

Neural and functional effects of long-term visual deprivation

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We examined visual processing in a patient (MM) whose corneal damage led to severe contrast deprivation from age 3 to 43. Five months postoperatively MM's spatial resolution remained poor: his psychophysically measured resolution limit was 1.3 cpd. A year post-operatively this resolution limit improved to 2 cpd. Spatial tuning, measured in area V1 using fMRI, was similar. Unlike normal observers, fMRI responses to counterphase gratings were weaker in V1 than in MT+ and responses are even weaker in higher areas (V2, V3, V4). Psychophysically, MM has little difficulty identifying simple shape cues, such as orientation and occlusion. However, he could not interpret more complex cues, such as illusory contours, perspective, and shape from shading. He also had difficulty identifying faces and objects. MM had less difficulty with complex motion cues, such as biological motion, KDE, and form from motion. Consistent with these results, responses in MT/MST were relatively normal, and retinotopic organization was relatively normal in V1. However, responses in higher visual areas were weak and disorganized, and faces and common objects did not produce the activity normally found in the fusiform gyrus. These results suggest that V1 and MT/MST were less susceptible to his visual deprivation than other visual areas. Many higher visual areas develop relatively late in infancy, and may have remained somewhat plastic at three years of age. In addition, higher visual areas may be more experience dependent than V1 and MT/MST. Both factors might make higher visual areas more susceptible to visual deprivation.