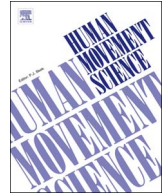


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Development and validation of the comprehensive praxis assessment for children aged 6–8

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ABSTRACT

This study examined the psychometric properties of motor praxis using a large school-based sample of children ($n = 239$). We developed and evaluated the construct validity of a motor praxis assessment using confirmatory factor analysis (CFA). A model with four latent variables was evaluated for goodness of fit. CFA established that the scale was multifactorial and supported the four-factor model (motor imagery, verbal gesture production, imitative gesture production and knowledge of object-use). The internal consistency, inter-rater reliability and concurrent validity of the praxis assessment mostly demonstrated good to excellent results for the full scale and the subscales. The motor praxis demonstrated an ontogenic progression in 6-, 7- and 8-year-olds, suggesting a developmental trend during these ages, but with the exception of gestural representation on imitation. Implications for motor development and clinical evaluation are discussed herein in relation to the four instruments.

1. Introduction

Praxis refers to the ability to perform complex learned motor actions. In children, it is essential to determine whether a task has been previously learned and performed in order to understand the origin of a praxis deficit. Praxis performance requires basic motor skills, knowledge of representations of movement, and transcoding these representations into movement plans (Dowell, Mahone, & Mostofsky, 2009). Implementation of this knowledge into a motor formula representative of the intended action follows. After this, the motor command should be correctly employed (Wheaton & Hallett, 2007).

Developmental dyspraxia is defined as the failure to have acquired the ability to perform age-appropriate complex motor actions, a failure that is not explained by the presence of inadequate demonstration or practice, ataxia, reduced selective motor control, weakness, or involuntary motor activity. In short, it is the failure to have acquired a skill that a child would ordinarily be expected to exhibit at a particular age (Sanger et al., 2006). Developmental dyspraxia and developmental coordination disorder (DCD) are often regarded as synonymous (Vaivre-Douret, 2014). DCD was the first term to be introduced by the American Psychiatric Association (APA) in the Diagnosis and Statistical Manual of Mental Disorders, revised third edition in 1987 and in 1994 and DSM-IV-TR revised in 2000 (Association, 2000).

To understand the etiology and prognosis of developmental dyspraxia, we need to have a better understanding of its nature. The most common method used to assess limb praxis is by observing a child/adult producing or imitating a range of gestures. Motor imitation is essential for young children to learn new motor skills, social behavior and skilled acts or praxis. Imitation is a primary learning strategy of young children. Vanvuchelen, Roeyers, and De Weerd (2011) disclosed four dimensions in the scale of imitation,

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labelled: goal directed versus non-goal directed procedural imitation and single versus sequential bodily imitation. Motor imitation usually falls under two categories: imitation of gestures and imitation of verbal instructions (Cermak, Morris, & Koomar, 1990). It is essential that children with dyspraxia receive early detection and effective intervention (Ruttanathantong, Siritaratiwat, Sriphetcharawut, Emasithi, & Saengsuwan, 2013).

Praxis movements can be classified according to two main categories: gestures and real tool/object use. Most clinical tests focus on the examination of gestures, the impairment of which has been demonstrated to be predictive of difficulties with tool use. Gestures can be tested in two principal domains: imitation of gestures demonstrated by the examiner and pantomime on command (i.e. elicited verbally). Gestures can also be tested for three types of semantic content (Goldenberg & Hagmann, 1998; Poizner et al., 1995); gestures are nonsymbolic if they are meaningless for the examinee (e.g., index finger on the tip of the nose) and symbolic if they are meaningful. Symbolic gestures are further classified as being intransitive and communicative in nature (e.g., a military salute), or being transitive, related to specific object/tool use (e.g., using a hammer). To complete a comprehensive assessment comprising the aforementioned measurements, the test of upper limb apraxia (TULIA) was developed and validated for research purposes and clinical practice (Vanbellingen et al., 2010). The clinimetric findings mostly demonstrated good to excellent internal consistency, as well as inter- and intra-rater (test-retest) reliability, both at the level of the six subtests and at the individual item level.

Praxis imagery has also been considered with reference to gesture production in children with developmental dyspraxia (Sinani, Sugden, & Hill, 2011). Praxis imagery involves a dynamic state in which an individual mentally simulates the performance of a specific motor action (Wilson, Maruff, Ives, & Currie, 2001). Ochipa et al. (1997) introduced the Florida Praxis Imagery Questionnaire (FPIQ) as a measure of praxis imagery, signifying imagery for learned skilled movements. The FPIQ presented the participants with 12 actions to imagine, one at a time. The participants were asked four questions about each action. The FPIQ assessed the individuals' ability to imagine complex motor acts (e.g., using a key to unlock a door) and then answer questions about those acts based on the internal representation. Different scales on the questionnaire assessed different aspects (e.g., kinesthetic aspect, body position, direction, and visual representation) of the same internal representation. For example, after subjects were asked to imagine using a key to unlock a door, they were then asked for information about the different aspects of the internal representation: the kinesthetic aspect (Which joint moves more, your finger joints or your elbow?), body position (Are your fingers straight or bent?), action (Does your thumb move up and down or rotate?) and object (Is the part of the key you insert into the lock longer or shorter than the part you hold?). Ochipa et al. (1997) found parallel praxis production and praxis imagery deficits in their patients with ideomotor apraxia, suggesting that the same representations used for gesture production may also be activated during mental imagery related to motor acts.

In clinical practice, the Sensory Integration and Praxis Test (SIPT) (Ayres, 2004) is one of the most commonly used assessments with a referenced norm; however, the complicated test procedure and scoring prevent its widespread use. In addition to SIPT, movement imitation, the praxis imagery questionnaire, and knowledge object-use have been used in studies on apraxia and dyspraxia. The purpose of the present study, which integrated the aforementioned tests developed by previous studies, was to develop a comprehensive praxis assessment and to validate the test using randomly sampled younger school age children.

From a theoretical perspective, Roy and Square (1985) suggested that praxis function comprises two systems: (1) a conceptual system that provides an abstract representation of the action and (2) a production system that incorporates a sensory-motor component of knowledge (generalized action programs containing information about space, i.e., “the orientation of objects and movements and the positioning of the fingers in a grasp and time,” p. 115) and a perceptual-motor process that enables the individual to organize and execute actions. However, no standardized dyspraxia scales are available in a clinical setting. Furthermore, tests currently available still do not cover all domains and semantic features of gesture production. The praxis assessments in the present study were designed to include these two systems. First, the praxis imagery questionnaire was used to assess the abstract representation of an action. Second, the gesture representation and knowledge of object-use were employed to assess a production system incorporating a sensory-motor component of knowledge.

This study was designed to address outstanding issues from previous studies in a number of ways, with the key aim being the development of a comprehensive praxis assessment, including praxis imagery, the nonsymbolic intransitive and transitive gestural performance, as well as the knowledge of object-use.

2. Methodology

2.1. Development of the praxis assessment

To develop a comprehensive praxis assessment, tests used in this study included three instruments: *praxis imagery questionnaires*, *assessment of gesture production*, and *knowledge of object-use*. The detailed content and test procedures were as follows.

2.2. Praxis imagery questionnaire

2.2.1. Items

The Florida Praxis Imagery Test was first presented by Ochipa et al. (1997) and used in their study to assess the deficit of praxis imagery in ideomotor apraxia. The test was modified by Wilson et al. (2001) for use with children. Considering changes over time and circumstances in Taiwan, the questionnaire was adapted and some items were modified according to a pilot survey establishing items that were appropriate and familiar to children aged 6–8 years. The face validity of the Chinese-version questionnaire was verified by three specialists who are mastering in pediatric occupational therapy. Two experts are professors working in the occupational therapy

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