Investigations of Verbal Cues and Self-Voice Perception Model

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Abstract—It is of great significance to explore the influence mechanism of verbal cues on self-voice perception under different conditions. The aim of this study is to probe the effects of verbal and non-verbal conditions on implicit task (experiment 1) and explicit task (experiment 2) of self-voice. Binaural auditory channels were used to present two voices successively, and the speakers included the participants, familiar and strangers. In the experiment 1, participants were asked to judge whether the pair of stimuli were pronounced by the same speaker. In the experiment 2, participants were asked to identify whether one of the stimuli was their own voice. The results show that there is no difference in individual voice perception of self (vs. non-self) under different conditions of verbal cues in the implicit task. In the explicit task, there is less accuracy in recognizing the voice of self than that of non-self. It is also found that there exists no difference in individual self-voice perception at different levels of factors.

Keywords—self-voice; perception mechanism; voice perception; verbal cues; self-disadvantage effect

I. INTRODUCTION

Self-voice perception (the capacity to recognize physical and mental aspects of oneself) is a highly developed ability in humans that underlies a range of social and interpersonal functions, such as the theory of mind and introspection [1]. Voice is one of the symbols of individual identification, which contains not only emotional information, but also identity information and speech information [2]. From the voice, individuals can not only know the immediate emotions of the speaker, but also know identity information such as the age and gender of the speaker, and even know the immediate emotions of the speaker. Self-voice perception is crucial for an individual's self-awareness and self-monitoring. Its destruction may have a harmful effect on one's quality of life [3, 4].

Individual self-monitoring of voice uses neural feedback mechanisms to distinguish self from non-self [5]. The ability of an individual to distinguish between self and non-self vocal cues is a fundamental aspect of self-awareness which assists in self-monitoring in verbal communication [6]. Previous studies have illuminated the connection identifying non-self identities to the degree of familiarity (1) individuals have different brain mechanisms for non-self identity perception with different familiarity degrees. In other words, individuals’ right superior temporal sulcus are activated when they recognize the voice of acquaintances (vs. the voice of strangers) [7]; (2) individuals' familiarity of the speaker can affect their judgment of voice identity [8].

Previous studies have shown that there are two different cognitive processing modes of self-voice perception. The results show that there is no significant difference in the accuracy of self-voice perception (vs. non-self) in the implicit task. In the explicit task, the accuracy of self-voice perception is significantly lower than that of non-self voice perception [9, 10]. The reason lies in the fact that there are two conduction pathways among individuals in the perception of their own voice: bone conduction and air-conduction. The individual perceives the self-voice in the recording only includes the air-conducted voice. The absence of bone conduction changes the characteristics of voice, so there is a difference in the cognitive ability between individuals who listen to recorded self-voices and those who listen to self-voices on a daily basis [11]. According to self-monitoring theory, individuals use a day-to-day perceptual representation of their own voices to monitor if they are self-voice in recordings [12]. Therefore, due to the mismatch between the self-voice in the recording and in daily life, there is a disadvantage effect in the individual perception of the self-voice (vs. non-self) in the recording. By filtering out the voice signal, that is, only keeping the frequency higher than the third resonance peak, it is found that individuals have a processing advantage in self-voice perception [13]. Therefore, the lack of acoustic information may reduce the influence of bone conduction on the individual's perception of the self-voice in the recording, and thus reduce the degree of an individual's monitoring of the self-voice in the recording.

From the macro point of view, there are two basic processes of identity processing. Firstly, individuals can distinguish between different identities; Secondly, individuals can perceive their identity constancy from different physical environments [14]. Non-verbal (vs. verbal) contains less information, which may reduce the individual's perception of the difference between the self-voice in the recording and the daily self-voice. Therefore, it is necessary to consider non-speech in voice perception. From the perspective of voice perception research, both verbal and non-verbal cues have an impact on individual voice perception processing, that is, individual voice perception processing is likely to be a collaborative processing process of bottom-up acoustic analysis and top-down voice processing [15]. There are two main deficiencies in previous studies (1) the research focus is confined to the perception of different voice identities, ignoring the
perceptual constancy of voice perception; (2) the influence of verbal cues on cognitive processing of implicit and explicit tasks in self-voice perception is not considered.

This study adopted [9] both implicit and explicit task perception paradigm of voice to discuss individual self-voice perception mechanism of different verbal cues. In experiment 1, participants were asked to judge whether the pair of stimuli were pronounced by the same speaker. In experiment 2, the participants were asked to identify if one of the stimuli was their own voice. This paper puts forth the study hypotheses are as follows: (1) In the implicit task: There is no difference between the self and non-self in the verbal cues; (2) In the explicit task: Individuals have processing advantages in non-self identity (vs. self-voice perception) in verbal condition. There is no difference between self-identity and non-self identity in non-verbal condition. (3) Individual self-voice perception (vs. non-self voice perception) has perceptual constancy.

II. EXPERIMENT 1

A. Participants and procedure

Thirty college students from a certain university participated in this experiment. Among them, 12 male students, aged (20.7±2.20), had no hearing impairment and obtained mandarin proficiency certificate. All the participants were of Han ethnicity whose mother tongue was Mandarin, without the knowledge of the purpose of the experiment. In this study, 2 college students (1 male and 1 female) were randomly selected to receive experimental materials from strangers. According to [9] in the study of implicit task content difference of voice perception to various stimuli (np2 = 0.35), the effect of using G*Power3.1, set Power to 95%, the alpha level of 0.05, calculate sample size of 15 participants.

2.2. Stimuli

Prepare: First, a week before the experiment, the participants were recorded in stereo mode in a selected recording room using a portable digital recording device (Roland r-26). Recording process is divided into two sections, the first stage to let the participants sit in front of the screen to 60 cm, lips to 10 cm, the distance to the microphone asked participants as clearly as possible, read quietly appeared on the screen of the text, a text after the need to pause and then to the next text recording, such as was non-self accordance with the requirements for the recording, insist on the recording again. At the same time, the participants were required to bring a person of the same sex who had been with them for at least one year, and record them. The previous procedure was repeated, and the voice material was defined as the voice of acquaintances. Then, two randomly selected college students (who did not know each each) were recorded. The recording procedure was the same as the recording process of the participants, whose voice material was defined as the voice of strangers.

According to Candini, et al. [9], stimuli all belong to the same semantic system. For example, the words used all belong to "animal". The words used in this study contain at least one participant's voice (AA-AB-AC), and the non-self-condition as excluding the participant's voice (BB-CC-BC) [9 163, 10 164, 16]. For the implicit task of self-voice perception, the variance analysis of repeated measures was conducted in participants with 2(self vs. non-self)×2(words vs. vocalization)×2(stimulus onset). Results show that no significant main effect of identity, F(1,28)=0.11, p>0.05, stimulus content of main effect significantly, F(1,28)=10.97, p<0.01, η²=0.32, the main effect of verbal cues significant F(1,28)=6.20, p<0.05, η²=0.18. The interaction of the identity and stimulus content the same significantly, F(1,28)=18.25, p<0.001, η²=0.40. Simple effect, found that under the condition of non-self, the same time is more than stimulate different accuracy, F(1,28)=22.99, p<0.001, η²=0.45. Under the self-condition, there was no significant difference in the accuracy of the same stimulation (vs. different stimuli), F(1,28)=0.41, p>0.05.

B. Implicit task: same owner-different owner

In order to better understand the relationship between different factors and self-voice perception, we will separate the identity (same speaker/different speaker). The reason is that there is one variation owner in the condition of same voice owner (AA-AB-CC) and two variation owners in the condition of different voice owners (AB-AC-BC).

C. Implicit task: same owner

Variance analysis of repeated measures of 3(self-self vs. familiar-familiar vs. stranger-stranger) × 2(words vs. vocalization)
\(2\times(\text{same stimuli vs. different stimuli})\) in participants. The Results show that no significant main effect of identity, \(F(1,28)=0.83, p>0.05\), but the main effect of verbal cues significant, \(F(1,28)=12.17, p<0.01, \eta^2_{p}=0.30\). Simple effect, found in the same condition, the words of the time is greater than the vocalization of the time, \(F(1,28)=12.32, p<0.05, \eta^2_{p}=0.17\).

D. Implicit task: different owner

Variance analysis of repeated measures of 3(3-self-familiar vs. self-stranger vs. familiar-stranger)×2(word vs. vocalization)×2(same owner vs. different owner) in participants. Results show that no significant main effect of identity, \(F(1,28)=0.33, p>0.05\), no significant main effect to stimulate content, \(F(1,28)=0.78, p>0.05\), the main effect of verbal cues significant, \(F(1,28)=12.17, p<0.01, \eta^2_{p}=0.30\).

E. Discussion

The first result confirms the hypothesis that there was no difference between self and non-self voice identification in the implicit task. At the same time, the results show that both the stimulus content and the verbal cue can affect the individual's voice identification in the implicit task. Specifically, there is a significant advantage in the accuracy of the same stimulus (vs. different stimulus) and the word (vs. vocalization), that is, the same stimulus and the verbal condition are more conducive to the individual's voice identification. From the interaction between identity and stimulus content, we can find that the self voice (vs. non-self voice) displays more perceptual constancy in the implicit task of individuals. It can be seen from the results of the same condition of the voice owner in the implicit task that the stimulus content (vs. verbal cue) has a greater impact on the individual's perception of voice identity.

In the implicit task, the results of different voice owner conditions show the opposite result, that is, verbal cues (vs. stimulus content) have greater influence on the individual's perception of voice identity. To some extent, this proves that there are two different basic processes of voice identity perception, that is, the stimulus content has a greater impact on the consistency of individual voice identity, while the verbal cues has a greater impact on individual voice identity. The result of the first experiment are consistent with [9]. It proves that individuals with Chinese cultural background also have implicit processing of self-voice perception. Experiment 2 will further explore whether individuals with Chinese cultural background have explicit self-voice perception processing and whether individuals still have perceptual constancy of self-voice perception.

IV. EXPERIMENT 2

A. Participants and procedure

It is the same as Experiment 1.

V. RESULTS

A. Explicit task: self vs. non-self

All 30 participants were operated in accordance with the experimental instructions, and the data of 30 (10 male) valid participants were statistically analyzed by using SPSS21.0 software. The definition of self-non-self is the same as experiment 1. For the explicit task of self-voice perception, the variance analysis of repeated measures in participants was conducted by 2(self vs. non-self)×2(words vs. vocalization)×2(same stimuli vs. different stimuli).

The results show that the identity of main effect significantly, \(F(1,29)=6.16, p<0.05, \eta^2_{p}=0.18\); Stimulate the content of main effect significantly, \(F(1,29)=5.12, p<0.05, \eta^2_{p}=0.25\), the main effect of verbal cues significant, \(F(1,29)=4.20, p<0.05, \eta^2_{p}=0.15\). The interaction of the identity and verbal cues significant, \(F(1,29)=5.22, p<0.05, \eta^2_{p}=0.15\). Simple effect, found that under the condition of non-self, words correctly is greater than the verbalization of the time, \(F(1,29)=12.37, p<0.01, \eta^2_{p}=0.30\). Under the self-condition, there was no significant difference in the accuracy of words (vs. vocalization), \(F(1,29)=0.003, p>0.05\). Simple effect, also found that under the condition of the word, not my accuracy is greater than the accuracy of the self, \(F(1,29)=12.71, p<0.01, \eta^2_{p}=0.31\). Under the vocalization condition, there is no significant difference between the accuracy of non-self and self, \(F(1,29)=0.83, p>0.05\).

B. Explicit task: same owner

Variance analysis of repeated measures of 3(3-self-familiar vs. familiar-stranger vs. stranger-stranger)×2(words vs. vocalization)×2(same stimuli vs. different stimuli) in participants.

Results show that the main effect of verbal cues is significant, \(F(1,29)=7.48, p<0.05, \eta^2_{p}=0.21\). Identity and verbal cue interaction significantly, \(F(1,29)=10.39, p<0.01, \eta^2_{p}=0.26\). Simple effect, found that under the condition of the familiar-familiar with words correctly is greater than the vocalization, \(F(1,29)=10.27, p<0.01, \eta^2_{p}=0.26\). In the stranger-stranger: words correctly is greater than the vocalization, \(F(1,29)=9.53, p<0.01, \eta^2_{p}=0.25\). In the self-self: there was no significant difference in the accuracy of words (vs vocalization), \(F(1,29)=1.26, p>0.05\). Implicit task: same owner.

C. Explicit task: different owner

Variance analysis of repeated measures of 3(3-self-familiar vs. self-stranger vs. familiar-stranger)×2(words vs. vocalization)×2(same owner vs. different owner) in participants. The results showed that Identity, stimulate the interaction content and verbal cues, \(F(1,29)=5.60, p<0.01, \eta^2_{p}=0.16\); Simple effect shows that under the condition of different stimulating - words, familiar strange (vs. self - familiar with accuracy), \(F(1,29)=5.74, p<0.05, \eta^2_{p}=0.17\).

D. Discussion

The results of experiment 2 show that there is a cognitive advantage in the non-self voice perception (vs. self-voice perception) in the explicit task. It is found that the stimulus content and verbal cues in the explicit task will have an impact on the individual self-voice perception. Specifically, different stimuli (vs. identical stimuli) and words (vs. vocalization) were more accurate. In addition, the interaction between identity and verbal cues was found, that is, the accuracy rate of non-self (vs. self) was higher under verbal conditions, but there was no difference between self and non-self under non-verbal conditions. It seems that the processing of self-voice perception in explicit task is different from implicit task.

In the explicit task, under the same condition of voice owner, there is no interaction between self (vs. familiar and strange), which still indicates that there is cognitive perceptual constancy in the self-voice perception of individuals in the explicit task. Under different voice owner conditions, there is no interaction between the condition non-self (vs. self), which further proves that individuals have cognitive perceptual constancy to self-voice perception.

VI. CONCLUSIONS

This study systematically discusses the mechanism of individual self-voice perception from implicit and explicit tasks, and finds that there are two different cognitive results of individual self-voice perception under verbal condition. In the non-verbal condition, because of the limited voice information, the influence of bone conduction on the self-voice in the recording will be reduced, so there is no difference between the self-voice and non-self-voice in the individual's implicit and explicit task. In addition, this study also finds itself in the individual the implicit task (vs. non-self) voice identification cognitive perceptual constancy, but this study considers only based on acoustic
generator factors within the individual difference. Future research can be conducted by involving different factors (e.g., environmental factors, social background, emotional) to explore the perceptual constancy of recognizing individual identities through voices.

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