Object interaction space represented in scene-selective regions

Wilma Bainbridge (1), & Aude Oliva (2)

1- Department of Brain and Cognitive Sciences, MIT
2- Computer Science and Artificial Intelligence Laboratory, MIT

Previous work has shown that different cortical regions are sensitive to objects of differing real-world sizes (Konkle & Oliva, 2012; Murrally & Maguire, 2012; Bainbridge et al, 2012). Whereas a region in the occipito-temporal sulcus (OTS) shows small object selectivity, scene-selective regions (parahippocampal place area, PPA; retrosplenial cortex, RSC; and occipital place area, OPA) show systematically more activity for objects that are large in the world than smaller objects. What is the nature of this scene-like representation of objects? Here, we study a novel, affordance-based object property: "interaction space". Interaction space is the area around objects that users traverse when interacting with the object. This interaction may include calculations of grasping, points and surface area of contact within this area, and is not necessarily conjoined with size. To fully deconvolve object interaction from physical size, we conducted a 2 x 2 factor design fMRI study with four conditions: 1) small one-handed objects (i.e., hairbrush), 2) large one-handed objects (i.e., umbrella), 3) small two-handed objects (i.e, hamburger), and 4) large two-handed objects (i.e., guitar). Stimuli were matched for ground truth size (based on physical sizes and weights), subjective size from an online survey, color, luminance, spectral energy, and retinal size. Results from a 2-factor ANOVA on beta values in functionally-defined ROIs show PPA, OPA, and RSC are sensitive to interaction space regardless of size, while PPA, OPA, and OTS are also sensitive to size regardless of interaction space. Importantly, effect sizes for interaction space in the PPA, OPA, and RSC were greater than those for object size, while the reverse was true for the OTS. These results suggest that interaction space is a perceptual object property that is represented in scene-selective regions, and that there may be an overlapping interaction-based representation of objects and scenes in the brain.

Funded by NEI EY020484 to A.O. and the DoD NDSEG Program to W.B.