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Is the phonological deficit in developmental dyslexia related to impaired phonological representations and to universal phonological grammar?

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ABSTRACT

To date, the nature of the phonological deficit in developmental dyslexia is still debated. We concur with possible impairments in the representations of the universal phonological constraints that universally govern how phonemes co-occur as a source of this deficit. We were interested in whether—and how—dyslexic children have sensitivity to sonority-related markedness constraints. We tested 10 French dyslexic children compared with 20 typically developing chronological age-matched and reading level-matched controls. All were tested with two aurally administered syllable counting tasks that manipulated well-formedness of unattested consonant clusters, as determined by universal phonological sonority-related markedness constraints (onset clusters in Experiment 1; intervocalic clusters in Experiment 2). Surprisingly, dyslexic children's response patterns were similar to those in both control groups; as universal phonological sonority-related marked-

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ness increased, dyslexic children increasingly perceptually confused and phonologically repaired clusters with an illusory epenthetic vowel (e.g., /ʁəbal/). Although dyslexic children were systematically slower, like both control groups, they were influenced by universal sonority-related markedness constraints and hierarchically ranked constraints specific to French over evident acoustic–phonetic contrasts or sonority-unrelated cues. Our results are counterintuitive but innovative and compete to question an impaired universal phonological grammar because dyslexic children were found to have normal universal phonological constraints and were skilled to restore phonotactically legal syllable structures with a language-specific illusory epenthetic vowel (i.e., /ə/-like vowel). We discuss them regarding active phonological decoding and recoding processes within the framework of the optimality theory.

Introduction

Developmental dyslexia, which affects approximately 7% of school-aged children, is a genetic-based neurodevelopmental disorder that cannot be attributed to inadequate intellectual, psychological, or educational background (e.g., Lyon, Shaywitz, & Shaywitz, 2003; Vellutino, Fletcher, Snowling, & Scanlon, 2004; Ziegler, Perry, Ma-Wyatt, Ladner, & Schulte-Körne, 2003). Previous studies have extensively documented that the phonological deficit, depicted as multidimensional difficulties, is the most reliable correlate of dyslexics' language disabilities that sustains the cognitive disorder (e.g., Castles & Coltheart, 2004; Ramus et al., 2003; Snowling, 2001; Ziegler & Goswami, 2005; Ziegler et al., 2008). Recent cross-linguistic studies have established that the phonological deficit tends to be a *universal* marker of reading difficulties (e.g., Goswami et al., 2011; Ziegler et al., 2010).

Although there is considerable evidence that the core deficit is phonological in developmental dyslexia, research has emphasized that there is no consensus on the origin of the phonological deficit (e.g., Ramus, 2001; Ziegler & Goswami, 2005). Over the past decades, the degraded/underspecified phonological representation hypothesis has been classically cited to account for dyslexics' phonological deficit and how it affects grapheme-to-phoneme correspondences that are essential to learn how to read (e.g., Bogliotti, Serniclaes, Messaoud-Galusi, & Sprenger-Charolles, 2008; Scarborough, 1998, 2005; Serniclaes, Van Heghe, Mousty, Carré, & Sprenger-Charolles, 2004; Sprenger-Charolles, Colé, Lacert, & Serniclaes, 2000; Swan & Goswami, 1997). Although research has well documented that listeners' perceptual system early dynamically tunes (i.e., analyzes, adjusts, and learns) to speech (e.g., Kuhl, 2004; Saffran, Werker, & Werner, 2006), little is known about whether—and, if so, how—dyslexic individuals' perceptual system tunes to phonological regularities (e.g., Bonte, Poelmans, & Blomert, 2007; Szenkovits, Darma, Darcy, & Ramus, 2012). Phonological regularities are of special interest because they encompass language-specific rules that govern how, and how frequent, phonemes occur and co-occur in languages. A phonological sequence such as /mʒ/ never occurs in French and, therefore, is labeled as phonotactically illegal, whereas /pʁ/ occurs in French (e.g., 'prix' *price*) and is labeled as phonotactically legal. Thus, *phonological grammar* is an innovative source to portray the nature of the phonological deficit in developmental dyslexia (also see Szenkovits et al., 2012). Phonological grammar, defined as a system of hierarchically ranked violable phonological constraints that do not differ from language to language (i.e., are universal) within the optimality theory (OT) framework (Prince & Smolensky, 2004; see also Moreton, 2002), rules the well-formedness of phonological sequences in a language. If phonological constraints are universal, how they are ranked is language specific.

In this article, we especially tap into the OT framework to test the *phonological grammar hypothesis* and further determine whether phonological representations themselves are degraded/underspecified or whether impaired phonological grammar underlies the phonological deficit in developmental