



The Computerized Perceptual Motor Skills Assessment: A new visual perceptual motor skills evaluation tool for children in early elementary grades



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ABSTRACT

Visual perceptual motor skills have been proposed as underlying courses of handwriting difficulties. However, there is no evaluation tool currently available to assess these skills comprehensively and to serve as a sensitive measure. The purpose of this study was to validate the Computerized Perceptual Motor Skills Assessment (CPMSA), a newly developed evaluation tool for children in early elementary grades. Its test-retest reliability, concurrent validity, discriminant validity, and responsiveness were examined in 43 typically developing children and 26 children with handwriting difficulty. The CPMSA demonstrated excellent reliability across all subtests with intra-class correlation coefficients (ICCs) ≥ 0.80 . Significant moderate correlations between the domains of the CPMSA and corresponding gold standards including Beery VMI, the TVPS-3, and the eye-hand coordination subtest of the DTVP-2 demonstrated good concurrent validity. In addition, the CPMSA showed evidence of discriminant validity in samples of children with and without handwriting difficulty. This article provides evidence in support of the CPMSA. The CPMSA is a reliable, valid, and promising measure of visual perceptual motor skills for children in early elementary grades. Directions for future study and improvements to the assessment are discussed.

What this paper adds

This paper presents a newly developed computerized tool which assesses the visual perceptual motor skills of children in early elementary grades. The findings suggest that the CPMSA is a reliable, valid, and promising measure of visual perceptual motor skills for young children.

1. Introduction

Many researchers and educators are interested in the topic of handwriting skills and their underlying performance components

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due to the high prevalence of handwriting problems among school-aged children. It is estimated that 5% to 33% of primary school children have problems producing legible handwriting (Duiser, van der Kamp, Ledebt, & Savelsbergh, 2014; Overvelde & Hulstijn, 2011; van Hoorn, Maathuis, Peters, & Hadders-Algra, 2010).

Some researchers believe that visual perceptual motor skills play an important role in proficient handwriting performance (Bo et al., 2014; Brown & Link, 2016). Previous studies have reported that visual perceptual motor skills demonstrate significant correlations with handwriting quality (Carlson, Rowe, & Curby, 2013; Maldarelli, Kahrs, Hunt, & Lockman, 2015) and speed (Brown & Link, 2016; Tseng & Chow, 2000; van Hartingsveldt et al., 2015). Specifically, studies have shown that kindergarten and elementary school-aged children with higher scores on standardized tests of visual perception or visual motor integration write faster and produce more legible handwriting than their peers with lower scores (Daly, Kelley, & Krauss, 2003; Duiser et al., 2014; Feder, Majnemer, Bourbonnais, Blayney, & Morin, 2007; Grewal, Vig, & Saini, 2014; Volman, van Schendel, & Jongmans, 2006). Because of the reported associations mentioned above, educators and clinicians often use visual perception and visual perceptual motor tests to screen for handwriting difficulties or they use these assessments as an outcome measure after handwriting intervention (Goyen & Duff, 2005). However, the use of these assessments in such a capacity continues to be debatable (Howe, Roston, Sheu, & Hinojosa, 2013; Maeland, 1992; Pfeiffer et al., 2015). Whether these tests are sensitive enough to measure changes in handwriting and related visual perceptual motor skills is a question that is often raised (Overvelde & Hulstijn, 2011; Pfeiffer et al., 2015; Prunty, Barnett, Wilmot, & Plumb, 2016; Wallen, Duff, Goyen, & Froude, 2013).

1.1. Purpose of the study

The purposes of this study were to develop a computerized visual perceptual motor skills assessment tool and to examine its psychometric properties. Reasons to develop a computer-based visual perceptual motor assessment are twofold. First, there is no visual perceptual motor assessment currently available that measures all components of visual perceptual motor skills. Clinicians and educators often need to combine more than one assessment tool in order to obtain a comprehensive understanding of a child's visual perceptual motor abilities. Second, the computer-based assessment overcomes some inherited limitations that paper-pencil tests possess. For example, the time required to administer and manually score paper-pencil tests is often lengthy and complicated and test materials and booklets tend to be cumbersome and inconvenient for carrying around. The computer-based assessment tool provides an objective temporal and spatial measurement of visual perceptual motor performance. It allows clinicians and educators to conduct a comprehensive assessment in a standardized test environment. Because the assessment is presented in the same way and in the same format for a specified time, errors in administration and bias are minimized.

2. Methods

The psychometric properties of the newly developed measure of visual perceptual motor skills were examined in three stages. First, we developed and assessed the content adequacy of the new measure using a focus group method. Second, we examined the measure's reliability and concurrent validity. Finally, we examined the discriminate validity using children with and without handwriting difficulties.

2.1. Development of the Computerized Perceptual Motor Skills Assessment (CPMSA)

We began the construction of the assessment with item development. We conceptualized two domains of perceptual motor skills using motor requirement as the differentiation criterion. The two domains are Visual Perception (VP) and Visual Motor Integration (VMI). Our research team identified six areas in VP and two areas in VMI based on the theoretical frameworks (Chalfant & Scheffelin, 1969; Maslow, Frostig, Lefever, & Whittlesey, 1964) and clinical relevancy gathered from the results of a systematic review. These areas were not to be considered exhaustive, but were seen rather as an initial classification for this assessment. Definitions of the subcategories of VP and VMI were then finalized by a focus group formed of eight practicing occupational therapists. Using the agreed upon definitions, the research team created an item pool. Items were compiled from textbooks, commercially available visual perceptual motor skills workbooks, or games designed for children. The same members of the focus group then selected items for each domain and subtest.

2.1.1. Item selection

Fifteen occupational therapists were recruited to establish the content validity of this new assessment. They were asked to review all items and judge each item's relevance to the VP and VMI domains and their respective subcategories. They were asked to agree or disagree with each item and its belonged category. Only items that received an average panel agreement of 85% were included in the assessment. As a result, all of the 111 items met the selection criterion and were included in the Computerized Perceptual Motor Skills Assessment. There were 90 items included in the VP domain, with 15 items for each subtest, and 21 items included in the VMI domain.

2.2. Description of the Computerized Perceptual Motor Skills Assessment (CPMSA)

The Computerized Perceptual Motor Skills Assessment (CPMSA) was developed to measure visual perception and visual motor integration skills comprehensively for children in early elementary grades. The Visual Perception (VP) domain consists of six subtests:

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