

available at www.sciencedirect.comwww.elsevier.com/locate/brainres

**BRAIN
RESEARCH**

Research Report

The processing of phonological, orthographical, and lexical information of Chinese characters in sentence contexts: An ERP study

Baolin Liu^{a,*}, Zhixing Jin^a, Zhao Qing^b, Zhongning Wang^a

^aDepartment of Computer Science and Technology, Tsinghua University, Beijing 100084, PR China

^bSchool of Sciences, Tsinghua University, Beijing 100084, PR China

ARTICLE INFO
Article history:

Accepted 19 November 2010

Available online 29 November 2010

Keywords:

Homophonic

Orthographically similar

Synonymous

Chinese sentence comprehension

Event-related potentials

ABSTRACT

In the current work, we aimed to study the processing of phonological, orthographical, and lexical information of Chinese characters in sentence contexts, as well as to provide further evidence for psychological models. In the experiment, we designed sentences with expected, homophonic, orthographically similar, synonymous, and control characters as endings, respectively. The results indicated that P200 might be related to the early extraction of phonological information. Moreover, it might also represent immediate semantic and orthographic lexical access. This suggested that there might be a dual-route in cognitive processing, where the direct access route and the phonologically mediated access route both exist and interact with each other. The increased N400 under the control condition suggested that both phonological and orthographical information would influence semantic integration in Chinese sentence comprehension. The two positive peaks of the late positive shift might represent the semantic monitoring, and orthographical retrieval and reanalysis processing, respectively. Under the orthographically similar condition, orthographical retrieval and reanalysis processing was more difficult in comparison with the other conditions, which suggested that there might be direct access from orthography to semantic representation in cognitive processing. In conclusion, it was shown that the direct access hypothesis or the dual-route hypothesis could better explain cognitive processing in the brain.

© 2010 Elsevier B.V. All rights reserved.

1. Introduction

Language cognition is one of the most important research areas in cognitive science. In the cognitive processing of a written language, we find ourselves asking the following questions: how do people extract meaning from the form and structure of a Chinese character (orthographical information)? How does phonology of a character (phonological information)

affect one's understanding of character meaning? How can sentence context affect character comprehension (lexical information)? All of the questions above provide important research subjects. So far, psychologists have suggested several models for the cognition of words, namely the direct access hypothesis, the phonologically mediated access hypothesis, and the dual-route hypothesis (Aronson and Ferres, 1983; Chen and Shu, 2001; Coltheart et al., 1993; Coltheart and

* Corresponding author. Fax: +86 10 62771138.

E-mail address: liubaolin@tsinghua.edu.cn (B. Liu).

Rastle, 1994; Landi and Perfetti, 2007; Mann and Wimmer, 2002; Perfetti and Zhang, 1995; Yin, 1990). Recently, more and more studies support the dual-route hypothesis, that is, the phonological mediation and direct access both exist in cognitive processing and interact with each other (Chua, 1999; Feng et al., 2001; Landi and Perfetti, 2007; Xie and Zhou, 2003; Zhou and Marslen-Wilson, 1999, 2000). Chinese characters originate from pictographic characters. At present, some of them still retain their pictographic characteristics. We suggested that the meaning of these characters could be immediately accessed from their orthographies. However, the others could not because they do not possess any pictographic characteristics. Hence, we predicted that the direct access hypothesis or the dual-route hypothesis might be more appropriate in cognitive processing of Chinese characters (see Fig. 1). In this work, we intended to study the processing of phonological, orthographical, and lexical information of Chinese characters in sentence contexts, as well as to provide further evidence for these hypotheses.

Under the direct access hypothesis, the meanings of words are extracted directly from orthographical information. Under the phonologically mediated access hypothesis, the brain uses phonological information as a medium for extracting meaning from orthographical information in words. Under the dual-route hypothesis, the direct access route and the phonologically mediated access route both exist and interact with each other.

The evidence for direct access hypothesis can be found in different studies. For example, some patients only maintain a cognitive route where they extract meanings orthographically from word but cannot transform the orthographical information into phonological information (Yin, 1990). Aaronson and Ferres (1983) suggested that phonological information is seldom used in word identification, but rather that orthographical information directly activates lexical entry. Ziegler et al. (1999) also suggested that the lexical processing of words was independent of phonological processing.

There is also abundant evidence for the phonologically mediated access hypothesis. One of them is based on research on language processing in children, which demonstrates that phonological consciousness helps to improve the rate at which a child learns to read (Mann and Wimmer, 2002; Torgesen et al., 1999). Perfetti and Zhang (1995) showed that

homophones would cause a delay and confusion on the judgment of meanings. This evidence suggests that the cognition of phonological information of Chinese characters was still a part of Chinese language comprehension in a silent reading model as in an alphabetic writing language.

Moreover, the dual-route access hypothesis has also been demonstrated by empirical evidence. Jared et al. (1999) hypothesized that readers with higher skills used the direct access route more, while the readers with deficient skills, such as children, mainly used phonological information as mediation. Landi and Perfetti (2007) suggested that the ability to extract phonological information from orthographical information was mainly uniform, but the conversion of orthographical information to meaning varied according to reading skills. Similar evidence also comes from research on the Chinese language. It is suggested that phonological mediation and direct access both exist in cognitive processing and interact with each other (Feng et al., 2001; Zhou and Marslen-Wilson, 1999, 2000).

In neurolinguistic research, ERP (event-related potential) is an ideal tool. Compared with other methods such as fMRI, ERP has a higher temporal resolution and is sensitive to the millisecond. Nowadays, various ERP components have been discovered relating to language processing, upon which our research is based.

The P200 is widely found in visual studies and can be modulated by a large and diverse number of cognitive tasks. Luck and Hillyard (1994) suggested that P200 appears to reflect a transdimensional feature detection process, such as the features of orientation and size as well as color, and it would occur when one of several simultaneously presented stimuli contains the relevant feature. In language studies, some researchers reported that P200 is related to the early extraction of the phonological and orthographical information from the written language (Serenio et al., 1998; Barnea and Breznitz, 1998; Landi and Perfetti, 2007; Liu et al., 2003). Serenio et al. (1998) and Barnea and Breznitz (1998) suggested that P200 could reflect lexical processing and that it could be modulated by lexicality, word frequency, and word regularity. In the study of Landi and Perfetti (2007), two groups of participants, categorized according to their proficiencies in reading skills, were asked to judge the pronunciations and meanings of words. The results showed that P200 component was sensitive to differences between skilled and less-skilled comprehenders during a semantic processing task and less sensitive in phonological tasks. In addition, Liu et al. (2003) also observed that a smaller P200 was elicited by graphically related pairs in the pronunciation task. Hence, through the observation of P200, we could investigate whether phonological or orthographical processing would be triggered.

The N400 is mainly relevant to semantic processing during cognition. Kutas and Hillyard (1980) first found that there was a negative ERP wave 400 ms after the onset of the critical word, which relates to semantic violations in sentences. Connolly et al. (1995) discovered that the maximum N400 effect indeed came from the sentences containing words with incongruous meanings, regardless of whether these words had the same initial syllables as original words. Liu et al. (2009, 2010) and van de Meerendonk et al. (2010) found that unexpected words could elicit N400 effect in sentence comprehension. de Grauwe et al.

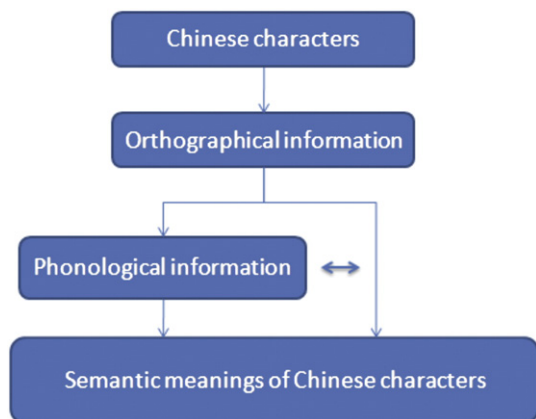


Fig. 1 – A sketch of a cognitive model of Chinese reading.

Download English Version:

<https://daneshyari.com/en/article/6265182>

Download Persian Version:

<https://daneshyari.com/article/6265182>

[Daneshyari.com](https://daneshyari.com)