Empty space is less crowded: stereo-defined 3D letters exhibit less crowding when they are concave than when they are convex.

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INTRODUCTION: The perception of figural shape from concave and convex 3D images has been found to rely on different local features even when their 2D projections are identical and when their global shapes can be perceived to be equivalent. This study investigated whether this difference corresponds to the same kind of feature detection processes believed to underlie visual crowding. METHODS: 20 healthy participants with normal or corrected vision (and screened for stereoacuity) identified capital letters (6˚) displayed briefly (150 ms) at 11˚ eccentricity in random dot stereograms on a CRT monitor synchronized with LCD shutter glasses. Regions interior to the planar contours of letters were rendered with either crossed or uncrossed disparities to produce convex or concave stimuli. Disparities increased smoothly and nonlinearly to a maximum of 6’ at points defined by a letter’s morphological skeleton. The main independent variable of figural depth structure (convex/concave) was crossed with the additional variables of target identity (13 possible letters), flanker presence (none or vertically aligned) and visual hemifield (left or right of fixation). Flanker letters could have three different spacings (roughly 1, 2 or 3 letter height units). Visual crowding was measured as identification rate for flanker displays minus single letter displays, separately for convex and concave conditions. RESULTS: Single letters were more difficult to identify when concave versus convex (79% versus 62% correct). However, concave letters also showed significantly less crowding (performance 41% versus 52% below baseline; above chance in both cases). Analysis of confusion showed qualitative differences in the patterns of errors for concave and convex letters. CONCLUSION: We interpret these results to mean that concave and convex letter recognition rely on qualitatively different feature detection processes. This difference may correspond to the coarse/fine feature detection bandwidth criterion for crowding proposed by Pelli et al. (2004, JoV).