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TEMPORAL DEPENDENCE OF NEURAL COMPENSATION FOR THE EYE'S ABERRATIONS

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Abstract

Purpose: We have recently found that the neural visual system is adapted to the eye's particular monochromatic aberrations *(Artal et al., ARVO 2003).* We performed additional experiments using adaptive optics to further explore the temporal dependence of this adaptation process.

Methods: We used an adaptive optics system to induce wave–aberrations, and therefore point spread functions (PSFs), that were either the usual wave–aberration or a rotated version by an angle of 45 degrees. In every subject the magnitude of the rotated aberrations was kept similar to the normal one. Accommodation was paralysed and an artificial pupil of 6 mm was used during the measurements. We measured visual acuity (VA) in three normal subjects for letters in white light when subjects view the stimulus through the adaptive optics system with their own aberrations or with the rotated version of their aberrations. Visual acuity was measured after periods of continuous adaptation to the rotated version of the aberrations.

Results: The average high contrast VA, expressed as the minimum angle of resolution (MAR) in minutes or arc, in the three subjects for their normal aberrations was 1.0. However, with the ocular aberrations rotated 45 degrees, VA increased to 1.55, indicating a quite significant reduction in visual acuity of a factor of 1.5. After 15 minutes of continuous viewing through the rotated aberrations, VA improved to an average value of 1.16. This represents a recovery of nearly 70% of the normal acuity level when the eye adapts. Longer temporal periods of 25 minutes were also considered in one subject, showing a slightly

higher recovery of acuity. A similar result was obtained measuring low contrast VA and blur matching in both monochromatic and polychromatic light.

Conclusions: These results further support the hypothesis that the neural visual system compensates to the eye's particular aberrations. Visual acuity is significantly reduced when measured with a rotated aberration pattern. We also found that this adaptation is partially reversed in a relatively short time of 15 minutes. These results may have important implications for understanding the impact of aberrations on vision, and could play a role in improving clinical refractive procedures.

Keywords: adaptation: blur • visual acuity • optical properties