



# A Study of Working Memory for Dyslexia with FNIRI Technology in the Context of Big Data

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**Abstract.** Reading ability is one of the most important language skills, and the common phenomenon of English dyslexia exists in Chinese universities. By analyzing the specific performance and difficult features of college English dyslexia and specific teaching cases, we propose a strategy to solve college English dyslexia. By using the FNIRI technique, the relationship between dyslexia and working memory and the characteristics of brain functional activity of dyslexic working memory are explored. Not only does it explore the application of the big data cognitive method of teaching to college English reading, but also improves students' independent reading ability, thus improving the quality of teaching.

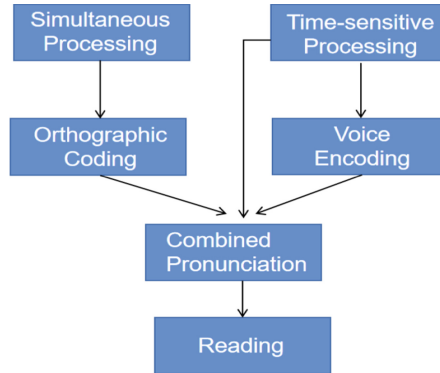
**Keywords:** FNIRI technology · dyslexia · working memory

## 1 Introduction

The 21st century is the era of knowledge economy, the era of talent quality competition, the comprehensive quality of college students will play a very important role in the development of society. In March 2014, the government work report for the first time “advocate national reading” as a key work of the government in 2014, in recent years, governments and cultural institutions at all levels also vigorously advocate “One of the important ways to improve the comprehensive quality of college students is reading [1]. In particular, college students in the new media era, as the future pillars and hopes of the motherland, are more likely to accept new things, and are easily influenced by changes in the social environment and reading environment, and are the first to produce changes in reading psychology and reading behavior. It is worthwhile to study the reading status of contemporary college students in the context of big data, what are their characteristics, what problems exist and how to solve these problems.

## 2 Dyslexia

Dyslexia in college students mainly includes vocabulary barrier, grammar barrier, language sense barrier, reading habit barrier, and logical reasoning barrier. Barriers in vocabulary refer to the poor mastery of English vocabulary, and sometimes the meaning



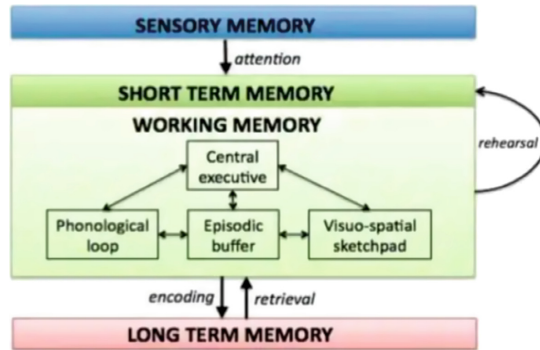
**Fig. 1.** Cognitive processes in coding

of many words may change in different contexts, which seriously affects one's reading experience; barriers in grammar refer to the poor understanding of key prepositions and conjunctions in English sentences, and the inability to grasp the logical relationship between paragraphs and sentences[2]; barriers in language sense refer to the regional differences in education level, The barrier of reading habit refers to the fact that many students habitually read one word after another when they read English articles, and when they encounter raw words, they tend to pause and fail to start from the whole reading, which seriously affects the coherence of English reading and makes it difficult to understand the central idea of the article; the barrier of logical reasoning refers to the fact that their language logic ability is insufficient and they are unable to The logical reasoning disorder refers to their insufficient language logic ability to summarize and conclude the central idea of sentences and paragraphs and to discover the connection between the meaning of sentences and paragraphs [3] (Fig. 1).

### 3 Materials and Methods

#### 3.1 Core Content of Working Memory

WorkingMemory (WM) was originally proposed by Baddeley in 1974 as an energy-limited memory system for the temporary processing and storage of information [4]. The model suggests that working memory consists of three components, namely, the centralexecutive and two subordinate systems, the phonological loop and the visuo-spatial sketchpad. The centralexecutive system is the core of the working memory model, which is an energy-limited system responsible for linking subsystems with each other and with long-term memory, as well as for coordination of attentional resources and strategy selection and planning; the visuo-spatial sketchpad mainly processes visuo-spatial information, which contains two components: the visual component (related to color and shape) and the spatial component (related to location); the phonological loop is responsible for the storage and control of sound-based information, which includes speech storage and articulatory control processing [5].



**Fig. 2.** Working memory model phonological memory tasks.

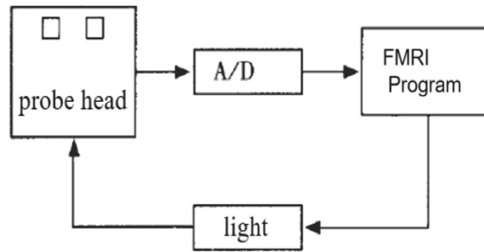
Research has found that working memory is closely related to reading, and that when a reader needs to recognize the material read or recall some knowledge, such as the rules of form-sound conversion, he must encode or recollect certain words or sentences. In other words, working memory can help students recall or process the structure, meaning, and phonology of words during reading. In developmental dyslexia research, working memory processing usually includes both word-form memory [6].

Clark et al. (1977) proposed a four-level model of spoken language comprehension. The model argues that the process of spoken language comprehension begins with the establishment of the structure of phonological representations of the discourse in question in working memory. Then, on the basis of the memory representation, the content of various phonological components of the discourse stream and their functions of the discriminative company are formed. Then, according to the discriminative result, the verbal reasoning level can build the corresponding propositional structure in the working memory. Finally, the speech comprehendor then integrates the various representations in the working, memory to form a complete discourse meaning. In this model, the role of working memory is first to characterize the original phonological form of the discourse input, and then to store the intermediate representational forms that emerge during the discourse processing. (Fig. 2).

Thus, phonological representations are the offshoot of the spoken language comprehension and processing process, and working memory sets a buffer for spoken language comprehension. Although Clark et al. did not specify the specific properties of this buffer at that time, in terms of its function, it corresponds to the phonological circuit in Baddeley et al.'s working memory model, and this important function of working memory has been accepted by many theories of speech comprehension [7].

## 4 Results & Discussion

FMRI is functional magnetic resonance imaging. As cognitive neuroscience becomes more mainstream in the field of psychological research, FMRI has become one of the most prominent psychological research tools used to explore the brain mechanisms underlying an individual's psychology or behavior. FMRI uses magnetic resonance



**Fig. 3.** Schematic diagram of the operating principle of the fNIRI imager

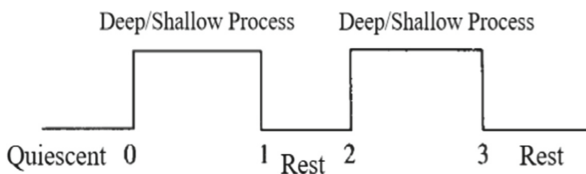
imaging to measure changes in the hemodynamics of neuronal activity and to identify the brain regions or neurons associated with the target psychological or behavioral condition. (Fig. 3).

Dyslexia is a specific neurocognitive disorder related to reading and writing. Studies have shown that patients with dyslexia have deficits in working memory, but exactly which system or systems have what kind of deficits remains unclear. In recent years, based on the dependence of cerebral blood oxygen levels, the FNIRI technique has become an important non-invasive means of probing functional brain activity. Existing studies of higher cognitive functions of the brain have found good agreement between functional near-infrared optical imaging (fNIRI) and fMRI.

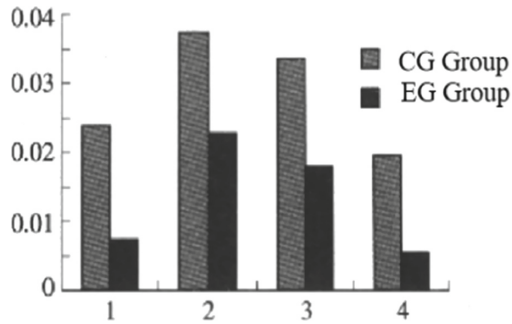
An exploratory study was conducted on the relationship between deep and shallow processing of working memory and dyslexia using fNIRI to investigate the local cerebral blood flow changes in the left prefrontal lobe of Chinese dyslexia, reflecting from one side that cognitive deficits in Chinese dyslexia are related to low cerebral blood flow and cerebral blood oxygen levels. The results of the study investigated the characteristics of cognitive and memory processing in dyslexia from the perspective of information processing, which have implications for both clinical diagnosis and treatment of RD.

Exploring the characteristics of cognitive and memory processing in dyslexic adolescents from the perspective of information processing has implications for both clinical diagnosis and treatment of RD. Since the present study only observed the BOLD response in the left prefrontal lobe of adolescents, the right prefrontal lobe was not studied. Therefore, whether there is a separation and lateralization between the two in the left and right brain regions remains to be further investigated. (Fig. 4).

In this study, changes in blood flow due to cognitive activity were observed in real time using the fNIRI technique. The subjects' left prefrontal orienting reflexes were activated during deep and shallow processing tasks, with increased BV and enhanced



**Fig. 4.** Schematic diagram of the experimental sequence [8]



**Fig. 5.** Difference in blood flow ( $\Delta BV$ ) between the two groups of different regions during shallow and deep processing [9]

activity in the corresponding brain tissue, indicating an activated state. This is consistent with previous findings of fMRT3 in normal subjects. (Fig. 5).

## 5 Conclusions

### 5.1 Improve the Ability to Remember and Accumulate Words

One of the most dominant features of dyslexia is the lack of appropriate word recognition skills. These results all indicate that children with reading difficulties have deficits in the use or manipulation of the phonological system. Only through extensive reading training, analysis and summarization of multiple word meanings can help college students successfully improve their reading speed. Teachers should encourage students to read a wide variety of reference literature during the instructional period, and they should provide relevant reading materials, both in and out of class, to guide students in their reading and improve their reading.

### 5.2 Emphasis on the Development of Language Sense

Pay attention to your own phonetic training, pay attention to the selection of materials in teaching phonetics, try to present authentic English phonetic materials to students in their original taste, so that students can understand the relationship between various elements that constitute the sense of speech, such as intonation, rhythm, stress, emotion and attitude. Creative English atmosphere to experience the wonders of English in an English-speaking environment and develop a sense of language. In the teaching classroom, the classroom is decorated to reinforce the English context and to innovate the English context, where everyone communicates in English, so that students are immersed in the use of English and develop the habit of thinking in English. Use different types of activities to encourage students to actively participate, develop their sense of language in multiple types of activities, encourage students to use more communicative ways about English in their daily lives and travels, and develop a sensitive ability to comprehend and perceive through extensive oral training.

### 5.3 Improve Your Working Memory Skills

Working memory training can significantly improve our control of attention and help us to reduce distractions. Working memory training positively affects the way we filter and manage information, which may help control mood and anxiety. You can improve your working memory through physical and mental exercise [10]. Physical exercise has been shown to improve concentration, memory, problem-solving skills and attention to detail. However, brain exercise is what really challenges your brain and helps it become stronger. Working memory can be trained by using repetition strategies that allow for increased working memory breadth. Compared to other strategies, repetition strategy training is more effective for individuals with low working memory breadth. The correlation between working memory breadth and reading ability was also improved after retelling strategy training [11].

Reading is an overall more complex cognitive process, which is not only as simple as reading, but also involves many aspects, such as vocabulary [12], language sense, reading habits, cultural background and other different aspects of the combined effect and influence, and at the same time these factors are also the key to many problems and obstacles in English reading for college students.

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