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Losing oneself upon placement in another's position: The influence of perspective on self-referential processing

Tianyang Zhang [a], Ying Zhu [a], Yanhong Wu [a,b,*]

[a] Department of Psychology, Peking University, Beijing, China
[b] Key Laboratory of Machine Perception (Ministry of Education), Peking University, Beijing, China

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ABSTRACT

Self-referential processing is considered to be an essential index for exploring self-consciousness. However, whether perspective is the determining factor of the self-reference effect (SRE), which is accompanied by self-referential processing, has not been established. The present study aims to address this issue by using a self-reference paradigm, in which the participants perform a self-reference task while adopting different perspectives. Our results showed that trait words presented with the self in the first-person perspective (1PP) were better remembered compared to trait words presented with others. Interestingly, these SREs were decreased and even reversed in the third-person perspective. When the participants viewed themselves based on their friend's perspective, no significant difference was found between the recognition performances of self- and friend-trait words. Moreover, an improved "remember" recognition performance of friend-trait words was found. These findings support the assumption that the 1PP is a necessary factor for self-advantage in self-referential processing.

1. Introduction

Humans are social animals. To maximize the likelihood of survival in the social environment, one needs the abilities to distinguish and reflect the "self" from the context of its environment or from others (Decety & Sommerville, 2003; Gallagher, 2000; Vogeley & Fink, 2003). Self-referential processing is arguably the most important cognitive processing of self-other representations in human interactions. Numerous behavioral studies on self-referential processing have employed the self-reference paradigm, which requires the participants to evaluate trait words in relation to self or to others and recall the words subsequently in an unexpected memory test (Klein & Loftus, 1988; Klein, Rozendal, & Cosmides, 2002; Rogers, Kuiper, & Kirker, 1977). These studies found that relative to the others-trait words, words associated with oneself elicit a memory advantage. This memory advantage is currently known as the self-reference effect (SRE), and it has been demonstrated in a wide range of materials (Kesebir & Oishi, 2010; Kim & Johnson, 2012; Sui, He, & Humphreys, 2012; Turk et al., 2011; Turk, Cunningham, & Macrae, 2008). Consistent with the behavioral findings, several neuroimaging studies have found that hemodynamic responses in the ventral medial prefrontal cortex (vMPFC) and posterior cingulate cortex increase trait judgments of the self relative to others (Han et al., 2008; Heatherton et al., 2006; Jenkins & Mitchell, 2011;

* Corresponding author. Address: Department of Psychology and Key Laboratory of Machine Perception (Ministry of Education), Peking University, 5 Yiheyuan Road, Beijing 100871, China. Fax: + 86 10 6275 5508.
E-mail address: wuyh@pku.edu.cn (Y. Wu).

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Kelley et al., 2002; Lombardo et al., 2010; Moran, Heatherton, & Kelley, 2009; Wu, Wang, He, Mao, & Zhang, 2010; Zhu, Zhang, Fan, & Han, 2007).

A central question in self-referential processing concerns the account and critical influence factor of self-advantage (Klein & Loftus, 1988; Ma & Han, 2010; Symons & Johnson, 1997; Wang, Zhang, & Sui, 2011). Many investigators have noted that human adults not only can assess or remember information related to themselves in their own perspective but also can assess or remember information by adopting the perspective of another person, seeing themselves "from the outside" (Nigro & Neisser, 1983; Robinson & Swanson, 1993; Ruby & Decety, 2004; Ruby et al., 2009; Vogeley et al., 2004). Several investigators have suggested that the perspective may be responsible for self-advantage (Vogeley & Fink, 2003; Vogeley et al., 2004; Wang et al., 2011). For instance, Vogeley and Fink (2003) proposed that the first-person perspective (1PP) is insufficient but necessary for human self-consciousness because the 1PP refers to the centeredness of one's own multimodal experiential space upon one's own body. Consistent with this notion, Wang et al. (2011) used a face orientation identification task to assess the function of the third-person perspective (3PP) in the self-advantage effect by manipulating the perspective. In this study, self-face or friend-face was randomly presented in different orientations on a computer screen; the participants had to judge the orientations of faces from their own position or from another person's position as quickly and accurately as possible within 1000 ms. Wang et al. found that the advantage effect was decreased in the 3PP. They also suggested that the self-advantage in face processing is evident among the participants who adopted the 1PP.

Although these findings support the assumption that self-face advantage benefits from the 1PP, whether the advantage effect is concealed under the difficult 3PP task has not been established (Zacks, Rypma, Gabrieli, Tversky, & Glover, 1999). From the previous results, the participants might sacrifice reaction time to ensure accuracy in the 3PP condition. Moreover, the studies mentioned above specifically concerned perspective in space or action; whether these results could generalize to a perspective on a more abstract level (e.g., perspective in language, nonverbal memory, social interaction or self-reflection) has not been defined. Meanwhile, previous studies have likewise found that self-related information can be categorized to that related to the physical self (e.g., self-face recognition, body recognition or agency) and the psychological self (e.g., personal traits judgment, autobiographical memory). Although some research has reported that making judgments about one's own personality traits, current mental states, and physical attributes share the same neural response modality (Jenkins & Mitchell, 2011), self-face recognition and personal traits judgment manifest in different behavioral and neural response modalities (Devue & Brédart, 2011; Gillihan & Farah, 2005; Van der Meer, Costafreda, Aleman, & David, 2010). Therefore, whether a perspective is responsible for self-advantage and whether the SRE based on self-referential processing is also involved in a perspective have not been established. Additionally, reasons that explain why the 1PP is necessary for self-advantage and why the 3PP can eliminate self-advantage have not been identified.

Compared with completing a face orientation identification task in the other person's position, a simpler task for participants is to reflect on their or others' personal traits in the other person's perspective, given that human adults need to use this social interaction skill to "read other's minds" in everyday life (Baron-Cohen, 1997). In fact, several earlier studies have explored the neural activity of self-referential processing in different perspectives using the self-reference paradigm (D'Argembeau et al., 2007; Ochsner et al., 2005; Ruby et al., 2009). However, these studies have primarily focused on distinct neural regions associated with self-referential processing and perspective and not on whether the perspective is responsible for self-advantage. From the behavioral data, we could not find direct evidence for the perspective that is responsible for self-advantage: Ochsner et al. (2005) found that response times for judgments involving direct appraisals or reflected appraisals (self in the other person's perspective) were made with similar speed; D'Argembeau et al. (2007) found that the primary effect of response times for judgment target and the interaction between judgment target and perspective was not significant. D'Argembeau et al. (2007) noted that different regions of the MPFC are related to self-referential processing and perspective and that the adopted 3PP can decrease self-referential neural processing in the left dorsal MPFC using MRI data. This finding implied that adopting different perspectives might affect self-advantage in self-referential processing.

In the present study, we used a self-reference task in conjunction with different instructions; we measured memory performances to examine whether adopting 3PP during self-referential processing would impair SRE. We used a mixed design with between-subject measures concerning a perspective factor, in which a participant only needs to adopt one kind of perspective (i.e., 1PP or 3PP). This design reduces the difficulty of 3PP, given that the participants do not need to repeatedly change their perspectives within the experimental task (Turk et al., 2012). Before the experiment, the participants were asked to choose a close friend. For the 3PP condition, the participants were instructed to imagine for a minute that they are placed in their friend's position; i.e., they need to represent their friend's knowledge or experience instead of their own knowledge or experience. Moreover, we carefully manipulated the cues of personal traits judgment task in the 3PP condition (see Method). Specifically, we unified the perspectives of the two pronouns in the cue sentence. For example, we used the following: "According to Tianyang Zhang (a close friend's name), is Zhijun Cao (participant's own name) optimistic?", instead of "According to Tianyang Zhang (a close friend's name), are you optimistic?" Using this type of manipulation, we avoid the possible confounding factor of perspective waving triggered by the change of pronouns within the trial. Furthermore, the purer effect caused by the 3PP is observed because pronouns, such as I or you, may promote a 1PP processing (Brunyé, Ditman, Mahoney, Augustyn, & Taylor, 2009). If the 1PP is an essential factor for self-advantage, SRE should be decreased or reversed when the participants adopt the 3PP. Alternatively, if the 1PP does not involve self-advantage, SRE should be unaffected by the perspective change.

2. Method

2.1. Participants and design

A total of 42 healthy Chinese participants (26 females and 16 males; 22 ± 2 years old) participated in the experiment. Half of the participants were assigned to the 1PP condition (13 females and 8 males; 22 ± 2 years old), and the other half were assigned to the 3PP condition (13 females and 8 males; 22 ± 2 years old). The participants were all right-handed and had normal or corrected-to-normal visual acuity. None of them had a history of neurological or psychiatric disorders. All of the participants provided informed consent prior to the experiment in accordance with Peking University's Psychology Ethics Committee. The experiment had a 2 (perspective: 1PP or 3PP) × 3 (the type of referential processing: self, close friend, or famous person) mixed design, with repeated measures on the second factor.

2.2. Procedure and stimulus materials

The participants were first asked to elicit trait judgments based on the 1PP or 3PP condition. In the 1PP condition, the participants were asked to judge, in their opinion, whether an adjective properly describes a specific person. The persons included were (1) self (e.g., "在你看來, 自己是樂觀的嗎?"["According to you, are you optimistic?"]), (2) a friend (e.g., "在你看來, 張天陽是樂觀的嗎?" ["According to you, is Tianyang Zhang optimistic?"]), and (3) someone famous (e.g., "在你看來, 姚明是樂觀的嗎?" ["According to you, is Ming Yao optimistic?"]). In the 3PP condition, the participants were asked to adopt a close friend's perspective during the entire experiment and judge whether an adjective properly describes a specific person. The persons included were (1) self (e.g., "在張天陽看來, 曹志軍是樂觀的嗎?" ["According to Tianyang Zhang (a friend's name), is Zhijun Cao (participant's own name) optimistic?]"), (2) a friend (e.g., "在張天陽看來, 自己是樂觀的嗎?" ["According to Tianyang Zhang, is Tianyang Zhang optimistic?"]), and (3) a famous person (e.g., "在張天陽看來, 姚明是樂觀的嗎?" ["According to Tianyang Zhang, is Ming Yao optimistic?"]). Each trial in the trait judgment tasks consisted of a "cue" sentence (white on a black background) above a personality trait adjective that appeared at the center of the screen for 2000 ms. The "cue" sentence and adjective disappeared, and then the participants had to respond within 3000 ms. After one practice block of five trials, each participant completed nine experimental blocks of 16 trials. Within each experimental block, the participants were asked to respond to one specific person.

After the trait judgment tasks, the participants received instructions for completing a numerical cancellation test within 5 min. During this time period, the participants were instructed to circle all the number 7s in a random number (integer, 0–9) matrix on the papers. This task was used to interfere with the participants' memory and prevent the participants from thinking about other things. After completing this task, the participants were asked to answer an unexpected recognition memory test. A total of 144 previously seen words and 144 never-seen words were randomly presented. The participants made "old" or "new" judgments using the keyboard without a time limit. If an "old" response was selected, they were asked to make a remember/know (R/K) judgment. If the participants could consciously recollect having seen the word in the trait judgment task and could retrieve any specific detail regarding the word, they were instructed to make a "remember" response. However, if they selected an "old" response simply based on a feeling of knowing and could not recollect any detail, they were instructed to make a "know" response. The memory for words can be classified into two types (Tulving, 1985; Van den Bos, Cunningham, Conway, & Turk, 2010; Williams, Conway, & Moulin, 2013): the subjective recollective experience (R-judgment) and the feeling of familiarity (K-judgment). Conway and Pleydell-Pearce suggested that the memory performance of R-judgment should be a solid index to reflect self-referential cognition (Conway & Pleydell-Pearce, 2000). If the 1PP is an essential factor for self-advantage in self-referential cognition, we predicted that R-judgment would be decreased, whereas K-judgment would be increased when the participants assessed a self-trait word in 3PP because the participants might perceive themselves as though they were assessing another person. In contrast, when the participants assessed friend-trait word in the friend's perspective, R-judgment would be increased, whereas K-judgment would be decreased.

A total of 288 unique Chinese adjectives were selected from those used in previous studies on personality trait adjective judgments. Each adjective consisted of two Chinese characters. Half of the words were positive and the other half were negative. Each of the Chinese characters subtended 1.0° ("cue" sentence) or 2.0° (trait adjective) visual angle. The experiment was conducted in a dimly lit room, in which the participants sat approximately 60 cm away from a 21-in. cathode ray tube monitor (1024 × 768 pixel resolution, 85 Hz refresh rate). The participants' responses were recorded using a keyboard. At the end of the experiment, the participants assigned the real scores of the adaptability and cohesion scale, which were obtained from the Chinese Interpersonal Relationship Scale.

3. Results

3.1. Real scores of the adaptability and cohesion scale

The independent sample *t*-test, which was applied to the real scores of the adaptability and cohesion scale data of the experiment, showed no significant difference in the real scores of the adaptability and cohesion scale between the 1PP

and 3PP conditions [$t(40) = -.735$; $p = .467$]. This finding indicates that no difference exists between the participants' and their close friends' adaptability and cohesion in the 1PP ($M = 23.1$; $SD = 3.0$) and 3PP ($M = 23.7$; $SD = 2.5$) conditions.

3.2. Corrected recognition scores

The mean corrected recognition scores (proportion of hits minus false alarms) in the recognition memory test were calculated for the six experimental conditions (Table 1) and were submitted to a 2 (perspective: 1PP or 3PP) × 3 (the type of referential processing: self, close friend, or famous person) mixed-design ANOVA, with the between-subjects factor perspective. The primary effect of the type of referential processing was significant [$F(2,40) = 53.52$; $p < .001$]. The post hoc pairwise comparisons revealed that the words encoded in the self-referential condition (mean, .63) garnered better memory compared to those encoded in either the close friend (mean, .59; $t(41) = 3.18$; $p < .005$, two-tailed) or famous (mean, .50; $t(41) = 9.23$; $p < .001$, two-tailed) referential conditions. Moreover, the words encoded in the friend-referential condition (mean, .59) garnered better memory compared to those encoded in the famous-referential condition (mean, .50; $t(41) = 6.57$; $p < .001$, two-tailed). Interestingly, we found a reliable perspective × type of referential processing interaction [$F(2,40) = 6.57$; $p = .002$]. The simple effects analysis revealed a significant effect of the type of referential processing in both the 1PP [$F(2,40) = 35.41$; $p < .001$] and 3PP [$F(2,40) = 24.68$; $p < .001$] conditions. The planned t-tests on simple effects showed that for the 1PP condition, the words encoded in the self-referential condition (mean, .68) resulted in improved memory compared to those encoded in the friend-referential condition (mean, .59; $t(20) = 4.44$; $p < .001$, two-tailed). However, for the 3PP condition, no difference was found between the self – (mean, .59) and friend – (mean, .59; $t(20) = -.254$; $p = .802$, two-tailed) referential conditions. Additionally, the simple main effects analysis also revealed a significant effect of perspective on the self-referential condition [$F(1,40) = 5.49$; $p < .05$]. A significant decrease in memory was found in the 3PP condition compared to the 1PP condition (Fig. 1A). However, whether this attenuation of the self-related memory is due primarily to fewer hits, larger false alarms, or a combination of the two is ambiguous. Independent sample t-tests revealed that for the self-referential condition, the proportion of hits in the 3PP condition (mean, 0.79) was marginal and significantly fewer than the hits in the 1PP condition (mean, .87; $t(40) = -1.89$; $p = .065$, two-tailed); however, no difference was found between the proportion of false alarms in the 3PP condition (mean, .20) and 1PP condition (mean, 0.19; $t(40) = .49$; $p = .621$, two-tailed). This finding indicates that the attenuation of the self-reference effect is attributed to the participants who were unable to recognize "old" self-related words, rather than to the participants who tended to regard "new" words as words they have observed. Moreover, no significant main effect of perspective was found [$F(1,40) = 1.73$, ns].

Considering the word valence influences, the mean corrected recognition scores were submitted to a 2 (perspective: 1PP or 3PP) × 3 (type of referential processing: self, close friend, or famous person) × 2 (word valence: positive, or negative) mixed-design ANOVA. In a similar pattern analyzed above, there was a main effect of the type of referential processing

Table 1
Mean corrected recognition scores, R/K scores, and standard deviations (SDs) in six experimental conditions.

Measure	1PP			3PP		
	Self Mean (SD)	Friend Mean (SD)	Famous Mean (SD)	Self Mean (SD)	Friend Mean (SD)	Famous Mean (SD)
Recognition	.68 (.12)	.59 (.11)	.53 (.09)	.59 (.12)	.59 (.11)	.48 (.11)
Remember	.64 (.10)	.47 (.13)	.43 (.10)	.50 (.16)	.55 (.14)	.40 (.18)
Know	.03 (.06)	.12 (.10)	.10 (.10)	.09 (.13)	.04 (.09)	.08 (.12)

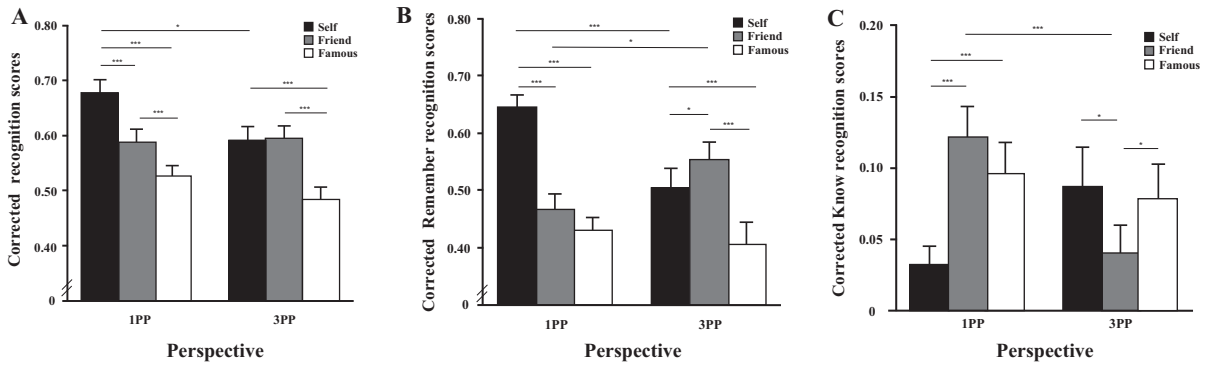

Fig. 1. Mean of corrected recognition scores (±SEM) as a function of the type of referential processing and perspective. $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

[$F(2,40) = 18.57$; $p < .001$] and an interaction between the type of referential processing and perspective [$F(2,40) = 3.41$; $p < .05$]. However, the main effect of word valence, the interaction between word valence and perspective, and the three-way interaction were not significant [$F(1,40) = 1.02$, *ns*, $F(1,40) = .12$, *ns* and $F(1,40) = 1.62$, *ns*, respectively].

3.3. Corrected "remember" recognition scores

For the "remember" responses, the corrected remember scores (proportion of hits minus false alarms) in the recognition memory test were calculated for the six experimental conditions (Table 1) and were submitted to a 2 (perspective: 1PP or 3PP) × 3 (type of referential processing: self, close friend, or famous person) mixed-design ANOVA, using the between-subjects factor perspective. Based on the total corrected recognition scores, the main effect of the type of referential processing was also significant [$F(2,40) = 40.54$; $p < .001$]. More importantly, we observed a reliable perspective × type of referential processing interaction [$F(2,40) = 21.27$; $p < .001$]. The simple main effects analysis revealed a significant effect of the type of referential processing, which was observed in both the 1PP [$F(2,40) = 43.10$; $p < .001$] and 3PP [$F(2,40) = 18.71$; $p < .001$] conditions. The planned *t*-tests on simple effects showed that for the 1PP condition, the words encoded in the self-referential condition (mean, .64) garnered better memory compared to those encoded in the friend-referential condition (mean, .47; $t(20) = 6.33$; $p < .001$, two-tailed). However, for the 3PP condition, the words encoded in the friend-referential condition (mean, .55) garnered better memory compared to those encoded in the self-referential condition (mean: .50; $t(20) = 2.298$; $p < .05$, two-tailed). The simple main effects analysis also revealed the significant effects of perspective on self-[$F(1,40) = 11.40$; $p = .002$] and friend-[$F(1,40) = 4.24$; $p < .05$] referential conditions. The self-related "remember memory" was significantly lower in the 3PP condition than in the 1PP condition, whereas the friend-related "remember" memory was considerably higher in the 3PP condition than in the 1PP condition (Fig. 1B). Further independent sample *t*-tests revealed that for the self-referential condition, the proportion of hits in the 3PP condition (mean, .60) was significantly fewer than the hits in the 1PP condition (mean, .74; $t(40) = -2.77$; $p = .009$, two-tailed); for the friend-referential condition, the proportion of hits in the 3PP condition (mean, .65) was marginally and significantly larger than the hits in the 1PP condition (mean, .55; $t(40) = 1.85$; $p = .072$, two-tailed); however, no difference was found between the proportion of false alarms in the 3PP condition (mean, .10) and the 1PP condition (mean, .09; $t(40) = .31$; $p = .757$, two-tailed). These findings indicate that the reason for attenuating self-related "remember memory" is attributed to the participants who were unable to recognize "old" self-related words, and the reason for enhancing friend-related "remember" memory is attributed to the participants who were able to recognize more "old" friend-related words. No significant main effect of perspective was found [$F(1,40) = 0.505$, *ns*].

Considering the word valence influences, the mean corrected "remember" recognition scores were submitted to a three-factor, mixed-design ANOVA. In a similar pattern analyzed above, there was a main effect of the type of referential processing [$F(2,40) = 38.09$; $p < .001$] and an interaction between the type of referential processing and perspective [$F(2,40) = 12.42$; $p < .001$]. However, the main effect of word valence, the interaction between word valence and perspective, and the three-way interaction were not significant [$F(1,40) = 2.67$, *ns*; $F(1,40) = .14$, *ns*; and $F(1,40) = 3.28$, *ns*, respectively].

3.4. Corrected "know" recognition scores

For the "know" responses, the corrected know scores (proportion of hits minus false alarms) in the recognition memory test were calculated for the six experimental conditions (Table 1) and were submitted to a 2 (perspective: 1PP or 3PP) × 3 (type of referential processing: self, close friend, or famous person) mixed-design ANOVA. The results showed a significant main effect of the type of referential processing [$F(2,40) = 3.12$; $p = .05$], with memory for words encoded in the self-referential condition (mean, .06) being characterized by fewer "know" responses compared to the friend-referential condition (mean, .09; $t(41) = -2.19$; $p < .05$) that were remembered. We also observed a significant perspective × type of referential processing interaction [$F(2,40) = 17.37$; $p < .001$]. The simple main effects analysis revealed the significant effect of the type of referential processing in both the 1PP [$F(2,40) = 15.90$; $p < .001$] and 3PP [$F(2,40) = 4.58$; $p < .05$] conditions. The planned *t*-tests on simple effects showed that for the 1PP condition, the memory for words encoded in the self-referential condition (mean, .03) were characterized by fewer "know" responses compared to that for words encoded in the friend – (mean, .12; $t(20) = -5.97$; $p < .001$, two-tailed) and famous – (mean, .10; $t(20) = -4.16$; $p < .001$, two-tailed) referential conditions that were remembered. However, for the 3PP condition, the memory for words encoded in the friend-referential condition (mean, .04) were characterized by fewer "know" responses compared to that for words encoded in the self – (mean, .09; $t(20) = -2.23$; $p < .05$, two-tailed) and famous – (mean, .08; $t(20) = -2.38$; $p < .05$, two-tailed) referential conditions that were remembered. Additionally, the simple main effects analysis revealed the significant effects of perspective on the friend-referential condition [$F(1,40) = 7.62$; $p < .01$]. That is, the friend-related "know" memory was significantly lower in the 3PP condition compared to the 1PP condition (Fig. 1C). No significant main effect of perspective was found [$F(1,40) = 0.279$, *ns*].

Furthermore, considering the word valence influences, the mean corrected "know" recognition scores were submitted to a three-factor, mixed-design ANOVA. In a similar pattern, there was a main effect of the type of referential processing [$F(2,40) = 6.91$; $p < .01$] and an interaction between the type of referential processing and perspective [$F(2,40) = 6.28$,

$p < .01$]. However, the main effect of word valence, the interaction between the word valence and perspective, and the three-way interaction were not significant [$F(1,40) = .76$, *ns*, $F(1,40) = 1.28$, *ns* and $F(1,40) = 1.21$, *ns*, respectively].

4. Discussion

The current results demonstrate that instead of the 1PP, the adopted 3PP in self-referential processing affects memory performance. Consistent with the results in previous studies (Klein & Loftus, 1988; Klein et al., 2002; Rogers et al., 1977; Zhu et al., 2007), we found that in the 1PP condition, trait words presented with self were better remembered than those presented with others (friend or famous person). Moreover, we found a reliable interaction between the perspective and the type of referential processing. These SREs were stable in the 1PP condition; however, they were decreased or reversed in the 3PP condition, in which the participants placed themselves in their close friend's position. No significant difference was found between the corrected recognition performance of self- and close friend-trait words, and there was a better corrected "remember" recognition performance for close friend-trait words than self-trait words. These results are consistent with our hypothesis that the 1PP is an essential factor for self-advantage (i.e., SRE). Thus, as the participants place themselves in the other person's perspective, self-advantage is decreased or even removed.

The present results may have important implications for the notion that the 1PP is a constitutive and a necessary pre-requisite for human self-consciousness (Vogeley & Fink, 2003; Vogeley et al., 2004). Self-consciousness is a complex construct in which self-advantage (e.g., SRE) has long been regarded as the accessible index and elaborate nature of self-consciousness (Cunningham, Turk, Macdonald, & Neil Macrae, 2008; Kelley et al., 2002). However, only few studies have indirectly investigated self-advantage in different perspectives through the neural activity (D'Argembeau et al., 2007; Ochsner et al., 2005; Ruby et al., 2009). Wang et al. (2011) found that self-advantage is eliminated in the 3PP condition of a face orientation identification task, which suggests that self-advantage in face processing results from the participants' adopting the 1PP. Nevertheless, as we had previously mentioned, the task used in the study by Wang et al. (2011) may have concealed the self-advantage effect under the difficult 3PP task and the floor effect. That is, the removal of the self-advantage effect may be attributed to the difficulty of the rapid response task instead of the perspective itself. In the present study, we ruled out this factor by using a person-traits reflective task in conjunction with different perspectives of a mixed design. We found that compared to the 1PP, the memory for self-trait words decreased, whereas the memory for other-trait words increased concomitantly in the 3PP. These findings indicated that the adopted 1PP is a necessary (but insufficient) factor for self-advantage and therefore provides preliminary empirical evidence that the 1PP may be a constitutive and a necessary pre-requisite for human self-consciousness.

Aside from being consistent with the corrected recognition scores, the corrected "remember" recognition scores further indicate that friend-trait words garner better memory in the 3PP. As we had previously mentioned, the memory for words can be classified into two types (Tulving, 1985; van den Bos et al., 2010; Williams et al., 2013): the subjective recollective experience (R-judgment) and the feeling of familiarity (K-judgment). Conway and Pleydell-Pearce suggested that the memory performance of R-judgment should be a solid index to reflect self-referential cognition (Conway & Pleydell-Pearce, 2000). In the present study, compared to the 1PP, we found a decreased rate of recollective memory and an increased rate of sematic memory for the self-trait word in 3PP. Compared to the 1PP, we found an increased rate of recollective memory and a decreased rate of semantic memory for friend-trait words in 3PP. These results supported that abandoning the 1PP and adopting the 3PP can not only eliminate self-advantage but also facilitate memory for others. Interestingly, the present study evaluates the essential factor of self-referential processing in an everyday social interaction skill (Baron-Cohen et al., 2000). Placing oneself in the position of another is regarded as an important ability for interpreting and predicting the behavior of others in terms of their beliefs and intentions.

An alternative explanation for the SRE decrease in the 3PP condition may be that compared to the 1PP condition, the task difficulty was increased in the 3PP condition; thus, SRE was only concealed under the difficult task that required additional attention. Several previous studies have found that behavioral performance (e.g., response time and accuracy) or neural activity is disturbed during the 3PP compared to the 1PP; these studies have suggested that this phenomenon may be attributed to the transformation of perspectives as a consequence of the costs of attention resources (Ruby & Decety, 2004; Vogeley et al., 2004; Wang et al., 2011; Zacks et al., 1999). Similarly, a recent study by Turk et al. (2012) reported that divided attention can impair memory for information held by self and others (Turk et al., 2012). Several lines of our experimental design and results, however, excluded this explanation. First, according to our design, we used between-subject measures of the perspective factor to reduce the difficulty of 3PP. Using this method, the participants do not need to repeatedly change their perspectives within the experimental task. Additionally, we controlled the manipulated cues of personal traits judgment task in the 3PP condition and unified the perspectives of the two pronouns in the cue sentence. Such manipulations prohibited the possible confounding factor of perspective waving triggered by the change of pronouns within the trial. Second, according to our results, no significant difference was found between memory accuracy in the 1PP and 3PP conditions. Such memory accuracy was far beyond the floor in both the 1PP and 3PP conditions (Table 1), suggesting that SRE was not concealed under the difficult task. Importantly, we employed a self-reference task in the 1PP condition (corresponding to the full attention condition) and the other task in the 3PP condition (corresponding to the divided attention condition). If the memory for self-trait words was decreased because of divided attention during the 3PP condition, such should also be the case for other-trait words. However, the memory for other-trait words did not significantly decrease. Instead, the

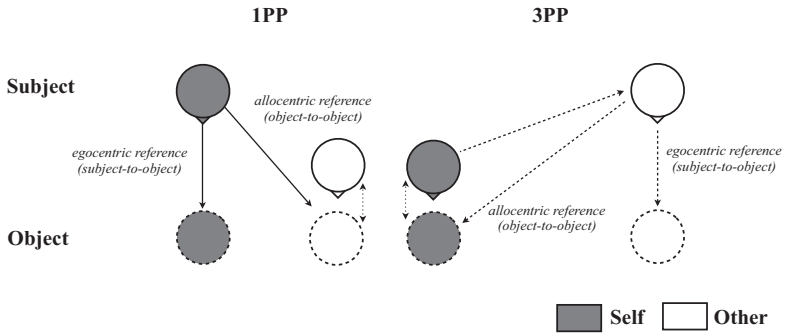

Fig. 2. A likely explanation for the present study. In the 1PP condition, the participants tended to use egocentric (subject-to-object) reference frames to process self-related information and allocentric (object-to-object) reference frames to process others-related information. In the 3PP condition, the participants tended to use allocentric reference frames to process self-related information and egocentric reference frames to process others-related information.

"remember" recognition accuracy of friend's trait words was significantly increased in the 3PP condition. Thus, such an explanation could not account for the current results.

If the memory for self-trait words in the 3PP condition was not decreased due to divided attention, why can the 3PP eliminate self-advantage? Moreover, why is the 1PP necessary for self-advantage? Based on the current results, we speculate that on the representational level (Vogeley & Fink, 2003; Vogeley et al., 2004), the participants use different reference frames when they process the related information of self-others in different perspectives. In the 1PP condition, the participants tend to use egocentric (subject-to-object) reference frames to process the self-related information and allocentric (object-to-object) reference frames to process the others-related information. On the contrary, in the 3PP condition, the participants first need to translate their own viewpoint into the other person's viewpoint. Although the task is centered on the body of the agent, the body of agent, however, is the other person's agent (Klatzky, 1998; Vogeley & Fink, 2003). The participants tend to use allocentric reference frames to process the self-related information and egocentric reference frames to process the others-related information (Fig. 2). Previous studies have shown that two different neural streams exist when the participants use the egocentric and allocentric reference frames; the egocentric and allocentric representations are encoded in the dorsal and ventral streams, respectively (Andersen & Buneo, 2002; Chen, Weidner, Weiss, Marshall, & Fink, 2012; Cohen & Andersen, 2002; James et al., 2002). Based on these findings, future studies may combine functional neuroimaging techniques and self-reference tasks to examine the possibility mentioned above. Although Vogeley and Fink (2003)'s review also involved perspective on a conceptual and abstract level, whether perspective in space and on a more abstract level (e.g., perspective in language, nonverbal memory, social interaction or self-reflection) shares the same mechanism requires additional studies.

One may argue that the present findings might reflect culture influence because the current sample is likely to be regarded as collectivist. Several previous studies have found that Western individuals tend to view the self as an autonomous entity that is separated from others; however, East Asians tend to view the self as a socially embedded entity with strong interconnectedness with others (Heine, 2001; Markus & Kitayama, 1991). Several recent neuroimaging studies have found that participants from different cultures have different neural responses during self-reference tasks (Chiao et al., 2009; Ray et al., 2009; Vanderwal, Hunyadi, Grupe, Connors, & Schultz, 2008; Zhu et al., 2007). For this reason, whether the culture factor might affect the ease of attenuating the SRE has not been established. In a pilot experiment (not presented here), we assessed whether self-construal priming can change the SRE pattern in different perspectives; we modulated the participant's self-construal through a priming task that highlighted an independent (self as an autonomous entity that is separated from others) or interdependent (self as a socially embedded entity with strong interconnectedness with others) perspective on self (Sui & Han, 2007); the participants were required to accomplish the same task as shown in the present study. However, we failed to find a different pattern between the independent and the interdependent self-construal priming group. Based on this primary result, it is unlikely that the culture factor (or different self-construal factor) would affect the ease of attenuating the SRE. Notably, this effect was an indirect and nonsignificant evidence. Future studies may recruit Western participants to further examine the likely cultural differences.

In summary, the present study demonstrates that adopted 3PP during self-referential processing can impair self-advantage. Although the emergence of SRE was stable in the 1PP condition, SRE was decreased or even abolished in the 3PP condition. Our findings generally indicate that the 1PP is a necessary (but insufficient) factor for self-advantage of self-referential processing, and these findings may provide a new empirical evidence supporting the assumption that the 1PP is a key feature of self-consciousness or a basic constituent of the "minimal self" (Gallagher, 2000; Vogeley & Fink, 2003).

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