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MEMORY - LEARNING

Involvement of fusiform gyri during performance of a face familiarity detection task. An fMRI study.

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Introduction.

Face recognition is an essential perceptive and cognitive act. The processes involved in face recognition have been widely studied in cognitive psychology[1,2]. This has led to the development of several models which are now being assessed by functional imaging. The majority of the imaging studies of face perception published so far have focused on the subprocesses enabling one to differentiate faces from other kinds of complex stimuli[3]. The subprocesses enabling one to distinguish familiar from unfamiliar faces have been given little attention. The few studies having dealt with these subprocesses have manipulated the face familiarity in a merely implicit way[4-6]. In the present fMRI study, we aimed at determining the neural correlates of the explicit detection of face familiarity using highly famous faces.

Material and methods.

14 young right-handed volunteers participated in the study. All gave their written consent.

Paradigm. Subjects were presented black and white photographs of faces taken from various view points (640 faces). Those photographs were rapidly refreshed (every 500 msec) so as to minimize naming and semantic processes at the detection of familiar faces. A two conditions block paradigm was used (5.5 min overall). During the unknown face (UF) epochs, subjects were shown a small number of famous faces (targets) within a series of unknown faces. During the familiar face (FF) epochs, subjects were shown a small number of unknown faces (targets) within a series of famous faces. Subjects were instructed to report in both conditions the detection of the target faces by means of an answer key. The responses were recorded so as to allow scoring of task performance. The number of target faces represented 4 % of the overall number of faces presented. Luminance and contrast as well as social and emotional content of the stimuli were randomized between the two conditions.

MR acquisition and data processing. fMRI was performed at 1.5 T, with a GRE EPI MR sequence (TR=2.8s, TE=45ms, α=90°). The volume explored in the transverse plane was composed of 25 adjacent 4 mm-thick slices. In-plane resolution was (4 mm)2. Functional maps were generated by means of SPM 96. The threshold for statistical significance in the group analysis was set at p=.05.

Results.

The ten subjects (27±5 y.o.) having obtained the best scores (94±4%, recognition of the famous faces) were retained for group analysis. Only the FF *vs* vs UF contrast revealed significant activations. Right dorsolateral prefrontal and orbitofrontal cortices (respectively Brodmann areas 46/49 and 47) as well as, bilaterally, the superior prefrontal and cingular cortices (Brodmann areas 8/32) were found to be activated. The cerebellum and the fusiform gyrus were activated bilaterally. The left fusiform activation extended caudally and rostrally into Brodmann areas 37 (Talairach coordinates of local maximum: x=-27, y=-50, z=-15) and 19 (x=-31, y=-62, z=-15), while the right fusiform gyrus was found to be activated only rostrally within Brodmann area 37 (x=40, y=-50, z=-18).

Discussion and conclusion.

Differences of activation linked to the familiarity of faces were found as subjects performed a direct familiarity detection task. The involvement of ventral occipito-temporal areas in the processing of familiarity is an interesting finding. Within these areas, only the fusiform gyri were found to be activated. A fame effect was also found in a recent implicit face familiarity detection study[4] and was restricted to the right fusiform gyrus, in an area located more anteriorly than that found in our study. Other studies failed to reveal significant fusiform activations related to fame[5,6]. Thus it appears that the explicit character of the face familiarity detection in a behavioural task centred on this process is an important factor for revealing the recruitment of the ventral occipito-temporal areas, in particular of the posteriorly located areas involved in face recognition.

References.

1. Ellis H, (1986), in The Neuropsychology of Face Perception and Facial Expression, R. Bruyer (Ed.), Hillsdale, Lawrence Erlbaum Associates, pp.1-27.
2. Burton M. et al., Cognitive Science (1999), 55:141-156 .
3. Kanwisher N. et al, J Neurosc (1997), 17: 4302-4311.
4. George N. et al, Nature Neurosc. (1999), 2: 574-580.
5. Tempini G. et al, Brain (1998), 121: 2103-2118.
6. Dubois S. et al, NeuroImage (1999), 9: 278-289. α