LANGUAGE LEARNING

IN SCHOOL-AGE CHILDREN

by

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ABSTRACT

This research investigated syntactic bootstrapping -- a process presumed to facilitate the acquisition of language knowledge -- in children with specific language impairment (SLI). This process involves the use of syntactic information to learn new verbs. Six SLI children (mean CA 7;9) were matched on grammatical comprehension abilities to six younger children with normal language (NL) development (mean CA 6;2). Sentences containing novel verbs were presented orally by the examiner to the children. The children demonstrated interpretation of the sentences in an object manipulation procedure. The experiment was designed to determine if the level of syntactic knowledge, as measured by grammatical comprehension, accounted for syntactic bootstrapping performance. A grammatical judgment task also tested the connection between syntactic bootstrapping and metalinguistic awareness. The results indicate that young school-age SLI children cannot predict new verb meanings from syntactic frameworks. Although data support previous findings (van der Lely, 1994), methodological adjustments made in the present study clearly justify claims made about the nature of syntactic bootstrapping. Data are interpreted as evidence that a group difference in syntactic bootstrapping is not the result of a deficit in syntactic knowledge, but rather due to other processes. Evidence was found that supports a relationship between syntactic bootstrapping and metalinguistic awareness. Interpretations were made considering an underlying process related to syntactic analysis that may explain the syntactic bootstrapping and metalinguistic connection, and perhaps ultimately the slower language learning overall of SLI children.

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CHAPTER 1: <u>INTRODUCTION</u>

INTRODUCTION

LANGUAGE ACQUISITION

Language acquisition theorists are divided about the uniqueness of language learning processes. One view is that children acquire language based on an interaction between innate, uniquely linguistic principles and the language environment (Chomsky, 1981; Pinker, 1989; Connell, 1990). Others claim that children's language development can be attributed to more general, cognitive abilities interacting with language input (Slobin, 1973; Chapman, 1979; Bock, 1982; Ellis Weismer, 1991; Johnston, 1993). By extension, attempts to explore the source of language difficulties in children with specific language impairment (SLI) have fallen near or within either of these two explanations.

Numerous authors, for instance, propose that the domain-specific linguistic deficits of SLI children point to the autonomy of a unique language acquisition mechanism (Connell, 1990; van der Lely, 1994). The Universal Grammar theory, for example, proposes that an innate linguistic system allows a child to make choices about the linguistic input after receiving sufficient evidence (Chomsky, 1981; Connell, 1990). Choices are driven by a "set of narrowly defined, innately given questions (parameters) about the nature of the input" (Connell, 1990). This theory suggests that the problem in SLI children is the mis-setting of parameters. Other researchers propose that language impairments of SLI children can be attributed to a general pattern of late onset and slow development due to a variety of cognitive processing limitations, such as in processing rapidly changing auditory information (Kamhi, 1981), constructing inferences (Ellis

Weismer, 1985), or accessing and coordinating complex mental schemes (Johnston, 1993). Due to the indirect method of obtaining information about the mind's internal organization and processing of linguistic knowledge, it remains to be seen whether SLI children's difficulties can be viewed as the outcome of innate, linguistic-specific mechanisms or as a symptom of general neuropsychological dysfunctions. Nevertheless, in both cases, research into the general nature of language is being used to investigate the question of how learning could go awry.

THEORY OF VERB LEARNING: SYNTACTIC BOOTSTRAPPING

Research on language learning in young school-age children suggests that learning processes involve an interaction between prior linguistic (and cognitive and social) knowledge and new language forms. One such language learning process, which Landau and Gleitman (1985) term 'syntactic bootstrapping,' entails the constructive use of syntactic knowledge to predict new semantic elements. Syntactic bootstrapping, also discussed with reference to 'reverse linking' (van der Lely, 1994) or 'frame compliance' (Naigles et al, 1992), is a procedure whereby the syntactic information in a sentence can be organized using syntactic knowledge and then mapped onto probable meanings. For example, children can use a canonical[1] interpretation of subject as agent and object as patient in an active transitive sentence to predict that a word in the verb position encodes not only some sort of action, but also some sort of causal relationship between the subject and the object. A standard assumption in a semantic theory is the inclusion of

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[1]The term 'canonical' is used both in the sense of a standard or typical constituency order in English, namely, SVO, and in the sense of appropriate thematic role assignment, such as in causal transitive sentences and locative-type sentences.

such a link between semantics and syntax (Jackendoff, 1983; Pinker, 1985, 1989).

The notion of syntactic bootstrapping brings with it certain assumptions. First, the learner has knowledge of the classes of words (syntactic categories), such as nouns, verbs, and prepositions. For example, the child knows that words such as 'book' or 'dog' (nouns) have different positions in an English utterance than words such as 'eat' or 'jump' (verbs). Children demonstrate their knowledge of word-classes in their early appropriate use of words. Second, the syntactic structure of an input utterance is recognized by some means, mechanism or device, sometimes called a parser (Caplan, 1987) or phrase structure analyses (Landau and Gleitman, 1985). In other words, the child is able to segment the sentence into separate constituents and determine their relationships. Third, there is a set of thematic role categories -- innate or learned (Bowerman, 1990) -- that the child has acquired somehow; for example, s/he has knowledge of agent, patient, goal, and so forth (Landau and Gleitman, 1985).

Current descriptions of English suggest that transitive action verbs are the most prototypical class of verbs (Pinker, 1989). Sentences with transitive verbs are canonical and, therefore, apparently easier to understand. Canonical syntactic representation in an active transitive sentence pairs subject [first noun phrase (NP) in the sentence] with agent of a causative event and object (second NP in the sentence) with patient. In an active transitive locative sentence, canonical syntactic representation pairs subject with agent of a movement event, object with patient, and oblique object (third NP) with goal. And, in an active transitive sentence in which two nouns in object position are joined with the conjunction 'and,' subject is paired with agent of a causative event and objects (second and third NPs) are paired with patient.

A small exercise here illustrates the use and benefits of syntactic bootstrapping. Consider the Latin expression, "agricola X lupum." Assume that you know, by whatever means, such as a parser, that the sentence is a transitive type, but you do not know the meaning of the verb, 'X.' You do know, however, that 'agricola' means 'the farmer' and 'lupum' means 'the wolf'. You analyze your knowledge of Latin syntax which states that the inflectional suffix '-a' indicates the subject of the sentence, and '-um', the direct object. This knowledge is, of course, different from that about English, where word order plays an important role. Using the syntactic knowledge, including knowledge about the transitive subcategorization frame, you 'bootstrap' into the meaning of 'X' as a causal action instigated by the farmer onto the wolf. In other words, you now know more about the meaning of the verb because of the process of using syntactic information, in the absence of contextual or pragmatic cues.

Syntactic bootstrapping is clearly a process that requires the syntacticalization of language knowledge. This means that the ability to organize syntactic input to learn verb meanings relates to the state of the syntactic knowledge store. According to some acquisition theorists, young children reach a point where their earlier meaning-motivated language structures become more formalized; that is, they move from functional to syntactic categories in their organization of knowledge (Johnston and Kamhi, 1984). If so, one can assume that the process of syntactic bootstrapping occurs sometime after the onset of syntactic acquisition and continues throughout school-age and adult years. The syntactic knowledge store grows to embrace, among others, a set of subcategorization frames[2] that we assume are "stored in order to learn verb meanings [and] are part of what constitutes language knowledge in the long run" (Landau and Gleitman, 1985). Syntactic bootstrapping is a continuous and regular action that can be predicted to increase in efficiency as one's knowledge of such frameworks, and the ability to access and analyze this knowledge, increases.

In the child with normal language development (NL), the most active period for learning base syntax is between eighteen months and four years (Morehead and Ingram, 1973). Studies have suggested that the ability to use syntactic cues, such as the number and ordering of NPs in an utterance, to learn verb meanings is found in NL children as young as 2;0 (Bowerman, 1990; Naigles, 1990). For example, in Naigles' (1990) study, children (mean CA 2;1) heard a novel verb presented in either a transitive or intransitive frame (e.g., *The duck is gorping the bunny/The duck and the bunny are gorping*). At the same time, two actions (causative and non-causative) performed simultaneously by the same two actors were shown on a screen. Then, the two actions were presented separately one after the other. Visual fixation time was measured and compared between the two separate single action showings. The children were shown single screens again and asked to find 'gorping,' for example. Results showed that children who heard novel verbs in transitive frames looked longer at video scenes representing causative actions rather than non-causative actions. Naigles' study supports the early operation of syntactic bootstrapping for young children who must infer the referents of novel verbs.

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[2]Subcategorization frames represent a set of syntactic patterns specifying the order and type of syntactic elements associated with a particular class of verbs. Traditional verb classes include transitive, intransitive, and ditransitive.

Considerable evidence exists to suggest that syntactic bootstrapping continues to be operative in determining the meanings of words, such as verbs and nouns (Naigles et al, 1992; Soja, 1992). In a study by Naigles et al (1992), when presented with an ungrammatical sentence in which the syntactic frame was inconsistent with the standard argument structure of the verb (e.g., *the zebra goes the lion*), preschool-age and younger school-age children (CA5-9) tended to alter the usual meaning of the verb to fit with the novel syntactic environment. This tendency gradually declined in 12-year-old children, who changed the syntax when presented with the same sentences. This study by Naigles et al (1992) especially relates to the present investigation in its emphasis on the constructive nature of children's language learning. Children are generally able to use what they know to help them learn more. Naigles et al's study emphasizes that young school-age children can and do use their knowledge of syntactic frames to predict meaning. In fact, they rely more on knowledge of syntactic structure than on 'known' verb meaning and arguments. Thus, syntactic bootstrapping continues to be a useful and important process in language learning.

The mapping process from syntax to semantics is typically used in conjunction with extralinguistic cues; however, when contextual cues, such as in the Latin example above, are vague or absent, syntactic bootstrapping may take precedence when learning new words. Landau and Gleitman (1985) underscore the syntactic-based learning process in their work with blind children. Despite the absence of visual experience, Landau and Gleitman show that blind children's language learning follows a similar course to that of sighted children. Their discussion of semantic values of subcategorization frames reinforces the need for a theory that illuminates the role of syntactic framework in the learner's organization of experience to gain lexical knowledge. Much of the discussion surrounding syntactic bootstrapping concerns the problem of how the child identifies the various distributional patterns in the input language, that is, the overall organization of the verb lexicon (see, for example, Pinker, 1989; Bowerman, 1990). Although the present study touches upon this aspect of the discussion, its primary focus is on extending the syntactic bootstrapping hypothesis to SLI children.

PURPOSE STATEMENT

In the same way that research from several theoretical perspectives on linguistic processes in general have informed our understanding of SLI children, the literature on syntactic bootstrapping might also be useful in understanding the nature of SLI children's language learning. The focus of the present study then is on a certain process, syntactic bootstrapping, that is presumed to facilitate the acquisition of language knowledge. Syntactic bootstrapping is proposed as a way for the child to reflexively impose order on the language s/he hears by referring to her/his own expanding range of linguistic knowledge. Specific evidence for the importance of syntactic bootstrapping in verb learning is provided in work by Landau and Gleitman (1985), Naigles (1990), and Naigles et al (1992). It may even be the case that young school-age learners, as Naigles et al (1992) show, are more capable of (or more dependent on) using syntactic knowledge than semantic knowledge. In other words, the interaction between the child's language learning processes and the language environment may crucially involve the reflexive use of syntactic knowledge.

This being the case, the child who cannot do syntactic bootstrapping is at a disadvantage. Upon hearing a new verb, the child cannot appeal to this presumably effective and common language learning process, and, thus, has a more difficult time learning the verb. The result, immediately and in the long run, is that this particular child cannot learn language as efficiently as the child who can do syntactic bootstrapping. This line of reasoning suggests that poor language learning in SLI children may be due in part to an inability to do syntactic bootstrapping. In particular, this thesis considers the possibility that syntactic bootstrapping abilities differentiate among school-age children with varying degrees of language learning proficiency. If so, the notion of the syntactic bootstrapping process may ultimately help us understand why some children have difficulty learning language.

LITERATURE REVIEW

PROFILE OF SLI CHILDREN

Children who have been diagnosed with a 'specific language impairment' show no evidence that their language difficulties were the result of substantially depressed intellectual functioning, hearing loss, or disturbance in socio-emotional behaviour and development. On standardized language tests, these children obtain scores significantly below age-expected scores. Their language age falls below their chronological age and mental age as established by nonverbal tests. SLI children encompass a heterogeneous group of children in terms of a linguistic profile -- some SLI children have more difficulties with language comprehension, others may exhibit difficulties with language production, and others may have phonological difficulties.

Although it is acknowledged that SLI children do not form a particularly homogeneous group in terms of patterns of linguistic deficits, the most typical profile of English-learning SLI children involves limitations primarily in the areas of grammatical morphology (Johnston & Kamhi, 1984; Leonard, 1989) and metalinguistic awareness (for a review, see Kamhi, 1987), although recent research provides evidence that nonverbal cognitive skills are also implicated (Ellis Weismer, 1991; for a review, see Johnston, 1993).

In Kamhi's (1987) review of the few existing studies of SLI children and metalinguistic ability, he concludes that they do not have a general or pervasive metalinguistic deficit. Their metalinguistic limitations are seen primarily in judgments of syntactic agreement and word order (Liles et al, 1977) and grammatical markers (Kamhi and Koenig, 1985). This being true, one could argue that knowledge of syntactic relationships underlies the observed difficulties in producing grammatical morphemes and in making metalinguistic decisions. Grammatical morphological functioning represents the ability to mark the grammatical relations in a sentence; metalinguistic functioning represents the explicit analysis of language structure. It is plausible that the same syntactic processing ability applies to both areas.

As Johnston and Kamhi (1984) have put it, the use of grammatical morphemes may require the use of syntactic knowledge in terms of "an appreciation of the structural properties of language as a formal object apart from any direct ties to specific meaning." They provide evidence which highlights a gradual 'syntacticalization' of language knowledge from semantically defined constituents to mature use of grammar. By implication, the SLI children may be delayed in the structural analysis of their own syntactic knowledge, a deficit that is reflected in the delayed grammatical morphemes.

Similarly, the ability to make metalinguistic decisions depends on one's knowledge of what constitutes language structure. A child's judgement about grammaticality demonstrates, in part, her/his ability to explicitly think about correct language structure, based on what s/he knows this to be. The inability of the SLI child to make similar grammatical judgments may be due to an underlying deficit in the area of syntactic analysis.

If this line of reasoning is valid, and a common syntactic deficit exists in SLI children's difficulties with grammatical morphemes and metalinguistic awareness, one might expect to see difficulties with syntactic bootstrapping also. This learning process again depends on knowledge of the syntax of a language, the system of 'rules/principles/mechanisms' that determine what combinations of words into larger units, especially into sentences, the language allows (McCawley, 1988). On a specific level, syntactic bootstrapping requires that the child access her/his knowledge of common syntactic patterns and their links to relational meanings. If this knowledge is unavailable, no inference about verb meaning can be made.

SYNTACTIC BOOTSTRAPPING: STUDIES OF SLI CHILDREN

Only one study that examines syntactic bootstrapping in SLI children has been done (van der Lely, 1994). In van der Lely's current work on canonical mapping, or, linking rules, in SLI children, she probes the analytical use of language by SLI children. Van der Lely's study represents a significant contribution to the exploration of psycholinguistic processes that are used to learn languages. In particular, she examines the theory that syntactic-semantic linking rules help children learn the meanings of verbs.

Van der Lely matched six SLI children (CA 6;1 - 9;6) on language abilities to 17 younger NL children (CA 3;4-6;6). In two initial tasks, the SLI children performed similarly to NL children in the ability to interpret semantic information. In the first task, called 'forward linking,' the children were shown the meaning of a novel verb in a scene acted out by van der Lely, who identified the verb for them (e.g., "This is tiving"). The children were then asked to say what was happening. The aim was to see if the children identified thematic roles and used the new verb. Both groups nonverbally identified the participants and their appropriate thematic roles and verbally stated these relationships in a sentence. In a second task, van der Lely used the same novel verbs as those used in the first task in an object manipulation task to show interpretation of verbs heard in a sentence (i.e., no semantic cues). However, it was unclear whether the SLI children were relying on their previous representations of the verb or whether they were using syntactic information.

In a third task, van der Lely used different novel verbs in an object manipulation procedure. Results showed that the SLI group were not as capable as the NL group of using the syntactic frame to predict verb meaning. SLI children performed significantly poorer on locative sentences than transitive sentences, unlike the NL group. As expected for this language level, both SLI subjects and NL controls had more difficulty with passive sentences than with transitive sentences. Thus, it appears from these results that SLI children had some difficulty in making use of syntactic bootstrapping.

Van der Lely concludes that SLI children have insufficient general syntactic representations of predicate-argument structure to enable them to make use of syntactic bootstrapping. She interprets these findings within a government binding theory of language acquisition, proposing a specific linguistic deficit in SLI children. However, van der Lely's claim that SLI children's difficulty with sentence comprehension is due to faulty 'mapping mechanisms' for learning verb-argument structure is confounded by methodological concerns. In particular, van der Lely's selection criteria for the language-age (LA) match group can be called into question.

VAN DER LELY'S STUDY: METHODOLOGICAL CONCERNS

Van der Lely's (1994) work is constructive in its attempt to explore the analytical use of language by SLI children, that is, what it is they learn about language from language itself. What draws some concern, however, is van der Lely's criteria for determining a language-age (LA) matched control group. In particular, she establishes a match between SLI and NL populations, based upon an index that (1) combined performance in comprehension and production of single word vocabulary and expressive morphology and, (2), did not consider comprehension of more general syntactic frames for both groups. The conclusion that SLI children's poorer performance on the syntactic bootstrapping task demonstrates a deficiency in syntactic representation is therefore questionable.

The details of the discrepancies found in van der Lely's LA match control group selection criteria can be summarized as follows: Van der Lely's focus is on comparing syntactic processes of SLI and NL children; however, a disparity exists in the linguistic characterization of the two groups of children. The mean LAs of SLI children were matched to those of their controls to within six months. Each child in the SLI group was individually matched to three NL children on the basis of a combined score from several standardized language tests. Yet, calculation of the mean LAs differed between the SLI and NL groups. The mean LAs of the SLI children were based on scores obtained from two tests of language comprehension: the Reynell Developmental Language Scales (RDLS) and the British Picture Vocabulary Scale (BPVS), and from two tests of language production: the grammatical closure subtest from the Illinois Test of Psycholinguistic Abilities (ITPA) and the Expressive Vocabulary from the British Abilities Scale (BAS). The mean LAs of the control group were based on scores from only the latter three tests. In other words, the mean LAs of the control group were based on scores from only one comprehension test, one that assesses single word vocabulary, and two production tests; whereas, the mean LAs of the SLI group were based on two comprehension tests and two production tests. Summarizing over vocabulary and syntax seems particularly ill-advised given recent evidence (Moore and Johnston, 1994) that SLI children may have disparate performance in the two domains. This leaves open the possibility that children matched by mean LA could, in fact, have quite different syntactic comprehension abilities. For example, an SLI child with a syntactic comprehension age of 4, a vocabulary comprehension age of 6, a syntactic production age of 4, and a vocabulary production age of 6 would earn a mean LA of 5. S/he could be matched to a NL child with a vocabulary comprehension age of 5, a syntactic production age of 6, a vocabulary production age of 5, and unknown syntactic comprehension level. The resultant 'matched' pair could, in fact, have syntactic resources that differed by two years or more.

Further examination of subject description data in van der Lely's Appendix confirms the possibility of mismatch. For example, the SLI child, MP, aged 9;6, achieved age-equivalent scores of 5;9-5;11 on the RDLS and 7;3 on the ITPA and 7;4-7;5 on the BPVS [age-equivalencies for MP's raw scores on the BAS were unavailable]. MP's LA was given as 6;5, which suggests that his performance on the general language comprehension test decreased the mean LA. One of MP's LA matches, MP1, had a mean LA of 6;3; yet, his age-equivalent scores were 5;3 on the BPVS and 6;2 on the ITPA. His score on the BAS must have been higher than these two scores to attain the LA that he did. What is noticeable are the wide differences between the individual test scores obtained by the two subjects, regardless of their similar mean scores. These figures call into question the construct of a mean language-age match used in van der Lely's study, and leave open the possibility that children in her SLI group did not have syntactic knowledge that was comparable to that of the NL group.

Because van der Lely cannot claim that the two groups are matched on grammatical comprehension, her conclusion regarding the relationship between syntactic bootstrapping abilities and comprehension abilities is not warranted. The possibility still remains that syntactic bootstrapping can be attributed to a certain level of language comprehension. In other words, both SLI and NL school-age children might perform similarly on a syntactic bootstrapping task if they were matched closely on grammatic comprehension.

PROCESSES RELATED TO THE ABILITY TO PROCESS SYNTACTIC INPUT

Considering the concerns about van der Lely's methodology, along with the assumptions made earlier about an underlying syntactic deficit in SLI children, it is apparent that the process of syntactic bootstrapping needs to be examined more carefully in this population. One possible way to interpret van der Lely's findings about syntactic bootstrapping and SLI children is to examine processes related to the ability to draw inferences from syntactic information. It may be the case, as van der Lely claims, that SLI children do not have the requisite syntactic knowledge for making the syntactic-semantic link in a bootstrapping task. It may also be true that access to syntactic knowledge is blocked for these children. Or, something else may be at stake. A number of language learning processes relate to the general ability to process syntactic input. They include parsing, comprehension, and metalinguistic awareness. Each process will be discussed here in terms of its relationship to the interpretation of a potentially observed syntactic bootstrapping 'deficit.'

Parsing

Definition

One of the first steps for the language learner is the ability to parse the language input. It is generally agreed upon that this parsing ability involves the recognition and segmentation of the input utterance into separate constituents such as words, phrases, and clauses (Aitchison, 1990). Landau and Gleitman (1985) assume that what the process of parsing reveals to the listener is a "licensed subcategorization frame for the verb that appears in the utterance" (Landau and Gleitman, 1985). Clearly, parsing is a process that requires access to and use of syntactic knowledge.

Role in Acquisition

The importance of parsing ability in language acquisition is quite evident. Faced with unfamiliar elements, the learner can first identify and segment the familiar elements. This deconstruction may occur on a word by word basis, or on a phrase or clause basis. In doing so, unfamiliar items may be marked for involvement in the learning process. At the very least, parsing may allow for word segmentation. Knowledge of phrase and clause structure may also push the process along.

Relationship to Syntactic Bootstrapping

Given this seminal role of parsing in language acquisition, the relationship to syntactic bootstrapping is obvious. Before syntactic bootstrapping can occur, the child must be capable of parsing language input. The syntactic aspect of parsing is where the connection lies. If the language learner fails, in some degree, of recognizing or segmenting sentence constituents, then, there is no entry, so to speak, into the syntactic bootstrapping process. The same point can be made about the relationship between parsing and comprehension. That is, the difficulties that SLI children have with comprehension and syntactic bootstrapping may ultimately be due to trouble with parsing.

Comprehension

Definition

Comprehension is typically construed as 'getting the message' or 'understanding' (Fraser et al, 1973; Klima and Bellugi, 1973; Bishop, 1979; Connell, 1986; Fey, 1986; Aram, 1991). For instance, Aram says that comprehension implies that "the listener has understood the words and grammar of what he has heard; that he has successfully analyzed the words and sentence structure that have made up the message" (Aram, 1982). The listener's understanding may actually depend on one or more areas of knowledge, such as contextual, semantic, syntactic, pragmatic, worldly, and so forth. In many cases, though, comprehension involves access to and use of syntactic knowledge. What you know about grammar helps you understand language. For example, if you know that 'NP + "was" + V-ed + by + NP' represents a noncanonical assignment of thematic roles, then you will understand who licked who in the sentence "The baby was licked by the dog." However, a lack of this syntactic knowledge (or an inability to use it) may result in a different, but still plausible, interpretation of the same sentence.

Role in Acquisition

What is not clear in many discussions of sentence comprehension is reference to that facet of comprehension that is used for language learning. Discussions of levels of language comprehension in SLI children and NL children have focussed on comprehension as understanding. Researchers who study the use of comprehension strategies by children (de Villiers and de Villiers, 1973; Chapman, 1979; Tager-Flusberg, 1981; van der Lely and Dewart, 1986; Precious and Conti-Ramsden, 1988) assume that young children approach language events heuristically and adopt, for instance, a 'child as agent' strategy (de Villiers and de Villiers, 1973), a word-order strategy or a probable-event strategy (van der Lely and Dewart, 1986; Precious and Conti-Ramsden, 1988) for arriving at the meaning of a sentence. Other comprehension strategies are discussed in pragmatic terms, such as the use of presupposition and inference skills (Rees and

Shulman, 1978) to arrive at the meaning. From the perspective of language learning, it seems clear that once a comprehension strategy is applied and sentence meaning is determined/estimated, this knowledge can be mapped onto unfamiliar words and syntactic frames.

Relationship to Syntactic Bootstrapping

The ability to comprehend can also be used to infer something new about language. When a child hears the utterance "Is the doggy running?" s/he typically has several cues available from which to estimate the meaning of the utterance, even though s/he may not yet know what the auxiliary verb 'is' represents at the beginning of an utterance. Salient cues such as intonation and facial expression may help the child understand the interrogative nature of the utterance. The child can then use this meaning to infer the meaning of the sentence construction, 'is + NP + V-ing.'

Given this role of comprehension in language learning, it is reasonable to examine the relationship between comprehension and syntactic bootstrapping. Demonstrated comprehension deficits in SLI children (Bishop, 1979; van der Lely and Harris, 1990) may point to a deficit in syntactic knowledge. In a study by van der Lely and Harris (1990), SLI children performed poorer than NL children in comprehending active, passive and dative sentences. The authors conclude that this comprehension deficit is a result of a misrepresentation in syntactic knowledge in assigning grammatical function to phrases. Another possible interpretation is that syntactic knowledge is present but that the children cannot use it to get the message.

Thus far, we have seen how estimates of meaning, that is, utterance comprehension can lead to new syntactic knowledge. It is equally true, however, that syntactic knowledge can serve comprehension. When all of the lexemes in an utterance are known, and the requisite syntactic representations are available, the determination of meaning can be straightforward. However, consider the case of an utterance that contains an unfamiliar lexeme. Here we can presume that syntactic bootstrapping serves both comprehension and language learning -- one uses syntactic knowledge to estimate the meaning of a sentence and, in the process, one ends up with a potential meaning for a novel verb.

Extending this argument, deficient syntactic knowledge cannot be used effectively or efficiently in either the service of syntactic bootstrapping nor in the service of comprehension -- which suggests a possible explanation for observed deficits in both areas.

Metalinguistic Awareness

Definition

Processes related to the ability to process syntactic input not only include access and use of syntactic knowledge, but also the explicit analysis of syntactic structure for purposes beyond parsing and comprehension. Language situations that invite metalinguistic judgements require the conscious use of syntactic analysis. Bowey (1988) defines metalinguistic functioning as the "ability to reflect on and manipulate the structural features of language." In this sense, Bowey explains, metalinguistic performance is different from comprehension and production in that it "requires the language system...to be treated as an object of thought."

Role in Acquisition

The role of metalinguistic functioning in acquisition can be understood by considering unconscious versus conscious language monitoring. Gombert's (1992) detailed model of metalinguistic development elaborates on the conditions necessary for metalinguistic functioning. In particular, Gombert's model distinguishes between epilinguistic and metalinguistic activities. Epilinguistic behaviour is the unconscious monitoring of language that nevertheless manifests a functional awareness of the rules of the organization or use of language (Gombert, 1992). Such 'epilinguistic' behaviour is a prerequisite for 'metalinguistic' behaviour, which is defined as a conscious and intentional analysis of language and its use. In making this distinction, Gombert attempts to account for the data that suggest a change from functional language use to the conscious control of language. Moreover, he argues that the conscious participation of the child in reflecting on language and its use can affect the acquisition and restructuring of knowledge. Along with any new organization comes the "creation of a possibility of linking this knowledge to other, new knowledge concerning the same forms or forms frequently associated with those which are in the course of being organized" (Gombert, 1992). In this sense, metalinguistic awareness is viewed as a language learning process as well as the product of acquired knowledge.

Relationship to Syntactic Bootstrapping

With this metalinguistic developmental role in mind, the relationship between metalinguistic awareness and syntactic bootstrapping can be explored. On a basic level, it is conceivable that the ability to use syntactic knowledge to estimate semantic elements is connected to the ability to consciously reflect on linguistic structures. Although the typical metalinguistic behaviour seems more conscious than natural occurrences of syntactic bootstrapping, the two abilities may require particular applications of the same analytical ability.

Landau and Gleitman (1985) suggest that there is a connection between children's advances, at about two years of age, in word learning (to include more verbs and adjectives) and two-word utterances. They presume that the 'onset' of the syntactic bootstrapping process for verb learning represents, partly, a shift to more control than before of the "predicate-argument logic in the syntactic format of the sentence" (Landau and Gleitman, 1985). This notion of 'control' may be a fore-runner of the explicit language analysis that is tapped by metalinguistic awareness tasks.

Although 'metalinguistic awareness' is not usually attributed to two-year-olds, writers such as Clark (1978) and Slobin (1978) use the term more broadly to refer to grammatical self-corrections of the sort that are seen in very young children. From this perspective, early metalinguistic performance, or at least epilinguistic performance (Gombert, 1992), is seen in the same age range as early syntactic bootstrapping. Moreover, both metalinguistic analysis and syntactic bootstrapping involve the use of organized language knowledge to create new knowledge. And finally, both processes occur following the formalization of earlier functional knowledge. These parallels in definition and developmental course could point to inherent connections between metalinguistic awareness and syntactic bootstrapping.

RESEARCH QUESTIONS

CAN SLI CHILDREN USE SYNTACTIC INFORMATION TO PREDICT THEMATIC ROLES FOR NOVEL VERBS?

The process of syntactic bootstrapping has an influential role in language learning. In particular, its role is heightened when contextual cues are vague or absent. The study of SLI children's ability to organize structural linguistic input using syntactic knowledge and then to map this knowledge onto meaning is an important part of the general investigation of how language learning is affected for these children. The single study that found poor syntactic bootstrapping abilities in SLI children is not conclusive due to methodological problems. The relationship between syntactic bootstrapping ability and access to and existence of syntactic representation has not been demonstrated. On the one hand, if syntactic bootstrapping abilities depend on access to and/or the existence of syntactic knowledge, then a good grammatic comprehension match between SLI and NL groups leads to the prediction that both groups will be equally able to perform syntactic bootstrapping. No significant differences should be observed between these groups on a syntactic bootstrapping task. On the other hand, it is plausible to assume that syntactic bootstrapping involves a facet of further language analysis. If so, then even if a grammatic comprehension match is established between SLI and NL children, group differences may occur on a syntactic bootstrapping task. A good comprehension match between the groups allows us to comment about the nature of SLI as well as the language learning process of syntactic bootstrapping.

DOES PERFORMANCE ON A SYNTACTIC BOOTSTRAPPING TASK CORRELATE WITH PERFORMANCE ON A METALINGUISTIC TASK?

The interpretation of syntactic bootstrapping as involving language analysis beyond comprehension may be corroborated with evidence of a connection between syntactic bootstrapping and metalinguistic awareness. Metalinguistic awareness differentiates itself from comprehension by its analytical function in language learning. Theoretical reasoning suggests the parallel development of syntactic bootstrapping and metalinguistic awareness abilities. Accordingly, we should observe equal performance in these two areas. If SLI and NL children perform equally on syntactic bootstrapping tasks, then both groups should be equally able to perform a metalinguistic awareness task.

CHAPTER 2: **METHOD**

SUBJECTS

Twelve school-age children drawn from a suburban school district participated in this study. Their chronological ages ranged between 5;7 and 9;7. The children were divided into two groups according to language ability. Group 1 consisted of six children with specific language impairment (SLI), between 6;0 and 9;7, previously identified by speech-language pathologists as having severe difficulties with language comprehension. Each child showed no evidence that their language difficulties were the result of a substantially depressed intellectual functioning, hearing loss, or disturbance in socio-emotional behaviour and development. Group 2 consisted of six children with normal language development (NL), between 5;7 and 6;11, selected from a pool of children in the age range of 5;0 to 7;0. Children in both groups were monolingual English-speaking.

Further eligibility criteria for selection consisted of scores received on the *Test of Language Development 2 - Primary* (Newcomer and Hammill, 1988) and the *Test of Nonverbal Intelligence-2* (Brown, Sherberou & Johnsen, 1990). Four of the language development subtests -- Picture Vocabulary, Grammatic Understanding, Sentence Imitation, and Grammatic Completion -- were administered to each child. Children in the SLI group met the criteria of a standard score of 7 or less (-1SD or below) on at least three of the four subtests, one being the Grammatic Understanding (GU) subtest. The language performance of the NL children fell within normal range (+/-1SD) on all four subtests. Children in both groups achieved normal range (+/-1SD) performance on the measure of nonverbal conceptual development.

Six SLI children were matched individually to six NL children according to raw scores on the grammatical comprehension subtest. Five of the matched pairs had raw scores within two points of each other. One of the pairs had a three point difference in its raw scores.

Table 1

Values for age, language subtests and nonverbal intelligence

		TOLD2-P				TONI-2
Group	CA[a]	PV[b]	GU[c]	SI[d]	GC[e]	
SLI						
1	6;0	10 (7)	14 (7)	4 (6)	15 (9)	8 (95)
2	6;7	15 (8)	15 (6)	7 (6)	13 (7)	11 (102)
3	7;6	22 (10)	16 (6)	7 (6)	17 (6)	12 (99)
4	9;2[f]	18 (7)	20 (7)	14 (7)	16 (6)	13 (92)
5	9;7[f]	15 (6)	20 (7)	7 (4)	16 (6)	13 (92)
6	8;9	17 (7)	20 (7)	9 (5)	14 (5)	13 (93)
Mean	7.93	16.17	17.5(6.67)	8.00	15.17	11.7 (95.5)
SD	1.46		2.81(.52)			(4.14)
NL						
7	5;9	16 (12)	16 (8)	16 (12)	17 (10)	7 (106)
8	5;11	17 (12)	16 (8)	13 (10)	10 (8)	10 (112)
9	5;7	10 (8)	19 (11)	19 (13)	13 (9)	12 (118)
10	6;11	19 (10)	20 (9)	13 (9)	21 (11)	11 (102)
11	6;3	25 (15)	21 (13)	18 (12)	16 (10)	8 (95)
12	6;7	23 (12)	21 (10)	21 (12)	23 (11)	12 (106)
Mean	6.16	16.67	18.83(9.83)	15.67	15.67	10 (106.5)
SD	.51		2.32 (1.94)			(7.94)

Note. The values represent raw scores. Standard scores from the TOLD2-P are given in parentheses. IQ from the TONI-2 are given in parentheses.
[a]CA=Chronological Age. [b]PV=Picture Vocabulary subtest. [c]GU=Grammatic Understanding subtest. [d]SI=Sentence Imitation subtest. [e]GC=Grammatic Completion subtest. [f]TOLD2-P scores for subjects 4 and 5 tallied from CA 8;11, the maximum scoring range on this test.

Mean age and test scores for the two groups are presented in Table 1. Analysis revealed no significant group difference on the raw scores of the GU subtest; T = -.90; df = 1,10; p = .392. Significant group differences on the standard scores of the GU subtest were found; T = -3.86; df = 1,10; p = .009. A significant group difference for chronological age was found; T = 2.80; df = 1,10; p = .030. Nonverbal IQ scores also demonstrated a significant group difference; T = -3.01; df = 1,10; p = .018.

Of nineteen SLI children tested, six reached criteria for this study. One child was not eligible because she was not monolingual English-speaking. The other twelve children were not eligible because they had a standard score of eight or more on at least the GU subtest of the *TOLD2-P*. Of eight NL children tested, two were excluded from the matching process because of above average scores on both assessment measures.

PROCEDURES

OVERVIEW

Each child participated in two assessment measures and two experimental tasks. In order to test language learning processes related to syntactic knowledge, two experimental tasks that require structural analytical skills were chosen for the present study. The first of these tasks explored the process of syntactic bootstrapping. The second explored metalinguistic awareness.

Both assessment and experimental procedures were administered during school hours in a small, quiet room in the child's school. All children were seen individually by the examiner. Order of presentation for the tasks was balanced across children. Some of the children completed both tasks in one session; others divided the tasks into two separate days, in which case, an interval of less than five days separated the two tasks.

ASSESSMENT PROCEDURES

Standard assessment procedures were administered, scored and interpreted by the examiner. Assessment procedures involved approximately one or two 20-minute sessions for each child. All children were first administered the *TOLD2-P* and the *TONI-2*, in that order. Procedures were conducted in a small, quiet, well-lit room in the child's school. The examiner and child sat opposite each other at a small table, with the testing material lying between them. Attempts were made with each child to establish rapport before testing. During testing, any comments that reflected on the accuracy of a response were avoided. Responses were scored during testing.

EXPERIMENTAL TASKS

Syntactic Bootstrapping Task

Overview

Eighteen sentences containing novel verbs were presented orally by the examiner to each child. An acting-out procedure was chosen as the vehicle for obtaining responses. The child used toys to act out the meaning of the sentence spoken by the examiner, assigning thematic roles to the novel verbs on the basis of the syntactic frame. For example, on hearing the sentence, "The girl baps the boy," the child should make the girl (agent) do something to the boy (patient). Semantic cues that might restrict possible meanings of the verbs were not provided. For example, the sentences were delivered without stressing or pausing unnecessarily after novel verbs. Also, the examiner did not use any facial or body gestures that might have influenced the child's interpretation of the sentence. Responses were videotaped, and scoring was done by the examiner both on-line and later from the videotape.

Materials/Design

The test items consisted of six reversible active transitive (T) sentences with novel verbs, six reversible active transitive locative (L) sentences with novel verbs, and six reversible active transitive sentences with novel verbs in which two nouns in object position are joined with the conjunction 'and' (C). The following are examples of each sentence type:

T = The woman soogs the bunny.

L = The bear gebs the boy to the woman.

C = The cow mofs the boy and the bear.

These three syntactic forms were chosen to encourage the child to differentiate the events represented by the sentences [i.e. contact causal (T/C) or causal directional movement (L)]. Sentence type C was chosen to provide the same three-argument surface structure as in sentence type L. This opportunity to distinguish sentences based on syntactic frames controls for a distinction based only on sentence length.

This task provides a means for investigating the ability to determine meaning based on syntactic structure [T=NP V NP; L=NP V NP PP; C=NP V NP *and* NP]. Upon hearing a novel verb, for which the child has no semantic representation, the child must turn to the syntactic information provided to learn more about that verb. The relevant syntactic cues are word order and functors, such as 'to' and 'and.' The process of using syntactic information is reflected in the child's manipulation of the toys to demonstrate the meaning of the sentence. For all three sentence types, a canonical interpretation should assign an agent (of a transitive causal event) thematic role to the first NP in the sentence. The second NP in all three sentences should take a patient thematic role, with the patient in an L-type sentence being involved in movement as opposed to just causality in T/C-type sentences. A further distinction should be observed between interpretations of the third NP in L/C-type sentences. In an L-type sentence, the child should interpret the third NP as a goal thematic role, indicated by the preposition 'to.' In a C-type sentence, the child should interpret the third NP as another patient thematic role, indicated by the coordinate conjunction 'and.'

The use of novel verbs is a critical feature of the task. They allow us to presume that the child's demonstration of the novel verb's meaning is based on a process that applies syntactic analytical skills to the sentences heard and not on semantic information about a known verb. The eighteen novel verbs were constructed under four conditions. They were: i) phonetically balanced, ii) phonotactically English, iii) part of a developmentally appropriate phonological inventory (in a CVC sequence), and, iv) not suggestive of existing English words. Each novel verb was presented in the third-person present tense form to eliminate any difficulties with tense markings. The novel verbs are presented as Table 2.

Table 2

Novel verbs used in Task 1

Trial verbs		
kuves	zems	mebs
Test verbs		
soogs	bifs	teebs
pids	gats	dokes
mons	zins	mofs
bims	nigs	voofs
keeds	dups	teks
gebs	fets	vips

Several default assumptions were made regarding the child's interpretation of the novel verbs. For T/C-type sentences, it was expected that the child would interpret the novel verb as representing a contact causal event such as in the verbs, 'kiss,' 'hit,' or 'kick.' For L-type sentences, it was expected that the child would interpret the novel verbs as representing a causal action that involved directional movement such as in the verbs, 'carry,' 'bring,' or 'push.' Another plausible perception of novel verbs in L-type sentences could have been interpreted like the verbs 'show' or 'talk to.' These, of course, would be more difficult to identify. As it happened, only three responses altogether could have been interpreted in this way.

Sixteen small toys were used that corresponded to common nouns, which were likely to be within the children's vocabulary. All the toys represented animate beings to create a semantically neutral context; that is, each toy could potentially participate in either an agent, patient or goal thematic role. Eight toys corresponded to people (man, woman, girl, boy, farmer, dancer, doctor, clown), and eight toys corresponded to animals (dog, cow, horse, cat, lion, monkey, bear, bunny). The toys were separated into two sets, with four people and four animals in each set. The sets of toys were switched halfway through the procedure to maintain interest in the task.

The eighteen sentences were randomized into three presentation orders. This procedure first involved creating six sentence frames per sentence type, and then distributing the eight nouns (representing the first set of toys) in a variety of the noun phrase positions throughout the sentence frames. Effort was made to distribute each noun with equal frequency in subject and object position in the sentence frames. Next, these eighteen sentence frames were randomized into three different orders; i.e., three sets. Then, the list of eighteen novel verbs was randomized into three different orders. Each verb set was assigned to a sentence frame set, and the verbs were inserted chronologically into the sentences, thus, creating three presentation orders of test items. Sets were alternated among subjects. See Appendix A for a list of test items in Task 1.

Procedure

Children were tested individually in a quiet room in their schools. Each child sat opposite the examiner at a small table. The 15- to 25-minute testing session began with a short briefing phase, followed by a trial exercise, and then the experimental item set. The first set of eight toys was placed on the table. The child and the examiner at first played with the toys, naming each toy and focussing on novel actions that could occur between the toys. This briefing phase was designed to familiarize the child with the names of the toys and with creating novel actions. The examiner prompted with the phrase: "This is the...," and the child would identify each toy. The examiner demonstrated possible novel transitive actions and then let the child do this. For instance, the examiner made the toy woman use her head to push the toy bunny. The child then had an opportunity to try different actions with the toys.

Next, the child was presented with the trial items. The examiner explained that they were going to play a fun game in which the examiner says a little story, and then the child makes the toys do it. She tells the child that the story might have funny words. She mentions that they can pretend it is a show for the videocamera that is turned on in the room. The trial exercise began with three sentences, one of each type, with known verbs so as to clarify the object manipulation aspect of the task for the child. If necessary, the examiner repeated the sentence to the child. If the child still had not started to use the toys to demonstrate the sentence, then the examiner demonstrated with the appropriate toys an event to match the sentence. This demonstration was meant to provide an example of what the child was supposed to do, not to direct the child's interpretation of subsequent sentences. Three trial sentences with novel verbs were then presented individually to the child to confirm that the child understood the inventive aspect of the task. T-type sentences were used here based on the assumption that they would be easier to identify and thus make the task more understandable at the trial stage. Feedback was provided during the trial exercise. Comments made included those of encouragement ("You're doing a good job") and task reminders ("You just make something up").

Following the trial exercise, the eighteen test sentences were then presented individually, without judgmental feedback. General encouragement was provided in the form of facial expressions and comments, such as, "I like your show/story." Each sentence could be repeated once if necessary. Audiotape presentation was not chosen for this task because it was felt that the unfamiliarity of the task required a balance in favour of increased attention and involvement in the task. This was accomplished better through live presentation of the stimuli.

The procedure was piloted on SLI and NL children. Changes were made to some of the toys that were consistently associated with aggressive actions; for example, one of the initial toys was a familiar television character who kick-boxed all the toys regardless of presentation item. The pilot sessions also allowed the examiner to standardize a presentation style.

Scoring Procedure

Each experimental task session was videotaped and subsequently transcribed by the examiner. On-line scoring also occurred; however, comparison of the two methods revealed that the vidoetape method presented a more reliable account of the children's object manipulations than the on-line scoring method. The scoring categories are summarized below.

<u>Correct</u>:

Canonical: the child's object manipulations corresponded to canonical thematic role interpretations of all the syntactic functions in the sentence presented.

Incorrect:

1) Role Assignment: the child chose most or all of the correct toys and inferred a causal event, but reversed or switched the thematic roles; for example, a toy manipulated in the role of agent corresponded to a noun in object position in the test item, or, toys corresponding to nouns in direct and oblique object positions were switched in their thematic roles;

2) Intransitive: the child chose most or all of the correct toys but failed to infer causality. Number of roles depended on how many entities a child tried to incorporate into the response; for example, a toy or several toys were made to act but not upon another toy. Some errors of this type also involved errors in role assignment, which were not scored separately.

3) Coordination: the child involved toys in more than one action, either with two different actions, such as the first noun phrase acting as agent on the second noun phrase and then doing a different action on the third noun phrase in a C-type sentence, or with the same verb, but changing the item in agent position; for example, the first noun phrase acted as agent on the toy in second noun phrase position but then the toy in third noun phrase position acted as agent on the toy in first noun phrase position in a C-type sentence. Errors of this type may also involve errors of role assignment, and one of the

actions may be intransitive. If so, the entire error complex was scored as a single error in C-type sentences.

4) Object Selection: the child chose one or more incorrect toys; for example, upon hearing 'lion' in direct object position, the child chose the 'cat' and manipulated it in a patient role;

5) Argument Omission: the child failed to act out all the thematic roles; for example, the item for oblique object in L-type sentences was frequently omitted or was chosen but not made to represent a goal thematic role;

6) Addition: the child added an additional event to the interpretation; for example, an L-type sentence was acted out by adding a further action to the event;

7) Unclear: the child manipulated toys so that thematic roles were unclear; for example, two toys were chosen and were put on the table facing each other.

8) No Response: the child picked up toys but did not manipulate them.

Error types 1, 2, 3, and 6 were mutually exclusive, but error types 4 and 5 could co-occur with any of these.

Metalinguistic Awareness Task

Overview

Eighteen sentences -- six grammatical and twelve ungrammatical -- were presented on audiotape to each child. The child indicated with a verbal response whether or not each sentence sounded 'right' or 'wrong' (i.e. ungrammatical). The response format was chosen to avoid systematic yes or no answers by any child. It was assumed that the task distinction between responding 'right' and 'wrong' was more salient than responding with a 'yes' or 'no.' Audiotape presentation was chosen to ensure a standard presentation of auditory information. Effort was made during recording to minimize emphasis on errors in each test item. Responses by each child were scored on-line by the examiner.

Materials/Design

The test items consisted of six active transitive sentences (T), six active transitive locative sentences (L), and six active transitive sentences in which two nouns in object position were joined with the conjunction "and" (C). This replication of sentence types between tasks was based on the assumption that the ability to use syntactic knowledge to estimate semantic elements (syntactic bootstrapping) is connected to the ability to consciously reflect on linguistic structures (metalinguistic awareness). We wanted to make direct comparisons between tasks with comparably difficult linguistic material.

Each set of six sentences contained the following features: three sentences with grammatical errors, one sentence with a lexical error, and two grammatically correct sentences. A word order error in a T/L-type sentence was made by placing the object after the subject (e.g.,"The lady the baby kisses"). In a C-type sentence, the error was made by placing 'and' after the verb (e.g., "The bear pushes and the tree the log"). The second type of grammatical error, omission, involved omitting a critically defining syntactic element in each sentence type. In the T-type sentence, the object was omitted (e.g., "The cat touches"). In the L-type sentence, the preposition 'to' was omitted, and in the C-type sentence, the coordinate conjunction 'and' was omitted. For the third type of grammatical error, subject-verb agreement, the subject was made plural in each sentence type, with the verb remaining in third-person present tense form (e.g., "The horses kicks the fence and the gate"). Since recognition of lexical errors occurs early in metalinguistic development, inclusion of such errors was made to reinforce for the child the linguistic distinction that was being asked for between 'right' and 'wrong.' This explanation also justifies the inclusion of two grammatically correct sentences per sentence type.

Verbs occurred in the third-person present tense form in all sentences to avoid difficulties with tense. Familiar common nouns were used in subject and object positions.

Two random orders of the eighteen items were constructed. The two sets of randomized sentences were counterbalanced among the children. See Appendix B for a list of test items used in Task 2.

Procedure

Each child was tested individually in a quiet room in the school. The examiner and the child sat at a table opposite each other. The 15- to 20-minute testing session began with a briefing phase, followed by a trial exercise, and then the experimental item set. In the briefing phase, the examiner told the child about a puppet she wanted to use in a puppet show. Sometimes, she explained, the puppet said things the right way and sometimes he said things the wrong way. The child was told that they would help the puppet by listening to some of the things the puppet had recorded on a tape recorder. Then the child was asked to tell the examiner if something sounded 'right' or if something sounded 'wrong.'

The trial exercise was intended to clarify the task requirements. If the child did not respond to the first item, the examiner repeated the sentence and the instructions. The second trial sentence was then presented, following the child's response. The trial exercise was also intended to make an obvious distinction between what sounded 'right' and what sounded 'wrong.' Accordingly, the exercise began with a grammatically correct sentence, followed by sentences with lexical and phonological errors. This choice was based on findings in metalinguistic literature which state that recognition of lexical and phonological errors in sentences occurs early in development. Next, a second grammatically correct sentence was heard. Feedback was provided in comments such as "You're doing well telling me what sounds 'right' and what sounds 'wrong'" to reinforce for the children the kind of choices they were making. Finally, two syntactically incorrect sentences were heard. One had an omission error in an L-type sentence; the other had an agreement error in a T-type sentence. This inclusion was intended to establish syntactic errors in the same category of wrongness as lexical and phonological errors. All participants demonstrated the ability to recognize appropriately at least both the grammatical sentences and the sentences with lexical and phonological errors. The eighteen test sentences were then played one at a time to the child. Feedback occurred in the form of encouraging neutral comments, such as, "You're helping him a lot" and "Thanks for listening carefully."

The procedure was piloted on SLI and NL children. Changes were made to simplify the instructions. Two of the grammatical sentences were changed to appear more familiar. The pilot sessions also allowed the examiner to standardize a presentation style.

Scoring Procedure

A child's response to the question "Does it sound right or wrong?" was scored correct if the child responded "right" when the sentence did not contain an error and "wrong" when the sentence did contain an error.

CHAPTER 3: **RESULTS**

The purpose of this study was to investigate the role of syntactic framework in the school-age learner's organization of experience to gain lexical knowledge. Two questions were asked. First, do SLI children use syntactic information to predict thematic roles for novel verbs? Second, does performance on a syntactic bootstrapping task correlate with performance on a metalinguistic task?

SYNTACTIC BOOTSTRAPPING TASK

The number of correct responses that each child made (maximum = eighteen) was recorded as a measure of the ability to accurately interpret syntactic information and use it to predict some meaning for the novel verbs. The SLI group's mean score for the Syntactic Bootstrapping task was 7.67 (SD = 2.58), and the NL group's mean score was 14.0 (SD = 3.58). The SLI children overall were able to interpret less than half of the sentences they heard. Alternatively, the NL children overall were able to interpret over three quarters of the sentences they heard. Separate scores were obtained for each sentence type to explore the children's ability to assess a variety of syntactic information. The mean number of correct responses per sentence type for each group is shown in Table 3. The SLI group performed worse than the NL group on all three sentence types in the syntactic bootstrapping task. The Locative-type (L) sentence was the most difficult to interpret for both groups, followed by Coordinated-type (C) and, then, Transitive-type (T) sentences.

Table 3

Mean Number of Correct Responses per Sentence Type in Task 1

Sentence Type	Group SLI	 NL
Transitive (T)	4.00 (SD = 1.10)	5.33 (SD = .82)
Locative (L)	1.17 (SD = 1.94)	4.33 (SD = 2.25)
Coordinated (C)	2.50 (SD = 1.05)	4.67 (SD = 1.03)

Note. Maximum score = 6.

To investigate the reliability of the observed group differences evident in Table 3, scores were subjected to a two-way repeated measure analysis of variance (ANOVA), Group (2) x Sentence Type (3), with number of correct responses in each sentence type category as the dependent variable. Language group (SLI and NL) acted as a between subject variable, and sentence type (T, L and C) acted as a within subject variable. Analysis revealed a significant main effect for group, $F = 12.74$; $df = 1,10$; $p = .0051$, and for sentence type, $F = 7.53$; $df = 2,20$; $p = .0037$. No significant Group x Sentence Type interaction was observed, $F = 1.72$; $df = 2,20$; $p = .2050$. These results indicate that the SLI group performed worse than the NL children in using syntactic information, in three different syntactic frames, to predict semantic roles.

The representativeness of this outcome was explored by examining the performance of individual children. This analysis determined the number of children in each group who correctly assigned any one role (T-type) or any two roles (L/C-type). For T-type sentences (with only two arguments), the criterion for a consistently canonical response was set at five or more canonical responses out of six, $p = .11$ (binomial distribution). For L/C-type sentences (with three arguments), the criterion was set at four or more out of six, $p < .04$. The remaining roles were considered to be defined by default. This probability model assesses the likelihood that the child will appropriately assign thematic roles, assuming the child has already selected the appropriate toys and determined the roles to be filled. It thus ignores the early phases of processing, but does enable a test of relative performance among children.

Only one of the SLI children passed the criterion for T-type sentences, and only one passed for L/C-type sentences. In the NL group, five children passed the criterion for the T- and C-type sentences, and four children passed the criterion for L-type sentences. These results support group analysis outcomes. Children in the SLI group were performing either at or below chance in their ability to use syntactic information to predict semantic roles. Children in the NL group were essentially able to perform the task.

Following confirmation that the two groups exhibited differences in their task performances, an analysis of errors was made to investigate the nature of errors made by each group. Proportion-of-error profiles were created for each group and are given in

Table 4. To make an error, a child could do one or more of the following (examples of what some of the children did are also provided):

1) choose most or all of the correct toys and infer a causal event, but reverse or switch the thematic roles (*role assignment error*); for example, a toy manipulated in the role of agent corresponded to a noun in object position in the test item, or, toys corresponding to nouns in direct and oblique object positions were switched in their thematic roles;

2) choose most or all of the correct toys but fail to infer causality. Number of roles depends on how many entities a child tries to incorporate into the response (*intransitive error*); for example, a toy or several toys were made to act but not upon another toy. Some errors of this type also involve errors in role assignment.

3) involve toys in more than one action (*coordination error)*, either with two different actions, such as the first noun phrase acting as agent on the second noun phrase and then doing a different action on the third noun phrase in a C-type sentence, or with the same verb, but changing the item in agent position; for example, the first noun phrase acts as agent on the toy in second noun phrase position but then the toy in third noun phrase position acts as agent on the toy in first noun phrase position in a C-type sentence. Errors of this type may also involve errors of role assignment, and one of the actions may be intransitive.

4) choose one or more incorrect toys (*object selection error*); for example, upon hearing 'lion' in direct object position, the child chose the 'cat' and manipulated it in a patient role;

5) fail to act out all the thematic roles (*argument omission error*); for example, the item for oblique object in L-type sentences was frequently omitted or was chosen but not made to represent a goal thematic role;

6) add an additional event to the interpretation (*addition error*); for example, an L-type sentence was acted out by adding a further action to the event;

7) manipulate toys so that thematic roles are unclear (*unclear error*); for example, two toys were chosen and were put on the table facing each other.

8) pick up toys but not manipulate them (*no response*).

As defined above, the eight error types are logically independent. There is no necessary co-occurrence of errors. However, it was possible for more than one error to occur in one test item. Nevertheless, multiple errors were few in both groups. The SLI group overall had multiple errors for nine items; the NL group had four.

The error types seen in Table 4 can be grouped into three general categories relevant to the syntactic bootstrapping process. First, the first three error types -- Role Assignment, Intransitive and Coordination -- concern errors specifically related to verb type. Next, Object Selection and Argument Omission error types are more tied to the noun phrase in the test item. Third, the last three error types can be loosely referred to as 'other'. According to this regrouping, both SLI and NL groups were identical in the proportion of 'noun phrase' errors made (27%), and relatively similar in the proportion of 'verb' errors made; that is, 47% for the SLI group and 65% for the NL group. However, SLI children made relatively more 'other' errors and fewer 'verb' errors, and NL children made more 'verb' errors and fewer 'other' errors.

Table 4

Proportion-of-Error Profile for Task 1

	Group	
Error types	SLI[a]	NL[b]
Role Assignment	23 (16)	27 (7)
Intransitive	11 (8)	19 (5)
Coordination	13 (9)	19 (5)
Object Selection	13 (9)	4 (1)
Argument Omission	14 (10)	23 (6)
Addition	13 (9)	0 (0)
Unclear	5 (4)	4 (1)
No Response	8 (6)	4 (1)

Note: The values represent a percentage of the total errors per group. Number of errors appear in parentheses.

[a]Of 62 incorrect test items, 71 total errors were made.

[b]Of 22 incorrect test items, 26 total errors were made.

On closer inspection of the data, however, almost half of the 'other' errors by the SLI group were made by two children in the category of additions. The addition error type is interesting in its own right. All nine incorrect responses consisted of two children adding more action(s) to L-type items following their initial 'correct' interpretation of the test item. This type of response was scored as incorrect because it did appear to be a distinctive, albeit erroneous, response type. An alternate interpretation of these responses might hold that the child responded appropriately and merely continued playing; however, this interpretation seems unlikely because the children clearly marked, for other response types, the end of the response by setting the toys back in a row on the table. They did the same thing for these L-type sentences, but only after they added the extra action(s). This pattern indicates that the additional action was considered part of the stimulus sentence. It is recognized that another plausible interpretation could be made in which the child should receive credit for appropriate bootstrapping abilities. With this in mind, the ANOVA was rerun with this alternate scoring. As expected, group differences decreased, yet significant differences still remained between groups, $F = 5.4$; $df = 1,10$; $p = .04$.

Exploring the role of initial short term memory in response patterns, two analyses were done. First, incorrect items were examined to determine which noun phrase (NP) was vulnerable; that is, when an NP was affected, which NP was it that was either omitted or substituted with an incorrect object. The assumption was that for a two-item choice, if initial short term memory were at fault, then the first item heard would be the least remembered. For the T-type sentences that the SLI group misinterpreted, only four out of a total of thirteen responses affected the NPs. Of these, both the first and second NPs were equally affected. The NL group had only one response in which the second NP was affected. For L/C-type sentences with three NPs, the prediction was that if initial short term memory were at fault, then the second NP would be most affected. Of the 49 wrong responses made by the SLI group for L/C-type sentences, 30 (62%) responses did not affect any of the NPs. The first NP was affected in 7 (14%) of the responses, the second NP was affected in 9 (18%) of the responses, and the third NP was affected in 3 (6%) of the responses. When we consider performance on the L/C-type sentences by NL children, 10 (56%) responses did not affect any of the NPs. The first NP was affected in 5 (28%) of the responses, the second NP was affected in 1 (5%) of the responses, and the third NP was affected in 2 (11%) of the responses. These data constitute weak evidence of a recency effect in the SLI group. But, by and large, the children in both groups had no more difficulty remembering the first or the middle NP than the last. These results suggest that initial short term memory is not being taxed in the syntactic bootstrapping task.

Further analysis of the Object Selection errors did suggest some role in the syntactic bootstrapping task for processing factors. Of nine object selection errors, seven of the substituted objects shared at least one semantic feature with the test item; for example, 'bear' was used for 'cow' and 'doctor' was used for 'man'. This may indicate that the children were operating near processing capacity.

Although these previous analyses here suggest the lack of a strategy in errors made, it was still possible that the children learned something about the novel verbs they heard. Data were re-scored requiring only that the child's response demonstrate an appropriate verb type. For T/C-type sentences, if the response demonstrated contact causality, it was scored as correct. For L-type sentences, if the response demonstrated causal directional movement, it was scored as correct; for example, if the child made a toy, regardless of choice, push or carry another toy to another toy, upon hearing an L-type sentence, then a correct response was noted. Results are provided in Table 5.

Table 5

Proportion-of-Total-Responses in Task 1 for which SLI and NL groups demonstrated appropriate verb type

	Group	
Verb type	SLI	NL
Contact Causal (n = 72)	75 (54)	92 (66)
Causal Directional Movement (n = 36)	56 (20)	78 (28)

Note: The values represent a percentage of the total responses per group. Number of appropriate responses appear in parentheses.

A similar spread between verb types exists for each group; that is, 19% for the SLI group and 14% for the NL group. To investigate the reliability of the observed group similarities evident in Table 5, scores were subjected to a two-way repeated measure ANOVA. Language group (SLI and NL) acted as a between subject variable, and verb type acted as a within subject variable. Analysis revealed no significant effect for group, $F = 2.98$; $df = 1,10$; $p > .05$. This analysis suggests that although significant differences exist overall between group performance on the syntactic bootstrapping task, more common ground can be found behind the children's responses than was initially evident.

Given group differences in nonverbal IQ, it seemed possible that general learning aptitude was responsible for the observed group difference in Task 1. The demands of the syntactic bootstrapping task require problem solving abilities which surpass everyday language use in an explicit reflection on language as an object of thought. It appeared as though the general problem solving skills of the sort tapped by a nonverbal intelligence test might be useful in such a task. To explore this possibility, scores on the syntactic bootstrapping task were again subjected to a two-way, repeated measures ANOVA, this time using nonverbal IQ as a covariant. When corrected for nonverbal IQ, significant effects still existed, for group, $F = 6.27$; $df = 1,9$; $p = .0336$, and for sentence type, $F = 7.53$; $df = 2,20$; $p = .0037$. There was again no significant interaction. Thus, variance related to group in the bootstrapping task could not be attributed to differences in nonverbal IQ.

METALINGUISTIC AWARENESS TASK

A second potential explanation for bootstrapping differences focuses on metalinguistic abilities. Perhaps children in the SLI group are less successful in using syntactic information because they are generally less able to consciously reflect on features of language. To explore this possibility, performance on the metalinguistic awareness task was analyzed by group, and scores for the syntactic bootstrapping task and the metalinguistic awareness task were compared. These analyses were based on the number of correct responses that each child made (maximum = 18). The SLI group's mean score for the metalinguistic awareness task was 12.67 (SD = 2.66), and the NL group's mean score was 12.83 (SD = 3.43). Both groups were able to correctly identify the grammaticality of about three quarters of the sentences they heard. The mean number of correct responses per sentence type for each group is shown in Table 6.

Table 6

Mean Number of Correct Responses per Sentence Type in Task 2

	Group	
Sentence Type	SLI	NL
Transitive	3.83 (SD = .98)	3.50 (SD = 1.76)
Locative	4.50 (SD = 1.05)	4.00 (SD = 1.26)
Coordinated	4.33 (SD = 1.03)	5.33 (SD = .82)

Note. Maximum score = 6.

Slight performance difference is observed between groups in the T/L-type sentences with the SLI group performing marginally better than the NL group. The SLI group, however, had more difficulty than their peers with the C-type sentence. Errors in the T-type sentence were the most difficult to identify for both groups in this task, as opposed to it having been the easiest sentence type to interpret by all in the syntactic bootstrapping task. For the SLI group, errors in L- and C-type sentences were equally identifiable. For the NL group, errors in the L-type sentences appeared to be more difficult to interpret than errors in the C-type.

To further investigate the reliability of differences observed in Table 6, scores for the metalinguistic awareness task were subjected to a two-way repeated measure ANOVA procedure, Group (2) x Sentence Type (3), with number of correct responses in each sentence type category as the dependent variable. Sentence type was treated as a within subject variable. Analysis yielded a significant main effect for sentence type, $F = 7.35$; $df = 2,20$; $p = .004$. No main effect for group was found, but a significant Sentence Type x Group interaction emerged, $F = 3.65$; $df = 2,20$; $p = .0445$. Further insight into the lack of the main effect for group is provided by a post hoc analysis of the Group x Sentence Type interaction. The group means for sentence type (see Table 6), reveal that the SLI group did somewhat better than the NL group on T/L-type sentences, but considerably worse on the C-type sentences. This led to overall group means that were similar. Table 6 also indicates that while T-type sentences were the most difficult for children in both groups, order of difficulty for the L/C-types varied by group.

Given group differences in nonverbal IQ, it seemed possible that general learning aptitude was responsible for the observed group difference in Task 2. The demands of the grammatical judgment task in requiring conscious and explicit reflection on language as an object of thought invite problem solving abilities beyond everyday language use. It seemed as though the general problem solving skills of the sort tapped by a nonverbal intelligence test might be useful in such a task. To explore this possibility, scores on the metalinguistic awareness task were again subjected to a two-way, repeated measures

ANOVA, this time using nonverbal IQ as a covariant. A significant difference still existed for sentence type, $F = 7.35$; $df = 2,20$; $p = .004$, and a Sentence Type x Group interaction remained, $F = 3.65$; $df = 2,20$; $p = .0445$. A main effect, however, for group was also revealed, $F = 7.67$; $df = 1,9$; $p = .0218$. Furthermore, the predictive value of nonverbal IQ was substantial, $F = 14.94$; $df = 1,9$; $p = .0038$. In the original, uncorrected, analysis, SLI children performed better (see Table 6) on the T- and L-type sentences (Mean 3.83 and 4.50, respectively) than NL children (Mean 3.5 and 4.0, respectively). When corrected for nonverbal IQ, the adjusted cell means revealed that NL children now performed better. Corrected values are provided in Table 7. Other data trends were unaffected.

Table 7

Mean Number of Correct Responses per Sentence Type in Task 2, Corrected for IQ

	Group	
Sentence Type	SLI	NL
Transitive	3.13	4.2
Locative	3.79	4.7
Coordinated	3.63	6.03

Note. Maximum score = 6.

While these findings are reasonable given the prior literature on metalinguistic abilities in SLI children, we are still left with the surprising finding that positive changes in nonverbal IQ lead to negative changes in metalinguistic score values in the ANOVA. That is, control for nonverbal IQ in this study amounted to statistically 'raising' nonverbal IQ values for the SLI group, with a concomitant 'lowering' of metalinguistic scores. This interpretation was corroborated by a correlational analysis which revealed a negative correlation (-.55) between the mean number of correct responses by all subjects in the metalinguistic awareness task and nonverbal IQ. This finding invites further exploration. Examination of scores obtained for selection criteria revealed that the matching variable -- raw scores on the grammatic understanding subtest (GU) -- related to nonverbal IQ in opposite directions for the two groups. That is, children with high nonverbal IQ scores had low GU scores in the SLI group, but high GU scores in the NL group. In comparing GU and metalinguistic scores, a reasonable correlation existed (.44). It seemed that language ability in this sample was confounded with nonverbal IQ. The small sample size and individual subject variance appear to have resulted in this confound.

With these results in mind, we looked at the relationship between performance on the syntactic bootstrapping task and metalinguistic skills. Partial correlation between performance on these two tasks, controlling for nonverbal IQ, was .75. This value was statistically reliable ($p < .01$) and indicated a strong degree of association in metalinguistic and syntactic bootstrapping performances.

SUMMARY

The results from this study show that SLI children's performance on the syntactic bootstrapping task was worse, overall and by sentence type, than the NL children's performance. This finding was not accounted for by nonverbal IQ. These results suggest that although the two groups were matched on grammatic understanding, the SLI children were less able to make inferences about syntactic frameworks to predict semantic information. In addition to this major finding, results can be summarized as follows:

1) The SLI group and the NL group showed similar types of errors in similar response patterns.

2) SLI children showed constructive understanding of verb type.

3) SLI children performed poorly on the metalinguistic awareness task -- a finding supported in prior literature.

4) Both groups' performance on the metalinguistic awareness task was a good predictor of their performance on the syntactic bootstrapping task.

CHAPTER 4: **DISCUSSION**

DISCUSSION

The present study was designed to investigate the ability of SLI children to constructively use syntactic knowledge to predict new semantic elements. This syntactic bootstrapping process requires the syntacticalization of language knowledge, which the child analyzes and applies to new language forms for the purpose of language learning. The language profile of SLI children includes difficulties related to syntactic elements as well as to language learning in general. Therefore, it was reasonable to suggest they would have difficulty with syntactic bootstrapping.

Indeed, data from the present study support the claim that SLI children have difficulty in making use of syntactic bootstrapping. The SLI children, overall, were able to interpret significantly less sentences than the NL group. These data are consistent with van der Lely's (1994) findings. However, some of the details of this initial research are not the same.

In particular, although both studies reveal numerous errors in role assignment made by SLI children, there were more 'other' errors found in the present study. This discrepancy is due to two methodological differences in task procedure. First, van der Lely scored responses on-line; whereas, in the present study, responses were scored both on-line and later from a videotape recording of the sessions. A comparison of the two scoring procedures revealed that valuable information was lost if results relied solely on the on-line scoring method. The videotape recording provided an opportunity to closely examine children's object manipulations, especially when the examiner assumed the child's actions were finished; for example, a causal action was added for several L-type sentences. The videotape showed that extended object manipulation occurred in the SLI group. On-line coding in this case would not have been sufficient to show that later material was acting as part of the child's response. On-line coding might have attended to the first part only and counted it as correct when, in fact, a more careful observation of the responses revealed a more systematic marking of this response type. Second, fewer 'ambiguous' responses in the initial study may have been the result of a rehearsal effect. When van der Lely was unsure of the child's intentions as to the toy's role, she asked the child to demonstrate the meaning of the sentence again, and the stimulus sentence was repeated. Van der Lely states that following such prompts few ambiguous responses were observed. No such procedure was used in the present study in order to ensure there was equal exposure to the input. Despite these differences, the present study confirms initial data; the syntactic bootstrapping process is a significantly more difficult task for SLI children to perform than NL children. We can interpret the present findings in terms of what might actually be involved in the syntactic bootstrapping process itself.

Because of the design of this study, we can say confidently that this process is something more than whatever processes are engaged by comprehension. The established grammatic comprehension match between the SLI and NL groups puts us in a better position than van der Lely to make this claim. Since the two groups were matched on grammatic comprehension, we can say that both groups are capable of similar degrees of parsing and comprehending, as indicated by their ability to understand the same level of sentences. This suggests that they have equivalent syntactic knowledge.

Although the children all had generally useful knowledge that they could use for the comprehension task -- for getting the message -- the two groups differed in their syntactic bootstrapping ability. In other words, the SLI children could not use the same syntactic knowledge that the NL children used in this language learning situation. Interestingly enough, some aspects of van der Lely's own experimental results suggested a similar interpretation. As an initial part of her experiment, van der Lely included a task designed to test 'forward linking' abilities. The procedure first involved the examiner modelling a novel verb with toy objects. For example, the examiner made a toy woman use her head to touch a toy man, while saying, "This is tiving." Then the child was asked to tell the examiner what happened. The aim was to see if the child used the novel verb in a sentence. In this task, van der Lely found an equal ability between SLI and NL children to nonverbally identify participants (in a scene modelling novel verbs) and their appropriate thematic roles and to verbally express these relationships in a sentence. This attests to the children's use of appropriate syntactic frame, as long as the meaning of the verb could be ascertained from nonverbal events. Thus, the lower performance of SLI children in the syntactic bootstrapping task must be due to some other process presumably involved in language learning.

A good candidate for what was contributing to the performance observed here might be initial short term memory processing. For example, it might be that the SLI children's poor performance in syntactic bootstrapping is because the children had trouble remembering aspects of the language input in the task. If initial short term memory were affected, we would expect to find evidence of a recency effect. In particular, for two-item choices, such as in T-type sentences, the first item (NP) would be affected more. And in three-item choices, such as in L/C-type sentences, the second item (NP) would be affected more. However, analysis of the SLI children's errors revealed that the children had only mild difficulty remembering the first or the middle NP than the last NP. Few responses involved NP errors, and weak recency effects, but no primacy effect, was observed only for L/C-type items. Therefore, it does not seem likely that their responses can be emtirely attributed to initial short term memory processing demands.

Another possible candidate for what was contributing to the SLI children's poor syntactic bootstrapping abilities might be general learning aptitude. For example, it might be the case that SLI children could not perform well in the syntactic bootstrapping task because they were not intelligent enough. The SLI group had a lower mean nonverbal IQ than the NL group, and the difference was significant. If general learning aptitude were involved, it was expected that when results were corrected for nonverbal IQ, groups differences would not remain. However, when corrected for nonverbal IQ, significant group differences still existed for the syntactic bootstrapping task. Thus, it seems unlikely that the SLI children's responses were affected by their lower general learning aptitude.

Since the group difference in syntactic bootstrapping ability cannot be attributed to representation of syntactic knowledge, access of syntactic knowledge, initial short term memory, or general learning aptitude, then the ability to do syntactic bootstrapping must involve a different use of language knowledge, one that is perhaps more analytical than the processes just mentioned. Initial evidence for this possibility comes from the fact that L/C-type items were more difficult than T-type items. It is also interesting to note the NP errors that maintained some of the appropriate semantic features. These findings suggest that the SLI children were affected by the analytical complexity of certain items. Analytical ability could possibly apply to other types of language performance such as metalinguistic judgments. Both syntactic bootstrapping and metalinguistic awareness occur following the formalization of earlier functional knowledge and both require the use of organized language knowledge to create new knowledge. As reviewed in chapter one, children's reflection on their own knowledge sets the stage for further language acquisition. The development of metalinguistic ability involves the conscious reflection by the child on the language system. In doing so, previous knowledge is weighed against this new control, and restructuring can occur. Syntactic bootstrapping and metalinguistic awareness may be linked by a common, explicit analysis of language characteristics in the service of language learning.

The connection between metalinguistic awareness and syntactic bootstrapping is supported by the present findings. Correlation was found that was significant and substantial between performance on these two tasks. The process of syntactic bootstrapping may have some similarity to what is involved in metalinguistic awareness tasks. Perhaps the two processes depend on some underlying ability to *consciously* analyze linguistic structures for the purpose of language learning. It may be the case that SLI children's limitations in both metalinguistic awareness and syntactic bootstrapping (as well as in other related areas such as grammatical morphology) are the result of an underlying deficit in the area of syntactic analysis or, rather, in the 'control' of syntactic knowledge for the purpose of language learning. Although syntactic knowledge is represented, this does not mean that a child will be able to analyze it and apply it to non-communicative tasks.

The present study provides further insight into the question of syntactic bootstrapping abilities in SLI children. Clearly, the syntactic bootstrapping process is problematic for SLI children. They have difficulty constructively using syntactic knowledge to predict new semantic elements; however, while language learning is difficult for SLI children, this disability is not absolute. As was shown by the outcome when the scoring system was changed, the SLI children in this study were able to learn something about the causality feature of novel verbs. Somehow, though, the children were unable to use this prediction of verb type tofully map its semantic consequences and make the appropriate thematic role assignment.

Although the SLI children showed some ability to infer verb meaning from syntax, they still did not perform very well in the syntactic bootstrapping task. The difficulties that were observed were not due to a lack of syntactic knowledge, to initial short term memory problems, or even to general learning aptitude. Rather, something else was contributing to the problem. The connection found between syntactic bootstrapping ability and metalinguistic awareness deserves closer attention. Syntactic bootstrapping may in fact be inherently related to metalinguistic awareness through an underlying ability to 'control' syntactic knowledge.

The present study contributes to our understanding of the nature of SLI children's difficulty with language. The SLI children's poor performance in syntactic bootstrapping indicates that this particular language learning process is not as readily available to them.

Consequently, the child who cannot analyze her/his syntactic knowledge will be less able to make inferences about the language s/he hears. Although contextual cues do contribute to language learning, it is assumed that syntactic bootstrapping plays a significant role in language learning. Without this opportunity, the child will be at a disadvantage for language learning. This is the case for SLI children. It is strongly suspected that syntactic bootstrapping abilities are implicated in the slower language learning profile of SLI children.

Besides telling us about the nature of SLI children's difficulties, the present research also tells us something about language learning for NL children. Clearly, syntactic bootstrapping is a process that is engaged when learning language beyond the early years. This is confirmed by the success of the NL children in applying syntactic knowledge of canonical syntax-semantic relationships to correct interpretations of the majority of the sentences they heard. Thus, syntactic bootstrapping is not linked only to an early period of development. Rather, ongoing word learning depends on one's attention to certain features, such as predicate-argument structure, in the absence of other features, such as contextual or nonlinguistic cues. This dependency is especially reinforced in an on-line, decontextualized situation, such as is represented in the object manipulation procedure designed to tap syntactic bootstrapping abilities. To paraphrase Gleitman (1990), the value of syntactic bootstrapping for language learning lies in the imperfection and insufficiency of language events, which may often not be saliently interpretable events nor syntactically interpreted utterances. Gleitman concludes from her investigations that NL children continue to use syntactic evidence to "bolster their semantic conjectures."

IMPLICATIONS FOR FUTURE RESEARCH AND INTERVENTION

The present findings contribute to an increasing literature that explores processing aspects of language functioning in SLI children. Such an apparent deficit that implies a deficit in analytical processing clearly warrants further systematic investigation. Additional research could be done using larger samples of subjects. As was the case in the present study, the small sample unfortunately revealed a confound between grammatic understanding and nonverbal intelligence, which affected conclusions that could be drawn from the metalinguistic findings. This invites further confirmation of the connection between metalinguistic performance and syntactic bootstrapping performance. The generalizability of the present findings are, of course, also limited by the particularity of the two tasks, as well as by the standardized instrumentation used to index general nonverbal abilities. The *TONI-2* looks at particular kinds of nonverbal skills, such as analogical reasoning, classification, and matching. Comparable results from other tests of nonverbal intelligence will add to our understanding of the involvement of general learning aptitude in these tasks.

The findings presented here could be expanded in several ways. Specifically, the observation of the addition-type errors made by the SLI children invites further investigation. Interpretability of these particular error types raises questions of whether they were peculiar to two children or the task setting and whether they would occur again. On a more general level, a study that included SLI children with normal range grammatic understanding with production difficulties could be designed so that the SLI children could be matched with their age peers. Similar task findings to the present study would confirm the present hypothesis that the syntactic bootstrapping process involves something more than the representation of syntactic knowledge.

The claim that SLI children have an inherent difficulty in an analytical phase of processing is worth exploring in future research. In light of the endeavour to move beyond questions of individual skills to the "interrelations among skills" (Plante et al, 1993), it may be useful, for instance, to consider claims about SLI children's inference constructing skills found in work by Ellis Weismer (1985).

In the most general sense, inference construction occurs when the individual elaborates on given information in order to derive implicit meanings (Ellis Weismer, 1985). Syntactic bootstrapping, likewise, involves some form of elaboration of given information (by analyzing syntactic knowledge). It is with respect to the processes' similar problem-solving venture that a connection between the two may be predicted. Inferential operations have been implicated in the poor comprehension abilities of SLI children (Ellis Weismer, 1985). Ellis Weismer's work suggests that a deficit in a cognitive process is related to inference construction. This process may be associated with analogical reasoning, whereby known concepts are used to solve novel problems. Future research may consider these possibilities.

It is clear that SLI children have trouble learning language. The present data indicate that a specific analytical process may be at stake. If so, it is not surprising that SLI children do not benefit fully from all exposures to language. Although other tools are available with which to construct knowledge, the task for SLI children is that much more difficult. The findings of the present investigation suggest that language intervention with SLI children may need to highlight the role of analysis of syntactic framework in predicting meaning. For example, therapy could explicitly focus on how predicate-argument structure is combined. Metalinguistic skills may also be an area of focus since tapping this ability may vicariously lead to improvements in syntactic bootstrapping. Similar results have been suggested between metaphonological training and increases in literacy success. The literature suggests that recent efforts to teach children to increase metaphonological awareness are successful not only in the main goal, but also in related areas, such as early literacy skills (Blachman, 1991). There may be a similar effect on analytical learning if explicit metasyntactic training is targeted.

Ultimately, the goal should be to try to find a way for learners to overcome their inability to make inferences about semantic information based on their syntactic knowledge. However, since young school-age SLI children may be at risk in benefiting from classroom instruction, involving the use of compensatory strategies, such as supporting language input with contextual and pragmatic cues, may be helpful. Finally, increased awareness of underlying difficulties in SLI children can affect the expectations held for these children. If we think that the child's syntactic knowledge is deficient, then our approach may take the form of focussed modelling. However, if we believe that the child has the required syntactic knowledge, but is having trouble analyzing it, then we might change our approach to emphasize structure and the meaningful relationships among syntactic elements.

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APPENDIX A

Task 1 Test Items

Set 1 (begin with set A toys)

The woman soogs the bunny.
The cow mofs the boy and the bear.
The bunny bims the farmer and the cow.
The farmer voofs the cow and the boy.
The bear gebs the boy to the woman.
The boy bifs the woman.
The bear teebs the dancer.
The bunny dups the bear to the farmer.
The farmer gats the cow.
(switch toys)
The cat pids the horse.
The monkey mons the man and the doctor.
The clown zins the horse and the cat.
The doctor fets the monkey to the lion.
The girl vips the doctor to the horse.
The girl nigs the monkey and the clown.
The man keeds the clown to the monkey.
The lion dokes the monkey.
The lion teks the cat to the girl.

Set 2 (begin with set B toys)

The cat gebs the doctor and the lion.
The girl zins the man.
The man soogs the clown to the monkey.
The lion voofs the monkey.
The girl fets the monkey and the clown.
The man mons the cat.
The girl dokes the doctor to the horse.
The cat bims the horse.
The horse mofs the clown.
(switch toys)
The bunny bifs the bear to the farmer.
The farmer gats the dog to the cow.
The farmer vips the cow and the boy.
The farmer nigs the cow.
The bear pids the boy to the woman.
The dog keeds the woman and the farmer.
The cow teebs the bunny to the boy.
The dancer dups the bear and the bunny.
The cow teks the boy and the bear.

Set 3 (begin with set A toys)

The bear teks the dancer.
The bunny pids the farmer and the cow.
The woman keeds the bunny.
The farmer nigs the dog to the cow.
The cow teebs the boy and the bear.
The bear bims the boy to the woman.
The bunny zins the bear to the farmer.
The boy dups the woman.
The boy gats the dog and the dancer.
(switch toys)
The doctor dokes the lion and the girl.
The cat gebs the horse.
The lion vips the monkey.
The clown bifs the horse and the cat.
The lion mofs the cat to the girl.
The man mons the clown to the monkey.
The doctor fets the lion.
The monkey soogs the man and the doctor.
The girl voofs the doctor to the horse.

APPENDIX B

Task 2 Test Items

Set 1

The cow chews the hay.
The baby licks the spoon and the bowl.
The dog bites the arm the leg.
The cat touches.
The boys mails the card to the girl.
The lady the baby kisses.
The girls eats the cake.
The teacher shows the paper to the nurse.
The bear pushes and the tree the log.
The mother hugs the girl and the boy.
The pen reads the book and the card.
The witch flies the broom the moon.
The nail brings the ball to the dog.
The horses kicks the fence and the gate.
The dog bites the bone.
The boy passes the ball to the girl.
The bed hits the pig.
The friend the flower gives to the lady.

Set 2

The dog bites the bone.
The nail brings the ball to the dog.
The bed hits the pig.
The horses kicks the fence and the gate.
The teacher shows the paper to the nurse.
The lady the baby kisses.
The boys mails the card to the girl.
The cow chews the hay.
The bear pushes and the tree the log.
The witch flies the broom the moon.
The cat touches.
The pen reads the book and the card.
The friend the flower gives to the lady.
The baby licks the spoon and the bowl.
The mother hugs the girl and the boy.
The dog bites the arm the leg.
The boy passes the ball to the girl.
The girls eats the cake.