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Discrimination of speech sounds by children with dyslexia: Comparisons with chronological age and reading level controls

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ABSTRACT

Previous studies have shown that children suffering from developmental dyslexia have a deficit in categorical perception of speech sounds. The aim of the current study was to better understand the nature of this categorical perception deficit. In this study, categorical perception skills of children with dyslexia were compared with those of chronological age and reading level controls. Children identified and discriminated /do–to/ syllables along a voice onset time (VOT) continuum. Results showed that children with dyslexia discriminated among phonemically contrastive pairs less accurately than did chronological age and reading level controls and also showed higher sensitivity in the discrimination of allophonic contrasts. These results suggest that children with dyslexia perceive speech with allophonic units rather than phonemic units. The origin of allophonic perception in the course of perceptual development and its implication for reading acquisition are discussed.

Introduction

Dyslexia is characterized by a severe reading impairment without other physiological or psychological problems (Lyon, Shaywitz, & Shaywitz, 2003; Shaywitz, 1998; Stanovich, 1996). There is a growing amount of evidence that phonological factors play a crucial role in the acquisition of normal

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reading and that phonological processes are impaired in children affected by dyslexia (Ramus, 2003; Ramus, Pidgeon, & Frith, 2003; Ramus, Rosen, et al., 2003; Snowling, 2000; Sprenger-Charolles, Colé, & Serniclaes, 2006). Indeed, it is now well established that to learn to read in alphabetic orthographies, it is necessary to learn to map graphemes with phonemes. This process is easier when children can use a shallow orthography than when they are faced with an opaque orthography (e.g., in Spanish vs. English; for a review, see Sprenger-Charolles et al., 2006). However, whatever the opacity of the orthography, it has nonetheless been shown that early reliance on grapheme–phoneme correspondences is a bootstrapping mechanism for future reading acquisition. For instance, children who were the best early decoders of grapheme–phoneme correspondences turned out to be the best readers. Evidence of this is provided by longitudinal studies (Share, 1995; Sprenger-Charolles et al., 2006) and by the fact that training based on grapheme–phoneme correspondences is the most effective (Ehri, Nunes, Stahl, & Willows, 2001; Ehri, Nunes, Willows, et al., 2001). In addition, dyslexics experience great difficulties when they need to rely only on grapheme–phoneme correspondences to read without the help of their lexical knowledge (i.e., for the reading of unknown words or pseudowords). Indeed, such a deficit is the key characteristic of developmental dyslexia, for this deficit is consistently found in group studies even as compared with reading level controls (Rack, Snowling, & Olson, 1992; Van Ijzendoorn & Bus, 1994; for French data, see Sprenger-Charolles, Colé, Lacert, & Serniclaes, 2000) and is systematically observed in most participants in single and multiple case studies (Sprenger-Charolles et al., 2006).

Finally, a good level in phonemic awareness seems indispensable for making appropriate use of grapho-phonemic correspondences. Indeed, among the prereading abilities linked to reading acquisition, phonemic awareness has been shown to be the best predictor of future reading level, whereas evidence for the unique contribution of syllabic awareness and rhyme awareness is very limited (for a review, see Sprenger-Charolles et al., 2006). In addition, deficits in phonemic awareness have been found to be more reliable across studies than have deficits in phonological short-term memory (STM) or in rapid naming (e.g., in English: Bruck, 1992; Chiappe, Stringer, Siegel, & Stanovich, 2002; Pennington, Cardoso-Martins, Green, & Lefly, 2001; in German: Wimmer, 1993). However, some discrepancies between the results of dyslexics faced with a transparent orthography have been reported in regard to phonemic awareness. Indeed, such a deficit was not observed in some studies (e.g., Landerl & Wimmer, 2000), whereas it was in other studies (e.g., in Spanish: Jimenez-Gonzalez & Ramirez-Santana, 2002; in Czech: Caravolas, Volin, & Hulme, 2005; in German: Landerl, Wimmer, & Frith, 1997; Wimmer, 1993; in French: Sprenger-Charolles et al., 2000; Ziegler et al., 2008). Nevertheless, it seems difficult to argue that the dyslexic's deficit in phonemic awareness is a mere consequence of reading acquisition given that in some of these studies that deficit was observed relative to reading-matched (or spelling-matched) control peers (e.g., in English: Bruck, 1992; Chiappe et al., 2002; Pennington et al., 2001; in Spanish: Jimenez-Gonzalez & Ramirez-Santana, 2002; in Czech: Caravolas et al., 2005) and even before reading acquisition in future dyslexics compared with future average readers (e.g., Sprenger-Charolles et al., 2000).

Most of the studies in this field have used tasks involving the explicit segmentation of spoken words (phonemic counting, phonemic deletion, and phonemic inversion). However, there is also some evidence for implicit phonological deficits in dyslexic children. Boada and Pennington (2006) showed that children affected by dyslexia performed consistently worse than controls when more segmental representations where required in lexical gating, priming, and syllable similarity tasks. This might reflect either a specifically segmental deficit or a core deficit in phoneme representation, with the latter having in turn several different consequences for achieving segmentation and other tasks. Interestingly, the results of speech discrimination experiments suggest that dyslexic children indeed have a deficit in phoneme representation that would be characterized by the use of allophonic, rather than phonemic, representations of speech sounds (Serniclaes, Van Heghe, Mousty, Carré, & Sprenger-Charolles, 2004). Allophones correspond to mere contextual variants of phonemes in the language of interest while being phonemic in other languages. For instance, some languages display a twofold distinction between /d/ (voiced), /t/ (voiceless), and /t^h/ (voiceless aspirated) stops, whereas other languages have only a single d/t^h distinction. However, in these languages, the /t/ consonant is also present as an allophone of either the /d/ or /t^h/ phoneme.