

N200 reveals uniqueness of Chinese word recognition

By ZHANG QIQUN

Chinese characters, as the sole ideographic scripts among the multitude of writing systems in use today, hold a remarkable distinction. Originating from oracle bone inscriptions, these characters have been employed for over 3,000 years. The question arises: does the exceptional nature of Chinese characters fundamentally influence the cognitive processes of the Chinese people? This inquiry carries immense significance, as a nation's social existence is essentially an outward manifestation of its cognitive framework, which permeates its culture, art, philosophy, religion, and even scientific endeavors.

The N200 response

A breakthrough in the study of the relationship between Chinese characters and thinking is the discovery by professor Zhang Xuexin and his team. With the use of event-related potentials, Zhang and his team observed a widespread negative deflection with centro-parietal focus elicited 200 ms post-stimulus onset when asking native Chinese speakers to discriminate between real Chinese words and pseudo- or non-words. Extensive studies confirm that the centro-parietal N200 is an event-related potential component specific to Chinese visual word recognition, which is identified as a neural marker that Chinese psycholinguistics have been seeking for three decades. As a neural marker for distinguishing word recognition across Chinese and other alphabetic scripts such as English, the presence of N200 confirms that the word recognition of Chinese and English involve essentially different brain processing—there is an enhance visual processing involved in the early stage of Chinese word recognition, which is completely absent in English word recognition.

The discovery of N200 likely reflects very early identification of the orthography of Chinese individual characters involving extensive and higher-level visual analysis. No similar visual analysis had been reported in word recognition studies involving alphabetic scripts [under similar experimental conditions]. This suggests that visual processing plays a more significant role in Chinese word recognition than in English, which is consistent with the meaning-spelling theory that the Chinese scripts are more thoroughly a visual language compared with the alphabetic scripts. The fundamental difference in how the brain processes Chinese characters compared to alphabetic scripts provides a neural marker for distinguishing between Chinese and Western cultures, and offers a new perspective for understanding the differences in Chinese and Western thinking and culture.

N200 enhancement effect

Moreover, studies show that the



An exhibition of Chinese calligraphy in the National Art Museum of China, Beijing, on July 15, 2023 Photo: CFP

N200 response presents a clear and large-amplitude enhancement upon repetition of Chinese words. Further information retrieval reveals that no comparable effects have been observed in the extensive recognition studies on images or English and other alphabetic scripts. Apart from English and other alphabetic scripts, the N200 couldn't be elicited in the experiments where Zhang asked Chinese college students, without any experience of learning written or spoken Korean, to read Korean words. Hangul characters are visually similar to Chinese characters. Both consist of strokes and radicals arranged within a square shape. The result indicates that N200 could not be solely attributed to certain physical properties of Chinese scripts, but rather to the meaningful linguistic content they convey on a deeper level. It has been reported that there is no N200 response when people perceive graphics, indicating that Chinese characters are not merely graphical symbols, but rather abstract visual symbols [with inherent linguistic meaning].

This important achievement in the study of Chinese characters reminds us of Immanuel Kant's Schema Theory. The N200 response discovered by Zhang and his team is a special brainwave elicited by reading Chinese characters. Kant's Schema Theory is a philosophical analysis and inference, while the N200 is the result of scientific experimentation. More research and experimentation are needed to demonstrate the possible relationship between the two. We cannot make hasty judgments about this. The following is merely a cautious logical inference: Kant's schema refers to a brain function, and "the procedural rule by which a category or pure, non-empirical concept is associated with a mental image of an object." N200 is the result of the brain's response to reading Chinese characters. Experimental evidence shows that N200 could not be elicited by reading English and other alphabetic scripts. Therefore, is there any overlap between the Chinese word recognition that elicits N200 and Kant's schema? If

we make a bold connection between the two, then Chinese character reading at least has the potential to enter the brain more quickly than alphabetic script reading. Based on Kant's theoretical description and Zhang's experimental results, we cannot completely dismiss the possibility of a significant overlap between Kant's schema and Chinese characters. In other words, Chinese characters may exhibit a closer alignment with Kant's concept of schema compared to Latin or other alphabetic scripts. If this inference holds true, it leads to the conclusion that individuals who read and utilize Chinese characters may engage in a distinct thinking process compared to those who use alphabetic scripts. The unique characteristics of Chinese characters potentially shape cognitive processes in a distinctive manner.

Emphasis on visual processing

In fact, a comparison between the recognition process of Western alphabetic scripts and that of Chinese characters reveals some distinctiveness. The recognition process of Western alphabetic scripts can be outlined as from the "appearance of things" to "pronunciation (letters)," "concept (a conversion from sound to concept)," and finally to "thinking." The recognition process of Chinese ideographic scripts can be outlined as from the "appearance of things" to "concept (concepts directly gained through visual perception of Chinese characters)," and then to "thinking." This is what Zhang and his team have repeatedly emphasized in their experiments, that Chinese character recognition is mainly achieved through visual processing. It indicates that Chinese character recognition can be faster than that of alphabetic scripts. Human vision, which operates by perceiving electromagnetic waves through the retina, is more informative than hearing, which relies on the perception of sound waves by the eardrum.

By using Chinese characters, Chinese readers rely more on the faculty of sight in their daily life. Accordingly, they appear less sensitive

in terms of hearing than Westerners. This distinctiveness becomes evident in various contexts, such as the theater. Traditional Chinese operas and Western operas differ in their singing styles and the intended purposes of vocal expression. Western operas typically prioritize vocal beauty, with lyrics often taking a secondary role. Chinese operas emphasize the expression of lyrics, with vocals as a secondary consideration. This necessitates clear pronunciation of individual words. In addition, subtitles have been used to display lyrics in Chinese theaters for various operas for a long time. Another example is poetry. The appreciation of Chinese poetry is mainly achieved by reading. When reciting a Chinese poem, especially an ancient poem, listeners usually "convert" it to text in their minds prior to understanding its meaning. In the aforementioned instances, sound, specifically instrumental music, assumes a supportive role in comprehending Chinese operas and poetry.

'A living schema'

In the preface to *Shuowen Jiezi*, an ancient Chinese dictionary compiled during the Eastern Han Dynasty, the author Xu Shen describes the legendary invention of writing: "The Scribe of the Yellow Emperor, Cang Jie, observing the traces of the footprints and tracks of birds and wild animals, understood that their linear structures could be distinguished from one another by the differences between them. When he first created writing by carving in wood, the hundred officials became regulated, and the myriad things became discriminated" (trans. Timothy O'Neill). "When Cang Jie first invented writing, it was presumably because he copied the forms according to their resemblances that they were called *wen* 'patterns.' Then forms and pronunciations were added to each other, so they were called *zi* (written words). As for *wen*, they are the basis of the images of things. *Zi* means to engender and to increase gradually" (trans. Bottéro).

A phrase from the *Book of Change*

describes the fundamental characteristics of the structure of Chinese characters: "Anciently, when Baoxi had come to the rule of all under heaven, looking up, he contemplated the brilliant forms exhibited in the sky, and looking down he surveyed the patterns shown on the earth. He contemplated the ornamental appearances of birds and beasts and the (different) suitabilities of the soil. Near at hand, in his own person, he found things for consideration, and the same at a distance, in things in general" (trans. James Legge). It means that the Chinese characters are derived from humanity and the appearances of other creatures. Chinese characters are meaningful by themselves, with every graphic representing an idea or concept. Although it is said that Chinese characters are "pictographic," they are not purely physical representations of objects, but somewhere between representational and abstract. Therefore, it can be said that Chinese characters are a "living schema," which appear in specific texts and elicit strong emotional responses from readers through visual perception.

As a "living schema," Chinese characters possess the essential characteristics of art, and have been appreciated as an art form. Chinese calligraphy displays the writing of Chinese characters through changing dots, lines, strokes, and the overall layout, exhibiting an artistic rhythm and picturesque appeal through ink and water. It integrates with the content of the texts, mutually reinforcing each other, with an aim to extract the truth of nature and life. As an art form, Chinese calligraphy is close to traditional Chinese painting. It has been widely recognized that "calligraphy and painting share the same origins" in China. On most occasions, alphabetic scripts can be superficially artistic through ornamental penmanship. The artistic significance of Chinese calligraphy is beyond the reach of the artistic forms of the other writings.

Legend has it that when Cang Jie invented the characters, the deities and Heaven worried [that deceit would arise from this, the focus would be lost, farming would be abandoned, and that world would be short of food] and rained millet; ghosts cried at night [as they were scared to be exposed by books]. The ancients regarded the birth of Chinese characters as a shocking event that made heaven and earth shake and deities and ghosts cry. Still, there are many mysteries about the "Chinese way of thinking" that arises from Chinese characters, and the culture that grows from them, waiting to be decoded.

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