Revealing Differential Mechanisms of Absolute vs. Relative Disparity Encoding in Human Extrastriate Visual Cortex and Impacts of Amblyopia on Them

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Background: Absolute and relative disparity cues are crucial for depth and 3D shape encoding, respectively. In human and non-human primates (NHPs), relative disparity cues are encoded by the stereo-selective columns, distributed within the extrastriate visual areas. In NHPs, evidence for *absolute* disparity encoding is limited to the motion-selective area MT (and V1). However, with regard to the differences in structural/functional properties of areas V3 and V3A between humans vs. NHPs, absolute disparity encoding in humans could start from earlier visual areas.

Methods: To test this hypothesis and to examine the impacts of amblyopia on development of absolute disparity-encoding mechanisms, seven individuals with normal vision along with five amblyopic (3 strabismic and 2 anisometropic) individuals participated in this study. Using high-resolution fMRI (7T), we measured the response to absolute disparity varying stimuli within stereo, motion- and color-selective clusters within visual areas V2, V3 and V3A. As the baseline, we also measured the response to zero-disparity stimuli moving in the plane fronto-parallel to the fixation spot. Stimuli were generated based on random dot stereograms. Stereo, motion- and color-selective clusters were localized based on a separate set of scans/stimuli.

Results: Besides area MT, variation in ***absolute*** (compared to zero) disparity evoked a significant response within the V3 and V3A motion- (but not stereo- and/or color-) selective clusters. The level of this activity was also significantly higher than the level of activity evoked by variation in relative (compared to zero) disparity.

Although we found motion-selective clusters in amblyopic individuals, as detected in non-amblyopic subjects (see also Kennedy et al.,), these clusters did not respond selectively to absolute-disparity-varying stimuli. Thus, the impact of amblyopia is not limited to stereopsis.

Conclusion: In humans, absolute disparity is encoded within motion-selective clusters distributed within areas V3 and V3A. Development of this absolute disparity encoding mechanism is impaired by amblyopia.