Dark-adapted L/M-cone-specific Visual Function Measured with a Commercial Perimeter

ARVO 2025 - Abstract Number: 2433 - B0120

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Purpose
In inherited retinal degenerations (IRDs) preferentially affecting L/M-cones, like blue cone monochromacy (BCM) or achromatopsia (ACHM), standard perimetric stimuli are seen by photoreceptors that are not L/M-cones. We investigated chromatic stimulus and background parameters to define a perimetric outcome measure estimating L/M-cone-specific sensitivity which is effectively dark-adapted (DA).

Methods
Thresholds to 440, 500, 600, and 650 nm were measured DA, or on increasing blue (455 nm) adapting backgrounds from -3.5 log phot-cd.m^{-2} (-1.4 log scot-cd.m^{-2}) to 2.0 log phot-cd.m^{-2} with a commercial perimeter (MonCvONE, Metrovision, Perenchies, France) in dilated eyes at extramacular locations. Chromatic data are presented in the native photopically-matched dB values except for adjustments to radiometric differences used to fit spectral luminosity functions.

Results
Chromatic thresholds elevated with increasing backgrounds (Fig.A). DA thresholds were mediated by rods (Fig.B). Light-adapted thresholds were mediated by rods and/or cones. 500 nm thresholds were well fit (Fig.C) by the rod threshold-versus-intensity (tvi) paradigm including saturation (PMID 23035049) up to -1.5 log phot-cd.m^{-2}, but deviated at higher backgrounds. Light-adapted 650 nm thresholds were well fit with the cone tvi; a 2 log wide plateau suggested L/M-cone function to be effectively DA. Near the end of the plateau region at -2.0 log phot-cd.m^{-2} (1.25 log scot-Td), the instrumental dynamic range was 34 dB and the physiological dynamic range before potential intrusion by normal rods was 23 dB.

Conclusions
DA L/M-cone-specific function with a dynamic range >23 can be estimated using 650 nm stimulus on a dim blue background in a turnkey commercial perimeter. This potential

outcome measure is especially relevant for gene therapies in BCM and ACHM where the aim is to improve long-wavelength sensitivity.

Layman Abstract (optional): Provide a 50-200 word description of your work that non-scientists can understand. Describe the big picture and the implications of your findings, not the study itself and the associated details.