Specific Language Impairment, Nonverbal IQ, ADHD, ASD, Cochlear Implants, Bilingualism and Dialectal Variants: Defining the boundaries, clarifying clinical conditions and sorting out causes

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Abstract

Purpose: The purpose of this paper is to provide an overview of a collection of invited papers on the topic "Specific Language Impairment (SLI) in Children with Concomitant Health Conditions or Nonmainstream Language Backgrounds." Topics include SLI, Attention Deficit/Hyperactivity Disorder (ADHD), Autism Spectrum Disorder (ASD), Cochlear Implants (CI), Bilingualism and Dialectal language learning contexts.

Method: The topic is timely due to current debates about the diagnosis of SLI. An overarching comparative conceptual framework is provided for comparisons of SLI to other clinical conditions. Comparisons of SLI in children with low normal or normal nonverbal IQ illustrate the unexpected outcomes of 2 X 2 comparison designs.

Results: Comparative studies reveal unexpected relationships among speech, language, cognitive and social dimensions of children's development, as well as precise ways to identify children with SLI who are bilingual or dialect speakers.

Conclusions: The diagnosis of SLI is essential for elucidating possible causal pathways of language impairments, risks for language impairments, assessments for identification of language impairments, linguistic dimensions of language impairments, and long-term outcomes. Although children's language acquisition is robust under high levels of risk, unexplained individual variations in language acquisition lead to persistent language impairments.

Although there is an extensive and robust research literature about children with Specific Language Impairment (SLI) (Leonard, 2014) https://www.nidcd.nih.gov/health/voice/Pages/specific-language-impairment.aspx), there is more work to be done: The causes of SLI are not yet identified; clinical symptomology is not mapped in detail across the full life span from toddlers to adulthood; and there are recurrent debates about how the condition of SLI is to be characterized in comparison to other forms of language impairment in children, or other conditions of language learning that could be confused with SLI. One potentially informative scientific approach is to compare children who meet the diagnostic standards of SLI with other groups of children with related developmental disorders (Rice, Warren, & Betz, 2005). Another approach is to compare children with SLI who do or do not speak dialectal variants of a conventional language or are learning multiple languages. Such comparative studies have been relatively sparse and widely distributed in the literature, making it more difficult to appreciate how the comparative approach can yield valuable and unique insights into unexplained individual variations in language acquisition.

The purpose of this paper is to provide an overview of a collection of invited papers on the topic “SLI in Children with Concomitant Health Conditions or Nonmainstream Language Backgrounds.” The papers were first presented at the ASHA Research Forum at the National Convention in November, 2014. The authors were invited to report on research underway in studies of children with Attention Deficit/Hyperactivity Disorder (ADHD), Autism Spectrum Disorder (ASD), cochlear

implants (CI), bilingualism and dialectal language learning contexts, and to highlight comparisons to children with SLI.

To establish a broader context for the set of papers, this overview begins with a brief summary of current controversies about the SLI diagnosis relative to a more general diagnosis of Language Impairment (LI). The overarching rationale has two interrelated themes: One is that well-motivated group comparisons may contribute new insights about the nature of SLI and the second is the converse-- comparisons with SLI can inform a more general notion of language impairment. A conceptual schema is proposed for interpreting the research designs and outcomes of clinical group comparative studies, introduced by an example of how the schema plays out for consideration of the relationship of nonverbal intelligence and language impairments in children, followed by a summary of the group comparative outcomes reported in each of the papers in the forum as they relate to the overall interpretive schema. The conclusion is that such group comparisons provide valuable clarifications about diagnostic methods, potential causal pathways, and methods of sorting out interrelationships among linguistic, cognitive, social, and academic achievement in children's development. Overall, the comparative design reveals valuable information about each group that is difficult to obtain by studying just one group. Cumulatively, the comparisons highlight the clinical and research value for the diagnosis of SLI as a pathway for improved understanding of the nature of language impairments in children.

SLI and LI in the wake of DSM-V

There is a long tradition of scientific debate about diagnostic labels for developmental clinical conditions. Language impairments of children are caught in the

cross-hairs of these debates because language impairments can be co-morbid with other developmental disorders or may be the only clinically significant developmental disorder or may be erroneously confused with other conditions of language learning, such as bilingualism. The interrelationships among children's language acquisition, cognitive, social, and academic development are intertwined and complex and interactions among these developmental outcomes vary over childhood.

The recurring debate about the integrity of SLI as a diagnostic entity and language impairments in general has recently flared up. The trigger for current debate was a new edition of the Diagnostic and Statistical Manual of Mental Disorders, DSM-5, published by the American Psychiatric Association in 2014 (*Diagnostic and Statistical Manual of Mental Disorders*, 2013). This 5th edition defines Language Disorder (LD) as "persistent difficulties in the acquisition and use of language across modalities (i.e. spoken, written, sign language or other) due to deficits in comprehension or production" and language abilities that are "substantially and quantifiably" below age expectations." (p. 42). This definition is applicable across a wide range of conditions in which language disorder can appear, including children who are deaf or hard of hearing, or who have Autism Spectrum Disorder (ASD), Attention Deficit/Hyperactivity Disorder (ADHD), or other neurological conditions such as cerebral palsy or traumatic brain injury. Although these co-occurring conditions appear in children, the most common form of language impairment in children is SLI, great than the estimated prevalence of ASD and ADHD combined (Redmond, in press). The National Institute on Deafness and Other Communication Disorders (NIDCD) defines SLI as "a language disorder that delays the mastery of language skills in children who have no hearing loss or other

developmental delays…is also called developmental language disorder, language delay, or developmental dysphasia…is one of the most common childhood learning disabilities, affecting approximately 7-8 percent of children in kindergarten…impact persists into adulthood." (http://www.nidcd.nih.gov/health/voice/pages/specific-language-impairment.aspx).

Several elements of DSM-5 inspired follow-up debate. One involved a new definition of ASD that adjusted the diagnostic criteria from the DSM-IV (*DSM-IV: Diagnostic and statistic manual of mental disorders*, 1994) in several ways. In DSM-IV, spoken language impairment was included as a diagnostic criterion for ASD. In DSM-5, a diagnosis of language disorder (LD) appears in the section on Communication Disorders and is independent of the ASD diagnosis. Instead, ASD diagnostic criteria include "persistent deficits in social communication and social interaction across multiple contexts," terminologically shortened to "Social Communication Impairments (SCI)." Nonverbal communications in social contexts are highlighted as central to diagnosis of ASD, whereas the definition of LD as a Communication Disorder stipulates deficits in vocabulary, grammar, and morphology as well as impairments in discourse. The section on Communication Disorders in DSM-5 also includes the diagnosis of Social (Pragmatic) Disorder (SPD), which excludes other medical or neurological conditions, and low abilities in the domains of word structure or grammar (i.e., LD) and ASD. Perhaps it is not surprising that there have been ensuing debates about how to differentiate LD, (Paul, 2013) SPD, and SCI, and discussions of how to bring the new diagnostic groupings into third party payment systems (Paul, 2013) (McCarty, 2013). In the interest of full disclosure, I served as an advisor to the Neurodevelopmental

Disorders Work Group for DMS-5, as reported in the manual. In that capacity I worked on a panel charged with the development of the categories for communication disorders. Advisors signed confidentiality agreements as part of the process.

In the process of vetting potential changes in the DSM-5 there was a public commentary period in June 2012 to inform the final decision-making process. A preliminary version of the LD section of the DSM-5 included the diagnosis of SLI as a "specifier" or possible sub-group within the over-arching LD category. Ultimately, after a commentary period, the category of SLI was not included in the DSM-5, and there were no sub-groups listed under the LD category, although one of the exclusionary criteria is "…are not better explained by intellectual disability (intellectual developmental disorder) or global developmental delay." (p. 42). The omission of SLI from the DSM-5 was one of the focal points for an ensuing debate about the value of the SLI diagnosis, a debate that appeared in a special issue of a scientific journal, comprised of a collection of two invited review papers, invited commentaries (including one by me) and a summary paper published in 2014 (Bishop, 2014; Ebbels, 2014; Reilly, Bishop, & Tomblin, 2014; Reilly, Tomblin, et al., 2014).

Among the issues raised in the papers and commentaries is the extent to which language impairment arises in a "specific" way, i.e. without other developmental delays or weaknesses. Intrinsic to this issue is a bit of a technical dispute having to do with the definition of where to draw the boundary between "typical" or "sufficient" nonverbal IQ for language acquisition for the purpose of an SLI diagnosis. Conventionally, this has been defined as an exclusionary criterion of a nonverbal IQ of 85 or above for the SLI group, in order to avoid confounds created by intellectual deficits as part of the causal

pathway. The unresolved question is whether to expand the lower level to include children with levels of nonverbal IQ as low as 70 or below, thereby introducing greater variability within the group of children with language impairments (note that the nonverbal IQ range in the affected group could be as large as 70-140 under this definition). One conclusion is that there are no interesting language differences between groups defined according to the conventional criterion and the expanded criterion (Reilly, Tomblin, et al., 2014). This working conclusion is part of the support for a general term such as Language Impairment or Language Disorders (as in DSM-5), which would be applied to a very broad range of children. However, this conclusion overlooks important counter-evidence to be examined in more detail in the following section.

When viewed from the broader perspective of scientific logic, this paper and the papers to follow in the forum collection explore in more detail the outcomes of comparisons across four groups of children: With and without SLI, with and without other conditions that could impact language acquisition. The discussion in this paper begins with the comparison of children with and without SLI and children with and without low levels of nonverbal intelligence (although not in the lowest range of "intellectual developmental disorder"), as an example of how such comparisons can be informative when considering the full set of possible comparisons as a conceptual schema. This interpretive framework will be extended to consideration of other group comparisons included in the collection of papers.

SLI and nonverbal intelligence

A distinction between verbal and nonverbal intelligence is ingrained in psychometric evaluation of human intelligence, with widespread use of “Verbal IQ” and “Nonverbal IQ” estimates (Wechsler, 1991). Although the distinction is commonly accepted, the existence of independent relationships is not as well understood when we consider children with language impairments. It is often assumed that language impairments in children are caused by low levels of general cognitive ability, as shown in a study of kindergarten teachers, female adults of comparable educational backgrounds although not educators, undergraduate students, and speech-language pathologists (Rice, Hadley, & Alexander, 1993). Each group, on average, when listening to samples of children’s speech rated a child with language impairments as less intelligent than a child without language impairments, although the samples were from children with typical or above levels of nonverbal intelligence. A follow up study replicated the results (DeThorne & Watkins, 2001). This assumption, while widespread, is not always accurate. The scientific literature includes well-documented counter examples of children with clinically low levels of nonverbal IQ who nevertheless have high levels of linguistic ability (Cromer, 2014; Smith & Tsimpli, 1995(Yamada, 1990)), although it is generally assumed that such aberrations from expectations are rare.

In the context of current debates about SLI, the issue regarding nonverbal intelligence focuses on the exclusionary criteria used to rule out intellectual impairment in children diagnosed as SLI. The open debate is whether the general diagnosis of LD, as in the DSM-5, regardless of levels of nonverbal intelligence, is preferred for clinical and research purposes (Reilly, Bishop, et al., 2014). One source of relevant scientific evidence compares two groups of children with language impairments (without other

clinically significant developmental disabilities): those with nonverbal IQs of 71-84 (defined as “Borderline Intellectual Functioning in DSM-IV, p. 684) vs those with nonverbal IQs 85 and higher. The widely accepted empirical generalization is that children with lower levels of nonverbal IQ tend to score somewhat lower on standardized tests than children with nonverbal IQs 85 and higher (J.B. Tomblin & Nippold, 2014), a tendency that persists over childhood and across different dimensions of language. Although informative, this observation focuses only on the statistically significant (although not definitive) associative relationship between nonverbal intelligence and language impairments and overlooks other possible outcomes that are crucial parts of the full picture.

Consideration of the full range of developmental outcomes indicates a need to consider non-associative, independent relationships between language acquisition and levels of nonverbal intelligence. Evidence from an NIDCD commissioned epidemiologically ascertained study of children with SLI provides such a perspective (J. B. Tomblin, Smith, & Zhang, 1997). The study assessed an epidemiologically ascertained socio-demographically diverse sample of 5-year-old kindergarten children in the U.S. The collected data included direct assessments of language, speech, and nonverbal intelligence. The criteria for nonverbal IQ for children with SLI was 85 or above on the Block Design and Picture completion subtests of the Wechsler Preschool and Primary Scale of Intelligence-Revised, known as the short form of the scale (Wechsler, 1989). Language impairment was defined by performance on selected subtests of the Test of Language Development-2:P (TOLD-2:P) (Newcomer & Hammill, 1988) and a narrative story task involving narrative comprehension and narrative

production (Culatta, Page, & Ellis, 1983). The criterion of -1.25 *SD* on a multidimensional diagnostic system score was found to be similar to a unidimensional diagnostic system using a single composite language score (derived from the set of 5 marginal language measures) which yielded a cut-off point of -1.14 SD, or roughly between the 10th and 15th percentiles, or a standard score of approximately 80 ((Tomblin, Records, & Zhang, 1996)J. B. Tomblin, Records, et al., 1997). Speech delay was defined as clinically low performance on the Word Articulation subtest of the TOLD-2:P validated to conversational speech samples (Shriberg, Tomblin, & McSweeny, 1999).

The results were reported as the proportion of children in typical or above levels of performance vs low levels of performance on the two dimensions of development, language and nonverbal cognition, using 85 standard score as the cut point for nonverbal IQ and approximately 80 standard score as the cut level for language. The four cells are displayed in Table 1. The typically developing children are in the upper left quadrant, with typical or higher levels of language acquisition and nonverbal IQ estimates; the lower left quadrant corresponds to the children with a conventional definition of SLI; the lower right quadrant includes a low/low group labeled “nonspecific language impairment” (NLI); and the upper right quadrant is for children with low nonverbal IQ and typical or higher levels of language acquisition, labelled as “Low Cognition” (LC). The percentage of children per cell are reported as 75% typically developing, 8.1% SLI, 5% NLI, and, rather surprisingly, 11.9% as LC (Shriberg et al., 1999) (Rice, Tomblin, Hoffman, Richman, & Marquis, 2004). The prevalence of children who have what could be called “spared language,” in spite of a nonverbal IQ in the

borderline range, is equivalent to or perhaps higher than the estimated prevalence of children with SLI!

The LC group, overlooked in the literature, deserves further consideration. These youngsters can be difficult to identify, because their low levels of nonverbal intelligence can be masked by their high verbal abilities, especially if no other neurodevelopmental disorders are apparent. They seldom appear in the scientific literature or in diagnostic systems. Without direct assessments of all children, with and without language impairments, these youngsters go undetected. Also note that when our studies focus on children with language impairments, the designs involve the other three cells and leave out the relatively large group of children (11.9%) who fall into this quadrant. Thus, extensive discussions of the nature of language impairments and the relationship of nonverbal IQ to language acquisition and language impairments can overlook or fail to account for the existence of this group.

The LC group can be dropped from longitudinal follow-up assessments (and therefore do not appear in analyses of predictors of long term outcomes) because their initial performance levels on language assessments are in the range of typical or above, and yet their low nonverbal intelligence levels exclude them from the control sample of "typical language" children. For example, in a follow up longitudinal study of the acquisition of grammatical tense marking this group was not included because their performance level was as high as the typically developing kindergarten children at the first time of assessment (Rice et al., 2004). By five years this group of children had mastered a property of the grammar that was very difficult for the SLI group. The group mean percentages correct for tense-marking are reported in Table 1. The means on the

grammatical tense marker test for the typical control group and the LC group did not statistically differ. Interestingly, children in the LC group had nonverbal IQs as low as 64 and flawless performance on the grammar task, similar to children in the control group. The SLI group score was statistically significantly higher than that of the NLI group, although with a small effect size. This group difference played out in the subsequent longitudinal data that demonstrated that at a detailed level of linguistic measurement, evaluating how the children mastered irregular past tense verb morphology, the two groups differed in their levels of performance over time (with lower performance by the NLI group). In addition to the quantitative differences, there were qualitative differences in the errors they made. The children in the NLI group persisted in an immature pattern of lower levels of performance in 1st, 2nd, and 3rd grade relative to the SLI group. When they were in 1st, 2nd, and 3rd grade they made grammatical errors unlike the children in the SLI group, indicating a more protracted learning of the morpho-phonological requirements of past tense irregular morphology. If the two groups had been collapsed into one LD group, this qualitative difference would have been obscured, as would the quantitative difference. Further, the exclusion of the LC group leaves completely out of the picture the real possibility that a group equivalent to the NLI group in nonverbal IQ would have performed at ceiling levels similar to the control group.

The group comparisons also clarify that children's grammar outcomes differed from the speech outcomes. Also reported in Table 1 is the proportion of children with SD (Shriberg et al., 1999); for the purpose of this presentation the data are collapsed across boys and girls (although there are clear sex differences). The distribution of SD

across the cells shows that at this age most children have age-appropriate speech production (98.2%), and the co-morbidity of SD with LI, collapsing across the SLI and NLI cells, is very low, 1.3% (0.51% with SLI). Essentially, SD and LI outcomes are orthogonal, which is not at all apparent in speech pathology practitioners' caseloads, which are predominately filled with children who have speech impairments or comorbid speech and language impairments, perhaps because children with speech disorders with limited intelligibility are more likely to be identified and referred for services (Zhang & Tomblin, 2000).

Comparisons of the distributions across the four cells inform our understanding of possible causal relationships. Although the performance of the NLI group suggests that low levels of nonverbal intelligence shares a causal pathway for SLI, this conclusion is undermined by the performance of the 12% of children in the LC group. Combined with the outcomes of the SLI group, the conclusion is that lower levels of nonverbal intelligence in this borderline range are neither necessary or sufficient for language impairment and therefore not likely to share a core causal pathway. This does not rule out an apparent potential additive effect if both conditions are present. Further, the patterns of group distribution for the tense marking measure in kindergarten clearly show that children with low levels of nonverbal intelligence can nevertheless show unexpected typical development in this part of the grammar, an asset that will make them appear more mature to their teachers and other adults than children with SLI. Collectively, the outcomes are not supportive of 1) a strong causal model positing low levels of nonverbal IQ as the driver for language impairments in children, and 2) characterizations of no meaningful differences between the SLI and NLI groups. It is

also clear that there is not a common causal pathway for speech and language impairments in children, an independence obscured by selection bias in clinical caseload (Zhang & Tomblin, 2000).

We are left with not one but two related causal questions: 1) What factors cause language impairments in children? 2) How do children with low levels of nonverbal intelligence nevertheless acquire formal properties of the grammar (such as tense marking) as quickly as typically developing children, without any special training? In effect, how do they avoid language impairments? A crucial test for any putative causal model will be how to answer both questions.

The logic of the comparisons illustrated in Table 1 has motivated other investigations of potential causal pathways for language impairments, most notably in studies of possible memory impairments of children with LI. For example, a study of 400 school-age children reported that approximately equal numbers of children were identified with specific impairments in either language or working memory (Archibald & Joaanisse, 2009). The interpretation is that working memory impairments do not always cause SLI and vice versa, although there may be an additive effect such that the combination leads to lower levels of performance on assessments. In effect, the existence of the unexpected group, the children with impairments of working memory but without language impairments, is a key piece of evidence that can be missed when studies are limited to comparisons of typically developing children and children with language impairments. The authors conclude that the specificity of groupings suggest an additive rather than a unidirectional causal pathway, a conclusion that would not

have been discovered if the group of children with working memory impairments without language impairments had been excluded from the study.

To recap, the perspective provided by a 2 X 2 contingency table sheds light on an often overlooked outcome cell in investigations of children with SLI, suggesting a need to consider 1) independent causal pathways for linguistic and nonverbal IQ outcomes, particularly in the domain of grammar; 2) independent causal pathways for speech impairments vs language impairments; 3) independent causal pathways for working memory impairments vs language impairments; and 4) whether an LD category can obscure clinically significant differences for children in the "borderline IQ" group vs children in the normal and above range of nonverbal intelligence.

SLI compared to ADHD, ASD, CI, Bilingualism and Bidialectalism

The contingency table framework of Table 1 can serve as a template for an overview of the papers to follow in the forum, comparing SLI to other conditions of language acquisition, as depicted in Figure 1. The use of this framework does not imply that the group comparisons to follow are obtained from population-based studies such as the example in Table 1. Instead, the state of the research is more in line with the example of the SLI and working memory study example above (Archibald & Joaanisse, 2009), in the form of experimental studies of selected groups of children. Recent research outcomes yield five comparison groups of interest: Children with ADHD, children with ASD, children who receive cochlear implants, children who are bilingual, and children who speak non-standard dialects. The first two comparisons, SLI/ADHD or SLI/ASD, are examples of co-morbid conditions that allow for examination of shared or non-shared symptoms and possible causal pathways. Comparison of SLI with

children who receive cochlear implants has not been highlighted in previous studies, but it will be suggested here that the outcomes of current investigations point toward possible differences in language acquisition abilities among children with CI that could be consistent with an SLI kind of phenomenon. The final two comparisons, SLI/bilingualism and SLI/dialectal differences, are essential for the identification of appropriate forms of linguistic measurement in order to detect children with SLI who are bilingual or bi-dialectal, as well as the determination of whether bilingualism adds to the linguistic burdens of children with SLI.

For the purpose of this overview, the comparisons can be summarized as a series of 2 X 2 designs with four cells of interest (Figure 1). Consider the cells identified as “A”, “B,” “C,” or “D” in terms of the possible scientific value of group comparisons. For example, children who have concurrent diagnostic categories (cell A) can be compared with children who do not have language impairments (cell C) to determine, for example, if children who are ADHD who also present with SLI are similar to children who are ADHD but without SLI in their performance on tasks thought to be on the causal pathway for SLI. If A= C and A $\neq B$ it would suggest causal pathways contributing to ADHD but not SLI. Another example is from investigations of children who are dialect speakers, with SLI (cell A) compared to a group without SLI (Cell C). If there is no difference between the groups in the use of certain grammar features (A=C) and there is a difference between children with SLI and a dialect compared to SLI children without the dialectal difference (A$\neq B$), it would suggest that the dialectal variant is the common element and this variant is not diagnostic of SLI. Investigation of children with SLI without ADHD, Autism, CI, Bilingualism, or Dialect (cell B) makes it

possible to identify language-specific symptoms without the possible confounding factors found in the more inclusive diagnostic grouping of “language disorders” across other diagnostic or linguistic categories. Another example is the case of children with cochlear implants (CI) who can be compared to children in cell D (typically developing children) to determine if the provision of a CI leads to typical language outcomes in young children. If some of the children with CIs are different from children in cell D then a next step could be comparison to children in cell B to determine if the children who do not achieve typical language outcomes share some linguistic features with children with SLI. As these examples suggest, there are multiplicative ways in which planned comparisons across groups of children as illustrated in Figure 1 can be informative about characteristics of language impairment in children and possible shared features or characteristics that can be clinically informative as well as illuminating about causal pathways.

Collectively, the papers in the forum highlight the value of differentiating across clinical conditions and across language learning conditions. In particular, such comparisons uncover the distinctiveness of language, social, and cognitive dimensions of child development in patterns of relative strengths and weaknesses in groupings across the four possible cells. Here are brief previews of the papers that follow.

ADHD and SLI: In a paper by Sean Redmond (Redmond, in press), he summarizes his program of investigation comparing children with SLI and ADHD. His studies are with monolingual children in elementary school, ages 7- to -8 years and screened to meet an exclusionary criteria of nonverbal IQs of 80 or above, normal hearing ability and speech ability to produce grammatical morphemes (Redmond,

Thompson, & Goldstein, 2011). He begins with the need to adjust for confounds in assessment, by noting that conventional assessments of ADHD include language-associated items, such as “does not seem to listen to what is being said to them.” He also notes the need to adjust for situational effects, which could erroneously attribute a trait of ADHD to a child whose presumed ADHD symptoms are situational. The DSM-5 includes this new standard in the criteria for ADHD, insuring that ADHD symptoms need to be present in non-academic settings. With these standards for assessment of ADHD in place he reports on comparative studies following the design of Figure 1. Comparisons of linguistic dimensions of performance across the groups reveal that for grammatical tense marking, both the ADHD-only group (C) and the control group (D) were at ceiling levels of performance and both were higher than the SLI-only group (B). On a sentence recall evaluation, the ADHD-only group (C) and the control group (D) were equivalent whereas the SLI-only group (B) performed at lower levels, a pattern that held for measures of non-word repetition and comprehension and production of narratives. In other words, the children with SLI-only showed signs of language impairment and the ADHD-only group did not. There was no indication of possible additive effects of SLI and ADHD, i.e., group B (SLI-only) was equivalent to group A (SLI + ADHD) on language assessment, and on sentence recall there was even a possible protective effect, SLI-only < ADHD + SLI.

Other comparisons offer insights into probable causal pathways by examining contingencies across groups for indices of possible processing breakdowns contributing to SLI. For measures of processing speed and temporal processing, the group with SLI-only (Group B) performed better than the group with ADHD-only (Group C) although

the group with ADHD-only performed higher on language assessments (Cardy, Tannock, Johnson, & Johnson, 2010)! These outcomes are inconsistent with a model that posits limitations in processing speed and temporal processing as contributors to language impairment, and instead suggests that such limitations are not sufficient for language impairment. It raises the possibility that attention rather than language was a factor in low performance on the assessments.

Other outcomes point to possible protective elements of ADHD (Sciberras et al., 2014). The most likely group to receive speech services were children with ADHD + SLI (group A), with a reduced likelihood for children with SLI only (group C). This could be because of the salience of the ADHD symptomology and the bias in referrals within service settings, particularly in the schools, perhaps an echo of the earlier data showing that speech impairments were salient for clinical services, as well. Further, the ADHD-only children (group C) had a lower risk for bullying by peers than did the children with SLI-only (group B) who were at highest risk. Such outcomes highlight the risk that children with SLI go undetected for services and at the same time are identified by their peers as vulnerable socially and likely to be bullied. Overall, this pattern of outcomes would not have been detectable without the full 2 X 2 contingency design.

ASD and SLI: In a paper by Helen Tager-Flusberg (Tager-Flusberg, in press), she summarizes studies of infants who have older siblings with ASD, with a particular emphasis on risk factors associated with language impairments. These outcomes she compares to the literature on SLI. In these studies of the early developmental period (birth to 3 years) and the definition of ASD that includes possible comorbidity of intellectual impairments, exclusionary criteria for nonverbal IQ are not invoked.

Although SLI symptoms can be present in children of this age range it can be difficult to identify given the exclusionary criteria and the wide variation in language acquisition evident in typically developing children. In the framework of the 2 X 2 contingency table, this program of investigation can be regarded as ultimately identifying the risk for outcomes across the four cells, in children old enough to be diagnosed. Toward that end, she notes that the risk factors for ASD-only (theoretically, cell C) are also found in studies of risk for SLI (theoretically, cell B). These factors include sex (male), a positive family history of delayed language onset or language impairments, delayed gesture or motor developments in infancy, and neural factors such as atypical brain lateralization for speech production. She also notes that more research is needed for the early pre-clinical identification stages of SLI, during the infancy and toddler period of development. ASD is identified earlier than SLI.

I note that she emphasizes the high risk for younger siblings to be subsequently diagnosed as ASD, reporting that 20% of high risk infants (younger siblings of children with ASD), or 1 out of 5, are subsequently diagnosed. In the SLI literature, it is reported in a population sample of 24-month-old children that 20% of children who were identified with Late Language Emergence (LLE) at 24 months were subsequently identified as SLI at 7 years (Rice, Taylor, & Zubrick, 2008) (Taylor, Zubrick, & Rice, 2013). In the SLI literature this level of risk can be regarded as equivocal. Some scholars argue for caution; they focus on the 80% who do not show SLI at later assessments, and advocate a “wait and see” approach (Dollaghan, 2013), whereas in the ASD literature the 20% is considered a strong indicator of risk that warrants clinical attention. Why the 20% is considered of high diagnostic import for the ASD research

community and of low diagnostic import for some scholars in the SLI research community is not clear. My inclination is to align with the interpretation of the ASD scholars.

The impact of the DSM-5 changes will affect comparisons of SLI and ASD, although it does not rule them out. Under the new diagnostic system the diagnosis of LD is excluded if the language disorder is "better explained by intellectual disability" and intellectual disorder is neither an inclusionary or exclusionary criterion for ASD. Intellectual impairments and language impairments are described as "Associated Features Supporting Diagnosis" for ASD. This suggests that studies following the design that Redmond used in comparing ADHD and SLI could be done for comparisons of ASD and SLI, although the samples would need to be selected in ways to avoid confounds with intellectual impairments and other possible assessment complications caused by severe speech problems or other associated features. These comparative studies could further explore potential causal pathways, as well as linguistic markers in SLI, ASD, and SLI + ASD to determine if the linguistic vulnerabilities are similar or different across conditions or if the risk indicators are shared across conditions and linguistic dimensions (Rice et al., 2005). This approach is also possible for children with Fragile X (Sterling, Rice, & Warren, 2012) or Down Syndrome (Caselli, Monaco, Trasciani, & Vicari, 2008; Eadie, Fey, Douglas, & Parsons, 2002).

CI/SLI: The longitudinal language outcomes of young children with CIs reveal unexplained individual differences in outcomes that bring to mind longitudinal outcomes for children with SLI. The paper included in this collection did not include explicit comparisons of children with CIs and children with SLI. In my summary here I frame the

results in the context of the 2 X 2 design framework to suggest possible advantages for pursuing the comparisons more formally.

In her paper, Ann Geers and colleagues (Geers, Nicholas, Tobey, Davidson, & in press) report on a longitudinal study of children who received a CI at a young age. Candidate participants were excluded if there was evidence of previously normal hearing or a progressive loss, below-average nonverbal learning abilities as tested in preschool, or language use other than English in the home. The longitudinal outcomes yielded three groups of children: 1) normal language emergence (about 30% of the sample), 2) late language emergence (about 30%), and 3) persistent language delay (about 30%), based on test scores at 4.5 and 10.5 years. Characteristics of the CI predicted outcomes. As expected, receiving a CI at a younger age increased the likelihood of normal language emergence following implant, although it did not predict whether a child with late language emergence showed a persistent language delay. Worse audibility for speech increased the likelihood of persistent vs resolving language delay. Bilateral CI use increased the likelihood of normal language emergence.

I wish to highlight two very interesting questions: 1) By what means do children with early limited exposure to verbal language input “catch up” to age peers by 4-5 years? 2) Why do some children not benefit from CIs to the extent other children do, when all related factors are similar? The first question points toward the robustness of language acquisition mechanisms when children are young. It is impressive that young children are able to overcome the challenges of significant degrades of auditory input early on and actually acquire language faster than the rate of hearing peers in order to catch up and then level off at the expected rate of acquisition following that period of

rapid change. Clearly, there is both plasticity in language acquisition mechanisms as well as an "overdrive" capacity that enables catch up. It is as if the acquisition mechanisms are primed at the early period of development and able to accelerate to make up for lost time when input is provided. This is not to say that the quality of input is unimportant; Geers and colleagues report that children with persistent language development had less access to soft speech than those whose early language delay recovered over time. The point here is that all of the children with CI had an early period of very limited input compared to hearing children, and about 2/3 of them caught up to hearing peers in their language acquisition. The phenomenon of "catch up" brings to mind the similar "overdrive" evident in toddlers with Late Language Emergence (LLE), 80% of whom overcome a delayed onset by 7 years (Rice et al., 2008). Yet it is also clear that the period in which the priming is available begins to fade relatively soon, well before 10 years although precise documentation is yet to be determined.

The second question points toward unknown sources of individual variation across children during the priming period and after. Roughly 1/3 of the children with CIs show persist language impairment to age 10.5 years. One possibility that comes to mind is that there could be unexplained individual differences in language acquisition aptitude, similar to SLI, which could combine with early hearing impairment to create additive risk effects for language acquisition subsequent to a CI. If so, how could this be determined? At this early stage of investigation into CI effects on language acquisition of young children, the full range of possible designs in terms of the 2 X 2 contingency table has not yet been explored but such an approach is likely to be informative. The available studies have examined children with CIs whose possible SLI

status is unknown, i.e., potentially in cells A or C, compared with hearing children's age-benchmarked language milestones (cell D). Comparisons of children with SLI who do not have hearing impairments or a CI (cell B) could be a valuable design addition. As in the comparison of ASD and SLI, better means of early clinical identification of children with SLI, in the toddler age period, would facilitate the comparisons of children with CIs with and without SLI.

Bilingualism/SLI: Most of the world's children grow up speaking more than one language. In the context of clinical services for children with language impairments it can be difficult to differentiate between the effects of learning language as a second language vs being late learning a native language, particularly if normative data is not available for the child's first language. Johanne Paradis (Paradis, in press) addresses this issue in her review of studies of English Language Learners (ELL) with and without language impairment (LI), thereby addressing cells A and C, as well as cell D, occupied in this case by monolingual typically developing children. In the studies she reviews, the participants are screened for nonverbal IQ levels to rule out intellectual impairments, yielding a broad range of nonverbal IQ across participants (for example, 73-136 as reported in an earlier paper by Paradis (Paradis, 2011)). She concludes that ELLS take longer than 3 years to converge on monolingual norms, and approach monolingual norms asynchronously across linguistic sub-domains. ELLs with LI acquire English more slowly than ELLS with TD. She further reveals other details of how ELL children and SLI children follow distinctive developmental language trajectories. Linguistic subdomains yield important differences. Morphological and non-word repetition abilities differentiate them most. Within their morphosyntax, ELL children are prone to particular

errors not documented in children with SLI. In contrast, ELL children have relative strengths in narrative uses of English; their story-telling abilities benefit from their general conceptual development as well as their underlying native language skills. Children's native language similarities and differences relative to English also matter in the details of how they acquire English, a conclusion that holds across children with and without SLI. Paradis highlights the need for assessment measures that apply across different languages, and reports that parent questionnaires on first language development and ELL norm-referencing (such as the Alberta Language Development Questionnaire (ALDeQ)) can result in accurate discrimination of ELLS with LI.

In addition to studies of ELL and SLI children following the general 2 X 2 design of Figure 1, Paradis also reports on studies with elegant extensions of the basic 2 X 2 comparisons. In those studies, there is planned comparison of monolingual English or French-speaking children with and without SLI to simultaneous bilingual English/French speaking children with and without SLI. Thus, unlike the ELL children who are learning English after they have acquired their native language, summarized above, in these studies the participants are children who are either monolingual or who are learning English and French bilingually from the onset of language. This extension of the comparative study design demonstrated that there is no additive disadvantage for children learning two languages simultaneously from birth. Bilingual children who are SLI show language skills similar to their monolingual peers with SLI. Paradis notes that other studies have reported similar findings for children with ASD and for children with Down Syndrome. She notes the need for developmental comparative studies of

children with and without SLI who are simultaneous versus sequential learners of English, to investigate the long term trajectories of bilingual effects.

Dialect/SLI: Just as a child's first language can affect acquisition of a later-introduced second language, so can a home dialectal variant of a language affect a child's later acquisition of the mainstream dialect. Janna Oetting and her colleagues report on an investigation of possible group differences on sentence imitation tasks between 70 African American English speakers with or without SLI and 36 Southern White English speakers with and without SLI. Participants were screened to eliminate children with hearing impairments and to include children in the nonverbal IQ range of 82-125. The design is a somewhat extended version of the 2 X 2 design of Figure 1. One column is AAE dialect, a second column is SWE dialect and a third implied column involves comparison to mainstream English-speaking children with or without SLI.

As with the studies of ADHD and bilingualism, it was important to develop suitable measurements. In this case, the researchers developed dialect-strategic scoring systems, intended to evaluate linguistic markers that were sensitive to SLI without confounding by dialectal variants. Their sentence imitation task, developed with consideration of what is known about grammatical differences in mainstream English speaking children with and without SLI, and with scoring adjusted for known features of AAE and SWE, differentiated the group of children with SLI from the children without SLI, across both dialects. That is, Group A performed at lower levels of grammar development than Group C and Group B performed lower than Group D. Under these assessment conditions, children with SLI had lower levels of verbatim recall, more ungrammatical recalls when the recall was not exact, and higher levels of error on target

grammar categories, especially those marking tense. The conclusion is that the assessments provided moderate to high levels of diagnostic accuracy to identify SLI within speakers of nonmainstream dialects of English.

As with the other comparisons in Figure 2, the study of dialect-speaking children also highlights that the linguistic details matter. As in the studies of ELL children, the features of the dialect that a child learns interact with the features of mainstream English in ways that require precise consideration in assessment, in order to avoid confounding SLI with dialectal variants. Another similarity is the need for longitudinal follow ups to determine how the differentiating features persist or fade over time, as children mature in their linguistic competencies.

SLI comparisons bring clarification about the nature of language impairments in children, possible causal pathways and clinical implications

This forum of papers collectively illustrates the great value of the diagnosis of SLI as a subset of the much broader grouping of all children with language disorders. Without the comparisons of Table 1 and Figure 1 there would be much less known about the unexpected. A truncated list of such findings includes: 1) There is an unexpectedly large proportion of children with age-appropriate language including formal grammatical properties in spite of mild-to-moderately low levels of nonverbal IQ (12% of the population at kindergarten); 2) There is greater social risk for children with SLI than for children with ADHD; 3) A putative cause of SLI, memory impairments, is shared with children with ADHD, even when the children with ADHD do not have language impairments, thereby weakening the conclusion of memory impairments as a cause of language impairments ; 4) There are possible shared risks for early language

impairments in children with ASD and children with SLI, although the diagnosis for SLI excludes ASD; 5) There are generally positive language outcomes for children with hearing impairments who receive CIs at young ages with two caveats—about 1/3 of the children require an extended time to catch up to age level expectations and about 1/3 of the children, for unknown reasons, do not catch up and instead demonstrate a pattern similar to the growth trajectories of children with SLI; 6) The language acquisition of children with SLI is not made more difficult by simultaneous bilingual language learning from birth; 7) Young sequential-learning ELL children require 3 years to catch up to age peers and could be mis-identified as SLI; and 7) SLI can be identified in bi-dialectal children by precise measurements of grammatical properties of spoken English.

The relatively simple designs of Table 1 and Figure 1 reveal that language acquisition is remarkably robust across different profiles of nonverbal IQ, ADHD, ASD, Bilingualism and Bi-Dialectalism, and SLI can be differentiated from each of these concurrent conditions. The available evidence (with the exception of the new literature on children with CIs and a few longitudinal studies of children with SLI (Rice, 2013) (J.B. Tomblin & Nippold, 2014) (Conti-Ramsden, St Clair, Pickles, & Durkin, 2012) is mostly cross-sectional snapshots of groups of children within relatively narrow age ranges, in order to make comparisons un-confounded with age-driven changes. This is related to the great challenges in ascertaining samples of children that meet the design requirements, involving assessing numbers of children in order to identify the children that meet the inclusionary and exclusionary criteria, in groups that can be difficult to identify. Under these conditions, multiple age levels are usually prohibitively time consuming and the opportunity to follow up with the children over time is often not

available. Yet these early investigations suggest the great need for longitudinal studies, beginning shortly after birth and continuing well into the elementary school years, in order to flesh out the apparently complex and unanticipated ways in which language, social, and cognitive dimensions of development unfold.

Causal models will need to be adjusted to account for the outcomes of comparative group studies. Models must account for the ways in which language acquisition is robust as well as vulnerable, and selectively spared as well as shared with other clinical conditions. At an empirical and conceptual level, programs of investigation must recognize the dimensionality within the linguistic system, given that some parts of the system are more vulnerable to age-related aspects of language learning in unaffected children, as shown in the studies of ELL children, and that these parts of the linguistic system, particularly in certain parts of the grammar, are shown to be sensitive to the identification of children with SLI, even in the context of bilingual or bi-dialectal language acquisition.

There are risks for the generic diagnosis of LD as the basis of comparative research. It could lead to the composition of groups for comparison that would not differentiate, for example, between ASD + LD and LD without ASD, given that LD is a diagnosis that can include ASD or other conditions; the grouping criteria could specify language impairments without other conditions, in which case it would amount to the diagnosis of SLI. Further, if LD is confounded with other developmental impairments, or with measurement error in bilingual or bi-dialectal children, the existence of SLI and NLI could go undetected in clinical caseloads and in research. Finally, if LD is assumed to be expected in the context of other development impairments, it is even more likely that

the sizeable proportion of children who would be expected to have language impairments but who do not, will continue to be overlooked as a vital part of causal research.

For clinical purposes, the comparative studies reveal that children with SLI are likely to be overlooked for services unless they also have ADHD or speech impairments, although the children with SLI are more likely to be bullied and suffer negative social consequences than the children with ADHD without SLI. This is a compelling example of how causal assumptions can operate in deleterious ways for the identification of children at most risk for poor language outcomes. Clinical decisions for bilingual and bi-dialectal children also require careful comparative studies of children with SLI, in order to recognize that bilingualism does not drive language levels lower in children with SLI in the context of simultaneous bilingual acquisition from birth, but sequential ELL learning causes delays that should not be confused with SLI.

The studies included in this forum are part of the long-standing pattern of a few such studies, distributed intermittently and widely across the literature. Given the informative-ness of this research design, and the high relevance for clinical services, it is hoped that more will follow. The diagnosis of SLI is needed not just for our understanding and treatment of persons with SLI but also for a better understanding of language acquisition in general, the causes of language impairment across all conditions, and improved clinical guidelines for identification and treatment of all persons with language impairment.

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Table 1: Categories of language outcome cross-tabulated by nonverbal IQ and language levels: Tense-marking scores and speech group outcomes nested within categories

		Nonverbal IQ +	Nonverbal IQ –
Language	+	***Typical & Above*** 75% (TNS[1] *M* = .90) (SP[2] ok = 98.2%	***LC[3]*** 11.9% (TNS *M* = .86) (SD[4] = 0.5%)
	–	***SLI[5]*** 8.1% (TNS *M* = .78) (SD = 0.51%)	***NLI[6]*** 5.0% (TNS *M* = .71) (SD = 0.77%)

[1] Grammatical tense marking
[2] Speech
[3] Low cognition
[4] Speech delay
[5] Specific Language Impairment
[6] Nonspecific Language Impairment

Figure 1: Overview of the group comparisons of interest in the forum