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The Variability in Children with Specific Language Impairment Compared to Children with Typical Language Development

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THE VARIABILITY IN CHILDREN WITH SPECIFIC LANGUAGE IMPAIRMENT
COMPARED TO CHILDREN WITH TYPICAL LANGUAGE DEVELOPMENT

by

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A thesis submitted to the faculty of

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ABSTRACT

A COMPARISON OF VARIABILITY IN CHILDREN WITH SPECIFIC LANGUAGE IMPAIRMENT TO CHILDREN WITH TYPICAL LANGUAGE DEVELOPMENT

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Master of Science

The purpose of this study was to determine whether children with specific language impairment (SLI) are more or less variable than children with typically developing language. In addition, the within child variability for children with SLI was analyzed to consider how heterogeneity influenced identification of areas of linguistic strengths and weaknesses in this population. Fifty seven children with SLI, 7:0–11:0, and fifty seven of their peers with typically developing language were assessed using five subtests and a composite language score from the Comprehensive Assessment of Spoken Language (CASL) (Carrow-Woolfolk, 1999). The children with typically developing language were significantly more variable as a group than the children with SLI. The heterogeneity of the children with SLI did not allow for the creation of subgroups based on language strengths and weaknesses.

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Table of Contents

	Page
List of Tables	ix
List of Figures	x
Introduction.....	1
Review of Literature	4
Categorization of Impairment in Speech Language Pathology	4
Definition of SLI.....	10
The Search for Subcategories of LI	15
Purpose of Study	23
Method	26
Participants.....	26
Standardized Testing.....	29
Analysis and Comparison of Group Variability	29
Analysis of Subtest Scores Produced by Children with SLI.....	32
Results.....	34
Variability Between Groups	34
Profiles from Subtest Scores of Children with SLI	45
Discussion.....	51
Reflections on Research Questions.....	51
Pragmatic Language and Future Research.....	56
Summary and Conclusions	57
References.....	59

List of Tables

Table	Page
1. Number of Items per CASL Subtest and Items required for Basals and Ceilings.....	30
2. Descriptive Statistics and Variance Ratios for Groups on CASL Subtests and Composite	35
3. Inferential Statistics for Brown-Forsythe Median Test	36
4. Comparison of Sensitivity and Specificity for CASL Subtests and Composite	44
5. Number of Subtests on which Children with SLI Scored a Standard Deviation	46
or More Below the Mean	46
6. Children with SLI Showing Weakness on One CASL Subtest	47
7. Children with SLI Showing Weakness on Two CASL Subtests	48
8. Children with SLI Showing Weakness on Three CASL Subtests	49
9. Children with SLI Showing Weakness on Four CASL Subtests.....	50

List of Figures

Figure	Page
Figure 1. Overlap of scores produced by children with SLI and typically developing children on the Antonym subtest.	38
Figure 2. Overlap of scores produced by children with SLI and typically developing children on the Syntax Construction subtest.....	39
Figure 3. Overlap of scores produced by children with SLI and typically developing children on the Paragraph Comprehension of Syntax subtest.	40
Figure 4. Overlap of scores produced by children with SLI and typically developing children on the Nonliteral Language subtest.	41
Figure 5. Overlap of scores produced by children with SLI and typically developing children on the Pragmatic Judgment subtest.....	42
Figure 6. Overlap of scores produced by children with SLI and typically developing children on the Language Standard composite scores.	43

Introduction

Children who present with impaired language skills in the face of relatively typical growth in other areas of development have been described in the medical, psychological, and education literatures for some time (Paul, 2007). Although a variety of labels have been used to characterize these children, the most common designation is specific language impairment (SLI; Leonard, 1998). SLI is considered to be a category of impairment, but it is generally recognized that the children identified with SLI display a high degree of heterogeneity. Researchers have accounted for this variability in various ways. One approach has been to divide the larger category into subgroups that describe more specific patterns of strengths and weaknesses (Conti-Ramsden & Botting, 1999; Conti-Ramsden & Crutchley, 1997; Rapin & Allen, 1987; Wilson & Risucci, 1986). A second approach is to view children with SLI on a continuum of both type and severity of language problem (Bishop, 2000; Brinton & Fujiki, in press; Rescorla, 2005, 2009). The difficulty with the first solution is that even with subgroups there continues to be overlap (Bishop, 1997b). The difficulty with the notion of continua is that children with SLI do not present a uniform progression from one end of the continuum to the other. The mixture of severity and symptoms might be better characterized as a “smorgasbord” rather than a continuum (Fujiki & Brinton, 2007). That is, children with SLI may present with patterns of strengths and weakness that result in a variety of individual profiles of development.

Clinicians faced with immediate treatment decisions must address the variability in the population with SLI by designing assessment and treatment procedures to meet each child’s individual needs. In clinical intervention, the general expectations suggested

by category membership (SLI) may have little clinical relevance. A deeper understanding of the variability within the group of children identified as having SLI would be helpful in understanding the characteristics and needs of this population.

The present investigation examined the variability of performance among children with SLI on a standardized measure of language ability. Formal measures are usually standardized on samples composed largely of typically developing children. If children with SLI show a great deal of variability on standardized test measures, however, the test reliability for children with SLI might be questioned. For the purposes of this study, The Comprehensive Assessment of Spoken Language (CASL; Carrow-Woolfolk, 1999) was administered to all participants. Subsequently, the variability of performance within the group of children with SLI was compared to the variability within the group of typically developing peers.

The second way in which the variability of children with SLI was examined was to consider how heterogeneity influenced identification of areas of strength and weakness. The CASL subtest scores for the children with SLI were examined to determine patterns of weakness within the group. For example, it was determined if any children displayed weakness in one subtest, such as Syntax Construction, and typical performance in all other areas of development. This analysis allowed general comparisons with existing subcategories of SLI, such as those proposed by Allen and Rapin (1980). Since the CASL contains subtests probing a number of linguistic and pragmatic behaviors, the analysis also allowed examination of the notion that the core deficit in children with SLI is in language form and content in the face of relatively intact pragmatic ability (Tager-Flusberg, 2004).

To address these questions, data from several previously conducted investigations were combined (Brinton, Spackman, Fujiki, & Ricks, 2007; Fujiki, Brinton, & Clarke, 2002; Fujiki, Spackman, Brinton, & Illig, 2008). Fifty-seven children with SLI and their typically developing peers were assessed using five subtests from the CASL (Carrow-Woolfolk, 1999). These subtests, used to produce an overall composite score, are titled (a) Antonym, (b) Syntax Construction, (c) Paragraph Comprehension of Syntax, (d) Nonliteral Language, and (e) Pragmatic Judgment. The following questions were addressed:

1. As a group, do children with SLI display more variability in performance on subtests of the CASL (that tap differing aspects of communication) than do children with typically developing language?

2. Do the patterns of impairment produced by children with SLI as measured by various subtests of the CASL reflect specific areas of impairment or a more pervasive disorder?

Review of Literature

The following review will focus on the practice of categorization as it relates to the field of communication disorders. In this discussion, details regarding the purposes and limitations of categorization will be considered. The review then focuses on the category of SLI. A definition of SLI is given followed by a description of various language weaknesses observed in these individuals. Attempts to define and subtype SLI are then discussed. Finally, the idea that children with SLI should be viewed on a continuum is considered.

Categorization of Impairment in Speech Language Pathology

Categorizing individuals with disabilities is a common practice in speech language pathology. Historically, the medical model provided the theoretical basis for the classification and treatment of various disorders, diseases, and physical impairments that impact communication (Duchan, 2004). Within this model the etiology, pathogenesis, and manifestation of a problem is considered. Categories are determined as groups of individuals demonstrate similarities across these parameters. One of the first speech-language pathologists to classify children with language impairment (LI) was Myklebust (1954). Myklebust developed a classification system for children with language disorders, which he called auditory disorders, and distinguished language disorders from hearing impairments and intellectual disability (Paul, 2007).

Since that time, many authors have presented categorization systems for children who have difficulty with language. Nelson (1998) presented a current example of such a categorization system. She organized children's language problems according to whether the impairment was related to central or peripheral processes. SLI, intellectual disability, autism spectrum disorder, attention deficit hyperactivity disorder, and acquired brain

injury were among the central impairments for childhood language disorder. Peripheral contributions to LI included hearing impairment, visual impairment, deaf-blindness, or other physical impairment. She also added environmental contributions such as neglect and abuse, behavioral and emotional developmental problems, and other mixed factors. Although there are a number of positive factors associated with categorization, there are also several concerns. Both the benefits and the limitations are reviewed in the following sub-sections.

Benefits. The practice of classifying individuals according to impairment serves several purposes. Historically, the most common rationale for categorizing individuals with disabilities has been to group people with similar traits and behaviors, thus simplifying assessment and treatment. Simeonsson et al. (2003) stated, “a key function of a classification system is its ability to serve as a framework for the development of assessment measures reflecting the specified dimensions of that classification” (p. 603).

Another benefit of using a categorical model is that it provides a common language among medical professionals and aids the communication process between diverse medical fields. For example, it is an understandable way to identify a type of client and what the client’s presenting problems are. In addition, this common language often provides the label necessary for children to receive language and other types of services within the public school system (Paul, 2007).

Further benefits to classifying individuals can be found within the framework of conducting research and within the educational setting. Nearly every research project has certain specifications for accepting participants. If a researcher is to glean useful information from the data, there must be uniformity among the participants as well as the

procedures employed (Nelson, 1998; Schiavetti & Metz, 2006). Classification is also used to qualify individuals for special services. Obtaining speech and language services for children within the public school system is an example of how this process works. Under current federal law, the Individuals with Disabilities Education Act (2004), particular guidelines are specified for classifying children with disabilities, including new guidelines for children with specific learning disabilities. In order to obtain federal funding for speech and language services rendered to students, educators must follow the appropriate guidelines for classifying individuals with disabilities.

Limitations. Although there are several reasons why categorization is advantageous, there are also limitations to this practice. These issues are discussed below. One problem with categorizing clients is that individuals within categories still tend to be highly heterogeneous. Paul (2007) stated, “although diagnostic categories are often thought to be useful because they describe similarities among clients, in fact two clients with the same diagnosis are often as different as night and day” (p. 13). Bloom and Lahey (1978) reported that the majority of children with LI do not fit nicely into a specific category. Frequently, children may have more than one factor that contributes to their impairment. These factors may be cognitive, physiological, or emotional in nature. Furthermore, assuming that the members of certain categories are homogenous often leads to the notion that these individuals can be assessed and treated in a similar fashion. Brinton and Fujiki (in press) stated, “Even children of similar ages with similar scores on standardized testing may not present similar behaviors in actual communication; children with the same diagnostic label often have highly variable profiles of communicative strengths and limitations” (p. 17). Similarly, Paul (2007) stated that the labels used do not

always clearly explain or delineate the level of language performance seen in a given child.

Approaching the issue from another perspective, Owens (2003) noted that placing children in different categories could result in overlooking the possibility that individuals with different diagnoses can be quite similar in their language behaviors. Consider children with SLI, autism, or pragmatic language impairment (PLI); children with these disorders can all exhibit language behaviors that are quite similar and which would likely be assessed and treated in the same way. Brinton and Fujiki (in press) proposed that the existence of categories implies that there are boundaries, when it may be more realistic to view some children with disabilities on a continuum.

Another limitation to a categorical model is that this perspective often fails to recognize the functionality and abilities of individuals while focusing on their disabilities (World Health Organization, 2001). Wiart and Darrah (2002) proposed, “the underlying assumption of a model that focuses solely on deficiencies of functioning as a result of impairment is that the return to a normal state is ideal and achievable” (p. 493). In other words, focusing on the specific impairments of a child lends itself to the notion that these individual deficiencies can and need to be repaired. Once these deficiencies are addressed, the belief is that typical function will be restored to the individual. This notion is often false and can be damaging if entertained by the individual with LI and his family. This is similar to using the label *language delay* to refer to a child: the assumption is that the child will eventually catch up to his peers, an assumption which may not be accurate.

A further limitation is that the practice of labeling children may cause clinicians to perceive behaviors that are not actually there, simply because they expect to see a

certain set of characteristics within a specific population (Brinton & Fujiki, in press). Owens (2003) presented a somewhat similar argument, suggesting that providing a child with a specific label can result in self-fulfillment. In other words, by assigning a child to a category, that child may be viewed as having the characteristics of the category and may not be viewed as an individual.

A current view. In the past decade, there has been a modest shift from viewing individuals with disabilities according to general categories of disability to classifying impairments according to the International Classification of Functioning, Disability, and Health (ICF; Washington, 2007; World Health Organization, 2001). The ICF recognized the effect of the physical and social environment on both the abilities and participation level of the individual. This framework is helping professionals in the medical fields to move away from labeling individuals and focusing instead on their strengths and needs (Paul, 2007).

The ICF is centered on three broad components. First, the ICF considers the body structures and function of the individual by classifying impairment as a problem with either an anatomical part of the body or the physiological functions of the body, including psychological functions. This classification process is completed by identifying each function under scrutiny using one of the codes provided by the WHO within the ICF. For example, code b16710 represents expression of spoken language and code b16702 represents reception of signed language. Each function is then rated on a five-point scale ranging from no impairment to complete impairment (Westby, 2007). Second, the ICF examines the activity and participation capabilities of the individual. This area addresses the individual's ability to perform specific functions experienced within activities of daily

living. The final component addressed within the ICF framework is the influence of contextual factors such as the physical, social and attitudinal environment in which people live their lives (Paul, 2007).

The ICF framework is gradually being implemented throughout many medical fields, including communication disorders (Paul, 2007; Perenboom & Chorus, 2003; Simeonsson et al., 2003; Washington, 2007; Westby, 2007). Washington (2007) noted, “the comprehensive view of health and common language offered by the ICF framework is useful for guiding clinical and research practices within speech-language pathology” (p. 242). He further observed that this framework was successfully applied to the fields of aphasia and traumatic brain injury and that the ICF can be applied to the study and treatment of SLI. Such an application would be beneficial because it would reveal more about the nature of SLI, increase the available assessment tools and outcome measures, and broaden the scope of goals and treatment for LI. For example, medical advances that can improve the function of the individual relating to the area of body structures and function could include increased technology. Increased technology could cover further study of the brain and the determination of the genetic etiology for language acquisition, comprehension, and production. Under the area of activities and participation, children with SLI need to be evaluated according to their ability to function in natural contexts. These contexts include participation in class projects, gaining information from reading, and following teacher directions. To address the area of contextual factors, information could be provided to caregivers and other significant individuals on how they can facilitate language development in a child with SLI (Washington, 2007).

Westby (2007) also outlined ways that the ICF can be implemented for individuals with LI. Westby stated that when classifying individuals with LI according to the ICF, the examiner begins by looking at deficits in body functions and then determines if there are impairments within body structures that can account for these deficits. The severity of each deficit is then classified on the five-point scale that ranges from no impairment to complete impairment. In order to determine what degree of impairment exists, subjective or quantitative measures must be used with caution, always ensuring that the measure used reflects the true nature of the child's impairment. Westby referred to the activities and participation level of children with SLI in the following manner: "impairments of language functions can restrict the variety and complexity of tasks that children can execute, which in turn may limit the life situations in which children can or will participate" (pp. 267-268).

The practice of categorizing and labeling children with different diagnoses has evident benefits and limitations. Despite innovative approaches such as the ICF, it is likely that categories of impairment will be used in the field of communication disorders for many years to come. In light of this likelihood, it is important to consider the category of SLI. In the following section SLI is defined and the ways researchers and clinicians attempted to deal with the heterogeneity of individuals within this category are examined.

Definition of SLI

In discussing categorization in relation to children with language difficulties, it may be helpful to consider how the terms LI and SLI have been defined and used. LI is often used as a general term for individuals who have a language disorder, with the terms disorder and impairment being synonymous. The American Speech-Language-Hearing Association (ASHA) defined language disorder as an impairment in "comprehension

and/or use of a spoken, written, and/or other symbol system” involving the form, content, and/or use of language (1993, p. 1). In addition to this general usage, the term LI can also be used to refer to the subset of these individuals who have language problems in the face of relatively typical development in other aspects of language. When used in this manner, the terms LI and SLI are interchangeable. Leonard (1998) defined children with SLI in the following manner: “These are children who show a significant limitation in language ability, yet the factors usually accompanying language learning problems—such as hearing impairment, low non-verbal intelligence test scores, and neurological damage—are not evident” (p. 3). Bishop (2000) provided a simplified definition by stating that SLI is diagnosed when children have difficulties with language, but are developing normally in other respects.

SLI was documented as early as the late nineteenth century, although the nomenclature has varied over the years. Early researchers termed the disorder congenital aphasia, hearing mutism, and delayed speech development. In the mid-twentieth century researchers used variances on the term congenital aphasia, such as: infantile aphasia, developmental aphasia, expressive developmental aphasia, and receptive-expressive developmental aphasia. Eventually, researchers began to use the term dysphasia in place of aphasia simply because *a-* implies the absence of language and *dys-* implies a disorder of language (Leonard, 1998).

More recently, the labels of language disorder, language learning disorder, delayed language, developmental language disorder, developmental LI, developmental language disability, specific language deficit, and even the broad category label of LI have been applied to children who could also be grouped under the label SLI (Allen &

Rapin, 1980; Casby, 1997; Leonard, 1998). Brinton and Fujiki (in press) pointed out that regardless of the changing nomenclature, the presenting problems must be assessed in each child and an intervention that focuses on individual needs should be put into place. Although children with SLI are considered to form a category, they present with highly variable behaviors and language profiles.

As noted above, children with SLI are a heterogeneous group. In order to deal with this heterogeneity, protocols have been employed to determine whether a child could be diagnosed with SLI. Stark and Tallal (1981) provided criteria for the diagnosis of SLI that has been widely used in selecting participants for research purposes since the early 1980s. Their criteria employed a performance IQ of at least 85 along with at least one of the following: (a) a receptive language age (LA) score that is at least 6 months below mental age (MA) or chronological age (CA), whichever is lower; (b) a combined (expressive and receptive) LA score that is at least 12 months below MA or CA, whichever is lower; or (c) an expressive LA score that is at least 12 months below MA or CA, whichever is lower. Stark and Tallal warned that these criteria must be met by employing a representative set of language tests. Stark and Tallal also stated that children identified with SLI could show no evidence of hearing impairment, cognitive deficit, neurological deficit, or emotional or behavioral disorder. They excluded individuals with peripheral oral motor or sensory deficits and those with craniofacial anomalies. Also, children with an articulation or phonological disorder as the primary language deficit were excluded because this indicated a mixed etiology. For the same reason, children over 7 years of age with a reading level more than 6 months behind their CA were excluded as well. Leonard (1998) noted that Stark and Tallal were among the few

investigators who proposed a criterion that required at least some deficit in both comprehension and production. Plante (1998) stated, “Since it first appeared, the Stark and Tallal criteria for the selection of children with SLI has had a profound influence on research with this population” (p. 951).

Leonard (1998) noted that a diagnosis of SLI is often based equally upon inclusion and exclusion. An example of exclusionary criterion is the requirement that children have no concomitant disabilities or disorders in order to be classified with SLI. The idea of a diagnosis based on exclusionary criteria suggests that the true nature and cause of the disorder are unknown (Stark & Tallal, 1981). Leonard stated that it is typically easy to identify a language disorder, but the difficulty of making a diagnosis of SLI lies in the exclusionary criteria. In other words, clinicians can conclude that a child has a language disorder, but it is more difficult to determine whether there are concomitant factors or not. A clinician must distinguish SLI from other disabling conditions that involve language disorders by testing hearing, neurological dysfunction, middle ear function, oral structure, oral motor function, and physical and social interactions (to ensure there are no symptoms of impaired reciprocal social interaction or restriction of activities) in order to make a diagnosis. Leonard noted that this is easily done in today’s clinical setting, but this has not always been the case. The measures currently used to rule out concomitant conditions are more extensive and reliable than those employed in earlier research on SLI. Lahey (1990) also cautioned against the use of an IQ score above 85 in conjunction with the inclusionary criterion of a low language test score. She argued that this combination could be problematic. All test scores have a small margin of error, but using two test scores introduces the risk of compounding this error.

Another peculiarity of the exclusionary definition of SLI is that children who have deficits in only phonological aspects of language production cannot be included within this group. Clearly, phonology is an important aspect of language production, but a deficit in this area is excluded from a definition of SLI. Leonard (1998) noted that this criterion is probably a throwback to an “era when developmental dysphasia was sharply distinguished (without much empirical basis) from problems of which phonology was an obvious part” (p. 14).

The most serious limitation with the Tallal and Stark (1981) criteria is the requirement of a gap between mental age and cognitive age, known as cognitive referencing. The idea of cognitive referencing developed out of the cognitive hypothesis, which stated that individuals must attain certain cognitive abilities before language could develop (Krassowski & Plante, 1997). Subsequently, many public schools adopted cognitive referencing as a criterion to qualify children for, or often exclude children from, language services (Ehren & Nelson, 2005). There have been several arguments against the use of cognitive referencing as a practice within the school system and other treatment settings over the years (Nelson, 1998). Ehren and Nelson (2005) stated that the practice of cognitive referencing often restricts therapists to the use of standardized tests and relegates the use of language samples, teacher reports, and other types of language evaluation to a supporting role in the assessment process. Another limitation of cognitive referencing is that IQ measurements are a sample of the child’s ability at a certain point in time, and may not indicate future ability (Krassowski & Plante, 1997). In addition, there has been little empirical evidence to support the theory that children who display a discrepancy between cognitive and mental age are better candidates for language services

than those who do not display this discrepancy (Cole & Mills, 1994). Regardless of these and other arguments against the use of cognitive referencing, it has still been widely used as a way to identify children with SLI both for research and clinical purposes. Although children with SLI are defined as a group, researchers and clinicians realize they are highly variable. Attempts by some of these researchers to organize and account for this variability are outlined in the following section.

The Search for Subcategories of LI

Heterogeneity in children with SLI. One way of dealing with the heterogeneity of children with SLI is to consider the types of problems that these children demonstrate as a group. In comparison with their typical peers, children with SLI show difficulty with non-word repetition tasks (Edwards & Lahey, 1998; Estes, Evans, & Else-Quest, 2007; Gathercole, 2006; Lahey & Edwards, 1999), verb acquisition and diversity (Thordardottir & Weismer, 2001), formulation of relative clauses and other complex sentence structures (Marinellie, 2004; Schuele & Nicholls, 2000), figurative language skills (Corts & Meyers, 2002), pragmatic language skills (Botting, 2004; Brinton, Fujiki, Spencer, & Robinson, 1997; Corts & Meyers, 2002; Ryder, Leinonen, & Schulz, 2008), social cognition (Brinton et al., 2007; Ford & Milosky, 2003; Fujiki et al., 2002; Fujiki, Spackman, Brinton, & Hall, 2004), and use of morphosyntactic structures (King & Fletcher, 1993; Leonard, Davis, & Deevy, 2007; Miranda, McCabe, & Bliss, 1998). In addition, researchers assessed the ability of children with SLI to formulate a narrative using correct sequencing, topic maintenance, conjunctive cohesion, and referencing and found that these children display deficits in comparison with their typically-developing peers (Gillam & Carlile, 1997; Miranda et al., 1998). It is important to consider that although group comparisons differ, it is likely that for every behavior listed above there

would be individual children with SLI who would not differ from their typical peers. Several studies verify that children with SLI exhibit weaknesses in different language areas, but it is rare to find studies that quantify and characterize the various weaknesses that individual children with SLI experience. This high degree of heterogeneity led some researchers and clinicians to suggest that children with SLI might be subgrouped based on specific profiles of strengths and limitations (Aram, Morris, & Hall, 1993). These attempts to delineate subgroups outlined the fact that individual profiles of children with SLI vary. The following section reviews several of these subcategory systems.

Subcategorization and SLI. One way of dealing with the heterogeneity of children with SLI is to place them into subtypes of the more general impairment. A review of several of the SLI subcategorization schemes is presented in the following section.

Rapin and Allen (1987) proposed an often-cited division of SLI that is based on clinical judgments. Rapin and Allen outlined six distinct subgroups of the disorder. These subgroups included (a) Phonological-Syntactic Deficit Syndrome, (b) Lexical-Syntactic Deficit Syndrome, (c) Verbal Auditory Agnosia, (d) Semantic-Pragmatic Deficit Syndrome, (e) Verbal Dyspraxia, and (f) Phonologic-Programming Deficit Syndrome. Children who fell under the Phonological-Syntactic Deficit Syndrome exhibited problems with pronunciation of speech sounds and fluency. Their utterances were short with grammatical errors and devoid of function words and inflection. Children with the Lexical-Syntactic Deficit Syndrome were similar to those with the phonological type, except they had typical articulation and exhibit problems with word finding. Verbal Auditory Agnosia referred to children who had very limited or absent speech along with difficulties understanding language. Children identified under the Semantic-Pragmatic

Deficit Syndrome had fluent and well-articulated speech, but exhibited echolalia or unanalyzed scripts. These children were often verbose but used language that was not communicative and had limited comprehension skills. Verbal Dyspraxia described children with adequate comprehension, but limited speech, short utterances, and impaired articulation. Finally, children with Phonological-Programming Deficit Syndrome were those who exhibited typical comprehension levels for their age but produced long, fluent utterances that were often unintelligible.

Other researchers based classification systems on the work of Rapin and Allen (1987) and labeled the resulting subgroups in similar fashion (Conti-Ramsden & Botting, 1999; Conti-Ramsden & Crutchley, 1997). Conti-Ramsden and Botting (1999) examined the viability and stability of the six subgroups proposed by Rapin and Allen. In general their work supported the identified subcategories, however, it was noted that the stability of the subgroups over time was highly variable. Forty five percent of children within a certain subgroup crossed over to another subgroup at later ages. In other words, the general profile pattern was stable (e.g. there are always children with SLI who have syntactic problems) but the individual children with SLI change their particular profile over time (the individual children with SLI who have syntactic problems will vary from measurement time 1 to measurement time 2). Thus, Conti-Ramsden and Botting stated that, “Although profiles of language strengths and weaknesses in the form of distinct subgroups appear to be stable over time, individual children’s language strengths and weaknesses change with time” (p. 1203). They concluded that SLI was a highly dynamic condition whereby the language profile, or subtype of the children, changed with developmental growth and other factors such as intervention.

Conti-Ramsden and Crutchley (1997) later proposed six different clusters of children with SLI loosely based on Rapin and Allen's (1987) six subgroups. Cluster 1 included children with good articulation skills but poor syntax and morphology skills. They also showed some difficulties with both comprehension and production. Cluster 2 children exhibited phonology problems, mainly production problems, and poor word reading skills. Children classified as Cluster 3 presented with deficits in all language areas tested, but did okay with naming vocabulary when given extra time. Cluster 4 was reserved for children who were quite similar to children in Cluster 3 but showed higher profile scores on each measure. Cluster 5 included children with similar profiles to those in Cluster 3, except they also did poorly on the naming vocabulary test. Children classified under Cluster 6 presented with semantic, receptive, and pragmatic language deficits. This attempt at classification employed children's language performance on psychometric measures as well as teacher report. The researchers noted that had the latter not been included, the children identified in Cluster 6 would not have been diagnosed with LI solely on the basis of their test performance.

A model proposed by Wilson and Risucci (1986) was based on clinical judgment, similar to Rapin and Allen (1987), as well as research and statistical analyses. These researchers proposed four subgroups for SLI including a group of children with low expressive and high receptive language scores, a second group with relatively low expressive and receptive language scores, a third group with deficits in auditory memory and word retrieval tasks, and a fourth group of children who displayed deficits in all language areas.

Recognizing the heterogeneity in the category of SLI, Tomblin and Records (1996) detailed a diagnostic system called EpiSLI that was intended for epidemiological research purposes. The system used five composite, norm-referenced scores in the areas of grammar, vocabulary, narration, comprehension, and production. According to this diagnostic system, a child scoring below $-1.25 SD$ on two or more of the composite tests could be diagnosed with SLI. Recently, some literature in the field of communication disorders suggested that the diagnosis of SLI be reserved for children over 3 years of age. For this reason, children who are under 3 years, but exhibit reduced expressive language skills, were termed late talkers (Rescorla, 1990, 2002, 2005, 2009).

Leonard (1998) reviewed several classification systems and noted that although the historical approaches to classifying subgroups of SLI may seem different, there are many commonalities. Based on this review, Leonard pointed out two basic subgroups for children with SLI divided by the following criteria: children with weak syntax and phonology and children with deficits in the areas of comprehension and production. He stated that these subgroups be divided further based on the degree of comprehension-production gap and severity of global language problems.

Perhaps the most common way to subtype LI is similar to that outlined in the Diagnostic and Statistical Manual of Mental Disorders. Children with LI are divided into two subcategories: those with expressive language deficits and those with receptive language deficits (Law, 1992; Paul, 2007). Paul (2007) and Law (1992) were both quick to point out the faultiness of such a simplistic division of language disorder, however. Paul noted that there is very little empirical evidence for the validity of this system of classification. Another group of researchers corroborated this notion (Tomblin, Zhang,

Weiss, Catts, & Weismer, 2004). Tomblin et al. administered several language tests to 225 kindergarten children who had poor language skills and 357 children with typical language skills. One goal of this study was to determine if distinctive dimensions existed among the resulting language scores. They noted that there was no “separate dimension for receptive and expressive tests” (p. 65). They further stated that the tests used to determine whether there was a distinction were common measures. Thus, if there were distinct groups of children with receptive or expressive language impairments they would not likely be identified using currently available testing methods.

Nonspecific Language Impairment. In addition to discussion about dividing SLI into specific subgroups, experts distinguished groups of children who fall slightly below the exclusionary intelligence criteria from children with SLI. These children scored between 70 and 85 on intelligence tests and had language deficits. Intelligence scores in this range placed a child above the range for a label of intellectual disability and below the cut off for SLI, so it was proposed that these children be identified as having nonspecific language impairment (NLI). Researchers have examined the language differences between children with SLI and children with NLI. It has generally been found that children with NLI have more severe impairments, but that their performance is not qualitatively different than children with SLI (Catts, Fey, Tomblin, & Zhang, 2002; Rice, Tomblin, Hoffman, Richman, & Marquis, 2004; Tomblin & Zhang, 1999). One example of the numerous studies conducted on this issue was that of Miller, Leonard, and Finnernan (2008). Miller, et al. conducted a study examining the ability of children with SLI, children with NLI, and typically developing children to judge the grammaticality of several utterances. They noted that typically developing children performed better than

the other two groups at this task, but that there was no significant difference between the performance of children with NLI and children with SLI. The fact that children with NLI and SLI often perform similarly has caused some experts in the field of communication disorders to speculate that it may not be necessary to separate children with NLI from children with SLI.

LI as a continuum. Some researchers have suggested that LI is better viewed as a continuum of impairment rather than distinct categories of impairment (Bishop, 2000; Brinton & Fujiki, in press; Dollaghan, 2004; Leonard, 1987; Rescorla, 2005, 2009; Tomblin, 1991). For example, Rescorla (2005, 2009) provided support for viewing children with SLI on a continuum in her research regarding late talkers. Rescorla defined late talkers as children under the age of three who exhibit expressive language delay, but typical receptive language behavior. Some researchers suggested that children under the age of three not be given a diagnosis of SLI, even though the exclusionary and inclusionary criteria for diagnosis is roughly the same as that of SLI (Rescorla, 2005). Rescorla found that the late talkers typically had better language outcomes than children diagnosed with SLI, but they still had mild language problems at the ages of 13 and 17. Thus, she proposed that they still be classified as having LI, but be considered either a subset of the disorder or as being at the mild end of a spectrum (Rescorla, 2002, 2005, 2009). Within this spectrum, children with NLI might be viewed on the more severe end of a range of children with various intelligence scores and language profiles.

Bishop (2000) introduced the possibility of a continuum of LI that included children with PLI. PLI is a term for individuals who exhibit impairment with the use of language, but present with relatively intact structural aspects of language (Bishop &

Norbury, 2005). Bishop stated that children with PLI might have social communication deficits as a result of SLI or ASD, and could be viewed on a spectrum bridging the gap between these two disorders. She stated, “in our current state of knowledge, it may be sterile to debate whether language-impaired children with pragmatic difficulties should be categorized with SLI or autistic disorder: truly intermediate cases may exist” (p. 99). She further emphasized the concept that children with a diagnosis of SLI may have language or pragmatic difficulties that extend beyond the traditional definition of SLI, and these behaviors may resemble that of a child with autism.

SLI could also be viewed as the low end of the variability that would typically occur in a normal distribution of language skills across a large number of children. In this conceptualization, it is proposed that children vary in their ability to solve math problems, play a musical instrument, and socialize with others. SLI is simply a manifestation of this variability in the capacity to produce and understand language. As a society Americans simply place more emphasis on the ability to communicate. Lower levels of skill in this area are more noticeable (Leonard, 1987; Tomblin, 1991). This notion has some similarity to the suggestion that language behavior be viewed on a spectrum. Rescorla (2005) speculated, “that children are born with different endowments for language, analogous to differential endowments for intelligence and that this differential endowment accounts in part for stability in individual differences in language skills across development”(p. 466).

Taxometric analysis. Dollaghan (2004) employed taxometric analysis with a large group of 3- and 4-year-old children with diverse language scores. These relatively new statistical analyses were designed to determine whether the existence of a specific

category was viable. The goal of the analysis was to determine whether the children's scores reflected a discrete group of children with language behaviors differing in kind from typically developing children or whether the distribution of scores was reflective of a continuum of language abilities. The results determined that the latter possibility was more likely. In other words, the language scores of these children did not reflect a discrete subgroup of poor language performance, but reflected a continuum of language ability.

Summary. There have been many attempts to separate children with SLI into subcategories based on their presenting deficits, underlying deficits, and etiology. One of the dilemmas in delineating subgroups for children with SLI is that overlap still exists between children in the different groups (Bishop, 1997a). In addition, children with SLI will often change from one subgroup to another over the years, because of the varying nature of SLI over time (Leonard, 1998). Despite these limitations, considering the more specific problems of children with SLI, and looking for similarities and differences among them, has provided a better understanding of the overall category of SLI.

Purpose of Study

It is generally accepted that children with a diagnosis of SLI display heterogeneity in their language profiles and communication behaviors, and there have been various attempts to deal with this variability (e.g., subtyping, etc.). The purpose of this study was to consider this heterogeneity from a clinical standpoint, documenting the variability of weaknesses in children with SLI. The level of variability among children, all meeting general standards for diagnosis of SLI, was documented by examining their performance on subtests of the CASL (Carrow-Woolfolk, 1999).

Each of the subtests was designed to assess specific areas of strength and weakness in children with SLI and allows clinicians to assemble individual profiles based on multiple subtest scores (Carrow-Woolfolk, 1999). The Antonym subtest was designed to assess the accurate retrieval and expression of single words. Poor performance on this test may indicate that specific word knowledge has not developed, word meaning is not completely understood, retrieval is poor, or there is difficulty in the oral production of words. The Syntax Construction subtest of the CASL was designed to assess the examinee's ability to use morphosyntactic rules to generate sentences. Poor performance in this subtest would indicate an expressive language deficit that could either be displayed for open-ended questions, questions with specific answers, or a combination of the two. Problems in one of these areas may help to explain variation in the child's ability to respond in the classroom or other environments. The Paragraph Comprehension of Syntax subtest assesses the child's ability to understand syntax. Poor performance on this subtest may indicate that the child lacks the ability to comprehend syntax. In some cases, poor performance on this subtest may also indicate severe memory problems. The Nonliteral Language subtest assesses the child's ability to understand nonliteral language such as figurative speech, indirect requests, and sarcasm. Poor performance on this subtest would indicate either that the child does not understand the need to comprehend the language nonliterally or that the child is unable to draw on environmental cues and world knowledge to aide interpretation. The Pragmatic Judgment subtest assesses the child's knowledge and use of the pragmatic rules of language. Poor performance in this area may indicate a lack of experience with pragmatically appropriate language or the child's inability to generalize this information from their environment. In addition, poor

performance on any combination of the subtests may indicate that the child has an inability to maintain attention and/or follow directions. Considering performance across all of these subtests, it was possible to identify patterns of impairment.

Method

Data for the current study was collected from databases gathered in association with previous research projects conducted by Drs. Martin Fujiki, Bonnie Brinton, and Matthew S. Spackman. Each project was reviewed and approved by Brigham Young University's Institutional Review Board. Written permission was obtained from the participating school districts. Verbal permission was obtained from the principals of the participating schools. Written consent was also obtained from the participating children, their parents or guardians, and their teachers.

Participants from previous research projects were included in the current research if their data contained the necessary subtest scores from the CASL. These subtests, used to produce an overall composite score, included (a) Antonym, (b) Syntax Construction, (c) Paragraph Comprehension of Syntax, (d) Nonliteral Language, and (e) Pragmatic Judgment. In addition, data regarding intelligence testing, age, gender, racial background, and school attended at time of testing were gathered from the participant files, databases, and videos.

Participants

The sample consisted of a total of 114 children, ranging in age from 7;1 to 10;11 ($M = 9;2$, $SD = 13.0$ months). Of those children, 62 were boys and 52 were girls. Fifty-seven of the participants had a diagnosis of SLI, and 57 children had typically developing language. The children with SLI and the children with typically developing language were matched for age and gender. Participating children were selected from 17 elementary schools in 3 local school districts. The socioeconomic status for the participants was measured from block group data from the 2000 census (U.S. Census Bureau, 2003). In the neighborhoods surrounding the 17 elementary schools, the mean

percentage of families with income levels below the poverty level was 4.5% ($SD = 2.7\%$). The children were included in the study based on the criteria listed below.

Participants with SLI. The group with SLI was composed of 31 males and 26 females ranging in age from 7;1 to 10;10 ($M = 9;1$, $SD = 12.5$ months). Racial distribution of participants included 47 (82%) Caucasians, 3 (5%) Hispanics of Mexican descent, 2 (4%) African Americans, 1 (2%) Asian American, and 2 (4%) children classified as other. In addition, the racial background information was unavailable for 2 (4%) of the children (total sums to 101% because of rounding error). They were included in this study according to the following qualifications:

1. Chronological age between 7 and 11 years.
2. Nonverbal or performance IQ of 85 or above on a formal standardized test of intelligence. Intelligence test data were obtained from the school file if it was available. If IQ scores were not available from the school file, a speech-language pathology graduate student administered the Universal Nonverbal Intelligence Test (UNIT). The following tests were used: UNIT; Test of Nonverbal Intelligence, 2nd edition (TONI 2); Stanford-Binet Intelligence Scale; Weschler Intelligence Scale for Children, 3rd edition (WISC-III); Woodcock-Johnson tests of achievement- revised (WJ-R); and Kaufman Assessment Battery for Children (K-ABC).
3. Hearing within the normal range. Hearing screenings performed by school district staff were used to make this determination.

4. Standardized language test score at least one standard deviation below the mean. Language tests performed by the school district staff and the researchers gathering the data were used to make this determination.
5. Placement in a regular education classroom.
6. Enrollment in speech-language pathology or language resource services at school with a diagnosis of LI.
7. No formal diagnosis of an emotional or behavioral disorder.

Participants with typically developing language. The group of children with typically developing language was composed of 31 males and 26 females ranging in age from 7;1 to 10;11 ($M = 9;2$, $SD = 13.3$ months). Racial distribution of participants included 45 (79%) Caucasians, 5 (9%) Hispanics of Mexican descent, and 2 (4%) children classified as other. In addition, the racial background information was unavailable for 5 (9%) of the children (total sums to 101% because of rounding error). Each participant with SLI was matched for age and gender with a typically developing peer from the same classroom, where possible. Children with typically developing language meeting the following criteria were recommended by the classroom teacher:

1. Same gender as the child with SLI.
2. Chronological age within 6 months of the child with SLI.
3. Academic performance within normal limits. Teacher report and school records determined academic performance.
4. No academic, behavioral, or speech-language problems requiring speech and language services, occupational therapy, psychological counseling, or other special services (e.g. resource).

5. Hearing within normal limits. Hearing screenings performed by school district staff were used to make this determination.

Standardized Testing

The CASL (Carrow-Woolfolk, 1999) was administered as a global test of language ability. The CASL was designed to assess the language skills of children and adults from ages 3 through 21 years. The skills tested are deemed necessary for children to become literate and successful in the school environment. The CASL was designed to assess the receptive, expressive, and retrieval skills of children within four language categories: (a) lexical or semantic, (b) syntactic, (c) supralinguistic, and (d) pragmatic. Five of the CASL subtests were administered to these participants. Each subtest contains a different number of test items ranging from 45 to 60, and employs basal and ceiling rules (see Table 1). Thus, each child was administered a different number of items for each subtest depending on the basal and ceiling calculations. The CASL subtest scores were then combined to produce a composite score. Speech-language pathology graduate students administered the CASL to most of the participants. If current CASL scores were available from the participant's school, these data were used. Standard scores for each subtest and a core composite score were obtained for each student using procedures outlined in the CASL administration booklet.

Analysis and Comparison of Group Variability

One of the reasons this research was conducted was to determine whether children with SLI were more variable, as a group, than children with typically developing language. As previously stated, the issue is important because of its implications for standardized testing. Higher levels of variability in children with SLI may suggest that

Table 1

Number of Items per CASL Subtest and Items required for Basals and Ceilings

Subtest	Items	Number of items required	
		Basal	Ceiling
Antonym	55	3	5
Syntax	56	3	5
Paragraph	45	1	Set total of 0 or 1 ^a
Nonliteral	50	3	5
Pragmatic	60	3	5

^aThe total raw score for an administered set of test items must equal 0 or 1 in order to obtain a ceiling.

test reliability data is somewhat misleading if the data were generated from samples largely composed of typical children.

All participants were assessed using five subtests from the CASL. From these subtests a composite score, termed the Language Standard, was calculated. Means and standard deviations (*SD*) were determined for children in both groups on each CASL subtest and the Language Standard. These data were then analyzed to determine the variance within the two groups for each measure.

A variance ratio was computed by dividing the variance measures from the group with typically developing language by the variance measures of the group with SLI. This was done because the group with typically developing language had larger variance ratios on all CASL measures. An *F*-test of independent variances was then conducted to test the null hypothesis that the variances of the two groups were equal. The alternative hypothesis was that the variance of the group with SLI was significantly larger or smaller than the group with typically developing language. The Brown-Forsythe median test was conducted as a second way of testing whether the difference in variance between children with SLI and children with typically developing language was statistically significant. The *F*-test of independent variances and the Brown-Forsythe median test are explained in greater detail below.

F-test of two independent variances. A hypothesis testing procedure called the *F*-test of two independent variances (Glass & Hopkins, 1984) was used to determine whether any observed difference in the group variances was statistically significant. The *F*-test of two independent variances was conducted by comparing the variance ratio for each subtest and the Language Standard to a calculated critical value. If the variance ratio

exceeded the critical value, the variances of the groups were determined to be significantly different on that particular subtest or composite score.

Brown-Forsythe median test. The Brown-Forsythe W50 test (Brown & Forsythe, 1974) was used to determine whether any difference in variance between the two groups was statistically significant. The Brown Forsythe W50 test was conducted by first calculating the median of the scores for each group on each subtest and the composite. The group median was then subtracted from each participant's standard score. Participants with a standard score greater than the median had a positive deviation score, whereas participants with a standard score less than the median had a negative deviation score. However, taking the absolute value of these scores resulted in positive deviation scores for all participants. Means and standard deviations were then calculated from the deviation scores for each group on each subtest and the language composite. The deviation scores were then analyzed to test whether the difference in the mean deviations of the two groups was statistically significant.

Overlap in scores between groups. The overlap of the five subtest scores and the Language Standard score produced by the two groups was also analyzed. This was done by examining scores from the children with typically developing language to determine how many of them had subtest scores more than one *SD* below the mean. Conversely, the number of children identified with SLI scoring in the average or above average range was also examined. In addition, sensitivity and specificity measures for these data were obtained for each subtest and the Language Standard.

Analysis of Subtest Scores Produced by Children with SLI

The CASL subtest scores for the children with SLI were also examined to determine patterns of strength and weakness. This analysis allowed general comparisons

with existing subcategories of SLI, such as those proposed by Rapin and Allen (1987). It also allowed an assessment of the supposition that children with SLI display a core deficit in language form and content, with pragmatic ability relatively intact (Tager-Flusberg, 2004).

In order to assess patterns of weakness within the group of children with SLI, the number of children scoring one *SD* below the mean on (a) one CASL subtest, (b) two CASL subtests, (c) three CASL subtests, (d) four CASL subtests, or (e) all of the CASL subtests was assessed. Children were then placed into categories depending upon which combination of low subtests they exhibited.

Results

Variability Between Groups

Means, standard deviations, and variances were computed for the five subtests and Language Standard scores for each group, and are displayed in Table 2. The variance estimates for the group of children with typically developing language were all greater than the variance estimates for the group of children with SLI on each subtest and the composite. This indicated that the children with typically developing language were more variable than children with SLI. Thus, the variance values of the typically developing group were divided by the corresponding variance values from the group with SLI to obtain the variance ratio, or test statistic, for each subtest and the Language Standard score. The variance ratios for each CASL subtest and the Language Standard are also displayed in Table 2.

F-test of two independent variances. The results of this analysis support the alternative hypothesis that the variances of the two groups were not equal for four of the six CASL measures. The variances of the children with typically developing language were significantly greater than those of the group with SLI on the following subtests: Syntax Construction, $F(56, 56), p = .0106$; Nonliteral Language, $F(56, 56), p = .0001$; Pragmatic Judgment, $F(56, 56), p = .0030$. The variances of the children with typically developing language were also significantly greater than those of the group with SLI on the composite Language Standard, $F(56, 56), p = .0028$, according to this statistical test.

Brown-Forsythe median test. The results of this analysis indicated that the average deviation from the mean was larger for the children with typically developing language on all subtests and the Language Standard (see Table 3). This difference in average deviation was statistically significant for the Language Standard and the

Table 2

Descriptive Statistics and Variance Ratios for Groups on CASL Subtests and Composite

Subtest	SLI			Typical			Ratio
	<i>M</i>	<i>SD</i>	Variance	<i>M</i>	<i>SD</i>	Variance	
Antonym	87.26	11.43	130.59	105.33	12.32	151.83	1.16
Syntax	81.91	9.76	95.33	102.25	13.33	177.80	1.87*
Paragraph	91.51	13.25	175.65	111.68	15.11	228.22	1.30
Nonliteral	83.16	8.36	69.81	106.68	13.84	191.58	2.74**
Pragmatic	76.37	12.16	147.77	101.30	17.66	311.78	2.11**
Standard	80.18	8.74	76.36	106.82	12.72	161.86	2.12**

* $p < .05$. ** $p < .01$

Table 3

Inferential Statistics for Brown-Forsythe Median Test

Subtest	Average deviation from median		<i>F</i> (1,112)
	SLI	Typical	
Antonym	8.67	9.75	.59
Syntax	7.81	10.79	5.38*
Paragraph	9.54	13.04	5.02*
Nonliteral	6.96	10.51	7.18**
Pragmatic	9.26	13.95	6.43**
Standard	6.60	10.61	11.01**

* $p < .05$. ** $p < .01$

following subtests: (a) Syntax Construction, (b) Paragraph Comprehension of Syntax, (c) Nonliteral Language, and (d) Pragmatic Judgment. These data supported the alternative hypothesis that the variances of the children with typically developing language were significantly larger than the variances of the children with SLI on the Language Standard and all but one of the subtests (see Table 3 for inferential statistics).

Overlap in scores between groups. The overlap between groups was assessed by charting the individual scores of children with SLI and children with typically developing language on a scatter plot. Scatter plots for each subtest were created to visualize the variability of children with SLI (see Figures 1-6). To quantify this information, the number of children with SLI who would be considered average or above average based on their individual CASL subtest scores and the Language Standard was calculated. Conversely, the number of children with typically developing language that would be identified as having LI based on individual CASL subtests or the Language Standard is presented. The results of this analysis are outlined in Table 4, along with measures of sensitivity and specificity for this sample of children.

As can be seen from the data in Figures 1 through 6, as well as the summary presented in Table 4, the number of individuals who would be misclassified varied by subtest. The subtests had much higher specificity than sensitivity. The Paragraph Comprehension of Syntax and the Antonym subtests were the poorest at identifying children as being impaired. However, even the best of the measures, the Pragmatic Judgment subtest, identified general impairment 75% of the time. It was surprising that the composite score, which should be more indicative of overall classification than the subtest scores, was not as accurate as the Pragmatic Judgment subtest.

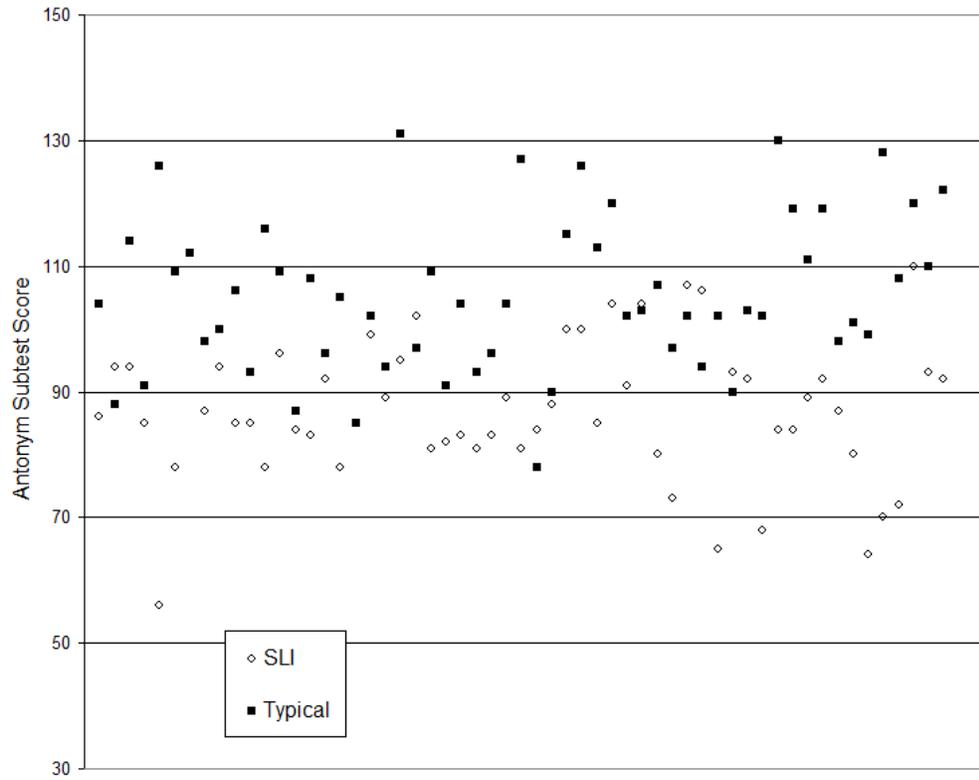


Figure 1. Overlap of scores produced by children with SLI and typically developing children on the Antonym subtest.

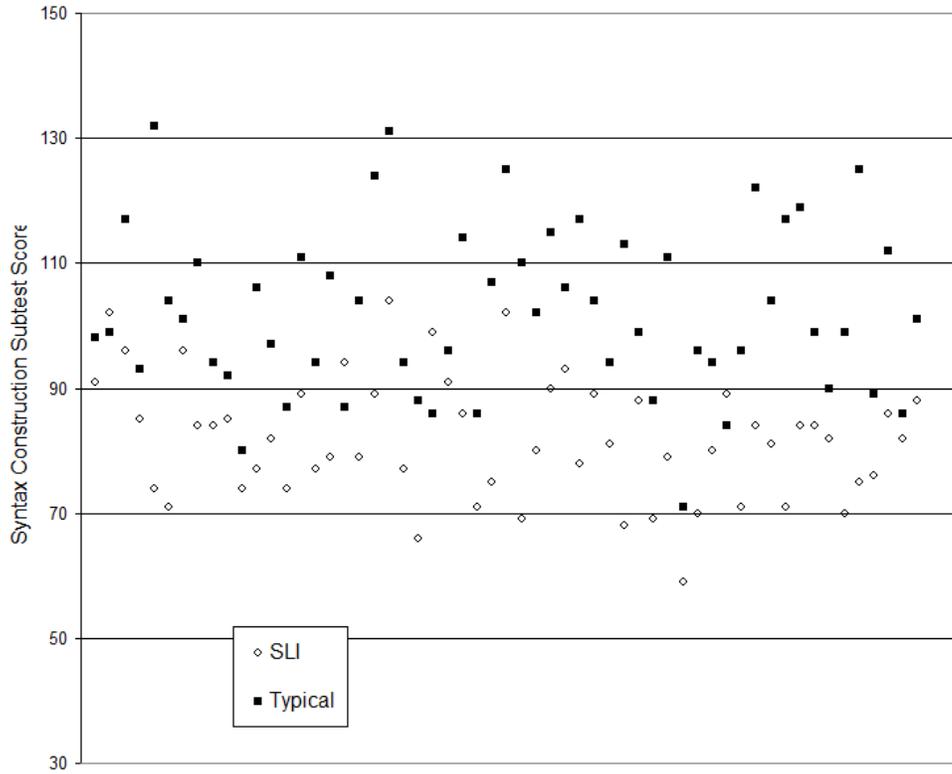


Figure 2. Overlap of scores produced by children with SLI and typically developing children on the Syntax Construction subtest.

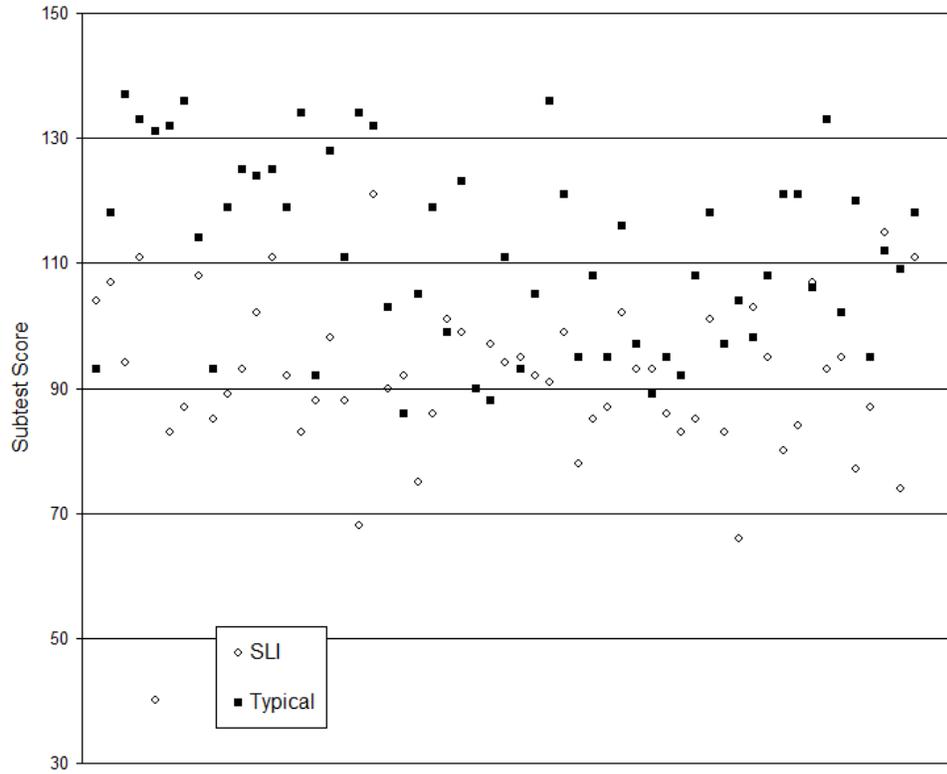


Figure 3. Overlap of scores produced by children with SLI and typically developing children on the Paragraph Comprehension of Syntax subtest.

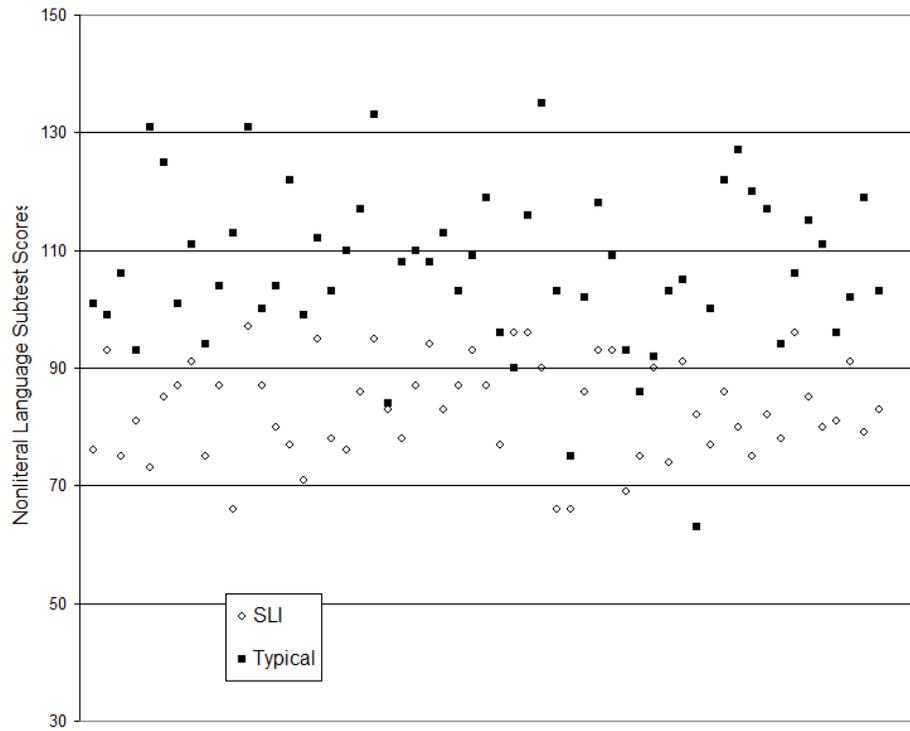


Figure 4. Overlap of scores produced by children with SLI and typically developing children on the Nonliteral Language subtest.

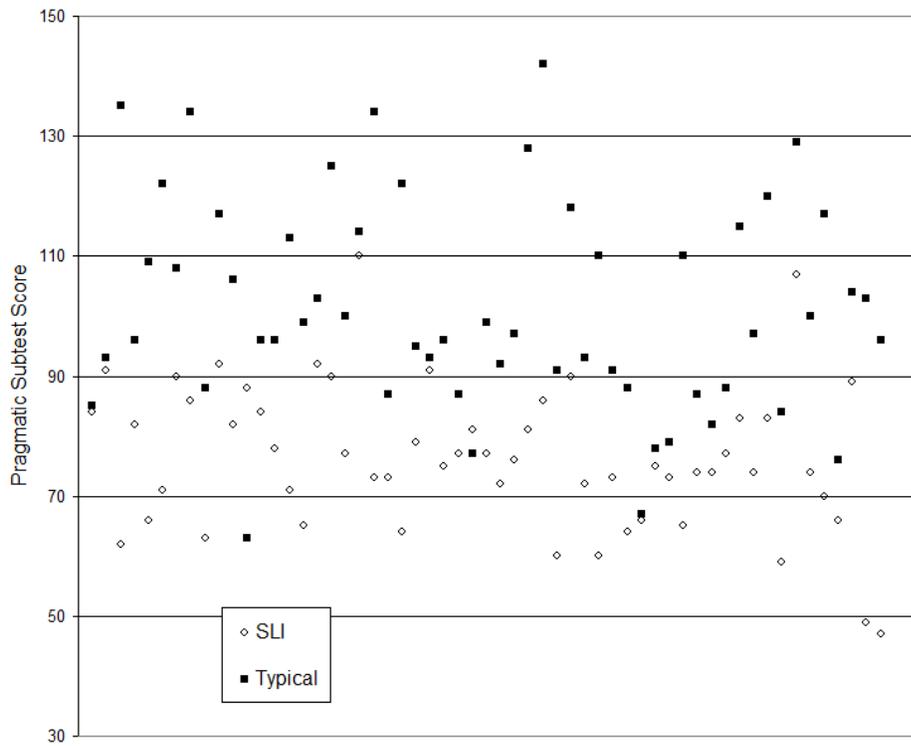


Figure 5. Overlap of scores produced by children with SLI and typically developing children on the Pragmatic Judgment subtest.

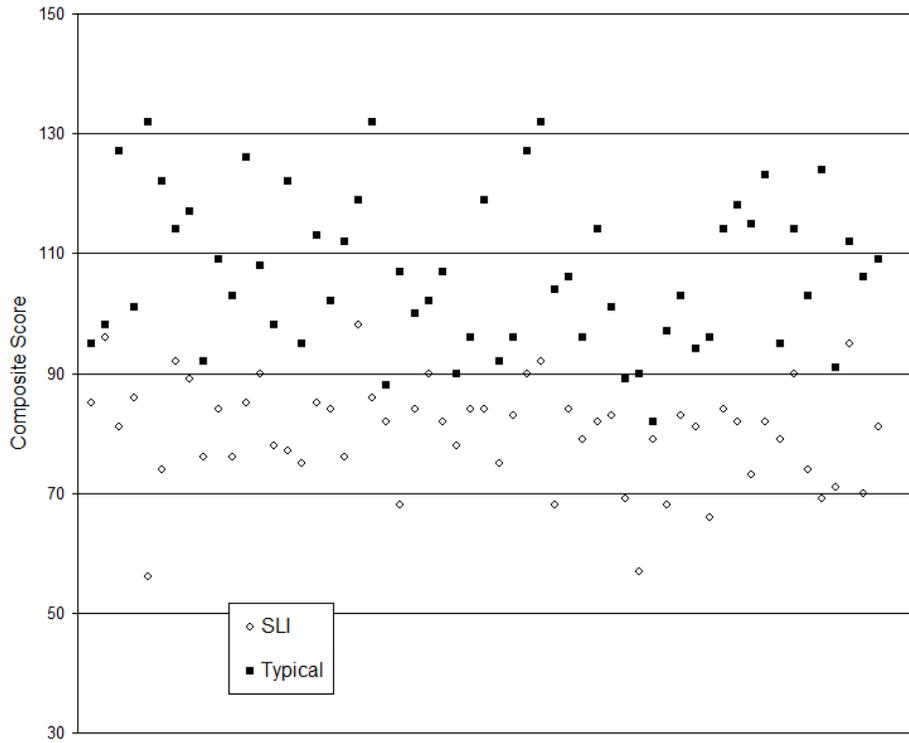


Figure 6. Overlap of scores produced by children with SLI and typically developing children on the Language Standard composite scores.

Table 4

Comparison of Sensitivity and Specificity for CASL Subtests and Composite

Subtest	SLI identified as typical	Typical identified as disordered	Sample sensitivity (%)	Sample specificity (%)
Antonym	34	1	40.35	98.25
Syntax	21	3	63.16	94.74
Paragraph	44	0	22.81	100.00
Nonliteral	27	3	52.63	94.74
Pragmatic	14	8	75.44	85.96
Composite	16	1	71.93	98.25

Profiles from Subtest Scores of Children with SLI

The subtest scores of the children with SLI were analyzed to determine how many children exhibited weakness on one, two, three, four, or all CASL subtests. First, the number of children scoring one *SD* or more below the average (100) on each CASL subtest was tallied. These results are outlined in Table 5.

In addition, the subtest scores were analyzed to tease out different language profiles of children with SLI. For example, children with SLI who displayed weakness in two particular subtests, but achieved average or above average scores on the other three subtests were all placed into the same group. The resulting 19 groups were delineated and labeled according to their areas of weakness on the CASL test. The different divisions of children with SLI were as follows: (a) average on all subtests, (b) one area of impairment, e.g., Antonym, (c) two areas of impairment, e.g., Antonym-Syntax, (d) three areas of impairment, e.g., Pragmatic-Nonliteral-Antonym, (d) four areas of impairment, e.g., Pragmatic-Syntax-Paragraph-Nonliteral, and (e) weakness in all subtests. The number of children in each group is presented in Tables 6 – 9.

As can be seen in Tables 6 through 9, the analysis of subtest grouping did not reveal notable subgroups of impairment. The largest number of participants falling into any combination of subtests was six, which occurred three times. Ten of the nineteen combinations included zero, one, or two children. The combination of subtests that seem to involve the most children were various grouping of poor performance on the pragmatic and nonliteral subtests, which involved 17 children.

Table 5

Number of Subtests on which Children with SLI Scored a Standard Deviation or More

Below the Mean

Number of Subtests	Number scoring > 1 SD below
0	6
1	6
2	16
3	12
4	13
5	4

Table 6

Children with SLI Showing Weakness on One CASL Subtest

Subtest	Number of children
Antonym	1
Syntax	1
Paragraph	0
Nonliteral	2
Pragmatic	2

Table 7

Children with SLI Showing Weakness on Two CASL Subtests

Subtest combination	Number of children
Antonym-Syntax	3
Pragmatic-Nonliteral	4
Syntax-Pragmatic	6
Pragmatic-Antonym	3

Table 8

Children with SLI Showing Weakness on Three CASL Subtests

Subtest combination	Number of children
Pragmatic-Nonliteral-Syntax	6
Pragmatic-Nonliteral-Antonym	1
Pragmatic-Antonym-Syntax	3
Pragmatic-Paragraph-Syntax	1
Pragmatic-Nonliteral-Paragraph	1

Table 9

Children with SLI Showing Weakness on Four CASL Subtests

Subtest combination	Number of children
Pragmatic-Syntax-Paragraph-Nonliteral	5
Pragmatic-Antonym-Syntax-Nonliteral	6
Pragmatic-Antonym-Paragraph-Nonliteral	1
Pragmatic-Antonym-Syntax-Paragraph	1

Discussion

Reflections on Research Questions

It is well known by researchers and clinicians that children with SLI are a highly heterogeneous group (Leonard, 1998; Paul, 2007). Several attempts have been made to account for this variability through establishing identification protocols for SLI (Stark & Tallal, 1981), delineating underlying factors that cause SLI (Bishop, 2006), creating subgroups of SLI (Rapin & Allen, 1987), and defining SLI on a continuum (Rescorla, 2005). Some researchers have stated that the language strengths and deficits of children with SLI could be described as a “smorgasbord” of language ability (Fujiki & Brinton, 2007). The following study built on this work by examining the categorization of children with SLI to answer two research questions.

Question One. Do Children with SLI Display More Linguistic Variability than Typically Developing Children? The simple answer to this question, based on the data gathered for this study, is no. On all subtests and the composite score from the CASL (Carrow-Woolfolk, 1999), children with SLI did not display more linguistic variability than their peers with typically developing language. However, this answer must be qualified by the fact that children with typically developing language showed significantly more linguistic variability on four of the five CASL subtest measures and the Language Standard Score. The level of significance from the Brown-Forsythe median test was used as the standard because this is a more sensitive measure of difference. Measures of reliability are employed with the assumption that two population groups will display equivalent variances. Conceptually, the reliability of a set of measurements is defined as “the proportion of the variance in the observed scores from a test that is due to true differences in the examinees” (Furr & Bacharach, 2009; Thorndike & Thorndike-

Christ, 2010). Mathematically, this means that the reliability is defined as variance of the true scores divided by the variance of the observed scores. Because children with typically developing language displayed more linguistic variability than children with SLI on five of the six CASL measures, the reliability statistics reported on standardized tests may be affected. On the Nonliteral Language subtest, Pragmatic Judgment subtest, and Language Standard, the variance of the group with typically developing language was more than twice the size of the group with SLI. This means that the denominator used in the reliability formula would be twice as large for the children with typically developing language than for the children with SLI for these three subtests. Unless the differences in the variability of the true scores for the two groups is similar to the differences in variability of their observed scores, then at least some of the five tests will be differentially reliable for the two groups. The fact that both measures, the F-test of two independent variances and the Brown-Forsythe median test, produced significant differences was concerning with respect to the reliability measures reported in the CASL manual.

In addition to examining the overall variability of the two groups, a number of analyses were performed to determine if the CASL could accurately separate children with SLI from their typically developing peers. The results of these analyses were mixed. Most subtests and the overall composite score did a relatively good job with specificity (identifying individuals who had typical language skills as being typical). These tests showed considerable more variability, however, when sensitivity was examined. Even using the one *SD* level as the defining point for disorder, which was the most lenient standard possible, several of the subtests performed poorly. For example, the Paragraph

Comprehension of Syntax subtest had a very low sensitivity of approximately 23%. This means that roughly 77% of the population with SLI would be viewed as typical if assessed using this measure. This may have been the case, but it would be highly unlikely given that comprehension problems are characteristic of children with SLI. The subtest with the highest sensitivity was the Pragmatic Judgment subtest, at approximately 75%. If these data are to be taken at face value, pragmatic problems would be the most common problems seen in children with SLI. This may have been the case, particularly in the database sampled. It would not be expected, however, given the notion that children with SLI have relatively typical pragmatic abilities (Tager Flusberg, 2004).

The scatterplots were a visual representation of the variability of children with SLI. They also illustrated the overlap in language ability between children with typically developing language and children with SLI. The scatterplots support the theory that children with SLI be viewed on a continuum, not as a group of children with the same language skills and characteristics.

Question two. Does the Within Group Variability of Children with SLI Reflect Specific Areas of Impairment or a More Pervasive Disorder? This question examined the existence of subgroups in the group with SLI. Based on the analysis of subtest scores, 19 different subgroups were found. These groups were very small, due to the large number of possible divisions. In fact, several of the groups contained only one member. Furthermore, if these groups were to be subsequently divided according to severity of weakness on the affected subtest(s), the number of groups would increase and the number of individuals within each group would decrease. These results seem to lend credence to the notion of either a continuum or a variety of language weaknesses that differ for each

child with SLI (i.e. “smorgasbord”). As an illustration of this inclination, the proceeding discussion focuses on the subgroups identified in this research study and the subgroups proposed by Rapin and Allen (1987).

Rapin and Allen (1987) proposed an often-cited subcategory system of SLI based on clinical judgments. Rapin and Allen outlined six distinct subgroups of the disorder. These subgroups included (a) Phonological-Syntactic Deficit Syndrome, (b) Lexical-Syntactic Deficit Syndrome, (c) Verbal Auditory Agnosia, (d) Semantic-Pragmatic Deficit Syndrome, (e) Verbal Dyspraxia, and (f) Phonological-Programming Deficit Syndrome. Although it is not possible to draw specific comparisons between the current results and the Rapin and Allen categories, some general comparisons can be made.

The five subtests of the CASL used for this research included: (a) Antonym, (b) Syntax Construction, (c) Paragraph Comprehension of Syntax, (d) Nonliteral Language, and (e) Pragmatic Judgment. Each of these subtests was designed with items that assess the receptive, expressive, and retrieval skills of children within four language categories: (a) lexical or semantic, (b) syntactic, (c) supralinguistic, and (d) pragmatic.

The Phonological-Syntactic Deficit Syndrome proposed by Rapin and Allen (1987) contains children with weakness in pronunciation of speech sounds and fluency along with several grammatical errors. This subcategory could possibly categorize the children in the CASL group that exhibited weakness on the Syntax Construction subtest, possibly the Paragraph Comprehension of Syntax subtest, and a combination of the two. So, this group would include one child from the group of children with SLI observed in the present study.

Children with Lexical-Syntactic Deficit Syndrome were very similar to the previous group of children except they also exhibited difficulty with word finding, but no articulation errors. The current analysis did not include an assessment of articulation or word finding. However, if children did poorly on the Antonym subtest due to a word finding problem, children from the Antonym and Antonym-Syntax groups could be included, producing a total of four children.

Children with Verbal Auditory Agnosia had limited or absent speech and comprehension deficits. This group could include the children from this research that exhibited difficulty on four subtests or all five subtests, as an indication of severity of LI. These two groups of children contained 17 members. However, every child in our sample was able to produce some speech, and this speech could not be described as very limited or absent, thus the category does not fit well with current observations.

Children with Semantic-Pragmatic Deficit Syndrome had fluent and well-articulated speech, but exhibited echolalia or unanalyzed scripts. This could be likened to children from the Pragmatic-Antonym group, a group with three members. The children from the Pragmatic-Antonym group display semantic weakness along with impaired pragmatic language.

There were two more groups proposed by Rapin and Allen (1987): Verbal Dyspraxia and Phonological-Programming Deficit Syndrome. Children from Rapin and Allen's Verbal Dyspraxia group displayed weakness in expressive language with relative strength in receptive language. This could be likened to the children who did poorly on all subtests excepting the Paragraph Comprehension of Syntax subtest, a group of participants that have already been categorized under the Verbal Auditory Agnosia group.

This group included 6 children. Children from Rapin and Allen's Phonological-Programming Deficit Syndrome group displayed weakness in producing intelligible utterances. This group did not seem to correlate with any of the groups outlined in the current data.

The process described above could account for 25 of the 57 (44%) children with SLI, if deficits in pragmatic language are included as a concomitant weakness in the Phonological-Syntactic Deficit Syndrome group and the Lexical-Syntactic Deficit Syndrome group. The remaining participants with SLI do not fit within the categories outlined by Rapin and Allen (1987). There are two explanations for this situation: (a) children with SLI are too heterogeneous to be divided into subcategories and (b) the CASL does not assess language characteristics that parallel those measured for Rapin and Allen's subgroups.

The children with SLI from our research were not assessed in the same way as the children from Rapin and Allen's (1987) research, and a more accurate comparison would have to be made in order to be conclusive. However, the 19 small subgroups delineated are an indication that children with SLI are too heterogeneous to fit into a small number of subgroups. The ideas of a continuum of language ability or a "smorgasbord" of language abilities and deficits in each child with SLI seem to provide a better characterization of children with this disorder based on the analysis of CASL subtest scores from this group of children with SLI.

Pragmatic Language and Future Research

Of note, but not addressed specifically in this study, is the fact that 50 of 57 (88%) children with SLI exhibited weakness in the area of pragmatic language skills. It is often suggested that children with SLI have difficulties with syntax and semantics, and that

their pragmatic abilities are intact. It is also assumed that any pragmatic difficulties they do have stem from problems in other aspects of language. The current study produced surprising results in this respect, with the most prominent area of impairment being in pragmatics. It is possible that deficits in other areas produced these problems, but consistent patterns were not observed. Thus, difficulty in specific aspect of languages, such as syntactic production, did not consistently link to difficulty in pragmatics. It would be interesting to determine if these children had pragmatic problems when observed in actual interactions, or if they had difficulty with the test format, which was largely based on making judgments of scenarios presented by the examiner.

Summary and Conclusions

Children with SLI have often been typified as a highly heterogeneous group. This is important because the reliability statistics on standardized language tests are based upon the assumption that the two groups have the same variance. According to this set of data, children with SLI did not display more variance as a group than children with typically developing language. In fact, children with typically developing language displayed significantly more variance as a group than children with SLI. This finding emphasizes the fact that typically developing children form a heterogeneous group, and cannot be thought of as representing a singular standard of performance. With respect to test performance, this finding has important implication for the reliability statistics provided in the CASL manual. Although the sample in the current study and the CASL normative sample were not identical, they do raise questions about the generalizability of reliability figures to a population with impaired language skills. If test developers assume that the variances of children with SLI and children with typically developing language are equivalent, then the assessment may be less reliable than the test manual indicates.

Although children with SLI did not display a significantly greater variance than children with typically developing language, the analysis of their performance on the CASL subtests suggested that they are a highly heterogeneous group. The analysis portrayed a large number of different profiles (19 groups) that these children could be divided into based on strengths and weaknesses in multiple language areas. Future research is necessary, preferably with a larger group of children identified with SLI, to determine whether subgrouping is a viable option for defining children with SLI or whether children with SLI could be classified on a continuum or as possessing several different combinations of language deficits. This data supports the latter theory.

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