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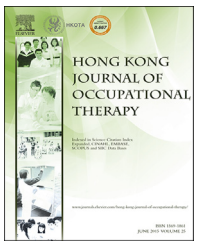

ORIGINAL ARTICLE

Performance of the Visual-Motor Integration of Preschool Children in Hong Kong

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KEYWORDS
Beery–Buktenica Developmental Test of Visual-Motor Integration;
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Rasch Measurement Model

Summary *Objective/Background:* The Beery–Buktenica Developmental Test of Visual-Motor Integration (VMI) is an important assessment tool used by occupational therapists working with children. The aims of this study were (a) to identify performance differences in the VMI between Hong Kong preschool children and their counterparts in the United States; (b) to develop local references for the VMI (fifth edition) for the preschool children in Hong Kong; and (c) to examine the dimensionality and the hierarchical ordering of the VMI items using the Rasch Measurement Model (RMM).
Methods: A total of 288 healthy children aged between 3 years and 6 months and 5 years and 11 months were recruited from 54 local preschools in Hong Kong using the multistage sampling method. VMI was administered to the children individually at their preschools.
Results: Hong Kong preschool children were significantly better than those in the United States in VMI performance ($p < .001$). The results of the RMM showed that the VMI fell within the acceptable levels of unidimensionality. Most items were found to be hierarchically ordered, although a few items were found to have the same level of difficulty.
Conclusion: The local reference developed in this study yielded additional insights for occupational therapists and psychologists with regard to the application of the VMI (fifth edition) for Hong Kong children aged between 3 years and 6 months and 5 years and 11 months.

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Introduction

Visual-motor integration (VMI) is the degree to which visual perception and finger—hand movements are well coordinated (Beery, 1997). Differentiation of figures with various combinations of lines, analysis of parts from whole, and synthesis of the parts into whole are significant in visual perceptual development. In the motor system, finger activity is further refined for precise manipulation. The interaction, integration, and coordination of visual and motor systems would be a critical component in children's development. Problem in VMI affects many domains of functional ability. VMI had been shown to be associated with several education-related problems, including gross and fine motor coordination difficulties, reading and mathematics difficulties, perceptual problems, and a decrease in overall academic achievement (Schneck, 2001; Todd, 1999).

The Developmental Test of VMI was first published in 1967 and had been considered to be a valid test for assessing VMI. It had been standardized five times between 1964 and 2003 that involved a total of more than 11,000 children in the United States. The test provided developmental age norms that covered an extensive age range. The fifth edition of the test focuses even more strongly on early childhood education than previous editions. It had been expanded to include standardized norms for 2-year-old children (Beery & Beery, 2006).

The test is a paper-and-pencil measure that consists of 24 geometric forms of increasing complexity, in which the children to be assessed are required to copy the geometric forms. It had been extensively used by psychologists, educators, and occupational therapists for measuring the level of VMI in children. The test serves to assist the assessors to recommend early intervention for children who demonstrate poor performance.

Salvia and Ysseldyke (2004) reported that the VMI had relatively high reliability and validity in comparison with other measures of perceptual-motor skills. Brown, Unsworth, and Lyons (2009) in their study on Australian children found that the VMI showed acceptable levels of scalability and unidimensionality using the Rasch analysis. However, there was a concern on the hierarchical ordering of the test items because several items were found to have similar logit values regarding the level of difficulty in the VMI. This concern had scoring implication as the scoring at ceiling level might not be valid.

Beery (1997) examined the performance of children among different ethnic groups. His study found that only about 1% of variance among the performance scores was attributed to ethnicity. Therefore, he proposed that the design of the VMI was cultural free. However, he agreed that Chinese children performed better than the U.S. children in the early age group, but the scores were similar from ages 9 to 17.

Mao (1995) investigated the cultural influence on the VMI skills of Chinese children in Taiwan. The result revealed that the VMI performances of the three groups of Chinese children aged 4, 7, and 10 exceeded those of the U.S. normative samples of the same ages. The findings reflected that the VMI dysfunction of Chinese children in Taiwan might be underestimated if the available U.S. normative data are used for interpretation. Therefore, the VMI scores have to be interpreted with this in mind for Chinese children in Taiwan. The results also highlighted that the hierarchical sequence of increasing difficulty of the 24 geometric figures in the VMI might not apply to the Chinese children in Taiwan. The researcher proposed that the hierarchical sequence of increasing difficulty in the VMI might be different across cultures. This is because children might find it easier to copy the geometric figures that they frequently encounter. The researcher proposed that validation of the VMI and establishment of normative data for the Chinese children in Taiwan were necessary before using it as a clinical evaluation tool.

Another study for evaluating the VMI skills in preschool- and elementary school-aged Chinese children was conducted in Mainland China: Shanghai and Ningbo (Cui, Zhu, Laukkanen, & Rabin, 2012). The study result revealed that the mean standard scores of the Chinese children aged 3—12 were significantly higher than those of the children in the United States except for the age groups of 3 years to 3 years and 11 months and 10 years to 10 years and 11 months. The study proposed that the early intensive handwriting training for Chinese children could conceivably contribute to the superior performance on the VMI. The study authors suspected that the relatively enhanced VMI performance of Chinese children might be related to the detailed geometric shapes and complex graphical nature of the Chinese characters in the local language.

In Hong Kong, there were limited studies on the VMI of preschool- or school-aged children. Lau and Lee (1988) had established the normative data of Bender Gestalt Test for 1,168 Hong Kong children aged between 5 and 10 years. They found that the visual-motor performance of Hong Kong children was about 1.5 years ahead of their U.S. counterparts, and the scores began to level off at about 8.5 years and were similar to the U.S. children.

According to Beery (1997), children's performance on VMI could be affected by inadequate visual perceptual, motor coordination abilities, or integration of both of these two domains.

There were many local studies on the performance differences in visual perception and fine motor aspects for children in Hong Kong. In the study by Cheung, Poon, Leung, and Wong (2005), it was noted that there was ceiling effect for 6—7-year-old children in Eye—Hand Coordination, Position in Space, and Spatial Relations subtests among the eight different subtests of the Developmental Test of Visual Perception Version 2. Chui, Ng, Fong, Lin, and Ng (2007) found that children aged 6—10 years in Hong Kong performed significantly better in the subtests of Visual-Motor Control and Upper Limb Speed and Dexterity in the Bruininks—Oseretsky Test of Motor Proficiency than those in the United States. The advanced performance in fine motor skills of the children in Hong Kong was proposed by the researchers to be due to early exposure to manipulating tools such as chopsticks and pencil. Chan (2001) suggested that children in Hong Kong outperformed their Western peers on the test of visual-motor functioning.

These findings suggest that Hong Kong children will achieve better scores in the VMI than their U.S. counterparts. Therefore, the aims of this study were (a) to identify