

THE APPLICATION OF THE SLIDING WINDOW ANALYSIS: THE BRAIN LOCATION AND THE WINDOW WIDTH

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Introduction

We examined an efficiency of our newly developed “Sliding Window Analysis (SWA)” in its detection of temporal information during fMRI scanning [1-2]. In the SWA, a small and fixed range of analysis window “slides” one by one volume along with the fMRI time course to give us transitions of the t-values between task and control conditions. We applied the SWA to data of a paired associative learning of novel faces and names. A decreasing timeline in the hippocampus was expected in this paradigm because the hippocampus is specifically involved in the encoding. As the associations are learned, the signals would be decreased in the region [3]. In this paper, we specifically investigate the determination of the voxels from which we extract the t-value information, as well as the window width that the SWA slides along with the time axis.

Materials and Methods

We analyzed 28 people who participated in our study (young 23, age 20-30, elderly 5, age 60-65, F/M = 11/17, all gave written informed consent). Volunteers made a forced choice between two personal names displayed with a human face during a 14 min event-related fMRI session in a 1.5 T scanner (MAGNETOM Avanto, Siemens, Erlangen, Germany). A condition Famous showed 7 well-known faces alternately, whereas a condition Unknown showed 7 faces unfamiliar to volunteers (age and sex matched). Each face appeared 8 times in total during a session. The same amount of null events (plus mark) was also included. These events appeared every 5 sec according to a scheduling algorithm [4]. Volunteers first made a guess at the names for unknown people but gradually memorized them. Correct answers were given with the duration of 1.5 sec immediately after 3 sec stimuli presentation, followed by a 0.5 sec blank. Numbers of the faces they could orally name were counted after the session. The EPI parameters were: TR 3000 ms, TE 56 ms, FA 90 deg, FOV 220 mm, 64x64 matrix, slice thickness 4 mm with no gap interleaved, 30 axial slices, 282 images per slice. The first 2 frames (plus 1 automatically executed frame) were discarded to avoid initial signal instabilities. After the preprocessing, the signal intensity was estimated using SPM5. The 2 conditions were analyzed in separate design matrices that included realign parameters. A random-effect group analysis was conducted (one-sample t-test at FDR $p < 0.01$, N=28). The SWA was applied individually using the design matrices. Among the 28 participants, one (female, age 20, high memory scored) was selected for detailed analysis. We determined 6 local maxima using the SPM of the Unknown condition ($p < 0.005$, uncorrected). The SWA was applied to the local maxima and the adjacent voxels. The window width (ww) for the analysis was set to 35, 70 and 140 frames.

Results and Discussion

The group analysis demonstrated activation near the anterior hippocampus for both hemispheres (Fig. 1). The selected individual showed 4 loci around the left hippocampus and 2 around the right. Among the 6 loci, the coordinates [30 -21 -19] showed a decreasing time course specifically when the window width was set to 140 (the left third of Fig. 2). The coordinates were consistent with the local maxima obtained through the group analysis (Fig. 1).

Conclusions

The SWA allows us to examine the detailed characteristics of the hippocampal activation. The information will be useful for the evaluation of the memory function in the dementia patients.

References

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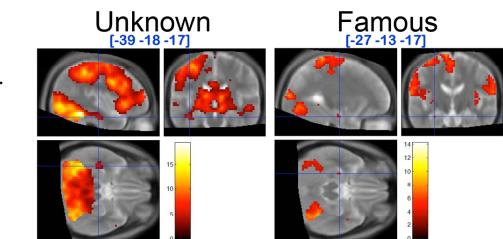
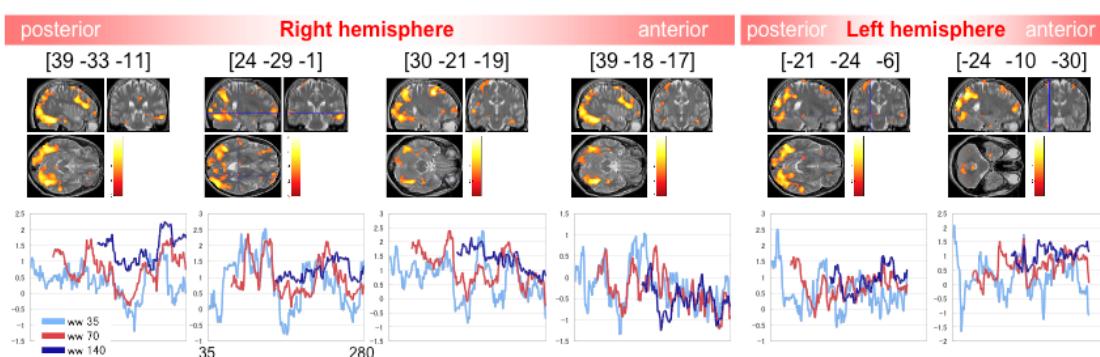


Fig. 1. Section images by the group analysis (N=28). The coordinates are Talairach's.

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Fig. 1. Time courses of t-values during the fMRI session. The x-axis is the time course, whereas the y-axis is the t-value.