Acoustic Cues for Sensory Modality and Referential Vagueness of Personal Pronouns: Me or Not? You or Not?

1st Aibao Zhou
School of Psychology
Northwest Normal University
Lan Zhou, China
zhoulabpapers@163.com

2nd Yanbing Hu
School of Psychology
Northwest Normal University
Lan Zhou, China
hybpsy2018@163.com

3rd Xiaoyong Lu
School of Psychology
Northwest Normal University
Lan Zhou, China
luxy@nwnu.edu.cn

4th Tao Pan
Department of information engineering
Lanzhou Resources and Environment Voc-Tech College
Lan Zhou, China
pant_revt@126.com

Abstract-**Personal pronouns are of great pragmatic significance, and among their numerous functions, referential vagueness is the key to the exploration of the self. In Experiment 1, the relationship of first-, second-, and third-personal pronouns with the self was discussed in acoustic condition, with gender consistency, pronoun type, and person type as independent variables. Experiment 2 records the frequency of the subjects on the SR button and the NSR button, and statistical analysis was performed on the SR button reaction. This study finds that the same pronouns show different self-cognitive processing under the different visual and acoustic stimuli, and the results support the dynamics of personal pronouns and possessive pronouns and self-relationships.**

Keywords-personal pronouns; self-cognitive; sensory modality; acoustic cues

I. INTRODUCTION

As James (1890) put it, self is the center of the personal psychic universe. Self is the core of consciousness, different from non-self, and there is a self-referential effect of processing, that is, people preferentially process their own related stimuli [1]. Researchers often use self-related (SR) stimuli and non-self-related (NSR) stimuli to study human self-recognition to see if self-referential effects (SRE) are ubiquitous. In a study of face cognition, the self-referential effect of the face was also found. This study found that people who are familiar with the face of the person will have a larger volatility in the P300 when they identify themselves. It takes more attention to resources when you see your face[2]. In a study of speech cognition, using the Oddball paradigm, with the selective attention of voice as an indicator, explored the interaction between self (SR) and non-self (NSR) and stimulus types, and found that when the subjects were exposed to them When it comes to its own voice, its self-acoustic law is easier to extract and classify than other people's voices[3]. In a complex and changing social context, people can quickly and accurately notice self-related information with high social adaptability[4, 5].

In addition, the memory of self-related information is superior to information under other coding conditions [6]. Self-related information appears to be subject to more elaborate and organized processing[7]. In the study of the ownership of an item, when the item is associated with the possessive pronoun "my" and "his", the recall of the "my" item is generally better than the "his" item[8].So it is a good explanation that SRE still exists when studying the content of unfamiliar SR. In recent years, substantial neuroscience research has been devoted to finding out whether the two processing modes associated with the "I" and the "me" (My) are embodied in the human language. As an ability to reflect on one's own feelings, thoughts, and behaviors, and to distinguish oneself from others, the basic prerequisite for the emergence of the self is the development of self-awareness in the first two years after birth[9, 10], the use of pronouns[11, 12], and the proliferation of neural networks like mirror neurons[13, 14].

In previous studies, pronouns were presented visually either in a sentence context [2], or in pronominal phrases [13-15], or in the absence of a semantic context, for example in the oddball task[8]. However, these studies of pronouns focused more on the presentation of visual stimuli, and few studies introduced second-person pronouns. By using German SRPs (first-person perspective) "ich" and "mein" ("I" and "my"), the second-person pronouns "du" and "dein" ("you" and "your"), and-NSRPs-(third-person perspective) "er" and "sein" ("he" and "his"), Herbert, Blume, and Northoff [16] proved that, in audio conditions, second-person pronouns were related to the self, and they were given priority during processing and distinguishing personal pronouns from possessive pronouns. However, in their study, only female voice was used for the stimulus materials, and no distinction was made between genders.

In order to explore, in the context of Chinese culture, whether the processing of pronouns will be different and explore whether the pronouns will have processing differences under the two kinds of visual and audio stimulation. Specifically, the hypotheses of this study were as follows for the acoustic conditions: (1) second-person pronouns are associated with the self, and first- and third-

person pronouns are associated with others when a second-person pronoun is introduced; (2) There is a difference between the personal pronoun and the SRE of the possessive pronoun; (3) these associations, interference, and differences are affected by the gender of the participants, and the consistency or inconsistency between the gender of the stimulus materials and the participant. For the visual condition, (1) when a second-person pronoun is introduced, first-person pronouns will be associated with the self and third-person pronouns will be associated with others, but participants may have different perspectives and second-person pronouns may be associated with the self and others; and (2) There is a difference between the personal pronoun and the SRE of the possessive pronoun.

II. EXPERIMENT 1

A. Participants

Eighty participants (40 males; aged 20 to 23 years, mean age 21.5 years) who were native speakers of Mandarin participated in this acoustic experiment. All participants were right-handedness, and none of the participants had any hearing impairment. The study has been examined and approved by the Ethics Committee of the School of Psychology of Northwest Normal University. Before the experiment, each participant signed an informed consent form and was sent a gift after completing the experiment.

B. Stimulus Materials

The voice was recorded by the same experimenter in a very quiet room by using a tape recorder (LLC-9000). The two people who recorded the voice (one man and one woman) were selected from the junior high school students of the Northwest Normal University, and the participants who participated in the experiment were strangers. They did not know the purpose of the experiment and did not participate in the subsequent experiments. The two students recorded the first, second and third personal pronouns "you", "I", "he" and the possessive pronouns "my", "your" and "his". The pronunciation is pronounced in a steady, non-emotional tone, and the experimenter can hear it. Cooledit pro 2.0 was used to intercept the audio, after which the durations of the words were unitized to ensure that all words had a duration of 500 ms. The basic frequency and intensity of the voice stimuli have been presented in Table 1.

TABLE 1. VOCAL PARAMETERS OF PRONOUNS IN DIFFERENT GENDER VOICES.

Gender of the voice	Vocal parameters	Pronouns					
		You	*I*	*He*	*Your*	*My*	*His*
Male	Basic frequency (Hz)	121.94	113.87	191.72	137.48	125.98	172.10
	Intensity (dB)	70.53	69.16	77.50	71.02	71.39	76.75
Female	Basic frequency (Hz)	235.57	217.82	167.47	217.59	218.19	193.02
	Intensity (dB)	64.42	67.94	69.09	67.19	64.23	62.90

C. Experimental Design

Experiment 1 employed a 2 (gender consistency: consistency or inconsistency of the gender of the participant and the stimulus voice) × 2 (type of pronoun: personal or possessive pronouns) × 3 (type of person: first, second, and third person) within-participants design. The types of pronouns and person, and gender consistency/inconsistency were within-participant variables, while the response types of the keystrokes made by the participants and the response time were the dependent variables.

D. Procedure

Each trial starts with a centering gaze point "+" time of 500ms. Then the participant will hear the voice stimulation from the earphone for 1000ms. Finally, let the subject respond as quickly as possible. SR. The experiment stimulates the difference in the presented material. In other words, the stimulus presented by the male voice is a procedure, and the stimulation presented by the female is a procedure, so the subject has to perform two procedures. In a program, there are a total of 5 blocks, one block is a practice experiment, the personal pronoun "ni", "wo" and "ta" contain two blocks, and the possessive pronouns "ni de", "wo de" and "ta de" respectively occupy Two blocks. In each block, each voice stimulus appears 15 times, for a total of 6 voice stimuli. So trials are a total of 180 (2*6*15). Each block is pseudo-randomly presented, ensuring that two identical blocks appear consecutively, and each trial is also pseudo-randomly present, ensuring that two identical voice stimuli do not appear consecutively. Participants sit 60cm in front of the computer screen and are required to press two previously set buttons. One button is SR and one button is NSR. The reaction button is balanced between the subjects. Stimulation through the headphones (SHP9500) and presentation through the ears. The randomized presentation of the stimulus was run on a computer via E-prime 2.0 (Psychology Software Tool 1996–2012) and the frequency of the reaction buttons was recorded. In the course of the experiment, the response of the subjects due to preemptive judgment, keystroke errors, etc., that is, the number of responses of each individual to each pronoun is 30, if the subject responds to a certain pronoun in "self" or "other" If the number of times on the category is less than 4, the data on the reaction category is rejected.

III. Results

A. Frequency of Responses by Reaction Categories

The frequency of participants' perception of the relation of each pronoun to others or to the self has been presented in Fig 1 and Fig2. The frequency of the voice stimulus and the gender of the subject is related to the frequency of "others" or "self".
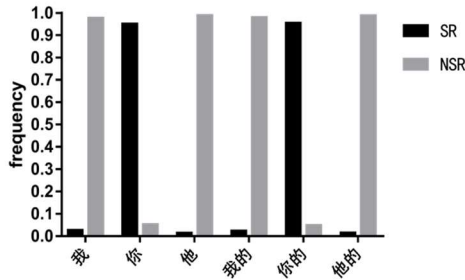
Figure1. Frequency of relating pronouns to others and to the self.
"我"="I"，"你"="you","他"="he";"我的"="my","你的"="your","他的"="his"
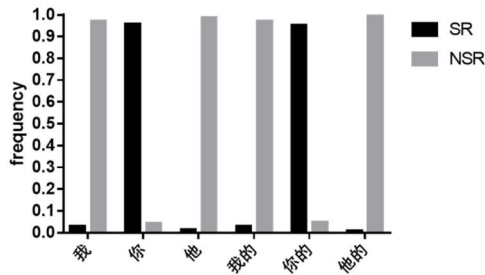
Figure2. Frequency of relating pronouns to others and to the self.
"我"="I"，"你"="you","他"="he";"我的"="my","你的"="your","他的"="his"

B. Reaction Time for High Frequency Categories

The reaction time for the high frequency categories (self or others) of the personal and possessive pronoun was examined. The descriptive statistics for these reaction times have been presented in Table 2.

C. Repeated Measures Analysis of Variance

Participants' reaction time was submitted to a 2 (gender consistency: consistency or inconsistency between the gender of the participant and stimulus voice) × 2 (pronoun category: personal and possessive pronouns) × 3 (type of person: first, second, and third person) analysis of variance. The analysis revealed a significant effect of gender consistency, $F(1, 79) = 22.36$, $p < 0.01$, $\eta2=0.957$, and of the person category, $F(2, 158) = 35.938$, $p < 0.01$, $\eta2=0.981$; but no effect of the pronoun category, $F(1,79) = 0.222$, $P = 0.639$. Further, there was no significant interaction effect.

IV. DISCUSSION

The results of Experiment 1 showed that, when a second-person pronoun was introduced in the acoustic condition, participants associated the first-person pronouns with others and the second-person pronouns with the self. This was because the relationship between the self and the first-person reference changed during listening to the stimuli. Specifically, the listener associated the second-person pronouns (you and your) with the self (listener) and the first-person pronouns (I and my) with the speaker [9, 10].

TABLE 2. REACTION TIME FOR PERSONAL AND POSSESSIVE PRONOUNS FOR EACH PERSON CATEGORY (MS).

Pronoun	Consistency of gender between participants and stimulus voice			Inconsistency of gender between participants and stimulus voice		
	First person	*Second person*	*Third person*	*First person*	*Second person*	*Third person*
Personal pronouns	701.59 ± 157.10	637.74 ± 141.90	638.93 ± 157.49	747.65 ± 188.63	673.46 ± 153.36	666.06 ± 164.79
Possessive pronouns	699.56 ± 188.69	644.55 ± 145.52	648.64 ± 167.64	739.67 ± 170.31	678.20 ± 145.74	679.10 ± 164.00

Further, in the acoustic condition, both first- and third-person pronouns were associated with others, but the reaction time for first-person pronouns was longer than that for third-person pronouns, with a statistically significant difference. Second-person pronouns were associated with the self and third-person pronouns were associated with others; however, there were no significant differences between their reaction times. This was because it is customary for people to associate "I" and "my" with the self, even if the participants associated "you" and "your" with the self in the acoustic condition. Further, the first- and second-person pronouns interfered with each, leading to longer reaction time for both as compared to that for third-person pronouns. Thus, no advantage of processing was observed.

In the gender consistent condition (male participants listened to the male voice and female participants listened to the female voice) the response bias was consistent as compared to that in the gender inconsistent condition (male participants listened to the female voice and female participants listened to the male voice). That is, both first- and third-person pronouns were associated with others, and second-person pronouns were associated with the self. However, because the same-gender voice was similar with the self's voice in terms of fundamental frequency and timbre, the familiarity led participants to adapting to and recognize the speech more quickly. Therefore, the reaction time of the participants for the same-gender voice was shorter than that for the opposite gender voice, for all personal pronouns.

In the acoustic condition, there were no significant differences in the response bias or reaction time between the personal and possessive pronouns, which may be caused by the limitations of behavioral experiments. This finding needs to be studied further.

V. EXPERIMENT 2

In order to confirm that the result of Experiment 1 is related to the acoustic way of presenting stimuli, Experiment 2 will explore by changing the sensory pathway, and the way of stimulating presentation will be changed to visual presentation, that is, when visually presenting the first person, second person and third person, people Whether the cognition of his pronoun is different from the cognition of acoustic presentation.

A. Participants

Sixty subjects with a native Chinese language (including 30 males; aged 20 to 25 years, average 22 years old) participated in this visual experiment. All subjects were right-handed and there were no visually impaired subjects. Before the experiment, each participant completed the informed consent form and sent a gift after completing the experiment.

B. Stimulus Materials

The stimuli included the first-, second-, and third-person pronouns "you," "I," "he," and the possessive pronouns "my," "your," and "his." All pronouns were presented in Chinese characters using Song Typeface, size 58.

C. Experimental Design

Experiment 2 uses the design of 2 (pronoun type: personal pronoun, possessive pronoun) × 3 (personal type: first person, second person and third person). In the experiment, the person type and the pronoun type are all the variables in the test, and the reaction type and response time of the test button are the dependent variables.

D. Experimental Procedure

Each trial starts with a centering gaze point "+" time of 500ms. Then the subject will see the stimulus from the screen for 1000ms. Finally, let the subject respond as quickly as possible to SR. In this program, a total of 5 blocks, one block for practice experiments, the personal pronoun "you" "I" "he" contains two blocks, the possessive pronoun "your" "my" "his" contains two Blocks. In each block, each voice stimulus appears 15 times, for a total of 6 stimuli. So trials are a total of 180 (2*6*15). Each block is pseudo-randomly presented, ensuring that two identical blocks appear consecutively, and each trial is also pseudo-randomly present, ensuring that two identical voice stimuli do not appear consecutively. The subject sat in front of the computer screen 60cm, was asked to press two previously set buttons, one button is SR, one button is NSR, the reaction button is balanced in the test room. Stimulation through the headphones and presentation through the ears. The randomized presentation of the stimulus was run on a computer via E-prime 2.0 (Psychology Software Tool 1996–2012) and the frequency of the reaction buttons was recorded. In the course of the experiment, the response of the subjects due to preemptive judgment, keystroke errors, etc., that is, the number of responses of each individual to each pronoun is 30, if the subject responds to a certain pronoun in "self" or "other" If the number of times on the category is less than 4, the data on the reaction category is rejected.

VI. RESULTS

A. Frequency of responses by reaction categories

The participants were divided into two categories based on their reactions to second-person pronouns (reacted as the self or as others), and the frequency of relating each pronoun with the self or others was computed for each participant (Fig 3).
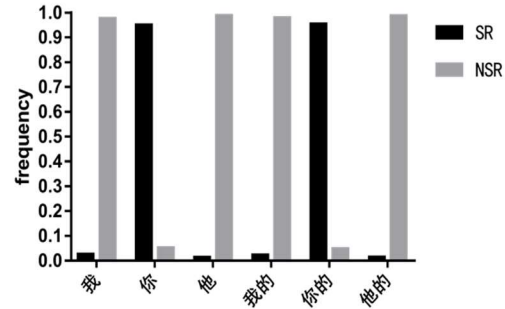

Figure3. Frequency of relating pronouns to others and to the self. "我"="I", "你"="you","他"="he";"我的"="my","你的"="your","他的"="his"

B. Statistics when SR Button Reacts

The participants were divided into two categories based on their reactions to second-person pronouns (reacted as the self or as others), and the reaction time for the personal and possessive pronouns was recorded for each person type. The descriptive statistics for these reaction times have been presented in Table 3. Repeated measures analysis of variance For the personal pronoun, the possessive pronoun performs the repeated variance analysis of the pronoun category (pronoun category: personal pronoun; possessive pronoun) × 3 (personal type: first person, second person and third person) in the reaction of the "SR" button.The variance analysis of the SR button reaction shows that the pronoun type main effect $F(1,59)=0.38$, $p>0.05$, $\eta2=0.006$, because there is no significant difference in the reaction of different pronoun types, the main effect F of the person type $=9.76$, $p < 0.05$, $\eta2 = 0.142$, because the subjects had different cognitive processing for different personal pronoun types. The interaction between the personal pronoun and the pronoun type $F(2,118)=3.61$, $p<0.05$, $\eta2=0.06$. Further simple effect analysis, under the personal pronoun type, the difference between the first person and the second person and the second person and the third person is significantly $p<0.05$, while the difference between the first person and the third person is not significant $p>0.05$; under the type of the pronoun, the first The difference between the first person and the second person and the first person and the third person was significantly different ($p<0.05$), but the difference between the second person and the third person was not significant $p>0.05$.

TABLE 3 PERSONAL PRONOUNS AND POSSESSIVE PRONOUNS IN RESPONSE TO THE "SELF" BUTTON (MS)

pronoun	First person	Second person	Third person
Personal Pronouns	653.19±207.43	697.46±220.18	655.12±193.41
Owner pronoun	632.61±174.33	705.35±236.08	700.23±267.45

VII. DISCUSSION

In Experiment 2, this study explores whether there is a difference in the self-cognitive processing of different person types in different pronoun types through visual presentation.

First of all, through the results of the button frequency in Experiment 2 (Figure 3), for different pronoun types, people's response to their buttons is not significant, indicating that there is no difference in the cognitive processing of personal pronouns and possessive pronouns. The results of the personal type indicate that people's cognitive processing of different person types is significantly different. According to (Figure 3), the participants classified the first person "I" and "My" into the NS component, and the third person "He" and "His" as the NSR. For the second person's button frequency, it is because people have different perspectives on "you" and "your", and people will have different processing. In a similar study, the 2PP pronouns combine aspects of both, self- and other-reference[17]。 Explain that when people see the second person, they sometimes use the second person as the "self" component because of different cognitive perspectives. For example, when listening to pronouns, the second person "du" ("you") was preferentially processed in Very early time. This early processing bias is well in line with the notion that when the self is addressed as the subject of experience, self-reference can be established pre-reflectively without self-reflection[16]. It is like the object is saying "you" or "your" to the subject, so the second person refers to the subject himself. When the subject looks at the second person from another angle, he will be treated as a component of NSR for example, The personal and possessive pronouns "du" and "dein" ("you" and "your") were processed similarly To NSRPs during the "fast" passive silent reading condition in which stimuli were presented at a presentation rate of 2.5 Hz [17]. It is like the subject saying "you" and "your" to the object, so the second person refers to the object.

In the visual representation of the possessive pronouns we can see that the reaction of the first person is the shortest relative to the second person and the third person. We can see that the reaction of the third person is significantly increased compared to the third person in the personal pronoun. This may be because the second person is perceived as being more cognitive than the need to perceive the third person as a need for more cognitive resources. The contrast between the two has a side-suppressing effect, making the reaction time longer, shorter and shorter, and ultimately The difference between the first person and the third person disappears [16].

VIII. CONCLUSION

In the acoustic condition, the pronouns "you" and "your" were related to the self, while "I" and "my" were related to others. Because of the mutual interference of first- and second-person pronouns, there was no obvious self-processing advantage of second-person pronouns. In addition, the influence of gender on the relationship between personal pronouns and the self was only reflected in the reaction time.

In the visual condition, first-person pronouns were related to the self, but owing to differing perspectives among participants, some participants associated second-person pronouns (you and your) with others, while others associated them with the self. When participants associated second-person pronouns (you and your) with the self, the introduction of second-person pronouns did not interfere with the processing of first- and third-person pronouns, and the advantageous effect of the self-processing of first-person pronouns persisted. When participants associated the second-person pronouns (you and your) with others, the difference between the processing of first-and third-person pronouns disappeared. In addition, in the visual condition, the reaction time for possessive pronouns was significantly longer than that for personal pronouns. This indicates that the cognitive processing methods of personal pronouns and possessive pronouns may be different, and further research is needed for their related research.

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