

Investigating the neural base of hearing one's own name by fMRI

T. Nakane^{1,2}, M. Makoto², T. Nakai², and S. Naganawa¹

¹Nagoya University Graduate School of Medicine, Nagoya, Aichi, Japan, ²NCGG, Ohbu, Aichi, Japan

Introduction:

One's own name attracts attention though in the crowd. Some studies report on the brain activity making use of such nature in the research of the patients with consciousness disorder [1]. The activity of cortical midline structure (CMS) has been reported by studies presenting self-related stimuli like one's own name, and has gathered attention in the research of consciousness disorder [2]. However, the activity in the frontal lobe area of CMS (fCMS) is observed in other cognitive tasks that require attention [3]. We hypothesized that the activation of the area is modulated by attentional states. In order to test this hypothesis, we performed an fMRI study to separate the effect of attention from self-referential processes.

Methods:

Thirty healthy adults (20-36 years, 15 females) volunteered to the study. Stimuli were vocalized names of participant's own (S), specific other's (R), and variable others' (C). S and R were repeated for 30 trials during a session, whereas C was always unique for all 60 trials. During a trial, two names were presented binaurally and simultaneously to simulate the 'cocktail party' situation. These two names were C with either S, R, or C. Each of the names was followed by 440 Hz or 880 Hz beep sound (duration 50 ms) whose onset was 600 ms after that of names (Fig.1). The experiment consisted of the following two sessions: 1) Top-down session: the participant judged whether the names contained S or R that are repeated targets (push one button) or only C that is non-repeated (push the other button). 2) Bottom-up session: the participant judged whether the beep was high or low. The experiment was tested in the event-related design. Functional images were acquired using 3T MR scanner (Magnetom Trio, A Tim System, Siemens) with GRE-EPI sequence (matrix size = 64 x 64; TR = 2900 ms; TE = 30 ms; FOV = 192 mm; FA = 90 degrees; slice thickness = 3 mm; number of slices = 39). The images were preprocessed and analyzed to make comparisons across conditions (RFX, $p < 0.005$, cluster-level FWE correction) with SPM8.

Results:

1) Top-down session: Behavioral data: the reaction time (RT) was longer in C (M = 1030 ms, SD = 152 ms) than S (M = 823 ms, SD = 161 ms) and R (M = 853 ms, SD = 147 ms) ($p < 0.01$, Tukey's HSD; the same applied hereinafter). The hit rate (HR) was higher in C (M = 97.2 %, SD = 5.81 %) than S (M = 91.9 %, SD = 9.49%) and R (M = 84.9 %, SD = 11.1 %), and also S higher than R ($p < 0.01$). fMRI data: The contrast S > C found activation in bilateral fCMS ([-2, 46, 4], $z = 4.43$) but R > C did not. The contrast S > R found bilateral fCMS ([-4, 48, -2], $z = 5.24$) (Fig. 2a). 2) Bottom-up session: Behavioral data: There was no significant difference across the tasks about the RTs (S: M = 507 ms, SD = 92.7 ms, R: M = 509 ms, SD = 113 ms, C: M = 520 ms, SD = 102 ms) and the HRs (S: M = 94.3 %, SD = 6.73 %, R: M = 94.1 %, SD = 7.18 %, C: M = 94.1 %, SD = 7.78 %). fMRI data: No activation was found in fCMS in any contrast (Fig. 2b).

Conclusions:

The results from the present study demonstrated the effect of attention in self-referential process in fCMS and supported our hypothesis. With the same stimulus set in these two sessions, the activation of fCMS showed difference: the activation observed in the top-down session but not in the bottom-up session. This supports the conclusion that fCMS activation in self-referential mental processes requires top-down attention to the stimulus. Our preferred interpretation for this is that attention to self facilitates preparation for social interaction by involving fCMS that also mediates various social cognitions in daily life.

References:

- [1] Di HB, Yu SM, Weng XC, et al., 2007, *Neurology*, 20, 895-9.
- [2] Laureys S, Perrin F, Brédart S, 2007, *Consciousness and Cognition*, 16, 722-41.
- [3] Duncan J, Owen AM, 2000, *Trends in Neuroscience*, 23, 475-83.

Figure 1: The time course of a trial in both sessions

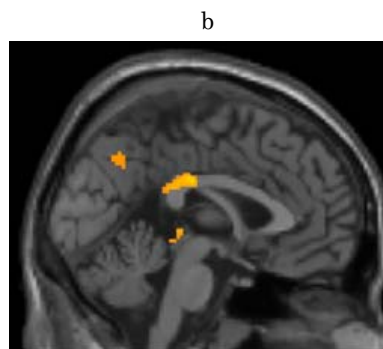
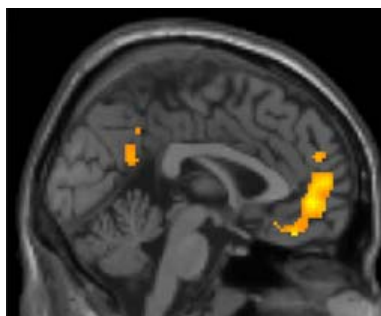
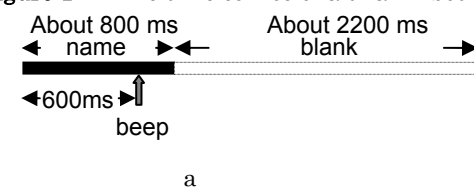


Figure 2:

The contrast S > R revealed activation in fCMS only in the top-down session and not in the bottom-up session. Left (a): top-down, Right (b): bottom-up. $p < 0.005$, cluster-level FWE correction.