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The contribution of processing impairments to SLI: Insights from attention-deficit/hyperactivity disorder

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Abstract

Slowed speed of processing and impaired rapid temporal processing (RTP) have been proposed to underlie specific language impairment (SLI), but it is not clear that these dysfunctions are unique to SLI. We considered the contribution of attention-deficit/hyperactivity disorder (ADHD), which frequently co-occurs with language impairments, to performances on processing tasks. School-aged children who had SLI without concurrent ADHD ($n = 14$), ADHD without concurrent SLI ($n = 14$), and typical development (TD, $n = 28$) performed two nonverbal speeded tasks and one auditory RTP task. RTP impairments were found in many children with SLI and ADHD, and some children with TD. Children with ADHD demonstrated slower processing speed than children with SLI or TD. Overall, findings questioned the uniqueness of these processing dysfunctions to language impairments and the validity of the behavioural paradigms traditionally used to estimate processing dysfunctions. Accounts of SLI should be further scrutinized by considering the influence of other disorders.

Learning outcomes: Readers will (1) become familiar with areas of overlap between SLI and ADHD, (2) understand some of the confounds associated with behavioural measures of processing speed in children, and (3) recognize the value in testing models of language disorders by including participants with other types of disorders.

Recent research investigating children with specific language impairment (SLI) has focused on specific perceptual or cognitive processing impairments, with a view toward finding fundamental causal mechanisms and markers of this disorder (Conti-Ramsden, Botting, & Faragher, 2001). Through pursuit of these objectives, a number of processing dysfunctions have been identified as possible markers of SLI, including impaired speed of processing (Kail, 1994; Lahey, Edwards, & Munson, 2001; Miller, Kail, Leonard, & Tomblin, 2001; Montgomery, 2005) and rapid temporal processing (Benasich, Thomas, Choudhury, & Leppanen, 2001; Tallal, 2000). The proposed link between these processing dysfunctions and language disability is drawn primarily from the fact that the children with SLI under study have, by definition, impaired linguistic functioning. Although this is a reasonable inference, a more intricate test of the proposed causal link between processing and language would be to examine the target processes in groups of children

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with other forms of impairments that do not involve language. Because this issue has received limited attention in the literature to date, we sought to explore the contributions of SLI and Attention/Deficit Hyperactivity Disorder (ADHD), a behavioural disorder that frequently co-occurs with language impairments (Baker & Cantwell, 1991; Beitchman, Hood, Rochon, & Peterson, 1989), to two aspects of processing proposed to be impaired in SLI: speed of processing and rapid temporal processing.

1. Processing dysfunctions in SLI

Slowed speed of processing and impaired rapid temporal processing have both been proposed to be causally connected to impaired language development and functioning. For example, in the generalized slowing account, children with SLI are thought to have a central dysfunction that involves slowing across all aspects of mental processing (Kail, 1994; Miller et al., 2001; Windsor & Hwang, 1999). Irrespective of the nature or complexity of the task, children with SLI are proposed to be slower than their peers by a constant factor. The time-dependent nature of speech is thought to make language development especially vulnerable to the effect of slow information processing (Miller et al., 2001). In the rapid temporal processing (RTP) dysfunction account (which some have argued to be subsumed under generalized slowing, see Montgomery & Windsor, 2007), children with SLI are proposed to have a central impairment in processing quick transitions in sensory input (Benasich et al., 2001; Tallal, 2000). The inability to process rapidly changing elements within the speech signal is viewed as a key contributor to language impairments, because a number of phonemic contrasts are signalled within extremely brief time frames. Thus, an underlying RTP impairment is proposed to interfere with development of the phonological system, and, consequently, spoken and written language (Tallal, 2000).

Although empirical evidence exists to support the presence of these processing dysfunctions in children with SLI, the models remain open to debate and controversy. The statistical analysis methods used to support the generalized slowing hypothesis have been challenged, with other analysis methods pointing to process-specific, not generalized, slowing in SLI (Windsor, Milbrath, Carney, & Rakowski, 2001). Although some have concluded that the evidence for a RTP dysfunction in language disorders is compelling (Farmer & Klein, 1995; Habib, 2000; Leonard, 1998), others have failed to find differences between children with SLI and children with typical language development in RTP (Heltzer, Champlin, & Gillam, 1996; McArthur & Bishop, 2001; Rosen, 1999). In addition, some authors have argued that this dysfunction is not specific to input that is rapid, but rather may reflect a broader based impairment in auditory processing (Heltzer et al., 1996; Rosen, 1999). Others have argued that RTP impairments may not be causally linked to language impairments (Bishop, Carlyon, Deeks & Bishop, 1999). Counterarguments to these criticisms have included the fact that RTP dysfunctions do appear in at least a subset of children with language disorders (McArthur & Bishop, 2004) and the fact that failures to identify this dysfunction in some children with language impairment may reflect inadequate measurement sensitivity or maturational changes across different age groups that have been studied (Bishop & McArthur, 2005; Joanisse & Seidenberg, 1998; McArthur & Bishop, 2005).

An additional source of debate arises from the potential confounds introduced by the behavioural paradigms typically used for measuring the processes of interest. Such confounds have been at the forefront of the controversy surrounding the RTP account. Because RTP paradigms place demands on higher level processes (e.g., attention, memory, learning), it is arguably difficult to attribute poor performance directly to impaired RTP. Indeed, Bishop et al. (1999) suggested that poor performances by children with SLI on RTP tasks might reflect attentional problems. Moreover, Ludlow, Cudahy, Bassich, and Brown (1983) found impaired performance on a task measuring RTP in a group of six children with ADHD who did not have concurrent SLI or learning disabilities. Although similar concerns have not been central to the critiques of other processing accounts of SLI, a confounding influence of higher level processes is certainly a plausible issue for studies examining these accounts as well.

2. The role of ADHD

Little research has explored whether the aforementioned processing dysfunctions are indeed *unique* to disorders of language, one of the precursors to proposing causality. Evidence for an impaired aspect of processing in children with SLI relative to children with typical development does not establish whether the process contributes to impaired language development. It is also important to determine that the dysfunctional process is associated with SLI and not another co-occurring disorder in the sample. The high rates with which other developmental and behavioural disorders occur in the SLI population (Baker & Cantwell, 1991) suggest that this possibility cannot be readily dismissed. It is