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Understanding developmental dyslexia in Chinese: linking research to practice

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Abstract

Dyslexia is one of the most common learning difficulties affecting approximately 9.7% of the school population in Hong Kong, Special Administrative Region of China. The education and support needs of primary and secondary students with dyslexia have therefore been of great concern to the community. In the present paper, research into the characteristics of the Chinese language with focus on the cognitive-linguistic characteristics, causes, and manifestations of dyslexia are briefly reviewed. Such work could provide the foundation to develop effective evidence-based identification, intervention, and support for students with dyslexia both inside and outside of school. Thus understanding the causes and mechanisms underlying dyslexia with reference to the special circumstances of the Chinese milieu allows better informed identification, remedial intervention, support service, and teacher education for further work on research and practice.

Keywords: Chinese language, dyslexia, intervention, support service, Hong Kong

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Dyslexia is the most common of the specific learning difficulties (or disabilities) that constitute a varied group, for example, specific language impairment (SLI), attention-deficit hyperactivity disorders (ADHD), and developmental coordination disorder (DCD). These difficulties tend to be present from birth and may occur concomitantly and lead to profound academic and social-emotional and behavioural problems (Osmond, 1993). Dyslexia is characterized by severe and pervasive difficulty in learning to read and spell despite normal intelligence, and in the absence of sensory and neurological impairment or environmental deprivation (Chung & Ho, 2010; Rose, 2009). In western countries, dyslexia is the most prevalent specific learning difficulties (nearly 80%) (Handler & Fierston, 2011) and has been extensively studied in alphabetic languages, particularly for English. Given the highly irregular sound-to-spelling correspondences in English, dyslexia is characterized by slow and inaccurate word recognition and by poor spelling that often result in difficulties in reading fluency and comprehension (International Dyslexia Association, 2002; Snowling & Hulme, 2012). These difficulties may typically result from deficits in major phonological processing skills. In contrast to the alphabetic languages, Chinese is characterized as a logographic and morphosyllabic writing system that has unique linguistic domains: phonological, visual-orthographic, morphological, and syntactic characteristics. Due to the differences between Chinese and alphabetic languages, dyslexia can be manifested in different ways and certain cognitive and linguistic functions associated with literacy problems may

manifest themselves differently from one language to the other (Bishop & Snowling 2004). Thus, the etiology and markers of dyslexia in Chinese are of great practical and theoretical rationality partly because these tend to differ slightly in some aspects from those of alphabetic languages. This paper will present an outline of characteristics, causes, identification, intervention and support of the primary and secondary school students with dyslexia in Hong Kong both inside and outside of school.

Epidemiology of dyslexia

Hong Kong is a special administration region of China since 1997 when the British relinquished its sovereignty to China. It has approximately 7.16 million population and the majority of people commonly speak Cantonese and use traditional characters as communication in their daily life. Twelve years of free and universal basic education from grades 1 through 12 are provided to every child in Hong Kong. As from 2007, movement toward the whole school approach to integration has been implemented in schools. Paying attention to the needs of students with dyslexia only started being acknowledged in 1980. It is in the last 20 years that dyslexia has been studied in Chinese population which is one of the largest population in the world. In Hong Kong, dyslexia has been conceptualized as a specific learning difficulty affecting individuals for whose literacy achievement and cognitive-linguistic skills fell below that to be expected on the basis of individuals' age and IQ. Thus, the operational definition of dyslexia can be viewed as IQ-achievement discrepancy-

plus model to classify students with dyslexia (for more details, see the Identification section). Using this definition, the prevalence rate of dyslexia is estimated at 9.7% with a boy-to-girl ratio of 2:1 (Chan, et al., 2007). Of these 6.2% were mild, 2.2% and 1.3% are moderate and severe respectively. This rate is similar to what has been reported in alphabetic languages.

Cognitive-linguistic explanations of dyslexia

In order to explain the diversity of cognitive-linguistic symptoms observed in dyslexia, several theories have been proposed to explain the origin, mechanisms, and signs of dyslexia. These theories hypothesize dyslexia as related to deficits that are phonological processing, auditory processing, visual processing, visual attention span visual-magnocellular, and related to automatic learning (Habib, 2010). Among these theories, the predominant phonological deficit explanations of dyslexia have been the major theory for explaining individuals with dyslexia. In alphabetic languages, it is widely recognized that the core deficit in dyslexia results from a phonological processing deficit underlying the failure to acquire adequate word recognition and spelling skills (see Snowling, 2000; Spafford & Grosser, 2005). Because of the close relationship between sound and spelling in English, phonological sensitivity is particularly important in learning to read and in turn makes it the key indicator of reading difficulties. Importantly, deficits in speeded naming, measured by a rapid automatized naming (RAN) (Bowers & Wolf, 1993; Wolf &

Bowers, 1999) may signify the disruption of the automatic processes involved in extracting orthographic patterns. Rapid naming could be represented as a second core deficit in dyslexia (see Bowers & Wolf, 1993; McBride-Chang & Manis, 1996; Wolf & Bowers, 1999). Aside from these deficits, dyslexic readers may have additional difficulties in visual-orthographic knowledge (Corcos & Willows, 1993), and morphological skills (Carlisle, 1995; Leong, 1999). These difficulties affect students' ability to encode printed words, to manipulate the word structures and to analyse the meaning of morphologically complex words.

Generally, variable multiple cognitive-linguistic causes of dyslexia are frequently observed in dyslexic students, and the phonological deficit might just be one among many and might not even be the core one underlying reading and writing difficulties in dyslexic individuals across languages. Multiple deficit hypotheses have therefore been proposed to explain the symptoms of dyslexia (Chung, Ho, Chan, Tsang & Lee, 2010; Ho, Chan, Tsang & Lee, 2002). This then leads to consideration of the way that the various cognitive-linguistic differences in non-alphabetic languages, specifically Chinese, affect dyslexic readers. An understanding of language characteristics is therefore necessary in order to uncover the multiple cognitive-linguistic skills and profiles of Chinese individuals with dyslexia. Before discussing dyslexia in Chinese students, a general description of the Chinese language will be briefly highlighted below.

Characteristics of the Chinese language

Chinese is a morphosyllabic writing system, the basic graphic unit of which is a character representing both a syllable and a lexical morpheme (DeFrancis, 1989; Mattingly, 1984). Chinese characters are composed of different strokes that make up radicals (Shen & Bear, 2000) that regularly inhabit certain positions in a character. Many semantic radicals tend to occupy the left or top position within a left-right ([jin1] 煙 'smoke') or a top-bottom ([faa1] 花 'flower') structure. A majority (80-90%) of characters are formed by ideophonetic compounds or compound characters, each component (or radical) comprising semantic and phonetic radicals. An example is [tung4] 銅 'copper', [gam1] 金 'metal' is the semantic radical that provide cues to the meaning whereas [tung4] 同 'same' is the phonetic radical conveying some pronunciation information. However, phonetic radicals are not always reliable cues to pronunciation. Only approximately 40% of the characters can be directly decoded from their phonetic radicals (Shu, Chen, Anderson, Wu, & Xuan, 2003). Thus, learning of Chinese characters tends to rely heavily on the relatively arbitrary associations between print and sound.

Most words in Chinese are multisyllabic with about two-thirds being bisyllabic components with two morphemes (Taylor & Taylor, 1995). Chinese words are often built and compounded by multiple morphemes. Many words sharing the same morpheme are semantically related or homograph morphemes, for example,

抄 (copy), 打 (hit), 抱 (hug), 拖 (drag), 拉 (pull) have the same semantic radical "扌" which means "hand." Chinese also contains a relatively large number of homophones. For example, [zung1] 中 'center' [zung1] 鐘 'bell' and [zung1] 終 'end'. Thus, sensitivity to different homograph and homophonic morphemes is vital for learning to read Chinese.

Another characteristic of Chinese is its non-inflectional nature, not changing the word form to indicate tense, number and so on. Thus tense is indicated by the use of empty words in conjunction with the main verb. For instance, looked is represented by 看 / hon3 / (look) 了 / liu 5 / (-ed, past action) and looking by 看 / hon3 / (look) 着 / zoek 6 / (-ing, continuous action). Chinese also has no plural form. Characters like 鞋、碟、刀 can be indicated as either singular– or plural– shoe/shoes, plate/plates, knife/knives. These characters can then be combined with the quantifiers showing plurality, for instance, 很少 (very few), 幾個 (some), 大量 (plenty of). Furthermore, aspect markers are grammatical morphemes acting as verbal affixes given that tense is not prominent feature of Chinese grammar. Consequently, a listener may determine whether the action of a verb is past or continuing through the aspect marker. For example, 已 is an aspectual particle indicating completed action, for example, 我已打掃好我的房間 (I already cleaned up my room). Thus, the semantic and grammatical information in Chinese is conveyed by word order and sentential context due to the lack of inflections,

function words, and unclear sentence boundaries. Morphological, syntactic, and morphosyntactic skills are particularly important for understanding Chinese sentences. Given the unique characteristics of Chinese, examining the manifestations of dyslexia is essential.

Cognitive-linguistic causes of dyslexia in Chinese

Understanding cognitive-linguistic skills and the individuals' profile may provide an overall framework of identification and intervention. A multiple cognitive-linguistic deficit hypothesis has commonly been used to account for dyslexia in Chinese (Chung et al., 2010). The most common causes of dyslexia in Chinese are visual-orthographic skills, morphological skills, syntactic and discourse skills, and rapid naming. However, less common is difficulty in phonological skills (Chung et al., 2010; Ho, Chan, Lee, Tsang, & Luan, 2004). Dyslexia tends to encompass deficits in a variety of cognitive-linguistic domains that are highlighted below.

Visual-orthographic skills in Chinese refer to individuals' awareness of conventional rules in founding characters and their ability to distinguish real characters from pseudocharacters, noncharacters and visual symbols. These skills have been reported to be vital for character reading and writing acquisition (e.g., Li, Peng & Shu, 2006; Li, Shu, McBride-Chang, Liu & Peng, 2012) and impairment (e.g., Ho et al., 2004). Typically, visual-orthographic skills have been measured by lexical decision (assessing the students' knowledge of Chinese character structure), radical position (tapping into

individuals' knowledge of the positional regularity of Chinese radicals) and delayed copying (assessing the students' ability to retain character information and differentiate between the orthographic units in characters). Because of the visually-complicated characters and lack of reliable print-sound correspondence, deficits in visual-orthographic skills, which may affect the foundation of orthographic lexical representations for acquiring novel words, are likely to contribute to reading and writing difficulties (e.g., Chung et al., 2010).

Morphological skills are the second area that is found to be strongly correlated with reading and writing in Chinese (e.g., Li et al., 2012; McBride-Chang, Liu, Wong, Wong, & Shu, 2011). In Chinese, morphological skills could be viewed as the ability to distinguish meanings among morphemes and homophones or as the ability to manipulate and access morphemes in words with two or more morphemes. Measures of morphological skills are commonly used, for example, morpheme discrimination (testing the students' understanding of the morpheme having different meanings in two morphemic words), morpheme production (measuring students' ability to apply and integrate their morphological and contextual information in given contexts) and morphological construction (requiring students to analyze compound words into sub-lexical components and to form words by combining morphemes in novel ways). Due to the morphological nature of Chinese and a vast number of homophones, insensitivity to the morphemic structures and meanings of characters may be one of the cognitive-

linguistic causes of reading and writing problems (Chung, Ho, Chan, Tsang, & Lee, 2011).

Rapid naming is the third area that is found to be particularly important for literacy acquisition and impairment. Rapid naming is thought to reflect an automatic process that retrieves verbal representations from orthographic patterns in the mental lexicon and the map of arbitrary symbols to spoken language (Wolf & Katzir-Cohen, 2001). Poor rapid naming is a good indicator of difficulty in learning arbitrary associations, slowness in the speed of access to the lexicon and poor quality of lexical representation. Indeed, studies of dyslexia in Hong Kong (Chung et al., 2010) have reported that deficits in rapid naming and visual-orthographic skills are more prominent in Chinese children and adolescents than poor phonological skills, probably because of the less regular print-sound relationship in Chinese (e.g. Leong, Tse, Loh, & Hau, 2008; McBride-Chang et al., 2008).

Syntactic skills have also emerged as a potential contributor to literacy skills in both typically developing and dyslexic students (Cain, 2007; Chung, Ho, Chan, Tsang, Lee, 2013). Typically, syntactic skills are assessed by measures that tap into individuals' grammatical error detection and correction and word-order patterns in Chinese. For example, morphosyntactic tasks that measure grammatical error detection and correction tend to be particularly strongly linked to reading and writing skills (Chik et al., 2012). Given that Chinese has an impoverished system of grammatical aspects and classifiers to

convey meaning, individuals with dyslexia may have difficulty in detecting and correcting morphosyntactic errors and syntactically anomalous sentences. This is partly because these students have not yet mastered the knowledge and rules of syntax, for example, word order, appropriate word use, and the existential sentence. Such poor morphosyntactic skills tend to preclude students from comprehending and using certain syntactic structures thus contributing to poor literacy skills.

Discourse skills are the fifth area that distinguishes Chinese students with and without dyslexia (Chik et al., 2012; Chung, Lo, Ho, Xiao, & Chan, 2014). The commonly used measure for these is rearranging various sentences into a coherent discourse. Therefore, attention to cohesive devices and certain story features including connectives, time and sequence markers, and semantic hints is required in order to form a meaningful and logical passage (Chung et al., 2014). Chinese is characterized by the extensive use of connectives and allows omissions of subject nouns/phrases in sentences (Chao, 1968; Li & Thompson, 1981). Without an understanding of the specific linguistic devices, e.g., pairs of connectives, comprehension of Chinese text becomes very difficult. Discourse skills are found to be particularly important in explaining the difference in reading skills of typically developing and dyslexic students (e.g., Chik et al., 2012). Studies of dyslexic students have found a significant lag in the development of their discourse skills (Cain, 2003). Therefore, a lack of sensitivity to text coherence and knowledge about cohesive devices and

discourse markers correlates with difficulties in reading comprehension and writing for comprehension. Together, a close examination of the cognitive-linguistic causes of dyslexia provides the foundation necessary to develop the identification tools and design effective support interventions.

Identification for Chinese students with dyslexia

A two-stage identification process is used for screening and assessment in Hong Kong. The first stage is to provide a quick and economical screening process that consists of standardized checklists and tests for parents and teachers to identify individuals at risk for specific learning difficulties. The five checklists and tests are currently available for screening, for example, The Hong Kong Learning Behaviour Checklist for Preschool Pupils (Parent version: Wong et al., 2006), the Hong Kong Specific Learning Difficulties Behaviour Checklist for Primary School Students (BCL-P(II): Ho et al., 2010) and The Hong Kong Behaviour Checklist of Specific Learning Difficulties in Reading and Writing for Junior Secondary School Students (BCL-JS: Ho et al., 2009), and The Hong Kong Reading Ability Screening Test for Preschool Children (RAST-K: Ho et al., 2011). These screening tools cover multiple possible key areas such as reading, spelling, writing, mathematics, language, learning, attention, memory, motor coordination, sequencing, visual-spatial orientation and socio-emotional adjustment. Among these screening tools, BCL-P(II) and BCL-JS can be administered online <http://www.psychology.hku.hk/hksld/>. Concerned teachers can make use

of these tools to evaluate their students' strengths and weaknesses in learning and literacy skills so as to provide initial assistance and appropriate support to these students. Students whose progress in learning and literacy remains unsatisfactory progress to the second stage of identification, they will be referred to professional psychologists for further assessment.

In the second stage, educational and clinical psychologists administer the standard comprehensive assessment including intelligence (IQ), cognitive-linguistic skills and literacy achievement tests to determine whether individuals are diagnosed as dyslexic. The Hong Kong Wechsler Intelligence Scale for Children (HKWISC-IV (HK)) is typically employed to measure individuals' IQ. The Hong Kong Test of Specific Learning Difficulties in Reading and Writing for Primary School Students (Second Edition) (HKT-P(II): Ho, et al., 2007) and The Hong Kong Test of Specific Learning Difficulties in Reading and Writing for Junior Secondary School Students (Second Edition) (HKT-JS (II): Chung, et al., 2012) are also used to identify cognitive-linguistic skills and literacy achievement. These include the following measures: visual-orthographic knowledge, rapid naming, phonological skills, morphological skills, syntactic skills, discourse skills, working memory, reading, spelling and writing. Given that the IQ-achievement discrepancy-plus model is currently used in Hong Kong, a combination of the following test scores: intelligence, cognitive-linguistic and literacy skills is used as the diagnostic criteria of dyslexia. To be diagnosed as dyslexic, students are required to have

adequate IQ but poor literacy (-1 standard deviation or more) plus at least one area of cognitive-linguistic deficit (-1 standard deviation or more). Though this two-stage identification process, students appear to receive the required support and intervention thus far.

In Hong Kong, the School-Based Educational Psychology Services (SBEPS), Education Bureau, Child Assessment Service, and Student Health Service of the Department of Health offer comprehensive multi-disciplinary team assessment to evaluate, assess, and identify the essence of individuals' challenges and learning needs, for example, the students with dyslexia. The SBEPS and Education Bureau cover services including remedial, preventive and developmental work at multi-levels involved in school system, teacher and student support. Particularly, these services provide psycho-educational assessment and intervention for students, consultation and professional development for teachers, conducting workshops for parents, and professional advice on the school policies and home-school co-operation to meet the students with dyslexia.

Three-tier intervention model

Schools in Hong Kong are encouraged to adopt the 3-tier intervention model which is underpinned by the 'Response to Intervention' (RTI) approach. RTI is conceived as a multi-tier prevention and intervention system, which involves different levels of intensity and individualization based on the needs of the students. Student progress is

monitored and the intensity or type of subsequent intervention and support is adjusted frequently as needed. The level of intervention, support and individualization increases in intensity if students do not respond to instruction. Students can also move in and out of different support levels according to their performance progress. Under the 3-tier intervention model, Tier 1 support is to provide quality teaching to all students in the regular classroom through continuous reviewing and monitoring of students' progress, offering to those students with persistent learning difficulties Tier 2 support includes "add-on" intervention or small group learning or more intensive Tier 3 individualized support.

To accomplish the 3-tier intervention model, a 5-year project - "Tiered Intervention Model on the Learning and Teaching of Chinese Language in Primary Schools" has been implemented in schools since 2011. This project is to support schools in enhancing cognitive-linguistic and literacy skills in junior primary school students from Grade 1 to 3 through the 3-tier intervention model. The core curriculum for this model focuses on three levels of skills: oral vocabulary and morphological skills (oral language skills), orthographic skills and word recognition strategies (word-level skills), reading fluency, syntactic skills, reading comprehension and writing strategies (text-level skills). This curriculum is built on foundational skills to mastery and incorporates complex skills across grade levels and is designed to reflect the changing developmental emphasis at different stages in the acquisition of literacy skills. Recent studies examining

the effectiveness of this model found that Tier 1 support was effective in improving cognitive-linguistic and literacy skills of children. The positive effects were also sustained at the end of Grade 2 (Ho et al., 2014; Ho et al., 2012). Furthermore, 18–58 % of students with literacy difficulties in Tier 2 and 7 % students with dyslexia in Tier 3 remedial groups, who initially were below the benchmark, achieved the benchmark of literacy after receiving the intervention for 1 to 2 years (Ho et al., 2014). With the continuous support of the Education Bureau, forty primary schools are invited to implement the model per year. Schools are offered support, for example, participation in school-based preparatory meetings, collaborative lesson planning meetings, review meetings with school personnel, and regular professional development workshops for teachers. The additional resources to schools also include financial subsidies, learning support grant, capacity enhancement grant, enhanced speech therapy grant, and so forth. Thus, schools can effectively integrate and adopt the resources and materials developed for the model with the school-based Chinese language curriculum that meets the need of all students.

Special examination arrangements

In order to remove the disadvantages induced by dyslexia instead of those related to the knowledge and skills being examined, primary and secondary students with dyslexia are eligible to apply for special examination arrangements. Special arrangements in internal school and public examinations have been implemented since 2010. Examples of such arrangements include:

extended examination time, enlarged font size of examination papers, use of computer in answering questions, the use of assistive tools, provision of short breaks during examination, special seating and examinations arranged in an alternative venue. These arrangements are to ensure fair and equitable opportunities for students with dyslexia to demonstrate their learning and achievement of relevant outcomes.

Teacher professional development

Schools are urged to adopt a whole school approach to foster an inclusive school environment. Teachers' professional capability in catering for students with diverse learning needs is therefore vital. From 2007 onwards, the five-year teacher professional development framework on integrated education has been implemented. This framework provides structured training courses on special education with a Basic Course (30-hour), Advanced Course (90-hour) and Thematic Course (90- to 120-hour) for in-service teachers in ordinary schools (Ho & Arthur-Kelly, 2013). These Government-funded (BAT) courses are to enhance teachers' capacity in catering for different types of students with diverse learning needs, for example, dyslexia. Each school is encouraged to have at least 10% to 15% of teachers completing the Basic Course and at least three to six teachers completing the Advanced Course and Thematic Courses. Workshops, seminars and sharing sessions are regularly offered to educators, parents, and paraprofessionals to enhance their awareness and understanding of students with dyslexia.

Concluding remarks and future directions

Dyslexia is one of the most common learning difficulties in Hong Kong and elsewhere in the world and can persist throughout life. Given the different cognitive-linguistic characteristics of Chinese and alphabetic languages, research into the nature and causes of dyslexia in Chinese has found differences and overlaps from alphabetic languages that need to be analyzed and understood. Understanding the Chinese contexts of research is essential for developing effective evidence-based identification, intervention, and support that are suitable for primary and secondary school students in Hong Kong. Future work pertaining to large-scale 3-tier intervention models can be further implemented on a school-wide basis with the support of professional teacher development. Research efforts can also expand on the cognitive explanations of dyslexia and make inroads in clarifying the neurological and genetic markers of these difficulties. All of these considerations should take into account the impact of cognitive-linguistic characteristics of different writing systems. Early identification of dyslexia, combined with effective early intervention and service provision seems dramatically to enhance the chances of success in education and life skills which is the aim of educators, administrators, and policy-makers.

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