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

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ABSTRACT

A few studies have shown that the function of the fusiform face area is selectively involved in the perception of faces, including the perception of racial difference. We investigated the neural substrates of the face-selective region called fusiform face area and the superiority of the same-race memory in the fusiform face area by employing event-related fMRI. In our fMRI study, twelve healthy subjects (Oriental-Korean) performed the implicit distinction of race while they consciously made familiarity judgments, regardless of whether they considered a face as Oriental-Korean or Caucasian-American. For race distinction as an implicit task, the fusiform face areas (FFA) and the right parahippocampal gyrus had a greater response to the presentation of Oriental-Korean faces than for the Caucasian-American faces, but in the conscious race distinction between Oriental-Korean and Caucasian-American faces, there was no significant difference observed in the FFA. These results suggest that different activation in the fusiform regions and right parahippocampal gyrus resulting from superiority of same-race memory could have implicitly taken place by the physiological processes of face recognition.

INTRODUCTION

People are better at recognizing faces of their own than faces of other races. The same-race advantage has been demonstrated with behavioral studies involving a wide variety of protocols, face stimuli, participants and cultural settings. Golby et. al (1) have shown differential responses in the fusiform region to the same-race faces and other-race faces using conventional block paradigm fMRI with gray photographs of Caucasian-Americans and Afro-Americans. The contrast-polarity-specific structure (2) showed that the bilateral fusiform areas responded much stronger for faces with positive than negative contrast polarity. In our case, gray photographs of Oriental-Koreans and Caucasians-Americans are a more similar in the contrast of faces compared to those of Caucasian-Americans and Afro-American. In this study, we present our findings, which are called same-race memory superiority, from the bilateral fusiform gyri and the right parahippocampal gyrus, and we employed event-related functional magnetic resonance imaging (fMRI) study.

MATERIALS AND METHODS

Twelve right-handed normal, healthy volunteer adults participated in the experiment. The stimuli consisted of gray photographs of 100 Oriental-Korean and 100 Caucasian-American and each 100 were split into 50 familiar and 50 unfamiliar groups. The faces were presented for 1000 ms, replacing a baseline of an oval checquerboard present throughout the interstimulus interval, with minimal SOA of 4.5 s and 100 randomly intermixed null events. Each subject were scanned during one session, In the session named the fame-judgment (implicit task), the 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 Caucasian-American. Incorrect answers were ignored. A 1.5T VISION system (Siemens Corps., Iselin, NJ) was used to acquired T2* weighted transverse EPI images (TR/TE/FA = 3000ms/60ms/90°, FOV=240 x 240mm^2, 24 axial slices, 5mm slice thickness with no gap). The acquired data were applied to SPM99 for the pre-processing such as realignment, normalization, spatial smoothing, and then the individual contrast images for the effect of interest were entered into one-sample **t**-tests to determine the group-level activation. The resulting statistical parametric maps of t-statistics at the each voxel were thresholded at **P < 0.001**; they were uncorrected for multiple comparisons. Statistical comparisons were made by one-way ANOVA between the Oriental-Korean and Caucasian-American faces.
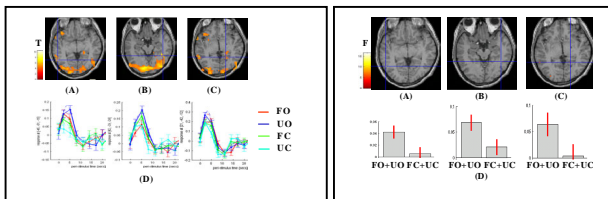
RESULTS

Fig.1.

Fig.2.

The event-related responses to all four types of responses (familiar Oriental-Korean, unfamiliar Oriental-Korean, familiar Caucasian-American, unfamiliar Caucasian-American) were extracted as described in our method section (Fig.1D). For the race discrimination as an implicit task, these regions showed a greater response to the presentation of Oriental-Korean faces than to the Caucasian-American faces. This pattern was confirmed by one-way ANOVA testing between the Oriental-Korean faces and Caucasian-American on the canonical parameter estimates (Fig. 2.D).

Fig.1. (A) The group activation map at the left fusiform area and (B) at the right fusiform area and (C) at the right parahippocampal gyrus. A lower statistical threshold was used (P < 0.001, uncorrected). (D) Event-related data, adjusted for confounding (FO as Familiar Oriental-Korean face, UO as Unfamiliar Oriental-Korean face, FC as Familiar Caucasian-American face, UC as Unfamiliar Caucasian-American face), was binned every 3s and then averaged over the subjects from corresponding regions based on peristimulus time (PST). Fig.2. (A) Orthogonal comparison: regions showing greater responses to the same-race faces (Oriental-Korean) than other- race faces(Caucasian-American), (FO+UO) – (FC+ UC), at the left fusiform area and (B) at the right fusiform area and(C) at the right parahippocampal gyrus. (D)Canonical Response (parameter estimates for the best-fitting canonical HRF) between the same-race and other-race faces [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)].

DISCUSSION

The main finding of this study was that greater activation in the bilateral fusiform gyri and right parahippocampal gyrus was observed with the presentation of the same-race faces compared to the other-race faces during the explicit perception of familiar faces among unfamiliar faces. 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 Caucasian-American faces as the explicit task by using the same methods of the present study. This finding indicates that there may be underlying mechanisms for face recognition due to the implicit knowledge that was revealed in task performance without any corresponding phenomenal awareness, and this implicit knowledge was inferred from the failures on subjective or objective measures of conscious perception (3,4). A further issue is the distinct process mediated by the fusiform regions that promote superior memory for same-race faces versus other-race faces. In the race evaluation of black and white social groups using fMRI, this may be more affected due to contrast differences such as contrast-polarity reversal than being due to any features (eyes, nose, mouth, hair etc.) used for identifying individual faces. We were focusing on the superiority of the same-race memory with a minimum of any contrast effect. Our results showed that any features identifying individual faces rather than any contrast difference caused by race groups could be the main factor used for race discrimination.

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