Stimulus Design for Experiments Concerned with Maximising Receptor Ratios

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The aim of this work was to explore a novel method for metameric light source design, for use in experiments studying the function of melanopsin, using a chromaticity based approach to find the optimal wavelengths of narrowband LEDs from which to compose a pair of metameric light sources. This method is an alternative to methods utilising the theory of metameric blacks, which are well suited to experimental design where there are pre-existing multi-channel stimulus generators for which optimum values are required. This method instead starts at a ‘blank slate’ state, and considers the optimum wavelengths with which to create a source with specific characteristics.

A metameric pair can have drastically differing melanopsin contributions, and thus can be used to study the effect of melanopsin, by substituting one of the pair with the other and noting any difference in effect (see the ‘silent substitution’ method). It is desirable that the differentiation in melanopsin contribution be maximised.

A simple metameric pair can be created using four spectrally distinct narrowband LEDs where two contribute exclusively to each light source of the metameric pair. The minimum requirement for metamerism in this case is that; when considered in a chromaticity space, the line connecting the chromaticities of the two LEDs contributing to the first light source must cross the line connecting the chromaticities of the two contributing to the second. The point at which these two lines cross should be the chromaticity of the metameric pair.

A matlab tool was developed which predicts the melanopsin contributions, and ratios of contributions of realisable metameric pairs. One such metameric pair, using close to optimal wavelengths, was manufactured as a proof of concept and for use in further experiments.

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