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Speech and oro-motor function in children with Developmental Coordination Disorder: A pilot study

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ABSTRACT

The protracted maturation and development of speech articulation underlies the complexity of the skill, and suggests it may be an area susceptible to a general deficit in motor control. Recent research suggests a high co-occurrence between Developmental Coordination Disorder (DCD) and disordered speech production. Despite this there has been no systematic investigation of speech motor control in children with DCD. We conducted a pilot study which looked at speech motor control in a group of children with DCD ($N = 5$) and a group typically developing (TD) children ($N = 5$). Movements of the upper and lower lip were recorded during non-verbal movements, single words, syllable sequences, and sentence repetition. In the baseline conditions (normal talking speed or an isolated utterance) children with DCD demonstrated a typical pattern of movement, albeit a slower and shorter movement. In contrast, when task complexity was increased the children with DCD showed an atypical pattern of movement. It was concluded that children with DCD demonstrate inferior motor control for complex speech gestures, suggesting that the motor deficit in DCD may indeed be a more generalized phenomenon affecting the speech motor system.

1. Introduction

The articulation of speech is a mechanical act that is executed by the complex speech apparatus including infralaryngeal (e.g., lungs), laryngeal, and supralaryngeal (e.g., tongue, lips) involvement

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as well as neural control mechanisms. In this way, speech articulation can be conceptualized as a complex skill of the oral motor system that requires careful and precise coordination (Keller, 1990). There are different levels of skill involved in orchestrating non-speech movements, and more complex sequences of movements to produce single syllabic words as well as longer trains of speech (Tasko & McClean, 2004). Studies of speech motor development have shown that children, and even adolescents, produce speech gestures that are similar to adults but do so more slowly and with greater temporal variability (Smith & Goffman, 1998; Walsh & Smith, 2002). A similar increase in variability is seen in adults with stutter (Boutsen, Brutten, & Watts, 2000; Smith & Kleinow, 2000) and apraxia (Strand & McNeil, 1996), and this has been attributed to underlying motor control mechanisms (Walsh & Smith, 2002). The protracted development of speech articulation throughout adolescence underlines the complexity of this skill and the underlying deficits in motor control mechanisms in disordered speech suggests that the development of speech articulation may be an area particularly susceptible to a general deficit in motor function.

Within the normal population a small proportion of children (~5%) present with Developmental Coordination Disorder (DCD) and exhibit difficulties in the coordination of eye and body movements that cannot be accounted for in terms of an intellectual impairment or identifiable physical disorder (American Psychiatric Association, 1994). Children with DCD have difficulties with fine motor tasks such as tracing, writing, and fastening buttons, and/or in gross motor tasks such as jumping, hopping, and catching a ball (Sugden & Wright, 1998). Children with DCD continue to exhibit problems throughout adolescence and do not simply grow out of their coordination problems (Losse et al., 1991). Research has demonstrated the increased variability of movement seen in these children (for example see Visser, 2003; Wilmut & Wann, 2008) and the high co-occurrence with other childhood disorders (for example see Kaplan, Wilson, Dewey, & Crawford, 1998; Visser, 2003). One such co-occurrence is seen between DCD and speech and language disorders (Gaines & Missiuna, 2007; Hill, Bishop, & Nimmo-Smith, 1998). A review of the literature concerning motor skill in specific language impairment (SLI) has highlighted that many studies have found significant movement difficulties in children (Hill, 2001). Moreover, the movement difficulties seen in children with SLI are very similar to those seen in children with DCD (Hill, 2001; Hill et al., 1998). To our knowledge, however, speech motor control has not yet been systematically investigated in children with DCD.

The current pilot study aimed to directly investigate lip movement in a group of children with DCD; the secondary acoustic aspects of the speech output produced lie beyond the scope of this initial study. Tasko and McClean (2004) have suggested that a description of speech production needs to include more than simple open-and-close movements which may not be representative of day-to-day communication. Therefore, movement kinematics was measured under four types of utterance ranging from open-and-close movements to sentence production. In addition, different levels of complexity were introduced: first each utterance was performed at a baseline level (normal talking speed or repeated just once), and then performed again at a level demanding a greater degree of motor control (fast talking speed or a continuous string of utterances). It was hypothesized that speech gestures that were more complex would specifically disadvantage children with DCD and the resulting pattern of temporal and spatial labial kinematic measures in the DCD group would be different compared to age-matched controls.

2. Method

2.1. Participants

Children with DCD were recruited through the Dyspraxia Foundation, UK. Five families agreed to participate and the age range of this group was from 9 to 13 years. For each participant with DCD a typically developing (TD) participant was recruited and age matched to within 6 months. All children were assessed using the Movement Assessment Battery for Children (MABC) (Henderson & Sugden, 1992). Children with DCD all fell below the 2nd percentile and TD children all fell above the 20th percentile. Participants were also assessed using the WISC-R and all fell within a normal range (an IQ score between 85 and 125). See Table 1 for details of participant scores. From the pre-screening it was judged that the children with DCD met criteria A–D of the DSM IV, but also that their selection