Implicit Distinction of the Race underlying the Perception of Faces by Event-Related fMRI

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A few studies have shown that the function of fusiform face area is selectively involved in the perception of faces includinga race difference. We investigated the neural substrates of the face-selective region called fusiform face area in the ventral occipital-temporal cortex and same-race memory superiority in the fusiform face area by the event-related fMRI. In our fMRI study, twelve healthy subjects (Oriental-Korean) performed the implicit distinction of the race while they consciously made familiar-judgments,regardless of whether they considered a face as Oriental-Korean or European-American. In the race distinction as an implicit task, the fusiformface areas (FFA) and the right parahippocampal gyrus had a greater response to the presentation of Oriental-Korean than European-American faces, but in the consciously race distinction between Oriental-Korean and European-American faces, any significant difference in the FFA was not observed. These results suggest that different activation in the fusiform regions and right parahippocampal gyrus resulting from same-race memory superiority could be implicitly taken place by the physiological processes of face recognition.

Key words: Fusiform face area (FFA) Race; Event-Related fMRI

INTRODUCTION

Face perception is the most developed visual perceptual skill in humans and plays a critical role in social interactions (2). The fusiform gyrus, part of the medial temporal cortex, is specialized for face perception (6) and is typically in the fusiform gyrus or adjacent sulci and has been called the fusiform face area (FFA). It seems that FFA might be involved not only during the retrieval of faces from long-term memory but also during the encoding of new faces into memory. People are better at recognizing faces of their own race than faces of other races (7). The same-race advantage that results from greater experience with faces from one's own race has been demonstrated with behavioral studies involving a wide variety of protocols, face stimuli, participants and cultural settings. Golby et. al (2001) showed differential responses in the fusiform region to same-race and other-race faces using conventional block paradigm fMRI with gray photographs of European-American and African-American. The contrast-polarity-specific structure (3) showed that bilateral fusiform areas responded morestrongly for faces with positive than negative contrast polarity. In our case, gray photographs of Oriental-Korean and European-American are a little similarity to the contrast of faces compared to those of European-American and African-American. We present finding called same-race memory superiority from the bilateral fusiform gyri and the right parahippocampal gyrus, event-related functional magneticresonance imaging (fMRI) study that directly compared the perception of Oriental-Korean face versus European-American face.

MATERIALS AND METHODS

The study was performed with informed consent on 12 right-handed normal, healthy Korean adults. The stimuli consisted of gray

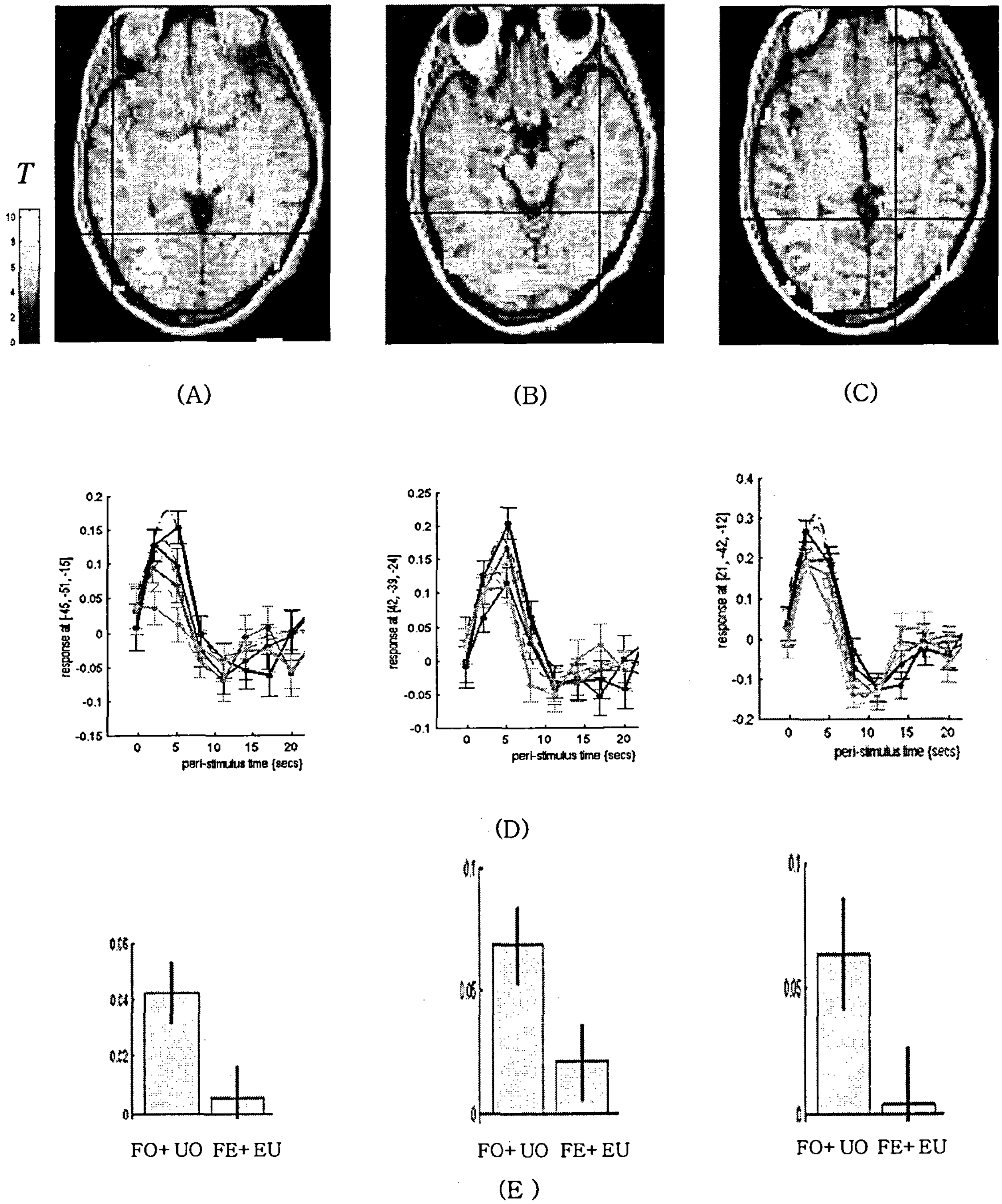

Fig. 1. (A) The group activation map at left fusiform area , (B) at right fusiform area , (C) at right parahippocampal gyrus with a lower statistical threshold was used ($P < 0.001$, uncorrected). (D) Event-related data, adjusted for confound (FO as Familiar Oriental-Korean face, UO as Unfamiliar Oriental-Korean face, FE as Familiar European-American face, UE as Unfamiliar European-American face), binned every 3s and averaged over subjects from corresponding regions (at left fusiform ; x=-45,y=-51,z=-15; at right fusiform; x=42, y=-39, z=-24 ; at right parahippocampal gyrus ; x=21,y=-42,z=-12) based on peristimulus time (PST). (E) Canonical Response (parameter estimates for the best-fitting canonical HRF) between same-race and other-race [in the left fusiform region ($F_{(1,10)}$ = 11.97, x=-45,y=-51,z=-15), and in the right fusiform region ($F_{(1,10)}$ = 10.26, x=42, y=-39,z=-24), and in the right parahippocampal gyrus ($F_{(1,10)}$ = 5.66, x= 21,y=-42,z=-12)]

photographs of 100 Oriental-Korean and 100 European-American and each 100 faces were split into 50 familiar and 50 unfamiliar groups. Four different categories of faces were presented: familiar Oriental-Korean faces (i.e., actors, actresses, public readers), Oriental-Korean strangers, familiar European-American faces (i.e., actors, actresses, public readers), and European-American strangers. The order of each face from four groups was a random sequence. The faces were presented for 1000 ms, replacing a baseline of an oval chequerboard present throughout the interstimulus interval, with a stochastic distribution of stimulus onset asynchrony (SOA) determined by a minimal SOA of 4.5 sec and 100 randomly intermixed null events (5). All visual stimuli were projected onto a half transparent screen using a projector connected to a personal computer. Subjects were instructed to press one of two possible buttons with either the index or middle finger of their right hand to indicate whether a face was familiar or not, regardless of whether they considered it as Oriental-Korean or European-American. Incorrect answers or false response were ignored. A 1.5 Tesla whole body MRI System (Siemens Corps, Iselin, NJ) was used to acquire 24 T2-EPI images (240mm Field-of-view, 64 x 64 in-plane resolution 3.75 x 3.75 mm, TE=60 ms). EPIs comprised contiguous slices of 5 mm thickness, acquired sequentially in a descending direction and continuously during one session. After discarding the first 5 volumes due to the unsteady longitudinal magnetization, 450 volumes were collected with an effective repetition time (TR) of 3 s / volume. After the off-line reconstruction, data were analyzed using statistical parametric mapping (SPM99, 1) based on the Matlab5 computing environment. Data was realigned, smoothed, and filtered to remove low-frequency noise. For fMRI group data analysis, all images of all subjects were analyzed in one design matrix, generating a fixed effect model hemodynamic responses to the stimulus onset for the four basic event-types (familiar Oriental-Korean, unfamiliar Oriental-Korean, familiar European-American, unfamiliar European-American) when matched for time of occurrence. The individual contrasts images for the effect of interest wereentered into one-sample t-tests to determine the group-level activation, treating subjects as a random variable. The resulting statistical parametric maps of t-statistics at the each voxel were transformed to Z values and thresholded at $P< 0.001$ uncorrected for multiple comparisons. Statistical comparisonbetween Oriental-Korean and European-American faces by one-way ANOVA was made.

RESULT AND DISCUSS

The main finding of this event-related fMRI study was that greater activation in the bilateral fusiform gyri and right parahippocampal gyrus was observed to the presentation of same-race faces compared to other-race faces during explicit perceptual of familiar faces among unfamiliar faces (Fig. 1D, Fig 2G) [$F(1,10)=11.97$, $P < 0.001$; $F(1,10)=10.26$, $P<0.001$; $F(1,10)=5.66$, $P<0.05$]. Before the present study, our preliminary results showed that any significant difference in the lateral fusiform cortex was not detected in the race discrimination between Oriental-Korean and European-American faces as the explicit task as the same method of present study. This finding indicates that there may be face recognition underlying mechanisms as the implicitknowledge that was revealed in task performance without any corresponding phenomenal awareness, the implicit knowledge was inferred from failures on subjective or objective measure of consciousperception (8). A further issue is the distinct process mediated by fusiform regions that promote superior memory for same-race versus other-race faces. Superior memory for same-race versus other-race faces was significantly correlated with greater signal in the bilateral fusiform gyri for same-race versusother-race faces. In the race evaluation of Black and White social groups using the fMRI, there may be more affected to contrast difference as contrast-polarity reversal than any features (eyes, nose, mouth, hair etc.) identifying individual faces. The contrast-polarity-specific structure that faces was be presented as positive or negative (shadows appeared as dark red in the positives and as light green in the negatives) (3) showed that the contrast-polarity reversal have an influence on disrupting the face recognition despite preserving all edges and spatial frequencies. In our study, we were focusing on the same-race memory superiority with the minimal of any contrast effect as contrast-polarity reversal that may result from the race evaluation of Black and White social groups. For the race distinction with the gray photographs of Oriental-Korean and European-American, our results showed that any features (eyes, nose, mouth, hair etc.) identifying individual faces other than any contrast difference caused by race groups could be related as the main factor of race discrimination. Differential recruitment of face-processing areas in the fusiform region by faces of different races may be due to difference in perceptual expertise derived from long-term differencesin exposure to same-race and other-race faces (4). Much more experience with faces one's own racial group may contribute importantly to the development of visual expertise with faces. Our finding would be any clue to understand a relationship between brain activity and behavioral race bias and will provide an insight into how variation in socialexperience may guide the organization of neural systems that process faces encountered on daily basis.

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