

# Ethnic Self-reference Effect: Behavioral and Event-related Potential Evidence

WANG Xi-ai<sup>1,2</sup>, FAN Wei<sup>2</sup>, LI Jin<sup>2</sup>, LI Hui-e<sup>2</sup>,

YI Wen-ting<sup>2</sup>, CHEN Zhi-yong<sup>2</sup>, ZHONG Yi-ping<sup>2</sup>

(1.Fuzhou Command Academy of Armed Police Forces, Fuzhou 350002, China;

2.Department of Psychology, Hunan Normal University, Changsha 410081, China)

**【Abstract】 Objective:** To examine an ethnic self-reference effect for members of ethnic minorities in China at explicit and implicit levels, respectively. **Methods:** Remember-Know(R/K) procedure was used in behavioral experiment and Event-related brain potentials were recorded when participants performed Oddball tasks in the ERP experiment. **Results:** A behavioral experiment showed that there was no significant difference between self-ethnicity and Han regarding recognition rate and R(remember) response. ERP experiment showed that the P2 amplitude elicited by self-ethnicity was larger than that elicited by Han and control ethnicity at the central and central-parietal sites. Self-ethnicity evoked a smaller N2 amplitude and larger P3 amplitude than Han and control ethnicity at all sites. Furthermore, this effect was more obvious in the left regional sites. **Conclusion:** The findings of this work suggest that there is no significant ethnic self-reference effect at the explicit level between ethnic minorities and Han. However, an ethnic self-reference effect was significant at an implicit level.

**【Key words】** Minority; Ethnic self-reference effect; ERP; Explicit; Implicit

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## 民族自我参照效应:行为和ERPs证据

王锡爱<sup>1,2</sup>, 范伟<sup>2</sup>, 李璿<sup>2</sup>, 李惠娥<sup>2</sup>, 易文婷<sup>2</sup>, 陈智勇<sup>2</sup>, 钟毅平<sup>2</sup>

<sup>1</sup>武警福州指挥学院,福州 350002;<sup>2</sup>湖南师范大学心理系,长沙 410081

**【摘要】 目的:**分别从内隐和外显层面研究少数民族的民族自我参照效应。**方法:**行为实验采用R/K范式进行研究,ERP实验采用Oddball范式进行研究。**结果:**行为实验表明自我民族同汉族在再认率和R反应上不存在显著差异;ERP实验表明,相对于汉族和对照民族而言,自我民族在头皮中部和后中部诱发了更大的P2波幅,在全脑诱发了更小的N2波幅和更大的P3波幅,且这种效应在左脑表现更为明显。**结论:**当以生活在汉族地区的少数民族为被试时,民族自我参照效应只存在于内隐层面而不存在于外显层面。

**【关键词】** 少数民族;民族自我参照效应;ERP;外显;内隐

## 1 INTRODUCTION

Performance while conducting a self-referential processing task has been found significantly higher than that of other referential processing tasks and is referred to as the self-reference effect. It has been explored through a variety of experimental manipulations. Information that is relevant to an individual participant tends to be remembered or recognized more than information related to other people. Sporadic indications regarding familiarity-like processes for recall have been provided by several studies, which used the Remember-Know(R/K) procedure for a free-recall paradigm<sup>[1,2]</sup>.

A growing body of studies showed that an event-related potential exists with the preferential processing of self-relevant stimuli. For example, a frontal P2 component was reported to have larger amplitudes during the processing of self-information, as compared with other related information, suggesting that self-related information elicits the enhanced recruitment of attention during early time points<sup>[3-5]</sup>. In addition, evidence has shown that a self-reference effect occurs with self-relevant stimuli following the N2 stage, such as one's own handwriting or the faces of persons of the same race. Specifically, self-relevant stimuli elicited smaller N2 amplitudes than self-irrelevant stimuli<sup>[6-9]</sup>. In addition to these early components, many other lines of research have found the role of P3 in reflecting the cogni-

tive processing of self-relevant information. For instance, highly self-relevant names elicited larger average P3 amplitudes than moderately self-relevant stimuli and minimally self-relevant stimuli<sup>[10]</sup>. Moreover, P3 amplitudes increased for one's own name compared to other names in a passive oddball task<sup>[5,10,11]</sup>.

Similarly, several related studies have also confirmed the existence of a collective self-reference effect. For example, in previous studies, the participants' colleges and families were selected as collective self-relevant stimuli. In contrast to non-collective self-referential encoding, recognition performance was better under the condition of collective self-referential encoding<sup>[12]</sup>. Once again, among participants who were Chinese, the findings demonstrated that recognition rates were significantly higher if trait words were encoded with Chinese references than with American references<sup>[13]</sup>. In addition, the existence of a collective self-reference effect has also been confirmed by a series of electrophysiology studies. Zhao et al. discovered that P3 amplitudes elicited by the names of the subjects' alma maters were significantly larger than those elicited by familiar and unfamiliar school names<sup>[11]</sup>. By using their own national flags as self-relevant stimuli to elicit the collective self, Fan et al. also suggested that participants' processing of their own national flags was better than that of familiar and unfamiliar national flags<sup>[14]</sup>.

As previously indicated, these studies regarding a collective self-reference effect primarily adopted different stimulus materials to induce different types of collective self-reference. However, these studies did not include assessment of individual interactions among the groups or the impact of cultural communication between groups. Therefore, by adopting a new kind of stimulus, in the present study we attempted to explore a new type of collective self-reference effect and an ethnic self-reference effect for a group other than that of a subject's own ethnicity. In the present study, we defined the ethnic self-reference effect as the phenomenon of performance under the self-ethnicity referential processing task being significantly better than that under an other-ethnicity referential processing task.

China has 56 ethnic groups, of which 55 are minorities. The population in China is over 1.3 billion,

with the Han occupying 92% of the total, while all 55-minority ethnicities comprise the remaining 8%. Because of the wide gap in population, each minority interacts mostly with Han people (other than self-ethnic interactions) during daily life. For this reason, each minority is inevitably influenced by Han culture. They speak Mandarin, wear Han costumes, celebrate Han holidays, and eat Han foods. Thus, knowledge of the minorities' specific languages, costumes, holidays, and dietary habits has slowly lessened and has even been forgotten. In this sense, little difference remains between these minorities and Han people.

However, some people believe this seeming lack of superficial difference belies significant differences at a deeper level. Because of the impact of traditional culture, a Chinese sense of identity with one's original group has been found deeply rooted into the subconscious<sup>[15]</sup>. Social identity theory also indicates that our identities are formed through the groups to which we belong, and it is believed that an in-group preference appears at an early age and proves to be lifelong<sup>[15]</sup>. Thus, we assume that while little difference is evident between each minority and the Han people at an explicit level, a stronger positive identity to self-ethnicity is maintained at an implicit level.

To verify the above-mentioned hypotheses, the present study attempted to examine an ethnic self-reference effect at both explicit and implicit levels for minorities living in Han regions. According to previous studies, as well as based on the current situation in China, we predicted there would be no significant ethnic self-reference effect at an explicit level among participants who were minorities living in Han regions. In contrast, we believed there would be a significant ethnic self-reference effect at an implicit level.

## 2 METHODS

### 2.1 Participants

Participants were 20 minority students (11 males; 9 females) aged 19 to 23 years (mean=21.3 years) who were enrolled in college and have lived in Han regions for 5-10 years (mean=7.6 years). All participants were healthy and right-handed, had normal or corrected-to-normal vision, and reported no history of brain injuries

or affective disorder. The study was approved by the ethical committee of the submitting author's academic institute, and each participant signed an informed consent for the experiment.

## 2.2 Materials

In the present study, we took the ethnicity to which each participant belonged as the collective self-referential category and Han as the comparison. To better illustrate group interaction, as well as the impact on the individual of ethnic group culture, we selected another minority as the control. To prevent familiarity with the stimuli and a self-reference effect<sup>[7]</sup>, we selected other minority groups with which each participant was most familiar as the control. The three categories of ethnic names were rated for familiarity on a nine-point scale(1=not familiar at all to 9=extremely familiar). The degree of familiarity was 8.33( $\pm$ 0.98) for self-ethnic names, 8.28( $\pm$ 1.09) for Han, and 8.12( $\pm$ 1.49) for control ethnic names. A post-experiment analysis showed no significant differences among the three categories of stimuli,  $F(2, 38)=1.11, P>0.05$ .

## 2.3 Procedures

**2.3.1 Behavioral experiment** In the present experiment, we employed an R/K paradigm to examine the ethnic self-reference effect at an explicit level. The stimuli included 240 adjective traits selected from the Chinese Trait Adjective Words Bank, among which one-half were positive items and one-half were negative items. Of them, 120 words were used for learning and marked as old items; the rest of the 120 words were used as distractors in a recognition test and marked as new items. After matching the positive and negative items, the numbers of words, word frequency, and stimuli were arranged in random order into three blocks. To eliminate a serial position effect, we arranged four words as buffer items before and after each block.

The formal experiment was divided into two phases: a learning phase and a test phase. Experimental stimuli were presented on a computer screen. During the learning phase, the participants performed three tasks: self-ethnicity referential processing(does this word describe people of your ethnicity?), Han referential processing(does this word describe Han people?),

and control-ethnicity referential processing (does this word describe people of XX ethnicity?). For each word, the participants responded on a five-point scale(1=not suitable at all to 5=extremely suitable). The different tasks were performed in different blocks, and the order was counterbalanced across the participants to control for a possible order effect. After completing the learning phase, the participants began recognition tests after a 3-minute break. In the initial recognition phase, for each item presented to them, the participants had to decide whether they recognized it by answering yes or no. If they answered yes, they were instructed to provide a response of R(remember; meaning they could recall a specific experience related to the item) or K(know; meaning they only had a feeling of familiarity but without specific details).

**2.3.2 ERP Experiment** In the present experiment, a three-stimulus passive oddball paradigm was employed to examine the ethnic self-reference effect at an implicit level. Five categories of stimulus were used in this paradigm. A small circle was used as the target stimulus, a big circle was used as the standard stimulus, and the three categories of ethnic names were used as deviants. The whole experiment contained 800 trials in total, divided into four blocks. There were several minutes for rest between blocks. The sequence of stimuli was randomized across subjects. In each block, the big circle was presented 144 times(72%), the small circle was presented 20 times(10%), and each category of ethnic name was presented 12 times(6%), respectively.

Subjects were seated in a quiet room at approximately 150 cm from the screen with horizontal and vertical visual angles below 5°. Each trial was initiated with a 300 ms presentation of a small white cross on a black computer screen, then a blank screen which varied randomly from 800–1200 ms, followed by one of the five categories of stimuli for 500 ms. After the presentation of the visual stimulus, a blank screen was shown for 1000 ms. The task of the participants was to observe carefully and make a behavioral response only to the small circle as soon as possible. The stimulus was terminated by a key press, or was terminated when it elapsed for 500 ms. No response was required for the big circle or the three categories of ethnic names.

The ERPs in each stimulus condition were averaged separately off-line with averaging epochs beginning 200 ms prior to and ending 600 ms after the onset of the stimulus. Trials affected by eye blinks(VEOG exceeding $\pm 50\mu V$  relative to baseline) or other artifacts(a voltage exceeding $\pm 50\mu V$  at any electrode location relative to baseline) were considered contaminated and excluded. The following 15 electrode sites were selected for statistical analysis: F3, FC3, C3, CP3, P3(left sites); Fz, FCz, Cz, CPz, Pz(midline sites); and F4, FC4, C4, CP4, P4(right sites). A three repetition measures analysis of variance was conducted for latency and amplitude of P2, N2 and P3. The corresponding ANOVA variables were stimulus type(self-ethnicity, Han, control ethnicity), frontality(front, front-central, central, central-parietal, parietal sites) and laterality(left, middle, right sites). The degrees of freedom for the F-ratio were corrected according to the Greenhouse-Geisser method.

The EEG was continuously recorded from 64 scalp electrodes located according to the international 10-20 system. All electrodes referenced to an electrode at the left mastoid and re-referenced off-line to an electrode at the bilateral mastoid. The horizontal EOG was recorded from two electrodes placed 1.5 cm lateral to the left and right outer canthi, and the vertical EOG was recorded from two electrodes below and above the left eye. The impedance was kept below 5 k. EEG was amplified and digitized at a sampling rate of 250 Hz.

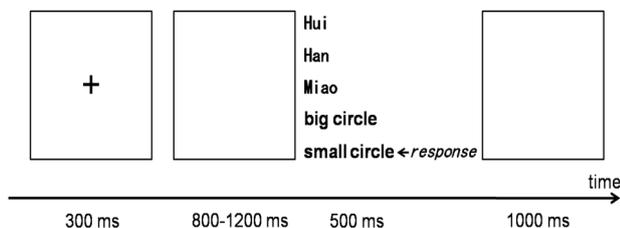


Figure 1 The sequence of events in an experimental trial

### 3 RESULTS

#### 3.1 Behavioral results

As shown in Table 1, an ANOVA revealed a significant main effect of task type,  $F(2, 38)=14.71, P<0.001$ , a significant main effect of R/K response,  $F(1,$

$19)=7.28, P<0.01$ , and the Task Type $\times$ R/K Response interaction was also significant,  $F(2, 38)=12.86, P<0.001$ . Further analysis discovered that the performance for self-ethnicity was significantly higher than for the control,  $F(1, 19)=3.63, P<0.05$ , but there was no significant difference with performance for Han,  $F(1, 19)=1.13, P=0.141$ . In the R response, self-ethnicity was significantly higher than the control,  $F(1, 19)=4.05, P<0.05$ , but there was little difference between the Han and self-ethnicity conditions,  $F(1, 19)=1.09, P=0.168$ . In the K response, there were no significant differences among three types of stimuli.

Table 1 Recognition rate and R/K response of three processing tasks

Results	S-E	H	C-E	Old items	New items
recognition rate	0.81	0.79	0.62	0.74	0.17
R	0.59	0.56	0.37	0.51	0.06
K	0.22	0.23	0.25	0.23	0.11

Note: S-E=self-ethnicity; H=Han; C-E=control ethnicity

#### 3.2 ERP results

As shown in Fig. 2, there were significant components of P2, N2 and P3 in the three tasks. ANOVAs indicated no main effects or interactions of latency for each component. For the amplitude of P2, the main effect of stimulus type was significant,  $F(2, 38)=2.91, P<0.05$ . Post-hoc tests discovered that P2 amplitudes elicited by self-ethnicity were significantly larger than those for Han,  $F(1, 19)=1.66, P<0.05$ , and for the control ethnicity,  $F(1, 19)=1.78, P<0.05$ , and the difference between Han and the control ethnicity was not significant. An interaction between stimulus type and frontality was significant,  $F(8, 152)=3.98, P<0.05$ . Simple effect analysis discovered that self-ethnicity evoked larger P2 amplitudes than other stimuli at the central,  $F(1, 19)=3.17, P<0.05$ , and central-parietal sites,  $F(1, 19)=3.30, P<0.05$ .

For the amplitude of N2, a main effect of stimulus type was significant,  $F(2, 38)=3.39, P<0.05$ . A post-hoc test discovered that the amplitude for self-ethnicity was smaller than for Han,  $F(1, 19)=2.12, P<0.05$ , and the control ethnicity,  $F(1, 19)=1.99, P<0.05$ , but the difference between Han and the control ethnicity was not significant. A interaction between stimulus type and frontality was significant,  $F(8, 152)=13.15,$

$P < .001$ , and simple effect analysis discovered that self-ethnicity elicited smaller N2 amplitudes than other stimuli at all sites, all  $F_s(1, 19) > 3.60$ , all  $P_s < 0.05$ . The Stimulus Type  $\times$  Laterality interaction was also significant,  $F(4, 76) = 5.08$ ,  $P < 0.05$ , and simple effect analysis discovered that amplitudes of N2 elicited by self-ethnicity at left-brain sites was significantly smaller than at middle-brain,  $F(1, 19) = 3.26$ ,  $P < 0.05$ , and right-brain sites,  $F(1, 19) = 4.02$ ,  $P < 0.05$ , but there was no significant difference between middle-brain and right-brain sites in amplitudes of N2.

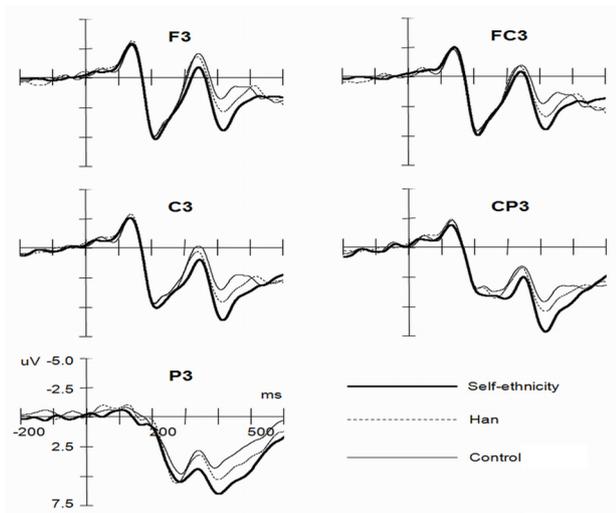


Figure 2 Averaged ERPs at F3, FC3, C3, CP3, and P3 for self-ethnicity, Han, and control stimuli

Regarding P3 amplitude, an ANOVA revealed a significant main effect of stimulus type,  $F(2, 38) = 4.06$ ,  $P < 0.05$ , and amplitudes of P3 elicited by self-ethnicity were significantly larger than those of Han,  $F(1, 19) = 2.07$ ,  $P < 0.05$ , and control ethnicity,  $F(1, 19) = 2.41$ ,  $P < 0.05$ , and amplitudes of P3 elicited by Han were significantly larger than those of control ethnicity,  $F(1, 19) = 1.84$ ,  $P < 0.05$ . The Stimulus Type  $\times$  Frontality interaction was significant,  $F(8, 152) = 4.09$ ,  $P < 0.05$ , and simple effect analysis discovered that self-ethnicity evoked greater P3 amplitudes than other stimuli at all sites, all  $F_s(1, 19) > 2.51$ , all  $P_s < 0.05$ . An interaction between stimulus type and laterality was significant,  $F(4, 76) = 5.60$ ,  $P < 0.05$ , and simple effect analysis discovered that amplitudes of P3 elicited by self-ethnicity at left-brain sites were significantly greater than at middle-brain,  $F(1, 19) = 4.06$ ,  $P < 0.05$ , or right-brain sites,  $F(1, 19) = 4.32$ ,  $P < 0.05$ , but there was no significant dif-

ference between middle-brain and right-brain sites in the P3 amplitude.

#### 4 DISCUSSION

In the R/K paradigm, an R response indicates whether the word was recollected and its retrieval accompanied by associated and contextual details, while a K response indicates only that the word evoked a sense of familiarity, without any accompanying contextual details. An R response is more sensitive to self-referential processing than a K response. The behavioral experiment showed that there was no significant difference between self-ethnicity and Han regarding the recognition rate and R response. These results illustrated that reference effects for self-ethnicity and Han were of the same extent, so no significant ethnic self-reference effect existed for this distinction that would correlate with results of previous studies regarding racial groups. A contact hypothesis has suggested that other-race experience may influence other-race face perception<sup>[16]</sup>. Slone et al. determined that the more other-race experience an individual has, the better they are at discriminating and recognizing other-race faces<sup>[17]</sup>. It is believed that communications and interactions with members of an out-group might enhance the positive identity of the out-group<sup>[18]</sup>. In the present work, all participants were minorities from Han regions, and they had numerous interactions with Han people during daily life. This interaction might produce a positive identity with Han culture, and the degree of recognition that was as extensive as for one's own ethnicity. After all, this was a performance of culture adaptation<sup>[19]</sup>.

However, we included other minorities, which were well known by the participants as a contrast condition. The minority participants who lived in Han regions might have communications and interactions with other minorities, but those were most likely to occur within an environment dominated by Han culture. Thus, the recognition rate and R response of the control ethnicity were significantly smaller than for Han and self-ethnicity, illustrating that despite familiarity with a certain minority, it was hard to produce a sense of identity with that group without direct influence by the culture of that ethnicity.

In the ERP experiment, self-ethnicity elicited

greater P2 amplitudes than Han and control ethnicity at the central and central-parietal sites, which might reflect a faster brain detection of these properties. Previous studies showed that more attention would be accepted for stimuli with stronger biological importance<sup>[20]</sup>. In the present experiment, self-ethnicity might be considered as directly linked with the individual participant at the biological level. This would indicate that early attention to stimuli related to self-ethnicity was rapidly differentiated from other stimuli in the brain, because of their salient biological importance.

Self-ethnicity elicited smaller N2 amplitudes than Han and control ethnicity, which was consistent with previous studies concerning one's own name, province, face, and handwriting<sup>[6,7]</sup>. Because of the importance of ethnic values to individuals, the participants' own ethnicity was recognized more easily, with less top-down cognitive resource consumption than for other ethnicities. This difference was most significant for the left brain, reflecting a left-brain advantage for processing ethnic stimuli. There was no significant difference in N2 amplitude between Han and control ethnicity, showing that information was roughly processed at these early stages and that more elaborate processing might be observed at later cognitive processing stages.

All three stimuli types elicited obvious P3 components. As compared with Han and control ethnicity, self-ethnicity elicited larger P3 amplitudes. P3 has been found to be related to cognitive resource allocation<sup>[6,7,21]</sup>; the more cognitive resources allocated, the larger the P3 amplitudes. Therefore, the larger P3 amplitudes observed while processing self-ethnicity indicated that the participants unconsciously used more cognitive resources for self-ethnicity. Additionally, it has been suggested that the P3 amplitude is modulated by emotion and that larger P3 amplitudes are elicited by emotional stimuli, as opposed to neutral stimuli<sup>[22]</sup>. In the present study, the self-relevant stimulus was the participant's own ethnicity, which involves a stronger sense of belonging, thus it might have evoked a stronger emotional response. In summary, a stronger emotional response, as well as an enhanced attention to self-ethnicity, would contribute to a greater P3. Otherwise, the results of the behavioral experiment showed that there was no

significant distinction between Han and self-ethnicity at an explicit level, showing that participants partly incorporated Han culture into their own self-identity, and the two could be differentiated only after elaborative processing. This effect was more prominent in the left brain, indicating that the processing of self-ethnicity had a left-brain advantage.

Therefore, judging from the processing time course, self-ethnicity had a processing advantage during the P2, N2, and P3 processing stages that showed the brain was sensitive to self-ethnicity and that an ethnic self-reference effect occurred during not only during the late P3 processing stage, but also in the early P2 and N2 processing stages. Some research has shown a processing bias for familiar materials, as compared with unfamiliar materials(Beauchemin et al., 2006; J. Chen et al., 2011). In other words, familiarity with the stimuli could cause contamination, if it were not equated in self-relevant studies. The present study excluded a familiarity disturbance by balancing familiarity with the stimuli, illustrating that a processing advantage for self-ethnicity was not elicited by familiarity with the stimuli. Therefore, our behavioral and ERP effects were most likely specific for the degree of identity with different ethnicities and thus further illustrated that participants had a stronger sense of identity to self-ethnicity.

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