Processing Motion Information via the Non-Fixating Eye in Monkeys with Strabismus

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Patients with strabismus perceptually suppress information from one of their eyes to avoid double vision. However not all parts of the visual field of the deviated eye are suppressed as evidenced by fixation-switch behavior in strabismus. The purpose of this study was to investigate if motion information supplied only to specific regions of the visual field of the deviated eye can lead to oculomotor responses.

Binocular eye movements were recorded in two exotropic monkeys (S1: OD - ~30°, OS - ~15°; S2: OD - ~20°, OS - ~30°) in a dichoptic viewing task. A fixation spot was shown at the center of the screen to one eye and a patch with a square wave drifting grating (patch size - 10° X 10°; grating velocity – right or left 10°/s; grating spatial frequency - 0.5 cycles/°) was presented to the fellow (deviated) eye at various locations on the screen with respect to the fovea of the deviated eye. The magnitude of optokinetic nystagmus (OKN) elicited by grating motion was analyzed. OKN responses for rightward and leftward grating motion were subtracted from each other for one of the monkeys to eliminate influence of underlying horizontal nystagmus.

In both monkeys, OKN responses were elicited when the patch was presented in the nasal retina of the deviated eye. The highest OKN responses were obtained when the drifting grating was shown within a region that included the fovea of the deviated eye. Magnitude of the response was larger when the grating is presented to the preferred eye while central fixation was shown to the non-preferred eye. We were convinced that fixation was not switched to the eye presented with the grating because the strabismus angle stayed constant during the presentation. Epochs when fixation switch occurred (fixating eye now viewing the motion stimulus) were also apparent because OKN responses were immediately enhanced and significantly more robust than in the test situation when the grating motion is presented to the non-fixating eye.

Our results suggest that oculomotor responses can be generated by a stimulus that falls on/around the fovea of the deviated eye. The OKN responses are generated even without an apparent fixation switch suggesting that although there is perceptual suppression of the deviated eye, the oculomotor system might have access to visual error signals.