

# Children with Specific Language Impairment and Their Families: A Future View of Nature Plus Nurture and New Technologies for Comprehensive Language Intervention Strategies

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## **ABSTRACT**

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Future perspectives on children with language impairments are framed from what is known about children with specific language impairment (SLI). A summary of the current state of services is followed by discussion of how these children can be overlooked and misunderstood and consideration of why it is so hard for some children to acquire language when it is effortless for most children. Genetic influences are highlighted, with the suggestion that nature plus nurture should be considered in present as well as future intervention approaches. A nurture perspective highlights the family context of the likelihood of SLI for some of the children. Future models of the causal pathways may provide more specific information to guide gene–treatment decisions, in ways parallel to current personalized medicine approaches. Future treatment options can build on the potential of electronic technologies and social media to provide personalized treatment methods available at a time and place convenient for the person to use as often as desired. The speech-language pathologist could oversee a wide range of treatment options and monitor evidence provided electronically to evaluate progress and plan future treatment steps. Most importantly, future methods can provide lifelong language acquisition activities that maintain the privacy and dignity of persons with language impairment, and in so doing will in turn enhance the effectiveness of speech-language pathologists.

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**Learning Outcomes:** As a result of this activity, the reader will be able to summarize what is known about language impairments of children with specific language impairment (SLI); (2) describe how SLI can be thought of as a family issue; (3) identify key forms of evidence in support of the role of genetics in increasing the risk of SLI; (4) describe at least two criteria for future apps to facilitate language acquisition in persons with SLI.

A good way to begin a discussion of future services for children with language disorders is to consider the current state of services. At school entry, 5 years of age, children in the United States with speech and language disorders are the highest percentage of children (6.4%) identified for special education services in a recent study of 20,100 kindergarten children followed to eighth grade, where identification was defined by teacher report of services.<sup>1</sup> Yet the study documents that children's likelihood of being identified as having speech or language impairments declines steadily over time, whereas the likelihood of being identified as having learning disabilities steadily increases and peaks in fifth grade, after which point it begins to decline. These outcomes can be compared with population-based studies of kindergarten children in which the children are assessed for speech and language abilities. When a large group of 5- to 6-year-old children are given individual language assessments, ~10% of children are behind their age peers in language acquisition, according to an earlier study of children in the United States and replicated in a recent study of children in England.<sup>2,3</sup> In both studies, ~70 to 80% of the cases of language impairment were of unknown origin, in children without intellectual impairments or children without an existing medical diagnosis. At school entry, this is approximately 2 children in a class of 30 children. These are the children I will focus on here, using the label of specific language impairment (SLI), following the definition of the National Institute of Deafness and Communication Disorders: "A language disorder that delays the mastery of language skills in children who have no hearing loss or other developmental delays."<sup>4</sup>

Let me preview some of the main points to follow. Children with SLI are relatively com-

mon in the general population. They are likely to be overlooked for services, perhaps in part because the reasons for their difficulties with language acquisition are likely to be misunderstood. SLI is likely to persist, despite a widespread assumption that children will "outgrow" it. As children with SLI transition into adolescents and adults, they are likely to acquire academic risks and social consequences that make them self-conscious in some settings. There is strong evidence that SLI is likely to be an inherited individual difference. The future brings the possibility of considering the role of nature as well as nurture in planning new forms of language treatments and the opportunity to develop new ways of teaching that allow persons across the full age range of SLI to pursue better grammar and vocabulary while maintaining their personal dignity. Innovative utilization of emerging electronic technologies could provide new teaching methods.

My view of the future is informed by the perspectives acquired from my 30-year program of longitudinal research on children with SLI and their families. My career began as a speech-language practitioner who was fortunate to have young children with SLI on my caseloads, first in school settings and then in a university teaching/research hospital setting. They taught me that I knew very little about the nature of their language impairments and how to teach them. I was then, and continue to be, fascinated by why language acquisition can be so difficult for these youngsters despite our best efforts to teach them and their great motivation to be "good in language." In this article, I rely on the reported research literature as well as on what I know from the data collected, even the data not yet reported, from my ongoing research and in the work of related laboratories. My perspective

is longitudinal, informed by the opportunity to follow people from when they were first seen at 3 or 4 years of age into their late 20s, after completion of their schooling and even as they become parents and their children are included in our study. The study also includes longitudinal documentation of the speech and language acquisition of their siblings as well as the speech and language abilities of their parents. As of this writing the total number of participants is 1164 across 341 families in an ongoing study of single-born children and a parallel longitudinal study of 1,376 twin children ages 2 to 14 years of age and their families.

### **CHILDREN WITH SPECIFIC LANGUAGE IMPAIRMENT CAN BE OVERLOOKED AND MISUNDERSTOOD**

Children with SLI can easily be overlooked. An earlier study of U.S. children reported that only ~25% of children with language impairments receive clinical services.<sup>2</sup> A recent English study found that only 39% of children with language disorder and no known diagnosis were referred to speech-language therapy.<sup>3</sup> Although in the general population speech impairments are unlikely to coexist with language impairments,<sup>5</sup> among children with language impairments, those with speech disorders are more likely to receive therapy for language impairments.<sup>2,3</sup> Furthermore, educational service records in our studies suggest that as children move forward in school they are likely to be dropped from speech-language services early in elementary school only to be later identified as in need of help with reading. Even when help is provided, it is often not enough time or not well integrated into the full scope of a child's communicative needs with peers or in classroom settings.

This is a tough problem for a child. Children without a robust language system are at a distinct disadvantage in their social interactions with other children and in their academic studies.<sup>6</sup> Their peers and adults around them are likely to misinterpret their "immature" language as signs of social immaturity or intellectual limitations, both of which are likely to be inaccurate interpretations.<sup>7,8</sup> It is widely reported that children with language impairments display elevated symptoms of social, emotional, and behavioral problems

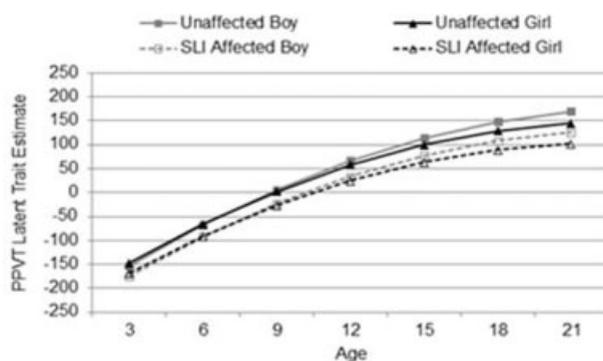
relative to peers and they are likely to be victimized by their peers and less likely to have many friends among their peers in preschool.<sup>3,9-12</sup> Although the reasons for this association are likely to be complex, I lean toward the likelihood that social, emotional, and behavioral traits of a young child can be influenced by limited language abilities.<sup>9,10</sup> This is especially clear when studying children learning English as a second language in the context of a preschool classroom with monolingual English-speaking children.<sup>6,13</sup> The second language learners in this context can also show signs of introversion/shyness, impulsivity, and noncompliance with the classroom rules—behaviors that drop away as they learn the dominant language,<sup>14</sup> suggesting that limited language competencies contribute to social awkwardness.

### **WHY IS IT SO HARD FOR SOME CHILDREN TO ACQUIRE LANGUAGE WHEN IT IS SO EFFORTLESS FOR MOST CHILDREN?**

This question requires consideration of two other questions, one bearing on the nature of language and language acquisition and the other bearing on the differences across children in the wherewithal essential to language acquisition.

#### **What Is Difficult about Language?**

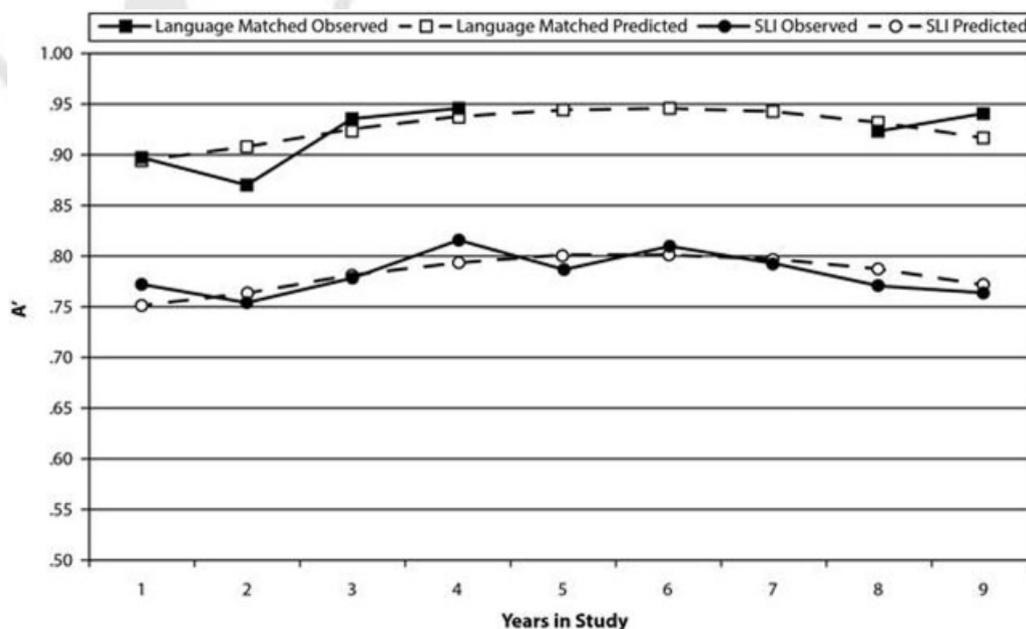
In our longitudinal studies, we have documented how language learning plays out over time for children with SLI. We study multiple dimensions of language. I use two of them here for illustration of a general pattern. Vocabulary development begins at 2 years of age and continues into adulthood. Data from children with and without SLI ages 3 to 21 years are reported in Fig. 1 (Fig. 3 from Rice and Hoffman<sup>15</sup>). You can see that the affected children, with the dotted lines, are at lower vocabulary levels from the beginning but they acquire new vocabulary at the same rate per year as their age peers, yet they do not close the gap because they do not learn new words at a faster rate than the unaffected children. Around 12 years of age, for both groups, the rate of new word learning slows for both groups but the slowing is most evident for girls with SLI. This leaves the



**Figure 1** Effects of specific language impairment (SLI) affectedness and gender on Peabody Picture Vocabulary Test (PPVT) latent trait estimates from final model. (Reprinted with permission from Rice and Hoffman.<sup>15</sup>)

adolescent girls with SLI at a marked disadvantage. This outcome had not been previously reported and is especially significant because adolescent girls with SLI are not likely to be receiving speech-language services, yet it is clear that they should be on the radar of speech-language pathologists.

Another example is the protracted period of time that children with SLI struggle with specific grammar deficits.<sup>16,17</sup> This is evident in their persistent difficulty in judgments of the grammaticality of simple questions with omitted auxiliary BE\* or DO\*.<sup>18</sup> This is shown in Fig. 2 which reports longitudinal data for



**Figure 2** Judgments of grammaticality of affirmative questions with or without auxiliary BE or DO in children with specific language impairment (SLI) and younger language-matched children. (Reprinted with permission from Rice, Hoffman, and Wexler.<sup>18</sup>)

\* BE refers to forms of auxiliary "be" (is, am, are, was, were).  
DO refers to forms of auxiliary "do" (do, does, did).

SLI children ages 7½ to 15 years compared with younger children (language matched at the first time of measurement) ages 5½ to 13 years. In this age range, the younger children know that omitted BE or DO auxiliaries in simple questions are ungrammatical, as expected from their knowledge of the adult grammar. In contrast, the children with SLI persist in judging the questions with omitted BE or DO as grammatical, as expected from what we know about their grammatical deficits. They do not close the gap during this long period. Subsequent data collection in our laboratory documents that this difficulty is robust across children with SLI and persists into adulthood. This means that some fundamental properties of the grammar are not well established for children with SLI all through their adolescence and into adulthood. It is important to note that not all properties of the grammar are difficult for children with SLI, but here we focus on the clinical markers that differentiate affected from unaffected children. Considering these two figures, it is clear that, compared with their age peers, children with SLI, on average, are likely to become young adults with relatively weak language systems, for both vocabulary and grammar acquisition.

### **What Causes These Persistent Differences for Children with Specific Language Impairment?**

We do not have a definitive answer to this question, but there are strong indications of genetic influences that may be unique to language. No single gene has been identified as the cause of language impairments, although a search for candidate genes is very active across multiple laboratories.<sup>19</sup> I have argued that it is likely that the genetic influences will involve regulatory mechanisms that influence gene expression at particular times in children's development, although this would be a complicated causal pathway that will require much more study.<sup>20</sup> Twin studies show high heritability for language impairments that increases with age and that varies according to grammar versus vocabulary.<sup>21,22</sup> Heritability estimates range from 0.26 to 0.60 across the ages of 2 years to adolescence.<sup>23</sup> Twin studies also shed light on the relationship of parental input style and

language acquisition, demonstrating that there are likely to be both child-to-parent effects and shared genetic effects on parent and child.<sup>24</sup> This suggests that parents with high verbal ability may share inherited strengths in language acquisition that influence parent-child verbal interactions and vice versa. This is important given that a child with SLI is likely to have a brother, sister, or parent with SLI or a history of SLI.<sup>25</sup> In our current family studies, we have families with a high proportion of persons (siblings and/or parents) with SLI and families with a low proportion. Most families of children with SLI have at least one other child with SLI and one or more unaffected children. The point is that within the same family, some children can be affected and others are not. This suggests that simplistic views that children's language problems are largely determined by parental behaviors needs to be rejected. Studies are underway to determine if such families have variant forms of genes that contribute to the likelihood of SLI, although there are no definitive findings in hand. Current pedigree studies of stuttering have identified rare variants of genes that account for some, but not all, of the cases.<sup>26</sup> This suggests that, as with stuttering, it is likely that the genetic causes of SLI will involve multiple genes, including rare variants, or gene regulatory pathways.

### **LOOKING INTO THE CRYSTAL BALL FOR GLIMPSES OF THE FUTURE**

#### **Future Models of the Causal Pathways of Specific Language Impairment and Other Forms of Language Impairment**

One reason why the children with SLI are so fascinating is that they do not show other developmental impairments that could complicate the causal pathways. Language impairments seem to be relatively independent of low levels of nonverbal IQ, attention deficit/hyperactivity disorder and autism.<sup>8,27</sup> This can be surprising given that caseloads are likely to include children with overlapping diagnoses, but in studies that evaluate a full range of children it is true, for example, that the

proportion of children with low levels of non-verbal IQ but spared language abilities is actually higher (12%) than children with SLI (8%).<sup>8</sup> I assume that in the not too distant future we will know much more about the genetics of language impairments. We very well might discover the genes involved before we work out how the genes drive the brain development needed for the early appearance of language in young children and the sustained growth of language abilities during childhood into adolescence. There is no doubt that genetic inquiry will persist and ultimately yield information of relevance to families and speech-language practitioners. The time scale for accomplishing this is unknown—it could move quickly or it could take generations.

### **Future Models of Language Intervention**

Future speech-language intervention could be much more driven by causal interpretations than is true at present. Just as medicine is becoming more personalized, with the beginnings of gene-treatment interactions for diseases such as breast cancer, this may be part of the future for enhancing human cognitive abilities. It could be that future language interventionists will require a quick DNA screen for possible genes or gene regulatory systems. Such a screen could provide likelihood estimates of whether a child will outgrow late language emergence at 2 years, or the likelihood that language acquisition will be a persistent challenge throughout adolescence and into adulthood. Such a developmental forecast would be of great value for a family and service providers for designing approaches to language intervention to ensure that an individual child is as well prepared as possible for what will undoubtedly be a world that requires high levels of language and communication skills.

Even now there are important lessons to be drawn from the families of children with SLI. In my laboratory we learn from the parents and other adults in the families that if they have a positive history of SLI as a child, they have clear memories of a sense that somehow they were not as verbally facile as their age peers and that their teachers often interpreted this as a lack of

motivation on their part although there was nothing they wanted more than to be verbally strong (able to win arguments, explain things to the teachers, and be popular with their peers). This childhood difference made them self-conscious especially around unfamiliar people. Not only did they lack the means to advocate for themselves, they did not encounter people who pointed out that language is just very difficult for some people, not because they are not smart enough or social enough or that they do not want to make the effort. The residual consequences persist. As adults, they may avoid highly verbal situations, such as interviews with unfamiliar people, as potentially embarrassing situations. In short, our families are teaching us that it can be hard to maintain one's sense of dignity as a person if the means of quick and well-formulated sentences and word choices are not available.

The family nature of risk for SLI has not been well incorporated into some of the standard clinical practices. Parents may be reluctant to attend school conferences with their child's school team because they remember their own unpleasant experiences in school settings or they fear embarrassment because they do not express themselves well in such settings. Or, if they attend, they may not have much to say, in part because they may not feel comfortable with how readily they can interact with their child's teachers. They may not understand why there is such difficulty with one of their children and not with others. If they are advised to read more to their child or children, they may not reveal they do not read well or do not enjoy the verbal interactions associated with book reading in part as a consequence to their own childhood experiences.

The likely long-term persistence of SLI is also not well incorporated into clinical services that tend to focus on younger children. Note that Figs. 1 and 2 make clear that school-aged children with SLI develop new language skills at the same rate as unaffected children through this period. Yet they do not, on average, close the gap with their age peers because they cannot learn faster than their age peers, and by adolescence they are likely to be dropping further behind. This means that if practitioners define their therapy goals as improvements in

language, the children will meet their goals and may be dismissed as no longer needing language services. The only way to evaluate whether the children are meeting age expectations is to conduct thorough assessments on age-standardized tests prior to dismissal, a time-consuming requirement that may be overlooked. The outcome is that the young child that a practitioner may have helped will nevertheless enter adolescence and adulthood with a very significant academic and social disadvantage due to limited language skills compared with age peers. By this time, the adolescent may be uninterested in language services if not actively avoiding them even if offered.

We need new approaches for language intervention for children, and we may well have new options on the horizon. Given what we now know about children with SLI, we need approaches to treatment that have the following characteristics:

- Applicable to a wide age range, from young children into adulthood
- Designed to evaluate known clinical markers for SLI
- Designed to provide treatment for dimensions of language (i.e., grammar, vocabulary, pragmatic abilities)
- Available on demand per person for private use, as often as desired at convenient times and convenient locations
- Does not require direct supervision by a speech-language pathologist
- Provides immediate documentation of levels of performance to user and to the speech-language pathologist
- Designed for appeal
- Designed for affordability

In sum, such approaches would embed treatment into the everyday lives of persons with SLI or other forms of language impairment, in ways that allow them to maintain their privacy and personal dignity, as personalized language assessment systems as well as personalized language practice systems. The advantages are many. Imagine a world where electronic devices could include brief interactive programs designed to evaluate a person's language abilities and then provide customized language practice activities, and at the

same time transmit data to a speech-language pathologist trained to interpret the data and oversee the overall treatment plan. The usage periods could be easily incorporated into the user's life activities, as sustained or brief, densely repeated or distributed over time, loud or quiet as preferred by the user. Video clips could provide examples of interactive uses of language in social settings. Such programs could be helpful to second language learners; persons with language impairments, customized for different age levels; and persons recovering from a stroke or other illnesses that impair language functioning. The programs could be implemented via interaction with talking avatars in various guises suitable to the user. Such systems could provide quick and accurate summaries of a person's performance and thereby provide an immediate feedback loop.

Electronic social media may provide more opportunities for persons with language impairments to communicate with each other about the many issues that arise in their lives as a consequence of persistent language impairments. Social media may become more incorporated in the services provided by practitioners in addition or supplemental to the long-distance service delivery systems that are emerging. There are some hints that these systems may be emerging but are not yet thought of as an integral part of intervention approaches, although they certainly could be.

Under these changes the models for service provision will change. One possible change is to focus on the family as the context for a child with language impairments. For example, if a child with SLI has a mother or father with a history of SLI, there may also be a risk of reading impairments in the family. The widespread practice to recommend to a mother to read more often to her child with SLI may be insensitive to why some mothers may find this difficult to do. Or recommendations to a mother to talk often with her child may be insensitive to why she is not a naturally talkative person. It may become best practice in the future to gather information about the family members as well as an individual child to develop a collaborative plan of intervention that works well for all.

A family perspective can also play out in planning for electronic service delivery systems for private language assessments and private language practice sessions as well as communications among family members.

## CONCLUSION

In the present, there is no longer good reason to regard nature and nurture as opposing forces when considering the causes of unexplained individual differences in children's language acquisition, such as those children with SLI who fall behind their peers. Instead, we can incorporate what is known into a comprehensive perspective that regards a child with SLI as a member of a family where other members of the family may have a similar history that was likely overlooked for speech-language pathology services. We can advocate for inclusion of children with SLI and other children with language impairments in caseloads of speech-language pathologists. We can aim to honor the privacy and dignity of adolescents and adults, especially, with histories of SLI or current undiagnosed language impairments that warrant language intervention services.

The future portends great advances in the kinds of language intervention approaches that become available as we learn how to harness the potential of electronic communication devices. We can expand the effectiveness of speech-language therapy beyond the physical boundaries and time constraints of office and schools and into the daily lives of persons with language impairments. We can expand our sense of who needs language intervention from the world of young children to include the lifespan of persons with SLI. Overall, we can embrace a future with exciting new possibilities that will enhance our effectiveness as practitioners.

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