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# Imitation of body postures and hand movements in children with specific language impairment

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### ABSTRACT

Within the domain-general theory of language impairment, this study examined body posture and hand movement imitation in children with specific language impairment (SLI) and in their age-matched peers. Participants included 40 children with SLI (5 years 3 months to 6 years 10 months of age) and 40 children with typical language development (5 years 3 months to 6 years 7 months of age). Five tests were used to examine imitation and its underlying cognitive and motor skills such as kinesthesia, working memory, and gross motor coordination. It was hypothesized that children with SLI show a weakness in imitation of body postures and that this deficit is not equally influenced by the underlying cognitive and motor skills. There was a group effect in each cognitive and motor task, but only gross motor coordination proved to be a strong predictor of imitation in children with SLI. In contrast, hand movement imitation was strongly predicted by performance in the Kinesthesia task in typically developing children. Thus, the findings show not only that children with SLI performed more poorly on the imitation tasks than their typically developing peers but also that the groups' performances showed qualitative differences. The results of the current study provide additional support to the view that the weaknesses in children with SLI are not limited to the verbal domain.

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### Introduction

Imitation plays a central role in the development of motor control, speech/language/communication, and social life (Tomasello, Kruger, & Ratner, 1993). Imitation is one of the most common

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ways for children to acquire motor or speech/language skills. Children use imitation to learn new motor skills and communicative actions and to facilitate comprehension of other individuals' behavior (Goldenberg & Karnath, 2006). As children learn to speak, they acquire speech/language by hearing the spoken words and speech sounds and not by receiving instructions on how to manipulate their articulators (Jordan & Rumelhart, 2002). Although children start to imitate very early in their lives, imitation is a complex task. The development of it is highly influenced by children's perceptual and gross motor skills and by higher cognitive functions such as working memory.

The Broca's area in the brain has an imitation mechanism through which the interpretation of hand movements is closely linked to language performance (Rizzolatti & Arbib, 1998). The motor area for speech appears to be responsible for directly matching the linguistic material and motor movements (Iacoboni et al., 1999). The Broca's area contains a matching system that facilitates language acquisition through imitation. This area has special importance in primates with respect to gestures and in humans with respect to language acquisition and processing (Cooper, 2006). Gesture, speech, and language are interrelated and show an overlap in neural control (Capone & McGregor, 2004).

The target population of this study, children with specific language impairment (SLI), experience difficulties in both language comprehension and production. These children show a later onset and slower progress in language development in the absence of hearing impairment or intellectual disorder. Although by definition the primary deficit in children with SLI is in language, an increasing number of researchers have suggested that these children's difficulties are not limited to their language skills (e.g., Archibald & Gathercole, 2006; Botting, 2005; Hill, 2001; Marton & Schwartz, 2003). Children with SLI show poor performance in working memory (e.g., Ellis Weismer, Evans, & Hesketh, 1999; Marton & Schwartz, 2003; Montgomery, 2000), in attention control (Noterdaeme, Amorosa, Mildnerberger, Sitter, & Minow, 2001), in procedural memory (Ullman & Pierpont, 2005), in nonverbal cognitive development (Botting, 2005), in visuospatial processing (Hick, Botting, & Conti-Ramsden, 2005; Marton, 2008), and in gross motor control (Bishop, 2002; Hill, 2001). Many of these skills have been reported to play a relevant role in imitation. Imitation is not a simple matching mechanism; it includes various motor, perceptual, and cognitive elements such as visuomotor perception, visual attention, short-term memory (Decety, 2006). Although imitation plays a major role in language development, the imitation skills of children with SLI is an uncharted area. Given the accentuated role of the Broca's area in imitation and the hypothesis that this area and the frontal/basal ganglia circuits are impaired in children with SLI (Ullman & Pierpont, 2005), we may expect a deficit in body posture and movement imitation in this population. Thus, the overall aim of this study was to examine different forms of body posture and hand movement imitation and the underlying motor and cognitive skills in children with SLI.

Language is a complex system that is interrelated with a number of nonverbal factors. Examples of these functions include imitation, gestures, gross motor control, and social engagement. We know that these factors affect language acquisition, but it is not clear which of these functions predict language impairment in specific disorders (Tager-Flusberg, 2005). Only a few studies have examined motor control in children with SLI, but their results indicate a relatively high prevalence of impairments in gross motor skills and gestures in this population. Motor performance is an indicator of underlying neurodevelopmental immaturity (Bishop, 2002). Based on the fact that the perceptual-motor translation is a defining property of imitation (Heyes, 2001), one would expect that children with poor gross motor skills show difficulty in imitation tasks.

In a review article, Hill (2001) concluded that an increase in task complexity and/or in the number of processes required to complete a motor task results in an increase in group differences between children with SLI and their typically developing peers. Thus, children with SLI not only perform more poorly than their peers in different motor tests but also show a more dramatic decline in performance with an increase in task complexity. This is in line with our previous findings on verbal cognitive tasks, where one of the major challenges for children with SLI was to perform simultaneous processing (Marton & Schwartz, 2003; Marton, Schwartz, Farkas, & Katsnelson, 2006).

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