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Abstract

In the last decade, researchers of hemispheric superiority have become increasingly interested in the length effect in word recognition in alphabetic languages. But little has been known about ideographic languages like traditional Chinese. The primary aim of this study is to investigate hemispheric laterality and the word length effect in Chinese script recognition. Different-length words consisting of two-, three- and five-characters were presented unilaterally in a lexical decision task. The results, from 23 Taiwanese subjects, supported the word-length effect showing significantly different recognition latencies for the multi-character words of different length, but no significant hemispheric lateralisation. There was a significant interaction between gender and visual field, with males tending to show a right visual field advantage.

Previous studies have demonstrated hemispheric lateralisation effects in recognizing words of different length (Ellis & Young, 1985), concrete and abstract words (e.g., Ellis & Shepherd, 1974) and a word/number difference (eg, Besner, Daniels & Slade, 1982). The principle finding of a right visual field (RVF) superiority has been repeatedly reported in physically long English words: increasing word length affects the left visual field (LVF) but not the RVF presentations, resulting in a RVF superiority.

The Chinese writing system, the so-called ideogram, is distinctive from the English writing system and is supposed to present more pictorial characteristics, involving an LVF superiority in recognition tasks. Chinese stimuli presented in the LVF are hypothesized to consume shorter time in lexical decision than those presented in RVF, because the right hemisphere, directly connected to LVF, is dominant in processing pictorial images.

In 1994, Fang conducted experiments with different-length Chinese words but failed to find a significant interaction between Visual Field and Word Length. Either a significant Word Length effect or a Visual Field difference was found in separate experiments. This failure to find an interaction between length and visual field is important given the robustness of the effect in English. Below we report a replication of Fang's experiment, but with an added manipulation of gender, to investigate word recognition in Chinese.

Experiment

The primary aim of this study is to investigate hemispheric laterality and length effects in Chinese script recognition. Different-length words consisting of two-, three- and five-character were presented unilaterally in a lexical decision task.

Subjects

In this experiment, we used subjects who were able to read Chinese in traditional fonts. Twenty-three Taiwanese students studying in the University of Edinburgh volunteered. Their average age was twenty-nine for twelve males and twenty-seven for eleven females. All of them were native Mandarin speakers and were skilled Chinese readers with normal or corrected-to-normal vision. Only one of them was ambidextrous, the rest were right-handed according to self-report. The criterion of handedness was which hand they use most frequently for writing, holding chopsticks and badminton rackets, and whether there were any of their family members who were ambidextrous or left-handed.

Design

The stimuli were 120 different-length vertically displayed Chinese words and non-words consisting of 2, 3 and 5 Chinese characters, which were chosen from the Corpus of Journal Chinese (1993). Each length category contained 20 non-words and 20 real-words. This was a within-subjects repeated measures design. Half of the words were presented in the LVF and the other half the RVF. Twenty-three volunteers were divided into two groups randomly. The stimuli were arranged in a Latin Square design, therefore the words used in the first group were identical to those in second group, except that the stimuli presented in the LVF for the first group were presented in the RVF for the second group.

Stimuli

Switching the positions of two characters within one word was the way we produced the non-words. For example, three-character words like 荷包蛋 changed to 荷蛋包. The fixation point was a 4 mm × 4 mm cross (Font: Bodoni MT Ultra Bold. Size: 24. Duration 1000 msec) presented at the center of the monitor. It was to draw participants' attention and fixate their eyes on the center. A masking pattern was produced by overlapping dozens of Chinese characters that did not appear in the formal experiment. In addition, there were fifteen practice trials preceding the experiment.

All of the Chinese materials were produced by PhotoShop, and presented by Psyscope Version 1.2b5 (1994) and a Macintosh computer. The size of each character was 13 mm × 13 mm and the inter-character space was 9 mm, thus the three different lengths of words were 13 mm × 35 mm, 13 mm × 57 mm and 13 mm × 100 mm respectively. All the stimuli were presented on the screen either 2 mm to the right hand side of the fixation point or 2 mm to the left hand side of the fixation point. The smallest visual angle was equivalent to 0.25 degree from the fixation point.

Procedure

Subjects were asked to complete the personal data questionnaire before doing the experiment. After being instructed to sit in front of the computer, they were to face the center of the monitor at a distance of 450 mm to 550 mm from their eyes to the monitor, and to press the right or left button with the right or left index finger to make lexical decisions. For all the subjects, pressing the right button with the right index finger was for real-words and pressing the left button with the left index finger was for non-words. The experimenter explained the instructions and watched subjects' responses during fifteen practice trials, then subjects would be left alone while the formal experiment was progressing. The Psyscope software recorded response latencies with millisecond precision.

The sequence of presentation was firstly a fixation point, presented centrally for 1000 msec, followed by a unilaterally presented vertical Chinese stimulus which was ended by the critical response or which ended automatically after 2000 msec, followed by a masking picture presented for 1000 msec.

Analysis and results

An analysis of variance of response latencies was carried out with Visual Field and Word Length as within-subject factors and Gender as a between-subject factor. A significant main effect was found for Word Length ($F(2,42)=270.832$, $p< .001$), but was not for Gender ($F(1,21)=.429$, $p> .05$) or Visual Field ($F(1,21)=.423$, $p> .05$). In the LVF, five-character words were recognized less efficiently than both two- and three-character words, however, the differences between two- and three-character words did not reach significance. On the other hand, in the RVF, response times to 2-character words were shorter than those to 3-character words which were in turn shorter than those to 5 character words. Thus, there was a strong main effect of word length, in the predicted direction, but not of Visual Field.

The two-way interaction between Gender and Visual Field was significant ($F(1,21)=6.014$, $p< .05$), but not the one between Gender and Word Length ($F(2,42)= .898$, $p> .05$) or between Visual Field and Word Length ($F(2,42)=.250$, $p> .05$). Figure 1 shows that Females tended to recognize Chinese scripts faster than Males when scripts were presented in the LVF. But the response time difference did not reach the significance level of .05. Gender differences were not significant either in the RVF or in the LVF. On the other hand, Visual Field was marginally significant in Males ($p= .086$) but not in Females ($p= .121$). That means, for Males, words presented in the RVF tended to be better recognized than those in the LVF. There was no significant three-way interaction between Gender, Visual Field and Length ($p> .05$).

In summary, a significant main effect was found for word length, with longer words taking predictably more time to process than shorter words. Although the response times in the LVF were slightly slower than those in the RVF, the main effect of Visual Field did not reach statistical significance, either by subjects or by items, nor was there any significant interaction

Table 1. The response latency of Lexical Decision for 2-, 3- and 5-character Chinese words in different visual fields. This table presents the figures analyzed by items.

RT(msec)	RVF	LVF	For Entire Population
2-character words	780.8219	767.8909	774.3564
3-character words	863.2826	875.1924	869.2375
5-character words	1145.5332	1182.9296	1164.2314
			Mean 935.9418

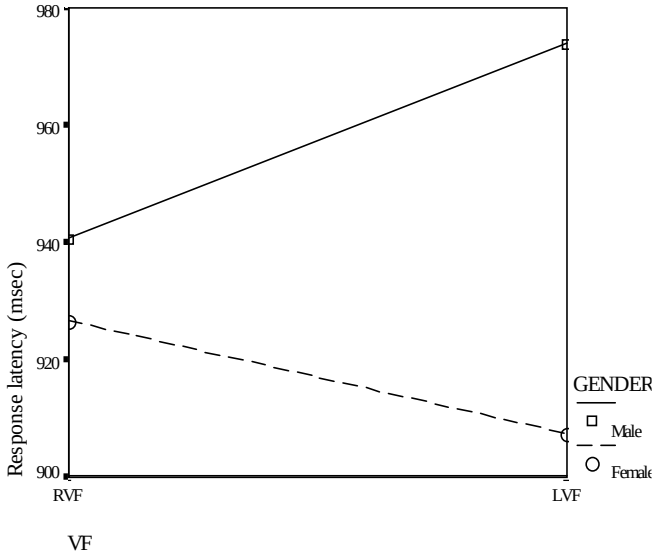

Figure 1 The interaction of Visual Field and Gender. The Visual Field difference was marginally significant in Males. That is, for Males, words presented in the RVF tended to be better recognized than those in the LVF.

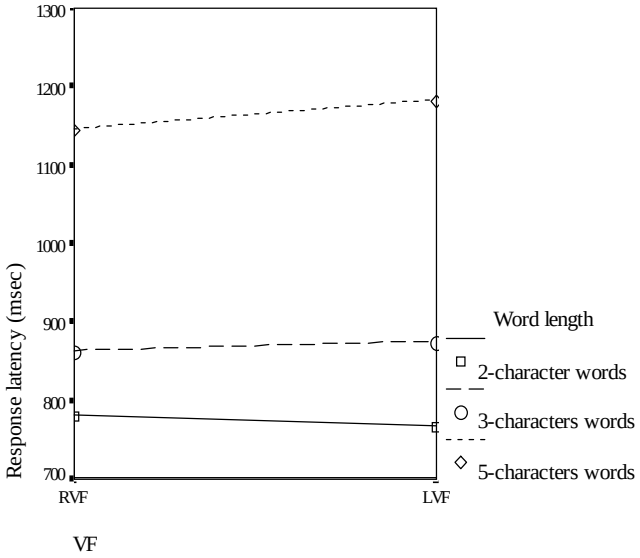

Figure 2 A significant main effect was found for Word Length, but was not for Visual Field or the interaction between Visual Field and Word Length.

between Word Length and Visual Field. In conclusion, hemispheric superiority for word length, as found in English, does not appear to exist in Chinese, from the results of this experiment.

Discussion

The methodology of this experiment was taken from Fang (1994). We extended the research of Fang by adding five-character words and introduced the gender differences. In the results, only the main effect of Word Length reached significance; neither the main effect of Visual Field nor the interaction between Visual Field and Word Length reached significance. There was, however, a significant interaction between Gender and Visual Field, the slowest reaction times coming from males responding to the LVF, supporting the idea that there are indeed visual field differences to be found in the processing of Chinese script, and comparable to those found in reading English orthography. Because of their interaction with gender, these visual field effects would seem to involve the lateralisation of phonological *versus* spatial processing. We may conclude that there is a qualitative difference between text processing in English and Chinese that prevents the emergence of a significant interaction between word length and hemifield in Chinese. Speculatively, the principal difference present in the current experiment is the vertical presentation of the words, compared with the exclusively horizontal presentation found in the relevant English experiments.

Two caveats are also necessary. Bole (1995) argued that the severity of the criteria in selecting handedness could affect the results of hemispheric superiority experiments. Mistaking left-handers for right-handers causes the data from right-handers to be less different from that of left-handers, and results in insignificant differences. Thus the current experimental procedure might be improved by using instruments such as the Edinburgh Handedness Inventory to investigate more detailed hand uses, together with a severe filter of subjects' family history in handedness.

Not all of studies of hemispheric lateralisation have reached the consistent conclusion that Chinese has significant LVF superiority with the increase of word length. But since Tzeng (1979) and following studies, it was accepted that Chinese words yield a RVF superiority whereas Chinese characters yield either a slight LVF superiority or inconsistent performance. However, many studies had failed to reduplicate these results. Thus arguments were raised from the consistency of hemispheric superiority in Chinese. Whether there is a consistent hemispheric lateralisation in recognizing Chinese words still remains doubtable.

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