

## Where in human brain is the representation of grasping movements?

N. Hattori<sup>1</sup>, H. Shibasaki<sup>1</sup>, L. Wheaton<sup>1</sup>, T. Wu<sup>1</sup>, M. Matsushashi<sup>1</sup>, M. Hallett<sup>1</sup>

<sup>1</sup>Human Motor Control Section, NINDS/NIH, Bethesda, MD, United States

### Introduction

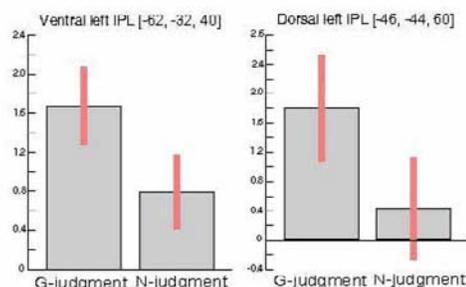
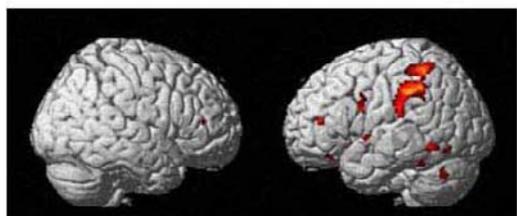
Grasping is one of the most fundamental behaviors for humans. The precise hand/finger movements involved in grasping are programmed by referring to stored motor representations, a key process in initiating such movements. Human neuroimaging studies have demonstrated that the parieto-frontal network including inferior parietal lobule (IPL) and ventral premotor cortex (PMv) plays an important role in controlling grasping movements. We hypothesized that a graspable object activates the motor program of grasping, while a non-graspable object does not, when a subject is asked to judge if visually presented objects are graspable or not.

### Materials and Methods

Fifty visual stimuli were prepared from a set of standardized line-drawn pictures [1], so that about half of them were expected to be judged as graspable and the remaining half non-graspable. The experiment consisted of two conditions; 'judgment' and 'resting'. In each judgment condition, 10 pictures were presented on a screen at a fixed interval of 6.3 s. Seventeen right-handed healthy subjects were asked to judge whether each presented object was graspable by one hand or non-graspable. They were instructed to make judgment internally and to avoid execution of any overt movement. In the resting condition, the subjects were asked to fixate on a black cross hair shown in the center of the screen. The scanning session consisted of alternate presentation of the two conditions 5 times. After the image acquisition, the subjects were shown the same set of pictures and reported their judgment of each picture as to whether graspable or non-graspable. Gradient-echo EPI images (TR/TE = 2500 ms/25ms, FA = 90°, slice thickness/gap = 5/1mm, FOV = 22 X 22 cm<sup>2</sup>, matrix = 64 X 64, 22 slices) were acquired at 3.0 Tesla. Data processing and statistical analysis were performed using SPM2. In the first-level, fixed-effects analysis, event-related responses time-locked to the onset of picture presentation were examined with the model including regressors for 1) judgment of the presented object as graspable (G-judgment condition) and 2) non-graspable (N-judgment condition) depending on the judgment made by each subject. Contrast images representing the effect of the G-judgment and N-judgment conditions compared with the resting condition were calculated and used for second-level, random-effects analysis.

### Results

Paired *t* test using contrast images of the two judgment conditions demonstrated two clusters in the left IPL (Brodmann Area 40) which were more activated in the G-judgment compared with the N-judgment condition ( $P < 0.05$ , corrected, Figure; top). The peak of the cluster located ventrally was activated statistically significantly in both the G- and N-judgment conditions compared with the resting condition (Figure; bottom left), whereas the peak located dorsally was activated only in the G-judgment condition (Figure; bottom right).



### Discussion

We found two clusters in the left IPL which were more activated in the G-judgment compared with the N-judgment condition, while we found no difference in any other parts of the brain including PMv. This result strongly suggests that the representation of grasping movement, which was likely operationally retrieved in the current experiment, is stored in the left IPL. Despite activation of the motor program, we presume the reason we found no PMv activation was because no attempt at movement execution was made and, therefore, no sensory-motor transformation was required.

**Figure** Brain areas more activated in the judgment of graspable objects than that of non-graspable objects (top). On the lower panel, parameter estimates (90% confidence interval) of the peaks of the two clusters showing activation associated with judgment of graspable objects (G-judgment) and non-graspable objects (N-judgment) are shown.

**Reference** 1. Snodgrass JG, Vanderwart M. J Exp Psychol 6:174-215 (1980).