

# Lessons from children with specific language impairment

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In the past decade, there has been an increasing interest among linguists and psychologists in the language development of children with developmental impairments such as Williams syndrome<sup>1</sup>, Down syndrome, and autism. Recently, children with specific language impairment (SLI) have been the focus of papers by Gopnik<sup>2</sup>, Joanisse<sup>3</sup> and van der Lely<sup>4</sup>. These papers join others<sup>5-8</sup> in examining the grammatical skills of these children in the hope of gaining insights into the nature of their language deficits, and to test theories concerning the cognitive bases and the possible biological and genetic bases of language development. A common issue within this work is the degree to which the development of language or particular sub-components of language (such as syntax and morphology) can be differentially affected relative to other aspects of language – or to more basic cognitive systems. Thus, in the same way that focal brain injury has been used for many years to provide a means to study questions of localization and modularity in mature language systems, investigators are now studying developmental language disorders to inquire about these issues in language and cognitive development.

Traditionally, SLI has been defined as a disorder in which a person's language does not develop at an expected and acceptable rate despite the integrity of the environment and the individual's sensory and cognitive systems. The parents are likely to begin to notice the language difficulties of children with SLI when they fail to demonstrate the normal rapid bursts of language development around the age of two years. Although many children who are late in the onset of language development do achieve normal levels of language by the mid-to-late preschool years<sup>9,10</sup>, there remains a substantial population of these children who, at school age, continue to manifest language difficulties<sup>11,12</sup>. Consequently, as the term SLI implies, the primary problem at presentation pertains to poor spoken language development. This is often later accompanied by problems with written language acquisition<sup>13,14</sup> but without other obvious developmental difficulties. Such children are thus considered to show a specific language impairment. Clearly, if the term is valid, such children should provide strong evidence for the existence

of a modular language development system that possesses its own dedicated biological basis and possibly even genes that are unique and dedicated to the service of these systems. Thus, children with SLI promise to provide a population of children in whom linguistic and cognitive boundaries are strained to the point of revealing disassociations that are difficult to identify in the typically developing child.

For more than 20 years, there has been evidence that children with SLI find difficulty with the development of grammar, morphology in particular<sup>15</sup>. Recently, van der Lely, Rosen and McClelland<sup>4</sup> have described these grammatical limitations in a group of children with SLI. It is important to note that van der Lely *et al.* believe that the only language or cognitive problem these children have concerns grammar. The principal evidence for their claim comes from one boy, AZ, who had been examined at intervals between the ages of 10 and 15 years. Van der Lely *et al.* presented data from several standardized and non-standardized tests and revealed a profile of a child who, despite near age-appropriate levels of semantic and discourse development, performed otherwise at around the level of a five-year-old<sup>4</sup>. AZ was also found to be unimpaired in all non-verbal tasks tested, even tasks that have often been found to be challenging to children with SLI.

Van der Lely's description of AZ is similar to Gopnik's account of several members of a family in Britain whom she described as having specific limitations in the acquisition of grammatical morphology<sup>16,17</sup>. These accounts share the point of view that SLI represents a condition in which the construction of grammatical principles is the key or sole factor that is impaired. Van der Lely *et al.* recognize that this focal deficit of grammar might not always be found in children with SLI; therefore they proposed that children with such a focal deficit form a subgroup within SLI (Grammatical SLI).

Limitations in the construction of grammatical representations could be the result of restricted experience with grammatical forms (as in the case of deaf language learners acquiring a spoken language) or it could be that the grammatical representations themselves are deficient because of a fundamental limi-

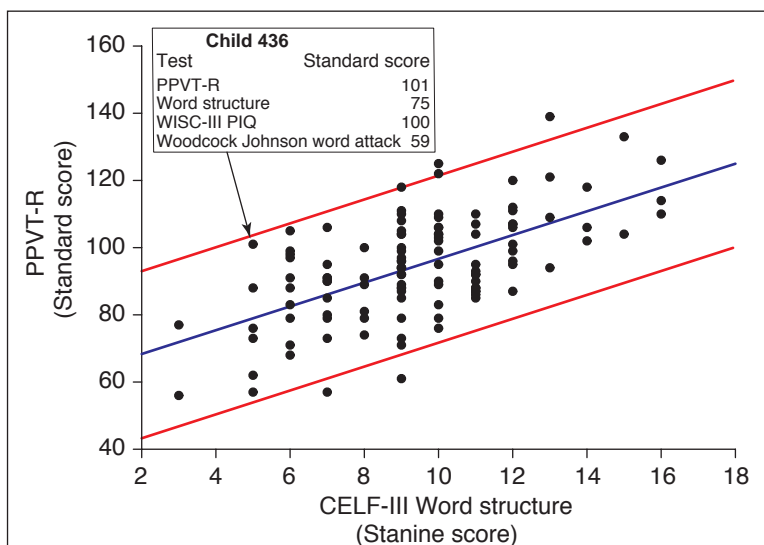
tation in the representational system. It is the latter viewpoint that van der Lely *et al.* espouse. Furthermore, they explicitly state that the individuals they have studied do not have deficits in other language systems such as vocabulary, nor do they have cognitive deficits. Thus, van der Lely proposes that these cases of SLI provide strong evidence for the existence of a separate system that is dedicated to the acquisition and use of grammar.

Recently, we have shown that in a large sample of children with SLI in which the children had performance IQs above 85, and a group of children with more generalized delay where language and performance IQ was below  $-1$  sd for age, had very similar language profiles<sup>18</sup>. In both groups grammatical performance was poorer than any other language domain. Vocabulary development was also affected in these children, but to a lesser degree. These data could be viewed as supportive of the view that grammar can be dissociated from other language systems. However, other analyses we performed did not support this view. A factor analysis of the language measures and non-language measures revealed a single factor for grammar and semantics, and a second factor for phonology or speech sound-production. Using a cluster analysis, we also found no evidence for subgroups of children who had specific deficits in grammar without associated deficits in vocabulary.

All these data suggest that grammatical skill stands out as particularly affected among children with SLI. Despite this, the evidence is far from convincing that the basis of this impaired language-learning system resides in, or is particular to, a grammatical acquisition system or grammatical representational system. It remains possible that there are children with a form of SLI wherein grammar is affected without other language and cognitive systems being affected. For the past four years we have been following a large group of children with SLI along with a group of normally developing children. We have examined these children with respect to grammatical achievement and lexical development. The results of these measures obtained in second grade are shown in Fig. 1. This scatter plot shows that across the whole group of children, there is a moderate correlation ( $r=0.62$ ,  $p<0.0001$ )

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**Fig. 1. Measures of language development obtained in second grade in a group of children with SLI.** This scatter plot shows that across the whole group of children, there is a moderate correlation ( $r=0.62$ ,  $p<0.0001$ ) between lexical development measured by the Peabody Picture Vocabulary Test-R (PPVT-R, Ref. 19) and the word formation subtest of the Clinical Evaluation of Language Fundamentals (CELF, Ref. 20). The scores on a number of tests are shown for one child (no. 436) whose data point in the scatter plot is indicated by the arrow. This child appears to show poor grammatical performance and normal lexical development, and might therefore be similar in profile to subject AZ (although, see text).

between lexical development measured by the Peabody Picture Vocabulary Test-R (Ref. 19) and the word formation subtest of the Clinical Evaluation of Language Fundamentals<sup>20</sup>, which examines use of grammatical morphology. These group data do not support a hypothesis of separate grammatical and lexical semantic systems. It is possible, however, to find in this group children who appear to be similar to AZ. In the figure we have identified one child (no. 436) who was  $-1.66$  SD below the mean for her age on the grammatical measure, but had normal vocabulary and performance IQ. Her poor grammatical performance was accompanied by poor reading. This child represents a classic type of profile of a child with SLI and could be used as evidence in support of van der Lely *et al.*'s claim that there may be a subgroup of children with SLI in whom grammatical performance is affected but vocabulary and non-verbal cognitive skills are preserved. It should be noted, however, that even this child does not fall outside the 95% confidence limits for the predictions made from a regression of vocabulary onto grammar. That is, in any bivariate distribution where there is less than a perfect correlation it is to be expected to find individuals who are discrepant from the typical relationship. Hence, data from groups of children that clearly do not support independence between vocabulary and grammar will also contain individual cases that would appear to do so. This highlights the problems that occur when individual cases are presented as evidence for a separation between subsystems of language. These individual cases might provide some form of evidence that there is an unshared variance between the two traits, but this will by

necessity occur unless the two traits are perfectly correlated.

Standing in contrast to the explanations of SLI that are rooted in limited grammatical representations (restrictions on competence) are those accounts that consider factors outside of the representation of the grammar and even outside a language specific learning system. Instead, these accounts present evidence for deficits in more general-purpose cognitive systems that are important for language acquisition but are not restricted to language acquisition and use. The recent paper by Joanisse and Seidenberg<sup>3</sup> along with several by Leonard and his colleagues represent such a viewpoint<sup>21-23</sup>.

During the past decade, Leonard has studied children with SLI from several different language backgrounds (English, Italian, Hebrew, Swedish, Spanish). Leonard and his colleagues have proposed that claims about deficits involving particular grammatical systems in children with SLI must be tested cross-linguistically to demonstrate that these deficits in grammar are language independent. Thus, if particular aspects of morphology, such as tense, are core features of SLI, the same grammatical deficits should occur across languages that contain very different ways of marking these grammatical forms, as well as different patterns of frequency and consistency with respect to these forms. Leonard has summarized these findings<sup>24</sup> as continuing to demonstrate that grammar is challenging to children with SLI; however, his results fail to show a consistent grammatical feature that is vulnerable across languages for children with SLI. Rather, those features that are most challenging are those that occur with low frequency in the language,

those that are inconsistently marked such as the past tense in English (regular and irregular forms), and those that are most perceptually challenging, such as unstressed syllables. These characteristics would suggest that the difficulties of children with SLI are not inherent limitations in their ability to build particular grammatical representations. Instead, these data suggest to Leonard that the limitation in language development for these children resides in limited cognitive capacity. To the extent that these cognitive limitations are similar in kind to those of younger, normally developing children, we should expect to find that children with SLI demonstrate the same patterns of acquisition across languages as do normally developing children, only those aspects of the grammar that are challenging to normally developing children are even more so for the SLI children. Leonard concludes that the cross-linguistic data show just this pattern<sup>24</sup>. Thus, according to this view, SLI simply represents a group of children who are inefficient learners.

This brings us to the one last issue that was raised by van der Lely and her colleagues. They conclude that the occurrence of a specific deficit in the grammatical system provides evidence that there is a specific biological, and in particular a specific genetic, basis for this deficit. In recent years, it has been shown that the occurrence of SLI is familial<sup>25-27</sup>. Family members of children with SLI are between four and eight times more likely also to have a language impairment than the general population. This familiarity is genetically influenced, as has been shown by twin studies<sup>28,29</sup>. Most recently, there has been one report of a linkage of developmental speech and language impairment to chromosome 7 (Ref. 30). This work, however, provides no evidence that genes are able to influence one domain of language and not others, nor does it even provide evidence that the phenotype that is associated with genetic variation at this locus is concerned with language rather than some more general cognitive process. Bishop has found phonological memory to be the most genetically influenced trait of those she has examined in children with SLI (Ref. 31).

Elman and colleagues have recently presented an argument for a cautious view concerning the manner in which genes contribute to language<sup>32</sup>. These authors argue for a differentiation between representations (knowledge) and the processes that give rise to representations. Genetic explanations of specific domains of behavior may refer either to the mechanisms that generate the representations or to the content of the representations. Van der Lely *et al.* appear to be using evidence of grammatical deficits in SLI as support for a genetically determined deficit in the capacity to construct specific grammatical representations; thus it appears that the genetic claims made by these authors pertain to content deficits. Before

it can be concluded that there are specific aspects of language content that are under specific genetic influence it will also be necessary to have some notion about the neurobiology of grammar; for instance, that we know of a protein or small group of proteins in the brain that plays a necessary and unique role in the development of cortical systems underlying these grammatical representations. After all, the only thing genes do is code for proteins or control the expression of other genes that code for proteins. As proteins are highly conserved in nature, it would seem unlikely that there could even be one new protein in biology that has a special role for language, let alone the number that would probably be necessary for influencing language.

At the present time, it seems far more likely to us that there are genes that do affect the brain systems or mechanisms that serve language. But these will also affect other cognitive functions and representations served by these brain systems. It might be fair to consider these genes as liability genes that will increase the probability that a person will be a poorer language learner. In a similar vein, if we suppose the trait of language learning to be continuous, the genes influencing language could be viewed as quantitative trait loci (QTLs) that, when combined, result in a person having a high level of the trait. It seems far more likely that QTLs will have non-unique, overlapping effects on a wide range of complex behaviors rather than simple discrete effects.

SLI has recently provided a valuable population upon which several very basic questions concerning language and cognitive development have been explored. It is not surprising to find divergent views given the complexity of the problems being addressed and the relatively recent introduction of a still poorly defined clinical condition into this debate. Fortunately, the study of these children for these purposes should benefit both the science of language and cognition and the children who present with these language-learning difficulties.

#### Acknowledgement

This study was supported by clinical research center grant P0-DC-02748 from the National Institute on Deafness and Other Communication Disorders, National Institutes of Health.

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