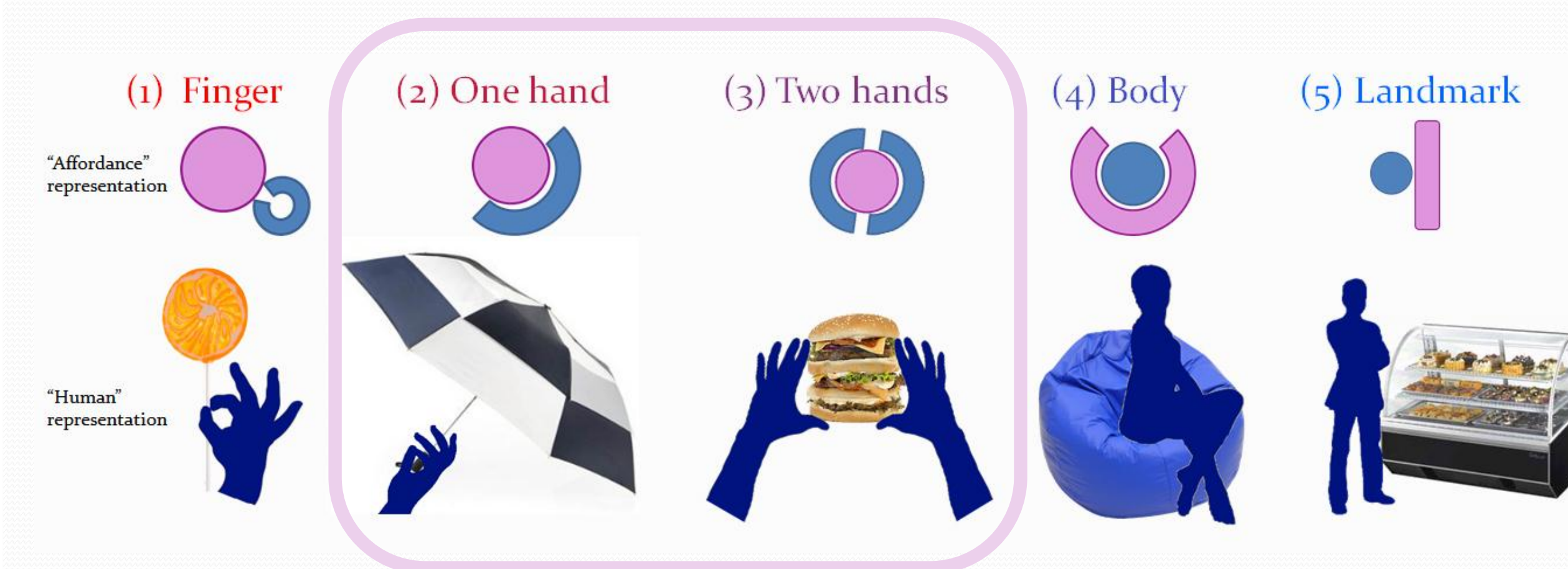
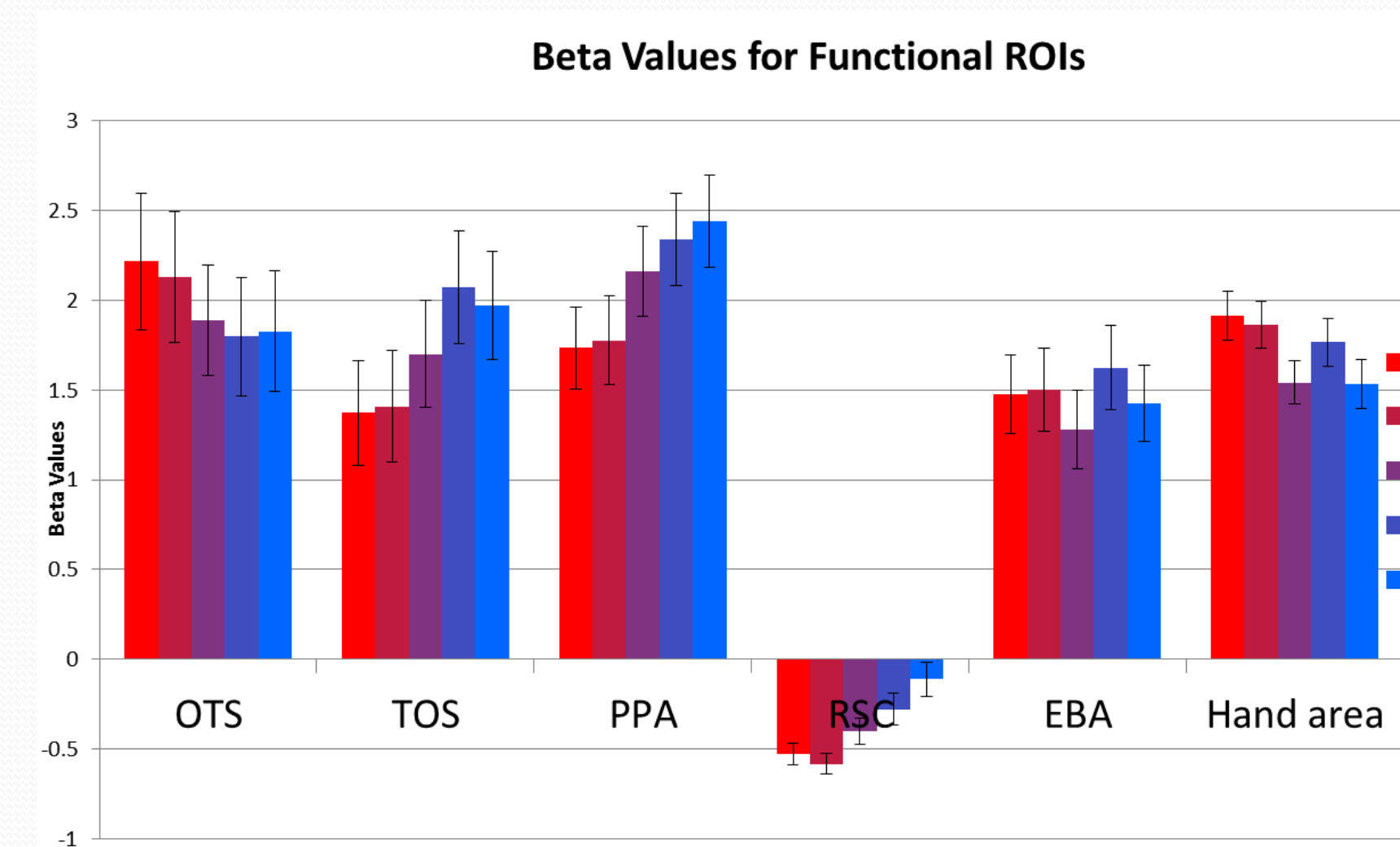


Wilma Bainbridge, Laura K. Levin & Aude Oliva

INTRODUCTION:

- Cortical regions have been found that are sensitive to object real-world size (Konkle & Oliva, 2012), shape (Grill-Spector et al, 1999) and usage (Lewis, 2006).
- Are these cortical representations solely perceptual, or is there also a role of action?
- We examine the property of *object interaction*, the manner and space in which parts of the human body approach an object (e.g., finger-space, one-hand space, body-space, etc).
- In a preliminary study (11 subjects), we found significant correlations between increasing object interaction space and brain activity in the PPA, TOS, and RSC. There was a negative correlation in OTS and no correlation in EBA and the hand area.



Is this effect truly because of interaction, or just real-world size?

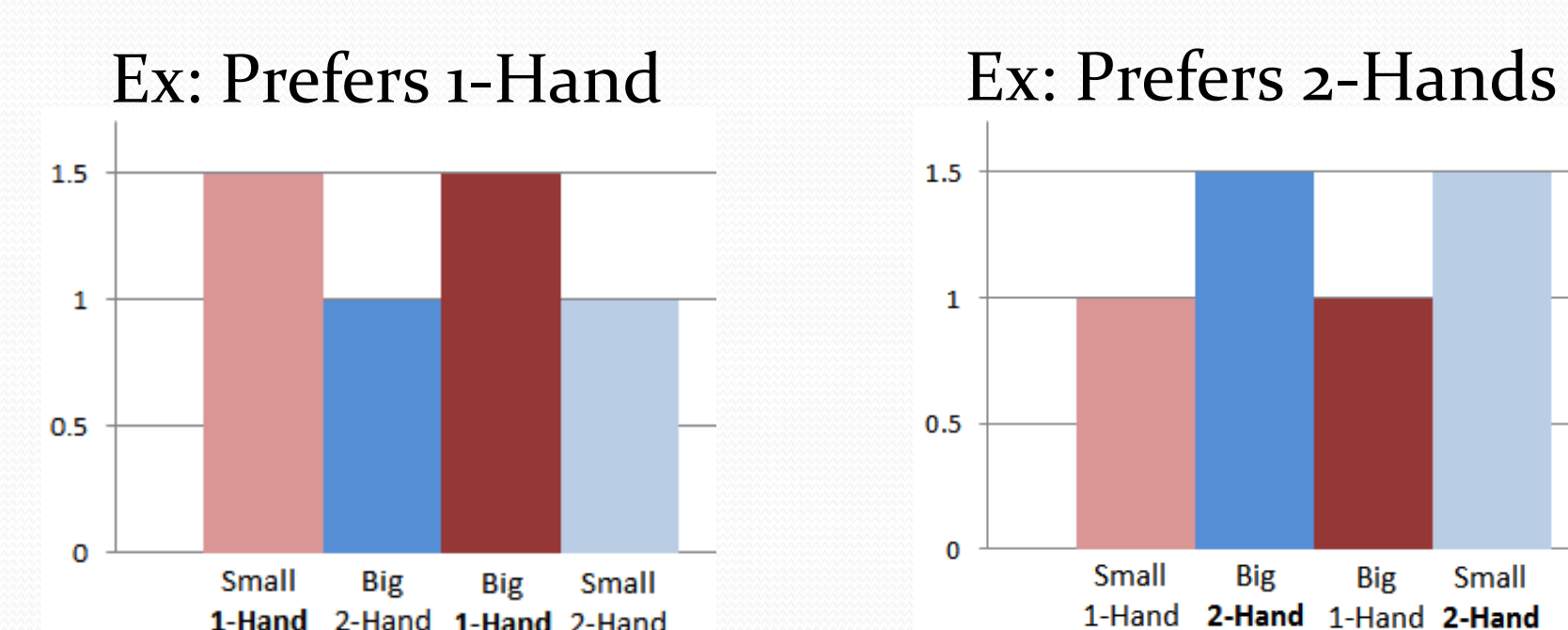
STIMULI:

We decided to look specifically at **one-hand** and **two-hand** objects for this study.

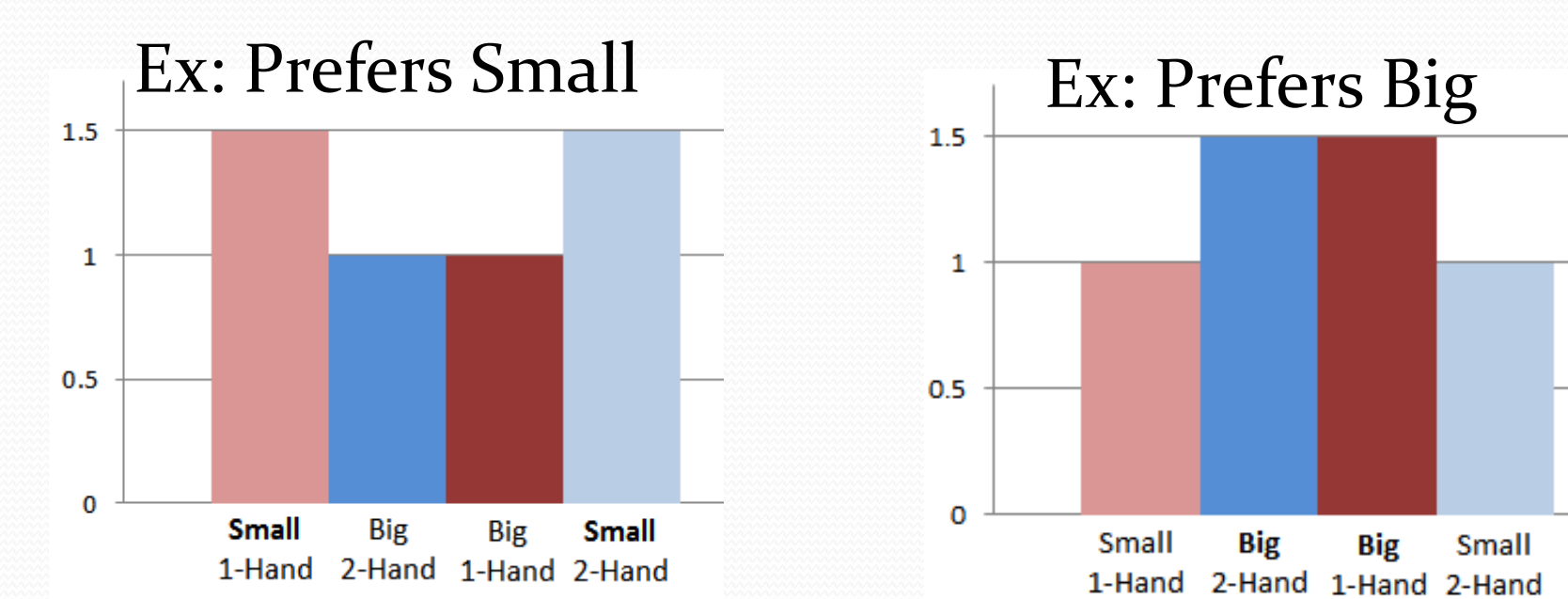


Predictions:

- If a region prefers **interaction**, it will look like:



- If a region prefers **size**, it will look like:



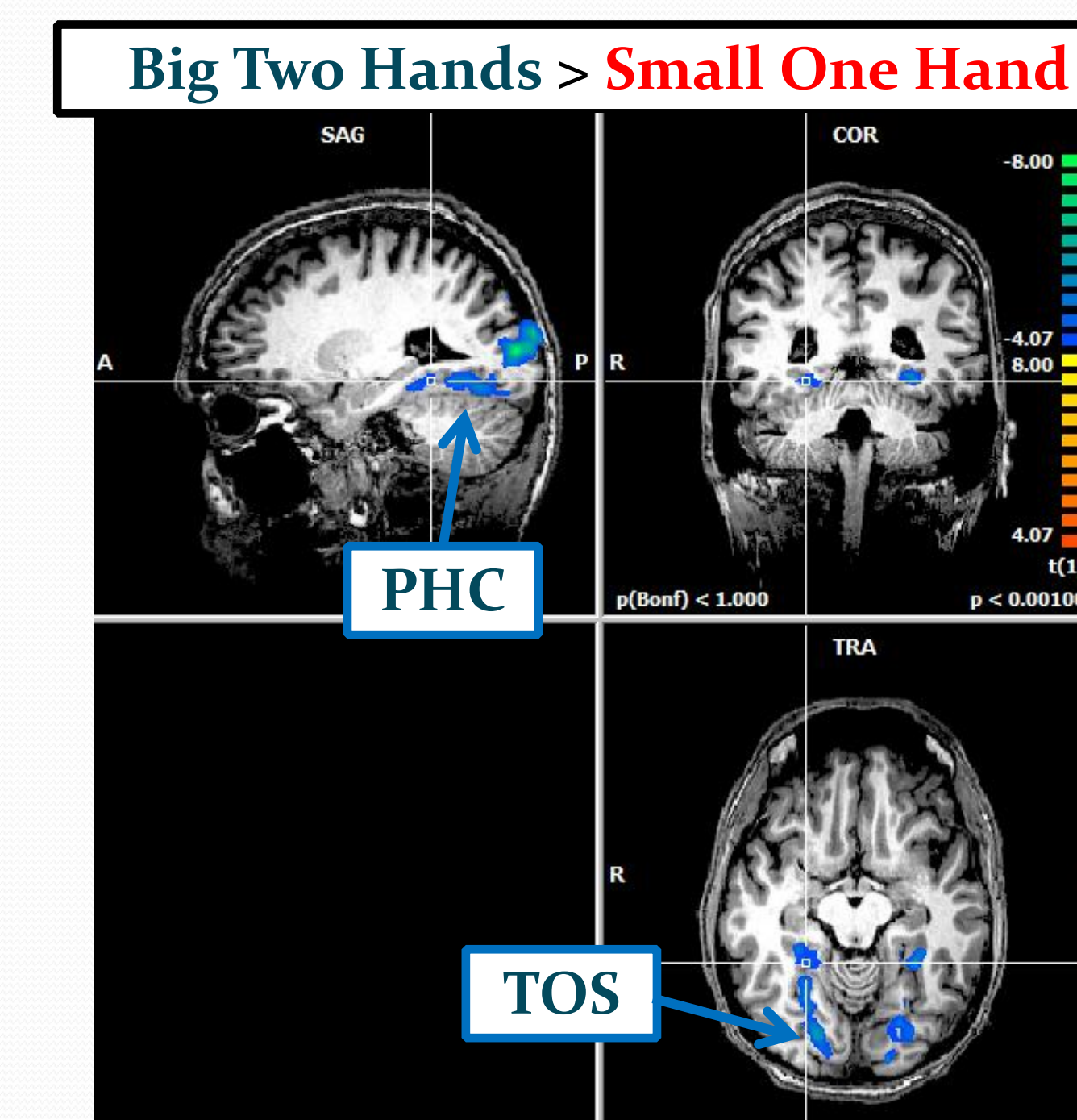
- Stimuli (40 per condition) were matched on:
 - Ground truth size (by diagonal) and weight (determined by shipping sizes and weights on online shopping sites)
 - Subjective size and weight on a Likert scale (Amazon Mechanical Turk study with 5 participants per image)
 - Color and luminance
 - Power spectra (indicating edges and textures in the image)
 - Retinal size (all images were made to fit tightly in a 350 x 350 pixel square)

IMAGING METHODOLOGY:

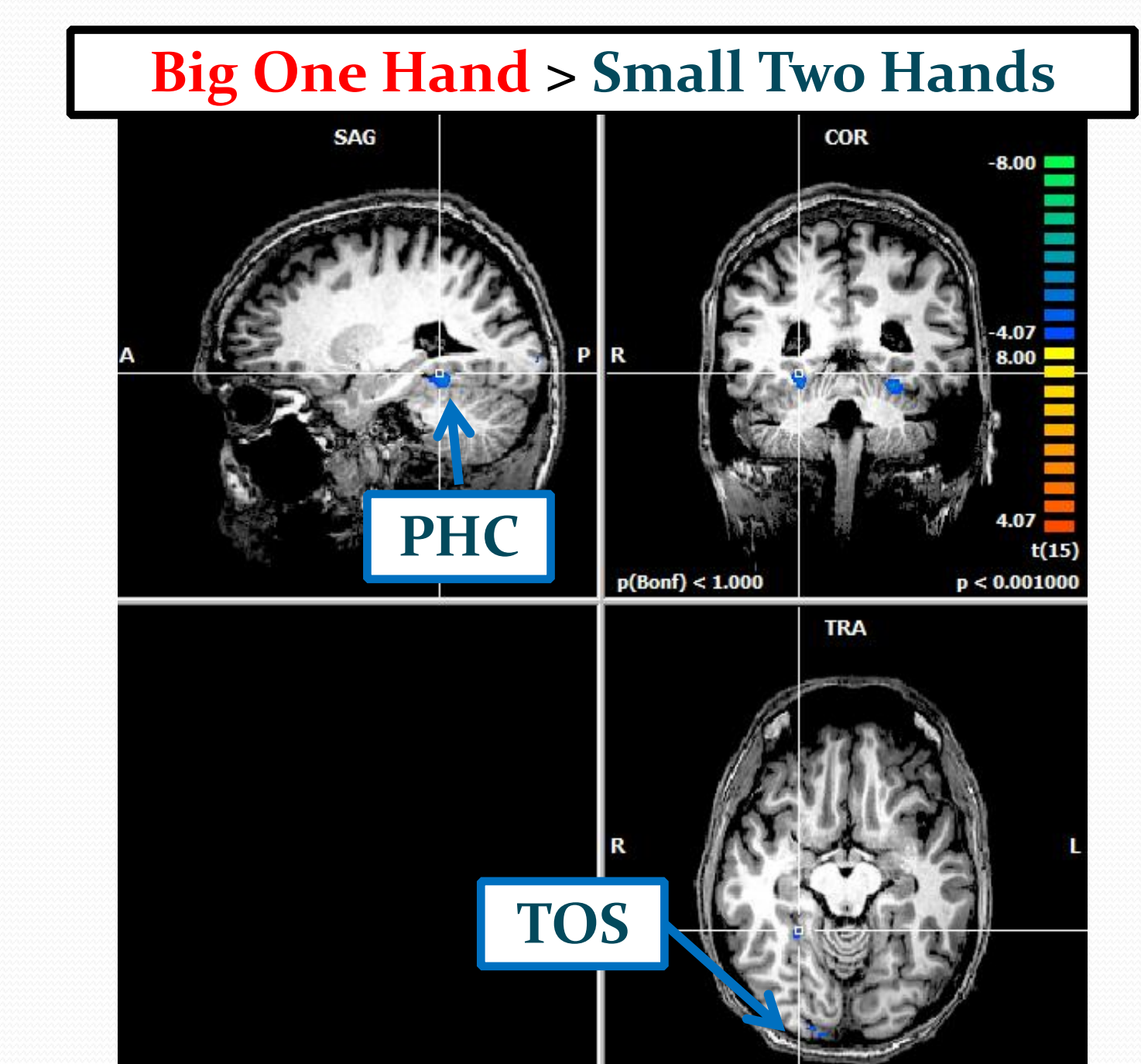
- 3T fMRI study: 32-channel head coil, 3-mm voxels, 33 slices, TR = 2
- 16 participants performed a 1-back task while viewing blocks of object images (600 ms presentation each) against a white background
- Individual Regions of Interest (ROIs) defined using independent face, scene, object, body, hand, and big/small localizers (See References for ROI definition citations)
- Participants were asked to think of how they interact with each object

RESULTS:

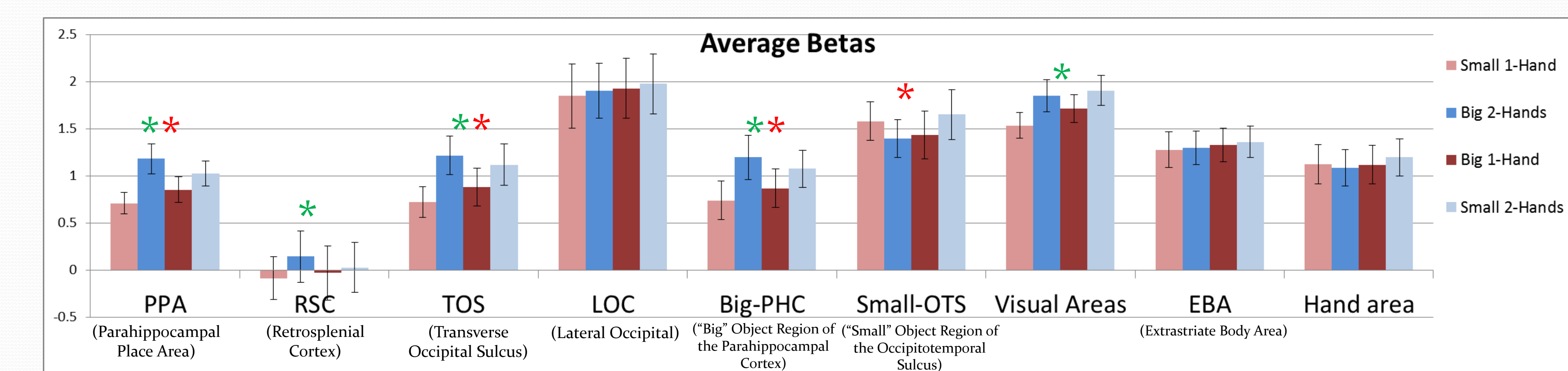
WHOLE BRAIN RANDOM EFFECTS ANALYSIS:



For both of these group analyses, there is more activity for the **two-hand conditions** (blue) than **one-hand** (red) in PHC and TOS, regardless of which is larger



ROI ANALYSIS:



* = Significant Effect of Object **Interaction**
* = Significant Effect of Object **Size**

- 2-Way Repeated Measures ANOVAs looking at the factors of size and interaction
- Several regions show a significant effect of interaction (Scene-related regions)
- However, several regions also show a significant effect of size – PPA, TOS, and Small-OTS
- LOC, EBA, and the hand area show no preference for neither size nor interaction

CONCLUSIONS & FUTURE DIRECTIONS:

- Increasing interaction with an object (two hands versus one hand) is linked with increased cortical activity in several scene-selective regions, even when stimuli are controlled for real-world size
- Perhaps the greater interaction space represents a larger spatial layout around an object
- Regions also appear sensitive to object size (such as the small-OTS)
- Future studies will examine if there are similar patterns in activity when a visual stimulus is held constant but the interaction changes (e.g., picking up a bottle versus opening a bottle)

REFERENCES:

- Auger SD, Mullally SL, Maguire EA. (2012). Retrosplenial cortex codes for permanent landmarks. *PLoS ONE*, 7(8): e43620.
- Bar M & Aminoff E. (2003). Cortical analysis of visual context. *Neuron*, 38, 347 – 358.
- Bracci S, Ietswaart M, Peelen MV & Cavina-Pratesi C. (2010). Dissociable neural responses to hands and non-hand body parts in human left extrastriate visual cortex. *Journal of Neurophysiology*, 103: 3389 – 3397.
- Downing, PE, Jiang Y, Shuman M, Kanwisher N. (2001). A cortical area selective for visual processing of the human body. *Science*, 293(5539): 2470 – 2473.
- Epstein R & Kanwisher N. (1998). A cortical representation of the local visual environment. *Nature*, 392, 598 – 601.
- Grill-Spector K, Kushnir T, Edelman S, Avidan G, Itzhak Y & Malach R. (1999). Differential processing of objects under various viewing conditions in the human lateral occipital complex. *Neuron*, 24: 187 – 120.
- Kanwisher N, McDermott J & Chun, MM. (1997). The fusiform face area: a module in human extrastriate cortex specialized for face perception. *Journal of Neuroscience*, 17(11): 4302 – 4311.
- Konkle T & Oliva A. (2012). A real-world size organization of object responses in occipito-temporal cortex. *Neuron*, 74: 1114 – 1124.
- Lewis JW. (2006). Cortical networks related to human use of tools. *The Neuroscientist*, 12(3): 211 – 231.