Glenn A. Fry Award Lecture 2012

Plasticity of the visual system following central vision loss

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Abstract:
Following the onset of macular disorders that lead to central vision loss, patients often adopt a retinal region outside the macular lesion as their "new fovea", or, the *preferred retinal locus* (PRL). The development of the PRL in itself is evidence that the visual system retains certain degree of plasticity and is capable of adapting to the vision loss even late in life. In this talk, I will present empirical results that show how eye-movement behavior and certain spatial properties adapt to the central vision loss, as evidence of plasticity of the visual system following central vision loss late in life. An important clinical implication of the plasticity of the visual system is that it may be feasible to improve visual functions of patients with central vision loss through perceptual learning.

Brief Outline:

1. The development of the preferred retinal locus (PRL) as evidence of plasticity of the visual system following central vision loss.

2. Oculomotor adaptation as evidence of plasticity of the visual system following central vision loss.

3. Acuity measured at the PRL using retinal imaging technique: how it compares to the normal periphery? Evidence of plasticity of the visual system following central vision loss?

4. Shape and size of the spatial interaction zone at the PRL: how it compares to the normal periphery? Evidence of plasticity of the visual system following central vision loss?

5. Shape and size of the spatial interaction zone at a "peripheral" location with respect to the PRL: Evidence of plasticity of the visual system following central vision loss?

6. Clinical implication of plasticity of the visual system: Perceptual learning as a method to improve visual function for patients.

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Presentation outline for Prentice lecture (30 minutes):

Title:

Purpose: To describe how modern efforts to define and measure refractive state of aberrated eyes, lenses, and refractive surgery outcomes have led to new insights about the nature of refractive error, the role of the eye's pupil, and new treatment strategies for refractive correction.

Outline:

1. Prentice's Rule for aberrated eyes and lenses
    a. review the derivation of Prentice's rule for a uniform-power lens
    b. repeat the exercise for a lens with spherical aberration
    c. implications for spectacle correction of spherical aberration
    d. Zernike pyramid as a graphical tool for summarizing Prentice's rule
    e. generalized Prentice Rule for arbitrary wavefront aberrations

2. Modern conceptions of refractive error and refractive state for aberrated eyes
    a. paraxial (Seidel) approximation
        - advantages & disadvantages
    b. spherical (Zernike) approximation
        - advantages & disadvantages
    c. optimum target vergence for maximizing retinal image quality
        - advantages & disadvantages

3. Clinical applications of wavefront methodologies
    a. refraction (wavefront measurement of refractive error)
    b. accommodation (wavefront measurement of refractive state)
    c. treatment to correct, or exploit, higher-order aberrations
    d. myopia progression