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Speech perception deficits by Chinese children with phonological dyslexia

Wenli Liu [a,b], Hua Shu [c], Yufang Yang [d,*]

[a] Institute of Psychology and Graduate School, Chinese Academy of Sciences, 100101 Beijing, China
[b] Department of Social Psychology, Nankai University, 300071 Tianjin, China
[c] State Key Laboratory of Cognitive Neurosciences and Learning, Beijing Normal University, 100875 Beijing, China
[d] Institute of Psychology, Chinese Academy of Sciences, 100101 Beijing, China

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ABSTRACT

Findings concerning the relation between dyslexia and speech perception deficits are inconsistent in the literature. This study examined the relation in Chinese children using a more homogeneous sample—children with phonological dyslexia. Two experimental tasks were administered to a group of Chinese children with phonological dyslexia, a group of age-matched control children, and a group of adults. In addition to a categorical perception task, a selective adaptation task was carried out. The results indicated that Chinese children with phonological dyslexia were less consistent than both the child and adult control groups in identifying stimuli within a given phonetic category. Furthermore, they did not show any significant adaptation effects in the selective adaptation task even when the adapting stimulus was identical to an endpoint stimulus in the test continuum. It seems that children with phonological dyslexia have a general deficiency in representing and processing speech stimuli.

Introduction

It is well established that developmental dyslexia is associated with deficits in phonological processing skills, especially phonological awareness (e.g., Bradley & Bryant, 1978; Morris et al., 1998; Stanovich & Siegel, 1994). Children or adults with developmental dyslexia show severe difficulty in tasks that ask them to consciously segment and manipulate phonological units (mainly phoneme) in syllables or words, for example, saying what *cat* would sound like without the *c*. Concerning the

* Corresponding author. Fax: +86-10-64872070.
E-mail address: yangyf@psych.ac.cn (Y. Yang).

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nature of phonological deficits in dyslexia, it has been suggested that the phonological representation in dyslexics is coarse and the representation of the phonemic level is deficient, and this may interfere with the establishment of mapping between graphemes and phonemes (Goswami, 2002; Share, 1995; Swan & Goswami, 1997). However, the concept of coarse phonological representation is still obscure and lacks empirical evidence. Exploring the speech perception process, which has focused on exploring how humans perceive phonological segments from running and variable acoustic signals, may provide a more direct approach to disclose the essence of phonological representation in children or adults with dyslexia. Among the tasks developed by speech perception researchers, the categorical perception paradigm has been used intensively to examine speech perception abilities in dyslexics. In categorical perception tasks, researchers develop stimulus continua that vary along one or more acoustic dimensions and range across two or more phonemic categories such as the voice onset time (VOT, i.e., the interval between the release of articulatory occlusion and the onset of voicing) continuum relevant to voicing contrast (e.g., /b/ vs. /p/). When these stimulus continua are presented to participants, their perception is not continuous but rather categorical; that is, their identification performances exhibit sharp changes at categorical boundaries, and their discrimination accuracy is nearly perfect for stimulus pairs that straddle a category boundary and is poor for stimulus pairs within a category (Liberman, Cooper, Shankweiler, & Studdert-Kennedy, 1967; Liberman, Harris, Hoffman, & Griffith, 1957).

Significant categorical perception deficits in children with developmental dyslexia have been revealed by some studies. In identification tasks, dyslexics have shallower identification functions and larger identification inconsistency with stimuli from the same category than do control groups. In discrimination tasks, they show lower discrimination peaks on stimulus pairs that straddle a category boundary but have higher discrimination scores on stimulus pairs within a phonetic category (e.g., Godfrey, Syrdal-Lasky, Millay, & Knox, 1981; Reed, 1989; Serniclaes, Sprenger-Charolles, Carré, & Démonet, 2001; Werker & Tees, 1987). Researchers suggest that speech perception is less categorical in dyslexics than in normal readers and that phonemic-level representations in dyslexics' long-term memory are less robust and more inconsistent than those in normal readers' long-term memory; this in turn results in failure of mapping between graphemes and phonemes (Breier, Fletcher, Denton, & Gray, 2004; Godfrey et al., 1981; Werker & Tees, 1987).

Serniclaes and his colleagues provided further evidence for categorical perception deficits in children with dyslexia and concluded that dyslexic children perceived speech in an *allophonic mode;* that is, they were more sensitive to acoustic differences within a native phonetic category and less sensitive to acoustic changes across native phonetic categories. Furthermore, the allophonic perception disrupted the invariance of phonemic-level representation and the mapping between graphemes and phonemes (Bogliotti, Serniclaes, Messaoud-Galusi, & Sprenger-Charolles, 2008; Serniclaes, van Heghe, Mousty, Carré, & Sprenger-Charolles, 2004).

However, some studies find that children or adults with dyslexia do not show categorical perception deficits or exhibit individual variability in speech perception abilities. Lieberman, Meskill, Chatillon, and Schupack (1985) compared the abilities of dyslexic adults and control groups to identify synthesized vowels and stop consonants. The results indicated that a subgroup of dyslexics did not show any deficits in identifying synthesized vowels or consonants. The finding that only a subgroup of dyslexics showed speech perception deficits was replicated in later studies (Adlard & Hazan, 1998; Joanisse, Manis, Keating, & Seidenberg, 2000; Manis et al., 1997; Ramus et al., 2003). For example, Manis and colleagues (1997) found that only dyslexic children with low phonemic awareness showed less sharply defined categorical perception than control groups. Joanisse and colleagues (2000) indicated that only dyslexics with additional language impairments showed categorical perception deficits. Furthermore, some other studies found that dyslexics had normal categorical perception when the experimental stimuli were more natural speech sounds (Blomert & Mitterer, 2004; Blomert, Mitterer, & Paffen, 2004).

It is obvious that the findings about the relation between dyslexia and speech perception deficits are far from consistent. The heterogeneity of dyslexia might be one of the reasons for the inconsistency of findings. Considerable studies have indicated that developmental dyslexia has different subtypes such as phonological dyslexia and delay-type dyslexia (Castles & Coltheart, 1993; Manis, Seidenberg, Doi, McBride-Chang, & Petersen, 1996; Stanovich, Siegel, & Gottardo, 1997). Children with