependant pupillary responses to light. Modelling these responses to invertebrate photopigment templates suggests that the human retina utilises fly-like mechanisms in the regulation of melanopsin dependent non-visual responses to light.