第109回 創薬科学セミナー・GTRセミナー

Kristina Nielsen, Ph.D.

Department of Neuroscience, Johns Hopkins University

Processing of 2D images via underlying 3D reality in area V4

16:00-17:00 on August 6 (Tue), 2019
Lecture room (205) in Pharm. Sci. Bldg.

Along the ventral pathway, image information (as collected by the retina) is converted into real-world object and scene understanding. Area V4, an important intermediate stage in this pathway, has previously been shown to represent contours of 2D planar shapes, consistent with processing of image-level information. In new experiments using single cell recordings in V4, we now show that a substantial fraction of V4 neurons are more responsive to 3D solid shape (shape-in-depth) than to 2D planar shape in the image plane. This selectivity is robust across radically different image cues (shading, specularity, binocular disparity, reflection, or refraction), ruling out lower-level explanations. These data show that encoding of 3D geometric information emerges much earlier in the ventral pathway than commonly assumed. To further probe the representation of this information, we also investigated how these tuning properties are spatially organized in the area using 2-photon calcium imaging. Again, we observe robust responses to both 3D solid and matching 2D planar shape. Intriguingly, we additionally observe strong local clustering of 3D- and 2D-responsive neurons in separate patches on the order of several hundred microns. At the same time, neighboring 3D and 2D patches are most responsive to congruent 3D and 2D shapes. This level of clustering further supports the notion that extraction of 3D volumetric shape is an important component of visual processing in area V4. Generally, our findings highlight that the ventral stream processes 2D images via their underlying 3D physical reality to much a larger degree than assumed so far.

Host: Fumitaka Osakada (ext. 6814)