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Visual profile of children with handwriting difficulties in Hong Kong Chinese

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ABSTRACT

The purpose of this study was to find out the visual profiles of children with handwriting difficulties (HWD) in Hong Kong Chinese. Forty-nine children with HWD (mean age 8.4 ± 1.1 years) and 27 controls (mean age 7.7 ± 0.7 years) were recruited. All subjects received eye examination and vision assessment included ocular health, refraction, accommodative functions, binocularity, visual perception (by Gardner reversal frequency test: recognition subtest; Test of visual perceptual skills (non-motor)-revised) and motor skills (by The Beery-Buktenica developmental test of visual motor integration; Detroit test of motor speed and precision). Higher percentages of tropia and phoria (of magnitude >6 prism dioptres) were found in children with HWD of 6.1% and 14.3% respectively. After adjusted for the effect of age, children with HWD showed significantly worse accommodative facility, directionality, visual discrimination, visual spatial relation, visual form constancy, visual sequential memory, visual figure ground, visual closure and visual motor integration. Studies reported the visual functions of children with HWD were mostly concerned with alphabetic languages, while studies concerning Chinese HWD were relatively less. This study provided the visual profiles of children with Chinese HWD. Based on the visual profile, further study is indicated to investigate the effect of optometric interventions on the assessment and remediation for children with HWD.

1. Introduction

Handwriting is an important medium for expressing, communicating and recording ideas (Erhardt & Meade, 2005; Reisman, 1993). For school-aged children, good handwriting skill is a prerequisite of learning. Children from kindergartens and primary schools spend 30 to 60% of their school time on fine motor activities, predominately on writing (Marr, Cermak, Cohn, & Henderson, 2003; McHale & Cermak, 1992). It was reported that 10–27% children showed handwriting problems of various degrees (Hammerschmidt & Sudsawad, 2004; Karlsdottir & Stefansson, 2002; Maeland, 1992). Children who are slow in handwriting may have difficulty to cope with the volume of school work and to finish within time constraint. Impaired handwriting can affect children's academic performance as well as psychological well-being (Bonney, 1992; Erhardt & Meade, 2005; Feder & Majnemer, 2007; Graham & Weintraub, 1996; Hammerschmidt & Sudsawad, 2004; Markham, 1976; Rosenblum, Weiss, & Parush, 2003). Poor handwriting not only frustrated children's learning, but also influenced teacher's evaluation of written work (Karlsdottir & Stefansson, 2002; Markham, 1976). Papers with poor handwriting were

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consistently marked lower regardless of the contents (Markham, 1976). Illegible handwriting further hindered the accomplishment of higher-orders skills including spelling or story composition (Feder & Majnemer, 2007). In a word reading task, children with HWD showed slower reading speed and larger number of errors compared with controls (Dusek, Pierscionek, & McClelland, 2010). In addition, character copying skills were found related to the development of Chinese literacy skills (McBride-Chang, Chung, & Tong, 2011).

Since good handwriting skill is so important for children, early and appropriate intervention is highly indicated. Investigation on the visual profiles of children with HWD, which may aid in the design of appropriate assessment tools and remediation programs, is of particular interest.

1.1. Relationship between handwriting and vision

Handwriting is not a simple fine motor task. It involves complex visual perceptual-motor integration. Good Handwriting requires the integration among visual perception, motor planning, cognitive, tactile and kinesthetic functions, gross and fine motor skills, as well as sustained attention (Bonney, 1992; Erhardt & Meade, 2005; Feder & Majnemer, 2007; Maeland, 1992; Reisman, 1993; Rosenblum et al., 2003). Various evidences suggested for the important role of vision in handwriting (Daly, Kelley, & Krauss, 2003; Smyth & Silvers, 1987; Tseng & Chow, 2000; Van Doorn & Keuss, 1992, 1993). The absence of vision during handwriting affected the spatial orientation of written words and caused an increase in errors produced, increase in stroke size and decrease in writing speed (Smyth & Silvers, 1987; Van Doorn & Keuss, 1992, 1993). Further support can be obtained from brain imaging study in which both dorsal and ventral visual streams were found involved at the initial learning stage of Chinese handwriting (Swett, Contreras-Vidal, Birn, & Braun, 2010).

Although vision and handwriting are closely related functions, limited studies reported the visual functions of children with HWD. Children with problem in handwriting showed weakness in visual memory, visual sequential memory, visual spatial relation, form constancy, figure ground and visual motor integration (Markham, 1976; Tseng & Chow, 2000; Volman, Schendel, & Jongmans, 2006). However, information about the binocular vision and accommodative functions of children with HWD were scarce. Only one study reported the increased binocular vision and accommodation anomalies including exophoria, convergence insufficiency, accommodation insufficiency and lower accommodative convergence in children with both handwriting and reading difficulties (Dusek et al., 2010).

1.2. Language difference

Unlike alphabetic scripts that compose left-to-right languages, Chinese characters are characterized by the spatial organization of strokes making visual-spatial perception important for the orthographic processing and writing of Chinese characters (Kao, Leong, & Gao, 2002). Neuroimaging evidences suggested different neural networks involved in the processing of Chinese characters and alphabetic languages (Sun, Yang, Desroches, Liu, & Peng, 2011; Wu, Ho, & Chen, 2012). Therefore, the complex orthography of Chinese characters as opposed to the phonologic alphabetic languages may lead to differences in visual motor demand.

1.3. Aim of study

Vision is an integral part of handwriting. The visual motor demand in handwriting may vary between languages. However, little studies reported the deficient visual functions in children with HWD and mostly were in alphabetic languages (Dusek et al., 2010; Markham, 1976; Volman et al., 2006). Investigation on the visual profiles of Chinese children with HWD may help to identify some possible handwriting performance components, which in turn, aid in the design of appropriate assessment tools and remediation programs (Feder & Majnemer, 2007). This study aimed to find out the visual profiles, from basic visual functions to higher order visual perceptual and visual motor integration skills, of children with HWD particularly in Chinese.

2. Methodology

2.1. Subjects recruitment

Seventy-six children, 49 with HWD and 27 controls, were recruited from different Hong Kong mainstream primary schools. All recruited subjects were studying primary 1 or 2 and using Chinese and Cantonese as their primary written and spoken language. By using a validated handwriting ability checklist (Tam, 2008), children were rated by their parents in the aspect of handwriting legibility, speed, physical and emotional responses. Completed checklists were assessed and compared against the suggested cut-off scores (Tam, 2008). Subjects scored 31 or above were classified as HWD and were recruited into the group with HWD, whilst subjects scored 30 or below were recruited into the control group. Children with physical impairments, learning disabilities, attention and behavior problems, neuromuscular disabilities and/or history of any previous intervention on handwriting were excluded from the study. All research procedures adhered to the tenets of the Declaration of Helsinki and were approved by the Ethics Committee of The Hong Kong Polytechnic University. The parents of the children were fully informed and written consent was obtained before all experimental measurements.