Abstract Number: 283

Available on CD-ROM in *NeuroImage, 31 (S163): 545 TH-AM.* 12th Annual Meeting of the Organization for Human Brain Mapping, Florence, Italy, June 11-15, 2006.

Human Brain Mapping 2006

FACTORS MODULATING LATE PREFRONTAL EVENT-RELATED POTENTIALS DURING SOURCE MEMORY RETRIEVAL

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Objective:

Brain imaging evidence shows prefrontal activation during various memory tasks. However, the specific roles the frontal lobes play in episodic memory is still a matter of debate. This study aimed to disentangle theoretical accounts of the prefrontal involvement based on objective features of the retrieval judgment (accuracy) and accounts concerning subjective aspects of retrieval (confidence).

Methods:

Seventeen healthy participants volunteered for the experiment (mean age: 27 years; 12 females; all right-handed). During the encoding phase, 160 words were presented acoustically, pronounced either by a male or a female voice. Participants had to decide if the word meaning was associated to a male vs. female sphere. During the test phase, the same words were presented visually while EEG was recorded from 128 channels. The information to be retrieved was the voice of the speaker at study (male vs. female). Additionally, confidence ratings about the voice judgment were required (high vs. low confidence). The ERPs were extracted off-line triggered by the test word onset and segmented for a temporal period extending from 100 ms pre-stimulus to 2000 ms post-stimulus (baseline-correction: 100 ms pre-Stimulus). Eight regions of interest (4 electrodes for each) were selected from the measured head space for analysis of the spatial scalp topography of the ERP effects (see Fig. 1). Two 2x2x2x2 ANOVAs were performed on the mean amplitudes in the 1000-1500 and 1500-2000 ms latency-windows, with confidence (high- vs. low-confidence responses), lobe (frontal vs. parietal), hemisphere (left vs. right) and region (anterior vs. lateral) as the within-subjects variables. For the accuracy analysis, the same ANOVAs were performed but the factor confidence was replaced by the factor accuracy (hit vs. miss).

Results and Discussion:

The results show that ERP amplitude was not modulated by retrieval success (Fig. 2, Panel A). However, a clear-cut dissociation was observed among the sets of prefrontal electrodes analyzed, along the anterior-lateral and left-right topographical dimensions, respectively. Waves evoked by low-confidence responses were more positive than those evoked by high-confidence ones. This pattern occurred in a set of bilateral anterior frontal sites [confidence x lobe x region interaction, for both time-windows, $F(1,16) \geq 7.9$; Fig. 2, Panel B]. Moreover, the ERPs were clearly more positive in the right frontal regions than elsewhere (1000-1500 ms), independently of accuracy and confidence [lobe x hemisphere, $F(1,16) = 7.3$, $p < .05$; Fig. 2, Panel C].

These findings are in conflict with accounts relating the prefrontal involvement in source memory to the successful retrieval, while support a monitoring account for the confidence effect on the anterior frontal regions. On the other hand, the right frontal positivity effect is explained through a metamemory process checking the memory search itself. This process would permit an evaluation of the confidence status of the judgment.

Conclusions:

This study provides converging insights to understand the prefrontal function in memory retrieval, demonstrating that a subjective feature, such as confidence level, modulates prefrontal ERPs, while accuracy does not. Moreover, present results suggest a fractionation of functions within the prefrontal regions during source memory judgments.