

Title: Principles of object representation in two object networks in IT cortex.

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Abstract: Understanding the neural mechanism of object recognition is one of central challenges in visual neuroscience. Last year at SFN, we reported discovery of a new “object network” in macaque IT cortex consisting of three connected, discrete patches of cells with highly consistent response selectivity to a set of objects (Bao & Tsao, 2016). Here, we further probed the coding scheme used by neurons in this object network. For comparison, we also probed neurons in a body network. We performed extracellular recordings in both the object and body networks while monkeys kept fixation for juice reward and viewed a stimulus set consisting of realistic objects and their silhouettes. A large proportion of neurons in both the object and body networks showed indistinguishable responses to the real objects and their silhouettes. This suggests that we can reasonably reduce the real object image space to a much simpler silhouette space. To explore how neurons code the silhouette space, we recorded responses of cells in the middle body patch and anterior object patch to 2000 silhouette images randomly sampled from a 30 dimensional (30-d) space, extracted from a large set of object silhouette images by principal components analysis. We then fed the same image sets (real objects, silhouettes of real objects, silhouette images sampled from 30-d space) into a trained deep network, Alexnet, and fitted actual neuronal responses to the 2000 random silhouettes to a linear combination of artificial neurons’ responses from AlexNet. We found this linear model could effectively predict responses of neurons to the real object silhouette images as well as to the original images, with correlation between predicted and actual neuronal responses as high as the noise ceiling. Overall, these results show that we can model the object code used in the macaque object and body networks with high precision, and that at least within these two networks, this code largely based on silhouettes of objects.