

Abstract of the thesis entitled

**An fMRI Study of Working Memory
for Phonological and Orthographic Information
in Normal and Dyslexic Chinese Children**

Submitted by

YANG Jing

for the Degree of Master of Philosophy

at The University of Hong Kong

in June 2005

The majority of studies relating to dyslexia have underestimated the contribution of working memory on reading acquisition despite of abundant behavioral evidence indicating verbal working memory deficits in dyslexics. According to Baddeley's multiple-component theory, verbal working memory is characterized by temporary manipulation and maintenance of verbal information for further processing. It consists of three components which are served by distinct neural circuitries: a central executive, that is associated with prefrontal cortex activation; a subvocal rehearsal mechanism based on the network that involves inferior frontal gyri, cerebellum, premotor and supplementary motor areas; and a phonological store that is localized in the left parietal cortex, specifically in the left inferior parietal regions. More importantly, studies on brain-damaged patients and normal subjects suggested neural correlates underlying working memory for various kinds of verbal information to be different. The present study used functional



magnetic resonance imaging technique to investigate the differences between normal and reading-impaired children in their neural mechanisms responsible for verbal working memory, and to explore the dissociation between phonological and orthographic working memories.

Thirty-three children from a primary school in Beijing participated in the fMRI experiments. These children were divided into a normal reading group and a reading-impaired group based on their performance in a reading test and Chinese language course. All of them were tested on both phonological and orthographic verbal working memory tasks as well as corresponding well-matched control tasks. Results showed that dyslexic children had less activation in brain areas responsible for subvocal rehearsal and central executive functions than normal controls during both phonological and orthographic working memory tasks. Specifically, apart from common activation in the left inferior parietal cortex, reading-impaired children had less active prefrontal cortex, premotor and supplementary motor areas, when responding to the two working memory tasks. Moreover, dyslexic children's bilateral inferior frontal cortex, anterior cingulate gyrus, and superior parietal regions along with the cerebellum were not as active as they were in normal readers in the phonological working memory condition. In contrast, brain activation patterns of normal and impaired readers were similar in solving orthographic tasks, except for activation in bilateral superior frontal gyri, inferior frontal cortex and the cerebellum. The findings suggested that impaired phonological and orthographic working memory systems could partly account for reading disabilities in Chinese



dyslexics who show less utilization of phonological rehearsal strategy and less superior executive control ability in reading and working memory tasks. The dyslexic children depend more on analogous regions in the right hemisphere as a compensatory strategy. General comparison of performance on working memory tasks reveals, apart from a common neural network for short-term memory of verbal information, phonological and orthographic working memory systems are different in their corresponding additional storage subsystems specialized for phonological and orthographic codes respectively. The present study helps to elucidate the neural mechanism underlying the defective verbal working memory system of Chinese dyslexic children. The findings could contribute to provide insight in developing alternative remedies for children with reading disabilities.

(490 words)

