THE GEOMETRY OF NEURAL SIMILARITY SPACES *Geoffrey K. Aguirre, Hospital of the University of Pennsylvania* – What is the relationship between the perceptual similarity of sensory experiences and the similarity of the neural responses that encode them? In a series of experiments we have studied the neural representation of objects and shapes in human visual cortex using this question as a guiding principle. With continuous carry-over, functional MRI (Aguirre, Neuroimage, 2007), we can measure the similarity of evoked neural responses to objects on either a focal (within voxel adaptation) or distributed (across voxel pattern) spatial scale. For simple two-dimension shapes and for faces we have found that perceptual similarity predicts neural response similarity, but that the visual information represented at focal and distributed scales differ, both within and across visual areas. Specifically, the dorsolateral potion of the "object responsive" visual area LOC represents a subset of object features with a spatially coarse code, while ventral LOC contains focal populations of neurons that represent the entire object appearance. These studies show that neural population coding of object appearance within ventral LOC reflects perceptual similarity. The precise metric properties of perceptual similarity may further predict the stimulus axes along which these representations are organized. We hypothesize that integral perceptual axes (perceived as a composite with a Euclidean distance metric) are represented by populations of neurons that are conjointly tuned to the axes, while separable axes (defined by a rectilinear metric) are represented by independently tuned neural populations. Using fMRI we may measure the geometric properties of neural adaptation to distinguish between conjoint or independent tuning for a population of neurons. For both two-dimensional shapes and for faces we find that neural tuning within ventral visual areas reflects the metric properties of perception. For shapes, curvature and thickness are independently represented while two arbitrary dimensions of shape variation have conjoint representation. For faces, left ventral areas are tuned to represent face features, while right ventral cortex modulates tuning between face features and wholes depending upon stimulus context and reflecting behavioral measures.