



Writing to dictation and handwriting performance among Chinese children with dyslexia: Relationships with orthographic knowledge and perceptual-motor skills



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ABSTRACT

The purpose of this study was to investigate the relationships between writing to dictation, handwriting, orthographic, and perceptual-motor skills among Chinese children with dyslexia. A cross-sectional design was used. A total of 45 third graders with dyslexia were assessed. Results of stepwise multiple regression models showed that Chinese character naming was the only predictor associated with word dictation ($\beta = .32$); handwriting speed was related to deficits in rapid automatic naming ($\beta = -.36$) and saccadic efficiency ($\beta = -.29$), and visual-motor integration predicted both of the number of characters exceeded grid ($\beta = -.41$) and variability of character size ($\beta = -.38$). The findings provided support to a multi-stage working memory model of writing for explaining the possible underlying mechanism of writing to dictation and handwriting difficulties.

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1. Introduction

Learning to write is a core part of the school curriculum in many Chinese-speaking regions, where children start their practice of writing from preschool years (Cheung & Ng, 2003; Lam, Au, Leung, & Li-Tsang, 2011). Primary school children are regularly assessed with writing-to-dictation tasks to evaluate their weekly learning outcomes (Cheung & Ng, 2003). Many school activities also expect children to develop effective handwriting skills to transcribe printed information on the texts so as to produce written answers on papers (Feder & Majnemer, 2007). In a Chinese school population, children with dyslexia are more commonly observed with persistent difficulties in acquiring basic writing skills than reading skills (Leong, Cheng, & Lam, 2000). This study aimed at identifying the factors that may possibly explain different levels of writing difficulties among Chinese children with dyslexia.

1.1. Nature of writing to dictation and handwriting in Chinese language

Writing to dictation is a multi-stage process that starts from the interpretation of auditory sounds as meaningful words, followed by the retrieval of the orthographic forms from the mental lexicon (Rapp & Caramazza, 1997). Because of the

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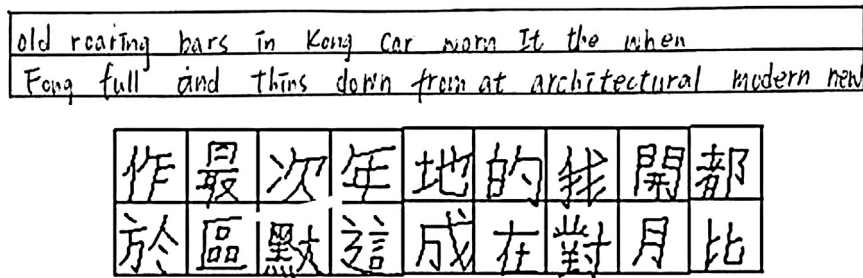


Fig. 1. A brief comparison between (a) writing English words on a horizontal grid lines; and (b) writing Chinese characters within the boundary of the square grid.

monosyllabic nature of the Chinese language, it requires the writers to distinguish the meanings of different homophone characters in the mental lexicon (Han, Song, & Bi, 2012). In addition, due to the logographic nature of the Chinese scripts, the majority of basic writing units in Chinese are non-semantic and non-pronounceable units that are termed *logo-graphemes* (or components) in Chinese psycholinguistics (Lui, Leung, Law, & Fung, 2010). It means that in writing to dictation, the writers need to recall the exact orthographic forms and positioning of these logo-graphemes. Moreover, in order to produce legible handwriting outputs, the writers need to pay attention to the formation of some 31 major stroke forms and six major stroke sequencing rules (see Law, Ki, Chung, Ko, & Lam, 1998, for illustration), and to write every character within the boundary of a square grid (Lam et al., 2011). This is different from the English writing system that requires writers to produce written words from the fixed set of 26 letters on the horizontal grid lines (Fig. 1). Leong et al. (2000) suggested that the complex orthographic rules in Chinese writing system is particularly challenging for Chinese children with dyslexia to acquire the basic writing skills.

1.2. Prevalence of dyslexia among the Chinese population

An epidemiological study found that about 9.7 to 12.6% of Chinese school children were affected by developmental dyslexia in primary school years (Chan, Ho, Tsang, Lee, & Chung, 2007). Among these children, a preliminary study by Ho and colleagues (Ho, Chan, Leung, Lee, & Tsang, 2005) showed that about 26% of them presented with co-morbid symptoms of attention deficits and hyperactive disorders (ADHD), while 10% of them had developmental coordination disorders (DCD). Despite such high prevalence of co-morbidity, researchers reported that the literacy learning difficulties among Chinese children with dyslexia were specifically related to their difficulties in performing cognitive-linguistic tasks such as rapid automatic naming (RAN), orthographic processing, and morphological processing tasks (Ho, Chan, Lee, Tsang, & Luan, 2004; Ho et al., 2005; McBride-Chang, Chung, & Tong, 2011). More recently, it was found that Chinese children with dyslexia might manifest difficulties in performing copying tasks more often than children with typical development (Lam et al., 2011; McBride-Chang et al., 2011). Lam et al. (2011) suggested that the expression of handwriting difficulties among Chinese children with dyslexia, which include a slow handwriting speed, a great average and variability of character size, and a low accuracy in copying, might underpin an immaturity of perceptual-motor and orthographic skills. Stroke errors such as missing strokes and producing concatenated strokes (i.e., inappropriate linking of two separate strokes into one single stroke) in handwriting were especially common among Chinese children with dyslexia (Lam et al., 2011). Another study reported that the ability to copy unfamiliar scripts could uniquely explain 6% of Chinese word reading and 3% of word dictation performance among children with or without dyslexia in the Chinese school population (McBride-Chang et al., 2011). The researchers suggested that inaccuracy in copying among children with dyslexia could reflect developmental problems in visual-motor integration and paying attention to detailed formation of visual-orthographic stimuli (McBride-Chang et al., 2011).

1.3. Purpose of the study

The main purpose of this study was to investigate the orthographic and perceptual-motor factors which might contribute to different levels of writing difficulties among Chinese children with dyslexia in Hong Kong. The target sample included the heterogeneous subtypes of developmental dyslexia with or without co-morbid conditions in attention deficits or fine motor clumsiness. This was taken in consideration of the growing body of research in support of the importance of investigating the learning-related deficits of developmental disorders as a whole (Nicolson & Fawcett, 2007, 2011). This study sought to identify the possible factors that might explain the individual differences in writing to dictation and handwriting among the heterogeneous subtypes of dyslexia. The conceptual framework was taken with references to the multi-stage working memory models of word writing (Berninger, Raskind, Richards, Abbott, & Stock, 2008; Rapp & Caramazza, 1997). These working memory models commonly suggest that there are multiple stages of cognitive process in word writing. In the pre-lexical stage, the auditory stimuli are recoded into the target words through semantic access. In the post-lexical stage, the graphemes of the target written words are retrieved from the mental lexicon. The retrieved graphemes are then temporarily

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