A comparison of spatial patterns of fixation preference during visual & auditory tasks in strabismic monkeys

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Purpose: Strabismic patients and animals often develop the ability to fixate on a target with either eye and eye choice is dependent on the targets’ spatial location. Fixation preference likely results from suppression of certain parts of the retina. The purpose of this experiment was to compare spatial patterns of fixation preference, when strabismic monkeys are presented with visual stimuli and auditory stimuli with no visual feedback and to investigate the role of neurons in the superior colliculus (SC) in this spatial fixation preference behavior.

Methods: 21 visual and auditory targets (red LEDs & speakers) were arranged 10° apart in a 7x3 array, at a distance of 57 cm. Binocular eye movements were measured in two head-fixed strabismic monkeys [M1 (XT~30°), M2 (XT~25°)] in a saccadic task. Neural recordings from the SC were obtained while the monkey performed a delayed saccade task. Spatial patterns of fixation preference were calculated by recording the incidence of using a specific eye to acquire the target at each spatial location.

Results: Strabismic NHPs fixated on far right target locations with their right eye and far left locations with their left eye for both visual and auditory targets. The border for a change in fixation preference, in response to auditory stimuli, for both animals passed through horizontal 0°. Preliminary data from single-cell recordings show that the retinal error from either eye is processed within the SC. Build-up activity within a cell (occurs between sensory and motor activity), appears to correspond with one of the visual error signals the brain is receiving. This suggests that the build-up activity may be used to facilitate eye choice. Furthermore, auditory stimuli elicit similar response characteristics from the SC cells.

Conclusion: We found that, in strabismic monkeys, spatial fixation preference was also observed during auditory stimulation, i.e., despite the absence of visual feedback. Our data therefore suggests that spatial fixation preference is multi-modal and retinal suppression additionally influences fixation preference during visual tasks. Preliminary analysis of neural data from sensory and buildup cells suggests that the superior colliculus plays an important role in eye choice for multi-modal (auditory and visual) stimuli.

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