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SHS 893: Independent Study with Paula Rabidoux, PhD

Specific Language Impairment and Auditory Processing Deficits

Specific Language Impairment

Specific language impairment (SLI) has been defined as a developmental deficit within the language domain specific to oral language abilities in the absence of deficits within other areas of development, including cognition and non-verbal abilities (Leonard, 1998). It is estimated that the prevalence of SLI is about 7% and that males are more affected than females. Risk factors for the development of SLI in childhood that lead to long-term language deficits include family history of language impairment, prematurity, low birth weight, and less than ideal prenatal and/or neonatal care (Pranthee, Thinkhamrop, & Dechongkit, 2007).

Criteria for diagnosis of SLI typically involve a combination of inclusionary and exclusionary factors (Leonard, 1998; Tomblin, Records, & Zhang, 1996). Inclusionary criteria involve language test scores lower than 1.25 standard deviations below the mean and a performance IQ of 85 or higher. Diagnosis of language deficits occurs in the framework of three areas of the language domain across two modalities, comprehension and expression. Language domains include vocabulary, grammar, and narrative abilities. Typically, a child is considered to have SLI if deficient performance in two of theses areas is documented (Tomblin et al., 1996; Catts, Adolf, Hogan, & Weismer, 2005). Exclusionary criteria include hearing impairment, known neurologic dysfunction, and abnormalities in oral/motor structure or function.

Characteristics of children with SLI include difficulty with semantics, syntax, and overall difficulties with discourse (Owens, 2004). Children with SLI often have difficulties with narrative formulation, naming abilities, phonological processing, as well as the comprehension and use of morphemes. Considerable difficulty with morphology and

syntax has been deemed the clinical marker of SLI in children (Leonard, 1998). However, there is considerable heterogeneity within the group of children considered to have SLI, which have led to several different theories about the origin and nature of the impairment. Three such theories include deficits in linguistic knowledge, deficits in general processing capacities, and processing deficits in specific mechanisms (Leonard, 1998).

Theory 1

Because children with SLI seem to have predominant issues with morphology and syntactic rules, deficits in linguistic knowledge have been implemented as the basis for SLI (Leonard, 1998; Gopnik, 1990). This theory proposes that the main feature of deficit for children with SLI is the inability to acquire knowledge of linguistic rules, principles, or constraints. Therefore, children have difficulty producing grammatical markers of tense, number or person. Gopnik (1990) reported this grammatical faculty deficit in a large family with several members having dysphasia *sic*, noting that the use and comprehension of grammatical markers for family members with language deficits were significantly less than family members without deficits. Gopnik further commented that these deficits were apparent across perceptual domains, including spontaneous speech production, writing samples, grammatical judgment and repetition, and therefore pointed to a specific underlying grammar issues rather than a peripheral processing system.

Theory 2

An alternative account for the basis of SLI is a deficit in general processing capabilities (Bishop, 1992). This theory states that a domain-general deficit underlies the deficits seen in children with SLI. Specifically, limited working memory capacity impacts the ability of a child to adequately coordinate linguistic and cognitive processes during language comprehension and expression. This theory implicates the complexity of material, amount of material, and time constraints on processing the material as factors that impact performance on different tasks. Recent findings from Im-Bolter, Johnson, and Pascual-Leone (2006) support the idea that a general processing deficit impacts performance of children with SLI on language tasks. Specifically, these investigators

found that children with SLI have difficulty activating schemes that are relevant to the task at hand, as well as difficulty suppressing schemes that are irrelevant to the task.

Theory 3

Lastly, processing deficits in specific mechanisms have been implicated in the deficits seen in children with SLI. Phonological processing deficits have been studied in this population with various outcomes. Gathercole & Baddeley (1990) investigated phonological processing and memory abilities in typically developing children as well as children with SLI through a nonsense word repetition task. Results suggested that children with SLI have more difficulty with the storage of phonological information in working memory than their peers. However, more recently Catts et al. (2005) investigated the relationship between phonological processing and SLI and found that children with SLI showed only mild deficits in phonological processing when compared to typical children. Additionally, children with SLI had significantly higher scores on tests of phonological processing when compared to children with dyslexia or a combination of SLI and dyslexia. Catts et al. (2005) proposed that deficits seen in children with SLI could be accounted for by other cognitive deficits rather than a deficit specific to phonological processing.

Temporal Processing

A specific issue with temporal processing has been proposed by a series of papers by Tallal and Piercy (1973, 1974, 1975). Deficits included the ability to process brief acoustic cues that occur in rapid succession. Subsequently, Merzenich et al. (1996) have reported significant gains in the ability to process brief acoustic cues that occur in rapid succession in children with SLI after intensive training through computer-based games. In addition to gains in auditory processing skills, children also demonstrated significant gains in language abilities in a relatively short amount of time. To explain these findings, Merzenich et al. hypothesized that children with SLI actually had age-appropriate language skills, but processing deficits in the auditory domain impacted their ability to access these skills in real-time. Some investigators have taken this hypothesis as

evidence that underlying processing deficits seen in these children did not impact language development to the degree assumed by Tallal and Piercy (Leonard, 1998).

SLI and Auditory Processing

The work started by Tallal and colleagues has led to the study of relationship between auditory processing abilities and language deficits in children as well as in adults. Figure 1 is a visual conceptualization of the relationship between auditory processing and language and learning, including higher-level cognitive factors contributing to the efficiency of processing at each level (Moncrieff, 2007). Other considerations that could be conceptualized in this model include memory as a higher level cognitive factor in processing, and the idea that reading impacts language abilities, which in turn can impact auditory processing abilities.

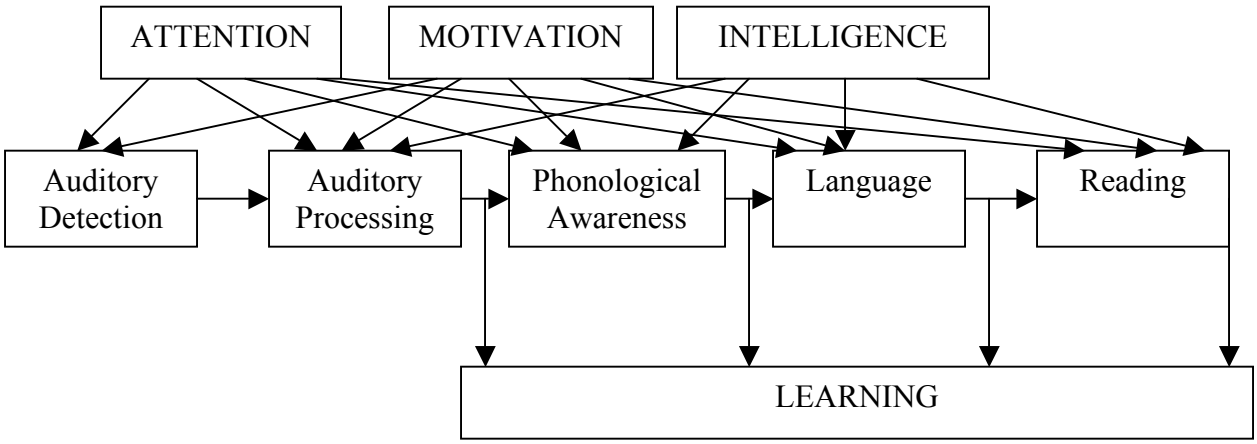

Figure 1: Auditory processing, Language, and Learning

Although some studies have suggested that basic auditory processing abilities are related to deficits in language processing (Tallal & Piercy, 1975), others argue that a clear relationship has not been established (Rosen, 2003; McArthur & Bishop, 2004). Tallal and Piercy put forth the rapid auditory processing deficit hypothesis by explaining that deficits in children with language impairment were explained by deficits in processing

rapidly presented auditory information. However, results from a study conducted by Corriveau, Pasquini, and Goswami (2007) indicated otherwise. In this study, children with SLI were tested on various measures of non-speech auditory processing abilities, including intensity discrimination, amplitude envelope onset rise time, two-ramp rise time processing, temporal order judgment, and two tasks of duration discrimination. Although a minority of the children participating in the study showed deficits in the processing of rapidly presented auditory information, deficits across children were more evident in the ability to temporally integrate information over a long period of time.

The idea that a rapid auditory processing deficit is not at the root of SLI was also investigated by McArthur and Bishop (2004). The results of experiments investigating backward masking abilities in children with and without SLI suggested that frequency discrimination is deficient in children with SLI regardless of the rate of presentation. Further, results from electrophysiological tasks suggested that children with SLI had age-inappropriate event related potentials when compared to control subjects regardless of their frequency discrimination abilities. Because ERP data of older children with SLI resembled that of younger controls, a developmental delay in the maturation of auditory processing was proposed. More research in this area is needed to formulate this theory completely.

It appears from the two studies discussed above that the nature of relationship between auditory processing deficits and SLI remains unclear. In an extensive review of available literature, Rosen (2003) concludes that some but not all auditory processing skills are impaired in individuals who have SLI and other deficits such as reading disability. Further, the fact that children with SLI have a range of auditory processing deficits with little or no relationship between severity of auditory issues and language deficits suggests there is no causal relationship between auditory deficits and language disorders. However, other researchers have pointed out that these discrepant findings could be due, in part, to the heterogeneity of the SLI population (McArthur & Bishop, 2001). Therefore, the importance of individual differences even within a group of children diagnosed with the same language deficit should be taken into account when

characterizing deficits in the auditory modality. These individual differences could include the effects of higher-level cognitive processing abilities in addition to considerations of lower-level auditory processing abilities. This is especially important considering the need for individually tailored treatment plans for remediation of deficits.

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