Unraveling new functions of an ancient vertebrate deep brain photoreceptor

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Evidence has accumulated for several light-sensitive structures outside the eyes which influence behaviour through non-image-forming photoreception. Extra-retinal photoreception has been best characterized in non-mammalian vertebrates and occurs at several sites, including the pineal complex and by so-called “deep brain” photoreceptors. Recently we were able to identify specific cholinergic inter- and motorneurons located in delineated brain domains of adult medaka fish which were proven to be light-sensitive, possible due to the expression of two groups of non-visual photoreceptors, VAL- and TMT-opsins (Fischer et al., 2013). We speculate that environmental light can modulate the information processing in the vertebrate brain by changing the physiological characteristics of opsin-expressing neurons, and thus shaping relevant perceptual behaviour outputs. Using the highly efficient transcription activator-like effector nucleases (TALENs) method for targeted genome editing, we successfully generated homozygous mutant lines for *tmt1b*. When assessed in an ethological prey/predator size discrimination assay, these fish revealed significant differences ($p<0.05$) in their stimulus-driven responses when compared with wild-type siblings. Interesting, by changing ambient light intensity, it was possible to manipulate the perceptual ability of the tmt1b-mutants, which suggests a light-mediated change of the intrinsic valences of relevant stimuli to the animal. To understand the different behaviour responses seen in the perception-mediated assay, a quantitative mRNA sequence transcriptome was made, comparing different anatomical parts of the adult medaka brain among age-matched wild-type and *tmt1b* homozygous siblings. With this strategy, we obtained a limited but strong set of candidate genes, e.g. neurohormones, that might explain how a light cue can mechanistically shape vertebrate behaviour.