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# Perception of speech and nonspeech stimuli by children with and without reading disability and attention deficit hyperactivity disorder <sup>☆</sup>

Joshua I. Breier, <sup>a,\*</sup> Lincoln C. Gray, <sup>b</sup> Jack M. Fletcher, <sup>c</sup>  
Barbara Foorman, <sup>c</sup> and Patricia Klaas <sup>d</sup>

<sup>a</sup> *Department of Neurosurgery, Vivian L. Smith Center For Neurologic Research, The University of Texas Health Science Center at Houston, Houston, TX 77030, USA*

<sup>b</sup> *Department of Otolaryngology, The University of Texas Health Science Center at Houston, Houston, TX 77030, USA*

<sup>c</sup> *Department of Pediatrics, The University of Texas Health Science Center at Houston, Houston, TX 77030, USA*

<sup>d</sup> *HIV and AIDS Malignancy Branch, National Cancer Institute and Medical Illness Counselling Center, Bethesda, MD, USA*

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## Abstract

The auditory temporal deficit hypothesis predicts that children with reading disability (RD) will exhibit deficits in the perception of speech and nonspeech acoustic stimuli in discrimination and temporal ordering tasks when the interstimulus interval (ISI) is short. Initial studies testing this hypothesis did not account for the potential presence of attention deficit hyperactivity disorder (ADHD). Temporal order judgment and discrimination tasks were administered to children with (1) RD/no-ADHD ( $n = 38$ ), (2) ADHD ( $n = 29$ ), (3) RD and ADHD (RD/ADHD;  $n = 32$ ), and (4) no impairment (NI;  $n = 43$ ). Contrary to predictions, children with RD showed no specific sensitivity to ISI and performed worse relative to children without RD on speech but not nonspeech tasks. Relationships between perceptual tasks and

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\* Corresponding author. Fax: +713-797-7590.

E-mail address: joshua.i.breier@uth.tmc.edu (J.I. Breier).

phonological processing measures were stronger and more consistent for speech than nonspeech stimuli. These results were independent of the presence of ADHD and suggest that children with RD have a deficit in phoneme perception that correlates with reading and phonological processing ability. © 2002 Elsevier Science (USA). All rights reserved.

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Children with specific reading disability (RD) consistently exhibit deficits in phonemic awareness, or the ability to manipulate the elements of spoken language (Blachman, 2000; Fletcher et al., 1994; Shankweiler & Crain, 1986; Stanovich, 1988). These deficits may be detected in children as young as 5 years of age, are predictive of future reading ability (Hatcher & Hulme, 1999; Hulme, Muter, & Snowling, 1998; McDougall, Hulme, Ellis, & Monk, 1994; Muter, Hulme, Snowling, & Taylor, 1997; Scarborough, 1998), and may have a direct role in the etiology of RD (Bradley & Bryant, 1983; Fletcher et al., 1994; Foorman, Francis, Fletcher, & Lynn, 1996; Shankweiler & Crain, 1986; Stanovich & Siegel, 1994; Wagner & Torgesen, 1987; Wagner, Torgesen, & Rashotte, 1994). While the association of deficits in phonemic awareness and RD is well established, the etiology of these deficits is not. The auditory temporal deficit hypothesis suggests that at least a subgroup of children with RD have difficulty processing rapidly presented acoustic stimuli, regardless of whether they are speech or nonspeech in nature. This deficit results in difficulty in the perception of brief portions of the speech signal, such as formant transitions, so that speech perception is inaccurate. Inaccurate speech perception, in turn, may lead to more elaborated difficulties in phonological processing, including poor phonemic awareness (Tallal, 1980; Tallal, Miller, & Fitch, 1993, 1997).

In initial studies that led to the formulation of the auditory temporal deficit hypothesis, Tallal and Piercy (1973a, 1973b) found that children with specific language impairment (SLI), who have more general receptive and expressive language deficits than most children with RD (Tomblin & Zhang, 1999), performed normally on discrimination and temporal order judgment (TOJ) tasks utilizing nonspeech stimuli (steady-state complex tones) when the interstimulus interval (ISI) was relatively long (428 ms). However, as ISI decreased, performance deteriorated relative to controls. Tallal and Piercy (1973b) interpreted these findings as suggesting a deficit in the speed of auditory processing, as lengthening the stimulus or the ISI improved performance. In another series of experiments, children with SLI were found to be deficient in discrimination and TOJ tasks for stop consonants (*/ba/* vs */da/*), while performance for steady-state vowels (*/æ/* vs */e/*) was similar to that of controls, unless the number of stimulus elements was large (five) (Tallal &

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