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Is the word the basic processing unit in Chinese sentence reading: An eye movement study

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Abstract

This study sets out to explore the basic processing unit in Chinese sentence reading in an eye movement experiment. In the experiment, four analogous conditions were created: normal Chinese sentence with no highlighting, highlighting that marked words, highlighting that marked the unit under slow reading conditions and highlighting that marked the unit under natural reading conditions. All eye movement measures indicated that sentence processing under the word condition was the most difficult. As a result, it was revealed that the word was not a basic processing unit in Chinese sentence reading. The segmented unit, which is the 'prosodic word' under the slow reading condition, is the smallest prosodic unit that can be accepted by the readers and within reader's perceptual span, and is thus more likely to be the basic processing unit in Chinese sentence reading. Moreover, the duration of pause is an objective marker of the basic processing unit.

Keywords: Basic processing unit; Chinese sentence reading; Eye movement; Prosodic word

1. Introduction

The basic processing unit in language is both fundamental and crucial. The basic processing unit is the basis of revealing the potential cognitive mechanism in the reading activities (Yan et al., 2016).

1.1. The studies of the basic processing unit in languages with word spacing

In most of the alphabetic writing systems, of which English is a notable representative, there exists the conspicuous space-marker between every two words. Accordingly, the word is considered as the basic processing unit and this has been proven by a host of research.

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Miller et al. (2007) found that the English speakers could accurately segment the sentences into words with the word spacing deleted. It was revealed in other studies that when the word spacing was deleted or replaced in the English sentences, the readers' reading efficiency would decrease dramatically (Rayner et al., 1998; Rayner and Pollatsek, 1996; Winskel et al., 2009). Similar effects were found in the studies of Spanish (Perea and Acha, 2009) and German (Inhoff et al., 2000).

Some studies regarding eye movements in the alphabetic writing systems pointed out that the readers preferred a viewing location on the left within a word and this location was called the Preferred Viewing Location (PVL). PVL was widely found in English (Rayner and Fischer, 1996; Rayner et al., 1998; Vitu et al., 1995), German (Radach and Kempe, 1993), French (O'Regan, 1981; Vitu et al., 1990) and many other languages. The effect of PVL was often used to prove that the word was the basic processing unit.

The studies on the word superiority effect also revealed that the word was processed as a whole instead of being divided into several single letters (Cattell, 1886; Healy, 1994; Johnston, 1978).

1.2. The studies of the basic processing unit in Chinese

Different from the Indo-European languages, Chinese is ideographic. The basic writing unit of Chinese is the character which occupies the same space area, and thus there is no space-marker between the characters or words. A character maybe a free morpheme (a character is a word, e.g. [ʐən^{35}] 人 'person' is a character as well as a word), but could also be a bound morpheme (e.g. [min^{35}] 民 in [ʐən^{35} min^{35}] 人民 'people' cannot form a word itself but can only form a word with [ʐən^{35}] 人). Sometimes a character can even be part of a morpheme (e.g. [pʰu^{35} tɑu] 葡萄 'grapes' is a word as well as a morpheme consisting of [pʰu^{35}] 葡 and [tɑu] 萄, but neither of the two characters is a morpheme). The differences between words and morphemes, and between words and phrases in Chinese are comparatively vague (Zhang, 2013). Accordingly, the determining of the basic processing unit in Chinese is rather complicated.

The previous studies have contributed a lot regarding the determining of the basic processing unit in Chinese sentence reading. However, divergent opinions still remain.

Among those previous studies, taking the word as the basic processing unit is supported by some studies (e.g. Rayner et al., 2007; Wang et al., 2010; Yan et al., 2010; Yang and McConkie, 1999). In those studies, taking the word as the possible basic processing unit in Chinese sentence reading was actually inspired by the alphabetic writing systems such as English.

For instance, Yan et al. (2010) proved from the perspective of the PVL that there was also PVL in Chinese sentence reading. The word, as a result, became the basic processing unit. However, when Li et al. (2011) tried to test this result by choosing the key words in different length, they found that the readers did not take the word as the unit of the saccade target.

The studies on the space between the words also support the findings that the word is the basic processing unit. Bai et al. (2008) investigated the processing difference among normal unspaced text, text with spaces between words, text with spaces between characters, and text with spaces between characters that yielded nonwords. It turned out that the spaces between characters would interfere with the processing of sentence reading, while the spaces between words would neither facilitate nor interfere with the processing of sentence reading. This result showed that the word was more likely to be the basic processing unit in Chinese sentence reading. However, according to Liu et al. (1974), the processing time under the word spacing condition was remarkably longer than the condition without word spacing. The spaces between words interfered with the participants' normal sentence reading. To some degree, there exists some problems in the studies of Bai et al. (2008) and Liu et al. (1974). The experimental materials collected by Liu et al. (1974) under the word spacing condition only included seven characters which made up six words. The monosyllabic words were the key components of their experimental materials. However, based on Zhang (2013), the monosyllabic words and the disyllabic words were almost equally distributed in the actual Chinese texts. Furthermore, according to Liu et al. (1974), the ecological characteristics of the experimental materials would affect the experiment results. Bai et al. (2008) mainly compared the processing differences between the character condition and the word condition and excluded the possibility of the Chinese character being the basic processing unit as evidenced by interference under the character spacing condition. However, characters and words in Chinese are not in a binary distribution. The language units not only consist of characters and words, but also phrases, etc. Furthermore, Bai et al. (2008) did not take into consideration that other language units could possibly be the basic processing unit. More importantly, in Bai et al. (2008), the units used in the experiment were mostly units larger than words. For instance, [nA^{51} ɕiɛ^{55}] 那些 'those', [xən^{214} xɑu^{214}] 很好 'very good', [niæn^{35} tɕhiŋ^{55} ʐən^{35}] 年轻人 'young people' and [fA^{55} xuei^{55} lɣ] 发挥了 'brought into play', etc. were all phrases. It signifies that the condition Bai et al. (2008) used to control the word segmentation was not pure word condition. As a result, taking the word as the basic processing unit in Chinese sentence reading could be problematic.

There is a common yet important issue that was not figured out in all the studies above and that is the defining of the word in the experiments. It was revealed in some studies that Chinese readers did not define the word according to the

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