ABSTRACT TITLE

TITLE: Peripheral photoreceptor activity during accommodation and emmetropization

PROGRAM # (Final ID)

ABSTRACT FINAL ID: 2332 - B0291

SESSION TYPE: Poster Session

POSTER BOARD # (DOI)

DIGITAL OBJECT IDENTIFIER (DOI): B0291

PRESENTATION START/END

SESSION ABSTRACT START TIME: 2:45 PM

SESSION ABSTRACT END TIME: 4:30 PM

SESSION # (Abbreviation)

SESSION ABBREVIATION: 288

SESSION TITLE: Refractive Errors, Myopia I

SESSION DAY & DATE: Monday, May 6, 2013

SESSION START TIME: 2:45 PM

SESSION END TIME: 4:30 PM

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Study Group:

ABSTRACT BODY:
Purpose: Myopia results when the eye grows too long for its optics. The importance of the peripheral retina in emmetropization has recently been appreciated and our group has argued that the relative activity of cone photoreceptors contributes as well. However, there has not been a systematic analysis of how peripheral photoreceptor activity might be stimulated by natural images during near accommodation over the period of life which emmetropization occurs. The present work uses mathematical modeling to develop a theoretical framework of emmetropization based on the observation that the peripheral retina is often exposed to distant scenes when the fovea is accommodated to near objects.

Methods: The OSLO ray tracing software (Lambda Research) was used to derive modulation transfer functions of a schematic eye (Escudero-Sanz & Navarro 1999 J. Opt. Soc. Am. A. 16:1881-91) for several eccentricities and accommodation states. The amplitude spectrum of calibrated natural images (Tkačik et al. 2011 PLoS One 6:e20409) were computed with a fast Fourier transform and fit with a 1 / f power law. The activity of photoreceptors was modeled as a difference of Gaussians. Finally, the transfer functions, amplitude spectrum and photoreceptor model were combined to obtain the response from the peripheral cone photoreceptor mosaic to the average natural scene.

Results: Accommodation to near objects results in a significant loss of medium and high spatial frequencies for images of distant objects in the peripheral retina relative to the fovea reducing the relative activity of photoreceptors there. This loss of frequency content is partially ameliorated by accommodative lag that has been observed in young children but decreases during emmetropization.

Conclusions: Considering the statistical environment and the optical transfer functions characteristic of common accommodation states we compute that the amount of information the peripheral retina receives about the visual environment during near accommodation to small centrally fixated targets changes systematically during emmetropization. This change may regulate the signals that control eye growth. The reason near work contributes to myopia may be because the spatial frequency content of the images produced in the periphery during such activity simulates the normal signals produced by natural scenes in peripheral retina of a young hyperopic eye.

(No Image Selected)

Commercial Relationship(s) Disclosure:

Brian Schmidt: Commercial Relationship: Code N (No Commercial Relationship)

Maureen Neitz: Commercial Relationship(s);Genzyme:Code F (Financial Support);Alcon:Code F (Financial Support);Alcon:Code P (Patent)

Jay Neitz: Commercial Relationship(s);Alcon :Code F (Financial Support);Alcon:Code P (Patent)

Grant Support: No

Support Detail: None

Clinical Trial Registration: No

Other Registry Site:

Registration Number: