

Time course analysis of t-values in fMRI of tool-use gestures with and without real tools

K. Matsuo¹, E. T. Bagarinao², Y. Ohgami³, T. Nakai¹

¹Department of Gerontechnology, National Center for Geriatrics and Gerontology, Obu, Aichi, Japan, ²National Institute of Advanced Industrial Science and Technology (AIST), Tsukuba, Ibaraki, Japan, ³Ochanomizu University, Bunkyo-ku, Tokyo, Japan

Introduction

It is likely that motor schemes in our brain gradually formed through our everyday action. Then, the motor schemes may be differently modulated between the right- and the left-handed peoples. We examined the difference comparing tool-use gestures with and without real objects using fMRI. An incremental analysis technique, that investigates the time course of the t-value along the fMRI series, was applied to clarify the difference [1-2].

Materials and Methods

Twelve right-handed volunteers (6 males) and 5 left-handed or ambidextrous volunteers (3 males) participated in this study. Four on-off style block-designed fMRI experiments (30 per block, total 4 min 30 sec) were conducted on a 3T MR scanner (GE Signa VH/i 3.0T). A gradient recalled echo spiral sequence was used with the following parameters: TE/TR/FA = 30/5000/70, FOV 22 cm, 72*72 reconstructed into 128*128, 4 mm thick interleaved, 30 axial slices, 54 frames. The four experiments were as follows: (1) right-hand tool-use gestures with having a real tool (e.g. wooden spoon), (2) that without a real tool (they performed as if they held the tool), (3) left-hand tool-use gestures with the real tool, and (4) that without the real tool. First, the data were analyzed using SPM2. A random-effect group analysis was employed to generate differential activation maps during the experiment with tools as compared with that without tools for the right-handers group (FDR $p < 0.05$). A fixed-effect analysis was applied for the comparison in the left-handed and ambidextrous people ($p < 0.005$, uncorrected). Also, the time courses of the incremental t-values of the peak in the primary motor cortex were examined for each volunteer and for each experiment.

Results

Activation maps for the right-handers (Fig. 1, left) showed that the experiments with real tools induced intense activation in the motor and supramarginal areas as compared with the experiments without tools, and that the effect was enhanced if the right hand (preferred hand) was used. For the left-handers (including the ambidextrous people), however, the effects were not clear (Fig. 1, right). However, the time course of the t-values efficiently showed that the increases of the t-values during gestures with real tools as compared with that during gestures without tools occurred during the use of the volunteers preferred hand (Fig. 2).

Discussion

The effect of the hand preferences onto the brain mapping can be investigated by the efficient use of the t-value examinations [1-2].

References

- [1] Bagarinao E et al., *Mgn Reson Engineering*, 19, 14-25, (2003)
- [2] Bagarinao E et al., *NeuroImage*, 19, 422-429, (2003)

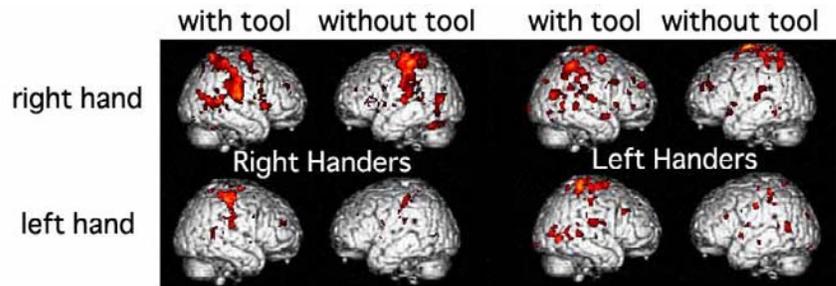


Fig. 1

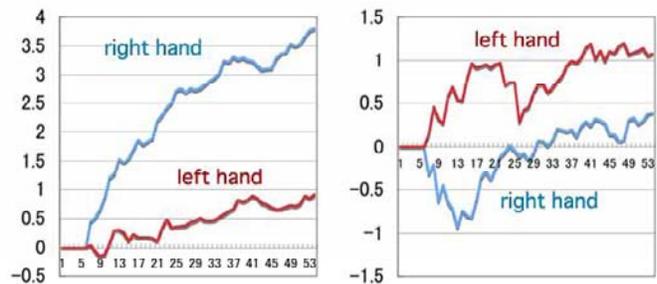


Fig. 2 Averaged t-values with real tools minus those without real tools.