cogió un cuchillo/ (pause)	(A)		grabbed a knife/ (pause)	(A)	
lo cogió al sapo/	(A)		grabbed the frog/	(A)	
lo quería matar/	(MS)	M	he wanted to kill it/	(MS)	M
y ya se acabó/			and it finished		

Child 33, age 8:10

Spanish version			***English version***		
Que era un niño/	(PS)		That there was a boy/	(PS)	
se levantaba/	(A)	E	got up/	(A)	E
entonces él tenía una ranita/	(PS)		then he had a frog/	(PS)	
ah entonces después salieron/	(A)		ah then they left/-	(A)	
a comer el papá y la mamá/	(G)	M	to eat the father and the mother/	(G)	M
entonces después ah la el nene estaba comiendo/	(A)		so then ah the the boy was eating/	(A)	
y la ranita estaba adentro del bolsillo entonces del nene/	(PS)		and the frog was inside of the pocket so of the boy/	(PS)	
y salió/	(A)	E	and left/	(A)	E
entonces después revolcó/	(A)		so then rolled over/	(A)	
se metió en la comida/	(A)		got into the food/	(A)	
después se metió en el agua/	(A)		then got into the water/	(A)	
donde había uno de esos que se hacen así (mimicking claws with hands) ¿que comen a la gente?/	(PS)	R	where there were one of those that do like this (mimicking claws with hands) that eat people?/	(PS)	R
entonces después se salió/	(A)	E	so then got out/	(A)	E
y se metió a la ensalada/	(A)		and got into the salad/	(A)	
entonces el hombre de la ensalada que iba a llevarla/	(A)		then the man of the salad that was to carry it/	(A)	
la llevó/	(A)		carried it/	(A)	
entonces una señora se asustó/	(MS)	I	so a lady got scared/	(MS)	I
entonces después la rana se fue adonde se hace la comida/	(A)		so then the frog went to where they make the food/	(A)	
y y revolcó todo eso/	(A)		and and rolled over all that	(A)	
entonces el que mandaba/	(A)		so the one that was commanding/	(A)	
la iba a matar con un cuchillo/	(A)		was going to kill her with a knife/	(A)	
y cogió ellos sartén/	(A)		and they grabbed skillet/	(A)	
para freírla/	(G)	M	to to fry her/	(G)	M
y entonces después el niño gritó bien duro/	(A)	M	and so then the boy screamed very loud/	(A)	M
y se acabó/			and it finished/		

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Delay Versus Deviance in the Language Acquisition of Language-Impaired Children

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To investigate the issue of delay versus deviance in the language acquisition of language-impaired (LI) children, the order of acquisition of a set of linguistic structures and the relationship obtaining between one structure and another were examined in comprehension and production over a 5-year period in a group of LI and language-matched normal children. The results demonstrated a marked similarity between groups, both in the point at which mastery of individual structures was achieved and in the overall patterns of acquisition demonstrated. These data suggest that LI children are constructing grammars based on the same rules and principles as those of linguistically normal control subjects, and that their linguistic impairments may be principally processing, not representational, in nature.

KEY WORDS: language acquisition, language-impaired children, delay, deviance, grammar

The mechanisms of first language acquisition are poorly understood. Theories of language acquisition seek to explain how children master a first language within a given time frame, in a relatively uniform manner; why children make only certain types of errors; how they come to know far more than they are ever exposed to; and how and why they move from stage to stage. Explanations have been based largely upon data from normal children. However, important insights into the nature of acquisition have also been obtained from studying children with known sensory and cognitive impairments, for example, blind children (Anderson, Dunlea, & Kekelis, 1984; Gleitman, 1981; Landau & Gleitman, 1985); deaf children (Jackson, 1989; Lillo-Martin, 1986; Newport & Meier, 1985; Pettito, 1983); and children with Down's syndrome and other mental retardation (Curtiss, 1982, 1988; Fowler, 1984, 1986).

Examining language acquisition in children with known language-learning difficulties may hold particular promise for elucidating both the principles and processes underlying language acquisition and the developmental relationship between these and other mental processes intimately interacting with language and its performance. Toward this end, a number of researchers have begun conducting neuropsychological, cognitive, and linguistic investigations of children classified as being specifically language impaired (LI) (Chiat & Hirson, 1987; Clahsen, 1989; Frumkin & Rapin, 1980; Johnston & Kamhi, 1984; Leonard, 1982, 1987; Leonard, Sabbadini, Volterra, & Leonard, 1988; Rom & Leonard, 1990; Tallal & Piercy, 1973, 1974; Tallal, Stark, Kallman, & Mellits, 1981; Tallal, Stark, & Mellits, 1985). This population is of special interest because they are reported to have language learning problems in the face of normal nonverbal intelligence (Benton, 1964).

One of the key questions regarding LI children is whether these children evidence significantly delayed but normal patterns of acquisition, or whether they evidence deviant acquisition patterns. From a theoretical standpoint, this question is central, because a finding of deviance in LI children's language acquisition may provide important insights

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into language acquisition by illuminating the consequences of altered or absent principles of grammar, of alterations or impairments of grammar-building mechanisms, or of specific nonlinguistic mechanisms that support or are intimately involved in linguistic processing. From a practical standpoint, this question clearly has important implications for the clinical remediation of childhood language disorders.

What would constitute deviance in the grammar of a young child? The process of mastering a first language involves both constructing a grammar, (or, perhaps, selecting the correct grammar by setting and resetting parameters [Hyams, 1986; Roeper & Williams, 1987]), as well as applying algorithms for putting that linguistic knowledge to use. Constructing the grammar involves establishing a knowledge base in the form of abstract structural linguistic representations and increasing the knowledge base or changing it in principled ways (i.e., moving from "stage" to "stage"). The second aspect of grammar acquisition is one of mapping linguistic knowledge onto processing procedures. These then constitute distinct areas in which language development can be deviant. At the representational level, deviance might be predicted to result in structure-specific difficulties, that is, difficulties with grammatical structures that embody particular formal properties in rules and representations unattested in the grammars of linguistically normal children or in clear deviations from the normal relationship obtaining between one aspect of grammar and another.[1] At the processing level, deviance might constitute atypical algorithms for parsing or mapping representations onto input or output procedures, such as string-length-limited mapping or otherwise incomplete mapping of representational information.

Despite the fact that there are numerous notions regarding differences between processing and representation, actually differentiating representational from processing deviance on the basis of linguistic performance is extremely difficult.[2] Nonetheless, this paper is concerned with whether LI children exhibit deviance at the representational level, that is, in their acquisition of linguistic form. Specifically, our study was focused on whether LI children construct grammars in the same way as normal children. A number of studies have addressed this question, directly or indirectly, yet the issue is by no means resolved.

Several investigators have reported an abnormal persistence of early acquired linguistic forms either instead of expected advances or in free variation with later acquired forms. In phonology, for example, Salus and Salus (1973) and Ingram (1976) have described the continued use of forms whose surface phonetic realizations are the result of early simplification and substitution rules alongside renditions of the same word that are the output of much more mature phonological rules. A parallel phenomenon has been reported in the area of morphology. Although LI children have shown similar orders of acquisition of select grammatical morphemes, they are reported to show atypical patterns with regard to the grammatical control of these forms in production. Johnston and Schery (1976) and Steckol (1976), for example, studied the acquisition order of a preselected set of grammatical morphemes and the stage[3] at which they appeared in production. In each of these studies, neither the earliest appearance of the morphemes examined nor their point of mastery (consistent control in production) occurred in the same developmental stage as obtained for normal children. Typically, LI children produced specific morphemes at earlier stages than normal children, but did not control them until later stages.

A number of other studies also report less frequent use of grammatical morphemes in production than is the case with MLU-matched normal subjects (e.g., Albertini, 1980; Beastrom & Rice, 1986; Clahsen, 1989; Cousins, 1979; Khan & James, 1983; Steckol & Leonard, 1979). In a similar vein, Johnston and Kamhi (1984) found that at equivalent MLU stages, LI children tend to produce constructions requiring the use of more nonlexical morphemes than do normal children, but then omit more of these forms in the obligatory contexts these particular syntactic structures create. In addition, while the LI children produced sentences of equivalent length to those produced by MLU-matched controls, on the whole they produced syntactic structures involving less hierarchical depth; that is, they achieved equivalent length through the predominant use of verbs (e.g., *go*) that subcategorize for at least two arguments, one of which typically involves a prepositional phrase, as in "Mommy went to the store," as opposed to verbs requiring sentential complements (e.g., *say*). A similar asynchrony between the use of particular lexical items and control over the syntactic structures these items require as complements or arguments has been reported elsewhere as well (Chiat & Hirson, 1987; Lee, 1966). These studies, then, appear to have found evidence of deviance in the interaction of morphology with syntax and syntax with lexical development.

In contrast to these suggestions of deviance, a large number of studies report findings that characterize LI children's acquisition as delay without deviance in their grammar. Research concerned with the acquisition of the lexicon has consistently found that LI children demonstrate normal acquisition patterns (Camarata & Schwartz, 1985; Chapman, Leonard, Rowan, & Weiss, 1983; Leonard, Camarata, Rowen, & Chapman, 1982; Schwartz & Leonard, 1985). Studies examining the acquisition of thematic roles and meaning relations in LI children find that LI children express the same

[1]Such a finding necessarily awaits a body of accepted facts regarding relationships between one module of grammar and another in development. But see Hyams (in press) and a number of papers in Roeper and Williams (1987) for examples of acquisition research directed towards this question.

[2]See Chiat and Hirson (1987) for an analysis of processing deficits involving incomplete mapping of certain kinds of linguistic units and resulting consequences in performance, and Gopnick (1990a,b) and Leonard, Bartolini, Caselli, McGregor, & Sabbadini (1991) for investigations into the possibility and consequences of incomplete representations in the grammars of LI children. See also Curtiss, Jackson, Kempler, Hanson, and Metter (1986) for discussion of the effects of length on sentence processing in aphasic adults and LI children.

[3]The concept of acquisition stage is not without controversy. In the studies referred to herein, "stage" represents developmental stage as defined by Brown (1973), which is based on particular characteristics of the child's production, most specifically MLU. The authors are not advocating either this definition or the use of MLU more generally as an acquisition metric. (See Berman, 1980, Klee & Fitzgerald, 1985, and Hyams, 1986, for specific arguments and evidence regarding the inadequacy of MLU or MMU as an index of grammatical development.)

range of thematic roles as do linguistically normal children (Freedman & Carpenter, 1976; Leonard, Bolders, & Miller, 1976). Curtiss and Tallal (1985) found no differences between LI and language-matched controls (matched for "language age" as defined in the Procedures section of this paper) on the range of propositional categories and structures expressed, even when those categories examined included many not typically examined in other studies, for example, irrealis (pertaining to the unreal or not yet realized), intentionality, causative, obligation, and temporality. Similarly, Chiat and Hirson (1987) found a rich variety of proposition types and structures in the speech of the LI child discussed in an insightful case study. In pragmatics as well, LI children are reported to express the same pragmatic functions as MLU-matched children (e.g., Leonard et al., 1982; Skarakis & Greenfield, 1982). And in morphology and syntax, despite differences noted in frequency of use, investigations of LI children's mastery of grammatical forms in production indicate a normal order of mastery (Cousins, 1979; Ingram, 1972; Johnston & Schery, 1976; and Kessler, 1975; Steckol, 1976, for morphology; Johnston & Kamhi, 1984; Leonard, 1972; and Menyuk, 1964, for syntax). However, despite reference to stage as defined by utterance length, no analysis examining the relationship between acquisition of these grammatical morphemes and specific acquisitions in other components of the grammar was carried out in these studies.[4]

The studies indicating delayed but normal development have focused on one piece of the grammar at a time, whereas those studies suggesting deviance implicate asynchronies between acquisition of one piece of the grammar and another. A key to uncovering deviance in the language acquisition of LI children may, therefore, lie in examining patterns of acquisition across components. However, the few studies that have done this have been cross-sectional and have, almost without exception, examined only production data.[4] In addition, the numbers of children studied have not been large. Given the variability known to exist among children, research investigating whether patterns of acquisition in LI children are deviant calls for longitudinal investigation and the inclusion of both comprehension and production data in a sizeable population of children.

To further investigate the delay versus deviance question, we therefore focused on whether LI children appear to construct grammars in the same way as normal children by examining the acquisition of a set of linguistic structures and the relationship obtaining between one structure and another, longitudinally, in a sizeable population of LI and normal children. We examined the order in which these linguistic structures are mastered in both populations, looking at comprehension as well as production. Included in the set were structures of morphology, syntax, and semantics, some of which are mastered in close proximity to one another in normal acquisition and some of which are mastered at distinctly different points in normal acquisition. A longitudinal (rather than cross-sectional) data base was expected to more accurately determine patterns of linguistic growth, that is, changes in linguistic knowledge from one point to another. Deviance in building the knowledge base as well as in moving from stage to stage would be reflected by difficulties with specific structures relative to the normal children and atypical patterns of acquisition order for structures within and across components.

Method

Subjects

The subjects were 28 LI children who met the following criteria:

1. A nonverbal performance IQ of 85 or better on the Arthur Adaptation of the Leiter International Performance Scale.
2. A mean "language age" at least 1 year below both chronological age and performance mental age. Language age was computed by averaging the scores achieved on the following standardized expressive and receptive language tests: the Sequenced Inventory of Communicative Development (SICD) (Hedrick, Prather, & Tobin, 1979), The Token Test (DiSimoni, 1978), the Northwestern Syntax Screening Test (Lee, 1971); the Carrow Elicited Language Inventory (CELI) (Carrow, 1974), and the Arizona Articulation Proficiency Scale (AAPS) (Fudala, 1980). All tests were equally weighted in the computation; thus the resulting index of language age represented an average of a child's comprehension and production performance.[5]
3. Normal hearing acuity[6] and no oral structural or motor impairments affecting nonspeech movements of the articulators.[7]
4. A monolingual English background, without significant dialectal differences from Standard American English in the home environment.
5. No manifestations of autism or other emotional pathology as determined by DSM III diagnostic criteria.
6. No frank neurological deficit (e.g., hemiparesis or seizure disorder).

In addition, the LI children comprised three defined clinical subtypes[8]: (a) those evidencing greater receptive than ex-

[4]As this paper was going to press, a few recent exceptions came to the authors' notice, for example, Clahsen, 1989; Loeb and Leonard, 1991; Leonard et al., 1991.

[5]A "receptive language age" (the mean of age scores on the receptive language tests) and "expressive language age" (mean of scores on the expressive language tests) were also computed. These scores were used to define our subgroup types but played no other role in the study reported herein.

[6]The standard audiometric procedures of the Speech, Hearing and Neurosensory Research center at Children's Hospital of San Diego were used. Children who evidenced hearing thresholds for pure tones at 250, 500, 1000, 2000, 4000 and 6000 Hz of 20 dBHL (ANSI, 1969) or greater, and whose speech reception threshold was greater than 20 dBHL in the poorer ear were excluded.

[7]An oral motor exam was given by a certified speech pathologist. Gross abnormalities of oral structure, inability to lateralize the tongue to the right or left or to raise the tongue tip and/or keep the lips closed, persistent drooling, and inability to chew, suck, or swallow normally was sufficient to exclude a child from the study.

[8]The research reported in this paper involves only one aspect of the larger study of which this was a part. A separate aspect of the study addressed the

pressive language problems (i.e., scores achieved on the expressive language measures were a minimum of 6 months higher than those achieved on the receptive language tests), (b) those evidencing more expressive than receptive difficulties, and (c) those manifesting significant and roughly equivalent expressive and receptive impairments. These three subtypes were almost equally represented in the group of 28 LI children (9, 9, and 10, respectively).[9] On induction into the study, the LI children ranged in age from 4:0 to 4:9 (years: months) with a mean age of 4:4.

The control group consisted of 32 normally developing children matched to the LI children at entry to the study on the basis of language age as determined by performance on the same set of standardized language tests. Each of the language-matched control subjects also met the following criteria:

1. A nonverbal performance IQ of 85 or better and not better than the highest IQ demonstrated by an LI subject.
2. A mean language age not more than 6 months below performance mental age and chronological age.
3. Normal hearing acuity, no motor handicaps, no uncorrectable visual impairments, and no oral structural or motor impairments.
4. A monolingual home environment without significant dialectal differences from Standard American English.
5. Normal emotional and social development for chronological age.
6. No neurological problems.

The control group ranged in age from 2:1 to 3:8 with a mean age of 2:9 at the beginning of the study. All of the subjects were part of a larger study (see Tallal, Curtiss, & Kaplan, 1988; Zeigler, Tallal, & Curtiss, 1990, for more details regarding the study and subject selection).

Procedure

Items[10] from the CYCLE (the Curtiss Yamada Comprehensive Language Evaluation, Curtiss & Yamada, 1988) receptive (R) and elicited expressive (E) measures were administered to the subjects at five distinct points in time—yearly (over the course of 5 years) for the LI children, and at 6-month intervals for the language-matched controls. A difference in sampling intervals for the two populations was built into the design in an attempt to equalize acquisition rates for the two groups. A protracted rate of language acquisition for LI children is well documented; however, the ratio of LI acquisition rate to normal acquisition rate has not heretofore been established, to our knowledge. Our estimate of a 2:1 relationship between the rate of linguistic growth for normally developing children and that of LI children has been confirmed by the results of a number of our studies, and is also confirmed by the results of the experiments described below.

The CYCLE-R items consisted primarily of picture-pointing items, in which the subjects had to select the picture (from a set of 2, 3, or 4) that corresponded to the test word or sentence. However, an object manipulation format was used to test locative prepositions. The CYCLE-E items were sentence completion items, in which the responses were constrained by picture, sentence-frame, and intonational cues. The structures tested and their identifying numbers are presented in Table 1. (See Appendix A for example items from the CYCLE.)

Scoring

Each CYCLE-R (receptive) subtest consisted of five items. A passing score was 4 out of 5 correct. Each CYCLE-E (expressive) subtest consisted of a pair of items. A passing score was 2 out of 2.

For each of the 29 CYCLE subtests given, scores were assigned on the basis of number correct. For our purposes, after a passing score had been achieved two data points in a row, the structure in question was assumed to have been mastered, and passing scores were automatically given for that item from that point on without further testing. Point of attainment was defined as the earliest data point of consecutive passes. So, for example, a performance of dp1-fail, dp2-fail, dp3-pass, dp4-pass would be assigned a point of attainment of data point 3.

Each subtest on the CYCLE is assigned a language level, roughly corresponding to the chronological age of point of mastery, based on normative sampling of 200 normally developing children between the ages of 2 and 9 years. Each CYCLE level was operationally defined as the youngest age at which at least 80% of this group achieved a passing score on at least 75% of all subtests assigned to that level.

The CYCLE items comprising the experimental battery covered three different components of the grammar: semantics, syntax, and morphology. Assignment of a subtest to a particular component of the grammar was based on whether the linguistic knowledge necessary to pass the subtest was primarily one of (a) lexical knowledge of semantic roles and relations (semantic knowledge), (b) knowledge of grammatical relations between phrasal and/or clausal constituents (syntactic knowledge), or (c) knowledge of bound and free-standing grammatical morphemes (morphological knowledge). Some of the structures included could have been assigned to more than one component, and in such cases, assignment of a subtest to a particular component was based upon the aspect of the structure being examined by the CYCLE subtest.

issue of subtype. The LI population who participated in the overall study was composed of unequal numbers of children in each of the clinical types described above. To address the question of subgroups, however, a subpopulation of 30 LI children divided into equal-sized groups (10 children) of each subtype was followed in some greater detail. These same children comprised the subject pool for the study discussed herein. Because these subgroup types may not be distributed equally in the population at large, we realize that this may limit the generalizability of our findings; however, analyses were carried out to determine if there were significant subgroup differences for the variables examined in this study. Because the subgroups performed similarly with respect to the areas of linguistic performance examined here (e.g., order of acquisition, etc.) the data from all three subtypes were pooled and considered together.

[9]At the beginning of the study there was an equal number of children (10) in each subgroup; however, one of the subjects in Subgroup 1 dropped out of the study before its conclusion. There was also an equal number of LI and normal children at the outset; however, a few of the original subjects were lost to attrition during the course of the 5-year study.

[10]The linguistic structures comprising the subtest battery used in the experiments reported in this paper were selected to address specific research questions and hypotheses in the larger study. These questions are not relevant and will not be discussed here.

TABLE 1. Linguistic structures tested.

Receptive		Expressive	
Subtest	Subtest name	Subtest	Subtest name
1	Negation in simple sentences (2)	16	Negation in simple sentences (2)
2	Object pronouns: *him, her* (2)	17	S VP (simple declaratives) (3)
3	Locative preps: *in front, in back* (3)	18	Regular past tense (3)
4	Subject (S S) relative clauses (3)	19	Future conditionals (4)
5	Noun singular/plural (3)	20	Possessive morpheme (4)
6	Progressive aspect: */-ing/* (4)	21	Negation in embedded clause (5)
7	Aux *Be* singular (4)	22	Verb singular (3rd person) (5)
8	Regular past tense (5)	23	Prep: *with* (6)
9	Aux *Be* plural (5)	24	Regular past participle (6)
10	Subject pronouns: *she, he, they* (5)	25	Counterfactual conditionals (7)
11	Possessive morpheme (6)	26	Subject (S O) relatives with relativized objects (7)
12	Subject (S S) relative clauses ending in a N-VP sequence (6)	27	Prep: *by* (8)
13	Object (O S) relative clauses (7)	28	Passive (with specified agent) (8)
14	Verb plurals (8)	29	Passive aux and past participle (8)
15	Object relatives with relativized objects (O O) (8)		

Note. Numbers in parentheses refer to level of CYCLE subtest. S = subject, O = object, N = noun, V = verb. S S stands for a relative clause modifying the matrix subject, in which the relativized constituent is the subject of the embedded sentence. S O refers to a relative clause modifying the matrix subject, in which the relativized constituent is the object of the embedded sentence. O S refers to a relative clause modifying the matrix object, in which the relativized constituent is the subject of the embedded sentence. O O refers to a relative clause modifying the matrix object, in which the relativized constituent is the object of the embedded sentence.

As a result of the structure of the CYCLE battery, then, order of acquisition could be assessed in terms of an expected pattern (or sequence) of acquisition both within and across linguistic components.

Procedure

The children of the study were given the "order of acquisition" battery consisting of the 29 subtests presented in Table 1, at five different data points. These data points were spaced at 1-year intervals for the LI children, and at 6-month intervals for the normally developing controls. Each child was tested individually by an examiner. All testing was carried out in quiet testing rooms at Children's Hospital, San Diego.

Results

Analyses were aimed at determining the developmental point at which the various linguistic structures were acquired in each group. A first analysis examined the order in which children in each group demonstrated mastery of the linguistic structures tested. This analysis was designed to test the possibility that individual LI children might evidence abnormal patterns of grammatical development (e.g., acquiring normally later-learned "difficult" structures before mastering earlier-mastered "easier" ones). We then analyzed the data by individual subtest (linguistic structure tested) to determine whether group differences could be found in the testing point (data point) at which mastery was attained. An additional analysis was conducted to examine the consistency with which subjects' acquisition of structures matched an increasing, sequential progression expected on the basis of the CYCLE norms. Finally, individual subject analyses were conducted to investigate whether other variables (socioeconomic, behavioral, neuropsychological) might correspond with individual performance patterns.

As might be expected in a longitudinal study of this magnitude and duration, there were a number of subjects who moved, missed testing sessions, and so forth, causing missing data points. Of the total 9,000 data subtest scores, 1,769 data points (19.7%) were missing. Approximately half of these missing data points were caused by the aforementioned factors. In addition, due to a procedural error, there was a systematic loss of data for the LI children's higher level subtests during the first two testing points. In order to ensure that these systematically missing data did not bias the final results, a series of analyses were undertaken.

The data were coded not only in terms of the data point at which subjects passed a subtest, but also in terms of the data point at which an uninterrupted sequence of data began. Thus, for example, a subject who passed a subtest at data point 4, but who systematically missed the first two data points, would be coded as "4-3" (passed at 4, data began at 3). The only cases that posed a danger to point of attainment and sequence analyses were those in which a passing score began at the same data point as the point at which data began (i.e., 2-2, 3-3, 4-4, 5-5). In these cases, it is possible that we could have erroneously missed an earlier point of attainment due to missing data, and thus obtained distributions skewed in the direction of higher values. Cases in which missing data were randomly distributed throughout a sequence, or in which missing data were contiguous with data points having fail scores, do not present problems, because of the requirement of having two passing scores in a row to establish mastery.

When the characteristics of the missing data were tallied, there were only 207 potentially problematic cases (2.3% of the total cases, 10% of the errors). The majority of these cases occurred for the later data points (3 and above). It therefore appears doubtful that missing data, either random or systematic, could have significantly influenced the outcome of the statistical analyses.

Deviation from Linear Sequence

To examine the general developmental order in which children mastered the structures tested, scores were first sorted by CYCLE levels. For the CYCLE subtests used in this study, there were seven levels, ranging from 2–8. The levels of each subtest are indicated in Table 1. For each subject, means were computed, by level, of the data points at which the subtests were passed. For example, the data point means at which Subject 1 passed the seven test levels were 2, 3.3, 3.5, 3.7, 4.5, 5.0, 5.5. Recall that in the present study there were six data points, with data point 6 indicating the structure was "not attained" within any of the data collection points.

With the data sorted in this fashion, the extent to which scores showed consistent maturational increase (higher level attained as chronological age increased) was then inspected. As in the example cited, it was expected that the mean data points for the seven test levels would increase sequentially. That is, the actual data points at which subjects passed these tests were predicted to increase along with increasing test levels.

As a first measure of deviance[11] we chose to define as "deviant" those cases in which subjects attained more "difficult" structures earlier than "easier" ones (e.g., subjects showing later points of attainment for Level 2 structures as compared with Level 3 structures). In order to quantify the degree of deviation from the linear sequence of acquisition expected from the CYCLE levels, the number of times the expected linear progression through levels was violated was computed for each subject. The data were scored such that an exception was registered each time a subject showed mastery of a structure on a higher test level before one on a lower test level, that is, a case in which a presumably more difficult structure was learned before an easier one (where "difficult" and "easy" are to be translated as "later acquired" and "earlier acquired," respectively).[12] Thus, a pattern such as 2, 3.5, 3.8, 4.2, 5.4, 4.9, 5.7 would be scored as having one violation of the canonical (expected) sequence. A deviant acquisition pattern would presumably show a greater number of sequence violations than the norm.

[11]Attending to "reversals" in the difficulty of acquired structures was undertaken because it represents a strong case of exception from expected acquisition patterns and is readily quantifiable. It should be pointed out, however, that there may be more subtle forms of order deviance not involving such reversals. For example, it may be that deviant language-learners attain structures in an expected sequential order, but show abnormal plateaus in which acquisition progress is slow. Future investigations need to address such issues.

[12]The terms "easier" and "more difficult" are being used for convenience and are not to be taken as claims about relative difficulty along some unspecified complexity or learnability metric. The issue of complexity in acquisition is a matter of linguistic or learnability theory and is not being addressed here. See Pinker (1984) and Hyams (1989) for interesting discussions of this issue.

The data revealed little difference in the number of exceptions to linear sequence as a function of group or test type (R, E). When considered by individual subject, the number of deviations ranged from 0 to 3 (M = 1.32), for sequences three to seven levels in length.[13] The distribution of error patterns was found to be quite regular. As shown in Figure 1, group means and standard deviations were largely similar across both test types.

These data were analyzed statistically by conducting a two-way analysis of variance (ANOVA), examining both group and test factors. The results show no significant main effects for group or test variables, and no Group × Test interaction. These data thus provide little evidence for group deviance in the LI population regarding order of acquisition.

Survival Analysis

In order to analyze possible group differences in the point of attainment of individual grammatical forms, we used life-table survival prediction (Kaplan & Meier, 1958). Survival prediction affords a highly robust test of how groups may vary in their ability to survive specific criteria over time. In the current application, survival was defined as not passing a subtest at a given data point; once a subject achieved mastery, s/he fell out of the study. For each of the 29 CYCLE subtests, separate survival curves were computed for the two groups of children, using the program BMDP2L (Dixon & Brown, 1981). A representation of the results for CYCLE Subtest 5 (noun singular/plural) is presented in Figure 2, which displays the percent of children surviving (i.e., not achieving mastery) in each group.

Group effects were analyzed statistically based upon a Cox Proportional Hazard function (Cox, 1972), with significance assigned using a generalized Savage (Mantel-Cox) test. The results are shown in Table 2, which lists for each CYCLE subtest the Mantel-Cox statistic and significance for df = 1. Following the Bonferroni inequality, the criterion for significance assigned to each subtest was considered to be $p < .01$. The percent of missing data was tabulated for each subtest, and subtests for which more than 50% of either

[13]Because of missing data, there were not always data for seven levels in a sequence period. The minimum number of levels considered to constitute a "sequence" was three.

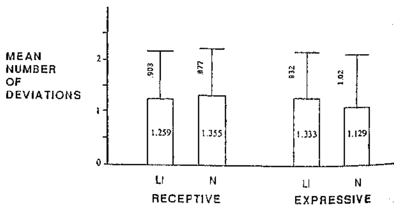

FIGURE 1. Means and standard deviations from the mean number of deviations from expected pattern of acquisition.

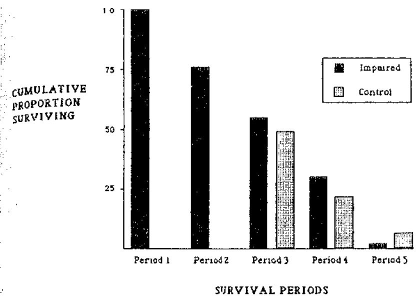

FIGURE 2. Survival analysis for noun singular/plural.

subject group were missing were excluded from further analyses. Missing data included eight higher level sub-tests (three receptive, five expressive). Table 2 therefore includes data for 21 (of the original 29) CYCLE subtests.

The results indicate no significant differences at $p < .01$, suggesting that distributions of the point of attainment for each test structure did not differ between the two groups. There were, however, two tests (6 and 21) for which the group difference approached significance at $p < .01$. (See Discussion for interpretation of these findings.)

The chief finding of this analysis is that the overall distributions of point of attainment are highly similar between the two groups for both receptive and expressive tests. That is, there seem to be few cases where the distribution of point of attainment for normal children is not closely matched by that of the LI subjects.

TABLE 2. Survival analysis results.

CYCLE subtest	Generalized Savage (Mantel-Cox)	Significance (p)
Receptive		
1	0.897	.344
2	0.004	.949
3	3.610	.057
4	0.511	.475
5	0.050	.823
6	3.960	.047*
7	0.537	.464
8	0.674	.412
9	0.062	.804
10	0.485	.486
11	0.020	.967
15	0.039	.891
Expressive		
16	0.004	.953
17	0.001	.987
18	2.770	.096
19	0.138	.682
20	1.780	.182
21	5.010	.025*
22	1.420	.233
23	0.068	.795
26	0.289	.591

*Tendency, $p < .01$

Individual Subject Data

A series of analyses were conducted to investigate whether other, nonlinguistic factors could be found to be associated with deviant (e.g., outlier) performance on order of acquisition. For this analysis, socioeconomic, behavioral, and neuropsychological variables in the performance of individual subjects showing potentially deviant patterns of acquisition were examined. Using the deviation from linear sequence data, potentially deviant individuals were identified based upon the number of exceptions from the expected order of acquisition. It will be recalled from the discussion on deviation from linear sequence that the mean number of deviations for each subject ranged from 0 to 3 (M = 1.32). For the present analysis, we focused upon those children showing the greatest irregularities in acquisition, that is, showing three deviations in sequence for either receptive or expressive tests. There were a total of 10 such children (4 LI, 6 control). Four of the children (2 LI, 2 control) showed deviance per this index on receptive tests, and 6 (2 LI, 4 control) children showed deviance per this index on expressive tests.

For these 10 subjects, it was asked whether there were quantifiable variables (socioeconomic, behavioral, neuropsychological) that might correspond with an excessive number of sequence violations. To answer this question, scores from a broad series of standardized and experimental tests were examined, including IQ batteries, medical questionnaires, and family history assessments. Also examined were data from Tallal's Repetition Test, a measure of rapid, sequential processing of auditory and visual stimuli (Tallal et al., 1988). The results of these tests were condensed into 14 variables, which were then inspected to determine whether outlier values (i.e., scores more than two standard deviations from the mean) could be found.

The results demonstrated almost no correspondence between children who are potentially deviant in acquisition order and socioeconomic, neuropsychological, or behavioral profiles. Only one child (LI Subject 1) showed an association with any of these nonlinguistic variables, namely, high prenatal risk factor. None of the variables considered, however, could be found to consistently correspond with these individuals' performance. Thus, no pattern of correspondences emerged for either group, suggesting that these outliers do not constitute a separate subgroup of either group. These findings, therefore, suggest that both the normal and LI populations show a comparable range of intrasubject variability in acquisition patterns, and that the most variable children do not appear to differ with respect to socioeconomic, neuropsychological, or behavioral status from other members of their group. Moreover, the percentage of outliers corresponds to fairly equivalent proportions of each group (14% and 19% of the LI and controls, respectively), suggesting that such children are equally representative of both the LI children and the normally developing controls.

Discussion

Our findings support the notion that LI children do not display deviant acquisition, because the acquisition patterns displayed by the LI and normal children were remarkably similar. These findings are consistent with other data on this population (although not all of the findings cited below have been interpreted in this way).

In the area of phonology, where research has focused on the phonetic realization of segments and syllables in the speech of LI children and the processes reflected therein, LI children are reported to demonstrate nearly identical phonological processes as those used by younger, normal children (e.g., Campbell & Shriberg, 1982; Compton, 1970; Ingram, 1991; Oller, 1973; Shriberg, Kwiatkowski, Best, Hengst, & Terselic-Weber, 1986). Even in the face of serious motor production difficulties or when evidencing atypical phonetic realization of language-particular phonological forms, LI children have been shown to use phonological processes that are both attested in the languages of the world and/or are common to younger, normally developing children (Camarata & Gandour, 1984; Ingram, 1991; Leonard, 1985; Leonard & Leonard, 1985; Lord, 1974).

In morphology as well, LI children apparently evidence normal word-formation processes. No study has reported affixation to the wrong syntactic category, or the wrong affixation process being employed (prefixation rather than suffixation, or vice versa). Moreover, recent studies have shown a normal sensitivity and adherence by LI children to well-formedness conditions regarding word and stem formation (Clahsen, 1989; Leonard et al., 1988; Leonard, Sabbadini, Leonard, & Volterra, 1987; Rom & Leonard, 1990), although difficulties with grammatical morphemes is reported to be a persistent problem for LI children cross-linguistically (Leonard et al., 1991, and above references).

Studies of syntax in LI children that have concentrated on descriptions of the syntactic structures used by LI children have found that they use NP, AUX, and VP structures attested in the speech of normal children and adults (e.g., Johnston & Kamhi, 1984; Leonard, 1972; and Menyuk, 1964). Even considering specific difficulties with grammatical morphemes of "low phonetic substance" (Pinker, 1984), the emergence of inflectional material and its relation to other properties of the syntax has not been shown to be aberrant (Leonard, Sabbadini, Leonard, & Volterra, 1987; Leonard et al., 1988).

In sum, there is considerable evidence to support a hypothesis of delay rather than deviance in the acquisition of linguistic form. Regardless of the grammatical component involved, no study has reported LI children to have hypothesized impossible rules of grammar, to have displayed patterns in the acquisition of the language-particular facts of English that are unattested for normal children, or to have reached deviant conclusions about the kind of grammar the target language embodies.

Our findings and tentative conclusions nevertheless conflict with several studies that do report deviance in the language acquisition of LI children. While there may be others, three reasons for this inconsistency suggest themselves. First, the size of the normal populations used in other investigations may have been inadequate to permit an accurate estimate of the variability in normal language acquisition, leading to an overestimation of deviance from the norm within the LI population. That is, even though our population was not huge, the smaller size of the normal groups heretofore studied may have masked the extent to which normal variability encompasses what LI children do. Only a study with a relatively large *N* and one that examines development over time within the same population of children can elucidate the extent to which this appears to be true.[14]

Second, the matching of children on the basis of MLU may be inadequate as a means for assessing deviance in acquisition. In our study the LI and normal controls were matched on the basis of much broader aspects of linguistic performance, including comprehension level. While this more extensive basis for matching allows, perhaps, for a more realistic comparison of language acquisition in LI and normally developing children, it has not prevented the larger study of which this was a part (see footnote 10) from uncovering many interesting group differences (Curtiss & Tallal, 1991).

Third, the deviance reported in other studies may pertain to control of the grammar in production and not to the nature of the linguistic representations embodied in the grammars of LI children. Thus, even the atypical production patterns reported (e.g., Johnston & Kamhi, 1984) do not necessarily reflect abnormal patterns of grammar construction or deviant linguistic representations of the relevant forms. Rather, these findings are consistent with a view of delayed but normal representational knowledge alongside potentially deviant output procedures (e.g., applying immature, inadequate, or incorrect algorithms for producing the relevant linguistic forms). As an example, in an interesting case study of an LI adolescent, Chiat and Hirson (1987) propose a model of processing deficits that is quite consistent with the notion that the impairments of LI children may lie at the level of processing rather than in structural representations, although it has recently been suggested that LI children do have representational deficits of morphological inflection (Gopnik, 1990a,b).

Our findings from this study, nevertheless, do not rule out deviance in the acquisition of grammatical form in LI children. First, there were differences between the two groups on mastery of two structures, each approaching significance: (a) the Auxiliary *be + ing* in the singular, and (b) negation in an embedded clause. In both cases, the LI children showed later mastery of these forms than the normally developing children.

Regarding acquisition of *be + ing*, we did not find that the LI children showed relative difficulty with all discontinuous morphemes or with all forms that move to Infl from VP; their pattern of acquisition with *be + ing* in the plural was not similarly affected, nor was their acquisition of the passive morphology *be + en*. Similarly, the phonetic substance of aux *be* singular is not arguably weaker than the noun plural marker, the possessive morpheme, or the third person singular verbal morpheme, none of which proved to be significantly different for the two groups. What is more, the semantics encoded in the singular progressive aux are not substantially different from either the plural progressive or the singular simple present, again, neither of which appear to have caused the same difficulties for the LI children. A linguistically meaningful explanation of this performance difference, therefore, remains elusive. Accounting for a similar difficulty and delay in the acquisition of negation within an embedded clause, without comparable difficulty with affirmative complex sentences of any of the types tested and without comparable difficulty of negation in single-clause sentences, also remains elusive at this point.

Second, discrepancies between our findings and those of other studies might at least in part be a function of methodological differences in data collection, especially the differences in performance on structured elicitation tasks as opposed to spontaneous speech. As some of our other work on this study reflects, LI children seem particularly sensitive to extralinguistic task factors. However, other findings from the larger study, taking into account the effects of task factors (e.g., Curtiss & Tallal, 1991) support our findings here of delay without deviance.

Third, this study was certainly not an exhaustive study of the question of deviance in the acquisition of LI children. Only a small portion of the many possibilities that could be explored relative to this question were covered. As new insights are gained into normal language acquisition, additional theoretically motivated hypotheses regarding what to examine and where to look arise.[15]

If the finding of delay without deviance continues to be supported in future studies, it suggests a highly constrained acquisition course, such that even in the face of impairments that LI children evidence in one or more nonlinguistic "support" systems (e.g., auditory processing, short-term memory), acquisition will unfold along highly specific lines. Moreover, it suggests that such nonlinguistic deficits may have the general result of delaying language acquisition and/or the specific consequence of affecting particular lexical items more than others (e.g., those with low "phonetic substance"), but not the consequence of affecting specific grammatical modules or principles in acquisition. It also suggests that stages of acquisition are better defined by specific changes in the grammar that have a variety of reflexes throughout the grammar and are evidenced by concomitant acquisitions in different components of the grammar.

Considering the variety and severity of nonlinguistic impairments LI children have been found to have, the fact that grammar construction in these children appears normal is rather remarkable. While the mechanisms involved in grammar construction remain a mystery, the present results notwithstanding, the finding of relatively normal grammar acquisition in the face of neurological and cognitive deficiencies suggests that the mechanisms of grammar construction in first language acquisition are robust and point to the evolutionary and functional significance of this human faculty.

[14]We feel confident that the children we included in our normal group were indeed normal, as they were accepted into the normal group only after they met all of our criteria, which included demonstrating normal neurological, sensory, emotional, cognitive, and linguistic function. None of the other studies to our knowledge used such rigorous group identification criteria.

[15]In addition, questions regarding the nature of the delay have yet to be answered. What is the slope of the delay? For example, does it start out more sharply and then flatten out, or vice versa, or is it flatter throughout development?

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APPENDIX
SAMPLE CYCLE ITEMS*

***CYCLE-R* (Receptive)**
SEMANTICS
Locative prepositions: *In front, in back*
Subtest item: *Put this spoon in back of you.*
MORPHOLOGY
AUX *Be* Singular
Subtest item: *The fish is swimming.*
Response picture choices: 1) one fish swimming
2) two fish swimming
AUX *Be* plural
Subtest item: *The deer are drinking.*
Response picture choices: 1) one deer drinking
2) two deer drinking
SYNTAX
Subject (S S) relative clauses
Subtest item: *The clown who is big is chasing the girl.*
Response picture choices: 1) big clown chasing girl 3) girl chasing little clown
2) girl chasing big clown 4) little clown chasing girl

***CYCLE-E* (Expressive)**
SEMANTICS
Preposition: *with*
Picture cues: 1) boy running and girl standing
2) boy and girl running together
Subtest item: *Here the boy is running to the girl. But* here *he is running* ________.
(with her, with the girl)**
MORPHOLOGY
Possessive morpheme
Picture cues: 1) boy holding ball
2) girl holding ball
Subtest item: *This ball belongs to* Michael *and this ball belongs to* Stacey.
Whose *ball is this?* ________.
(Stacey's ball, Stacey's)**
SYNTAX
Subject (S O) relatives with relativized objects
Picture cues: 1) boy holding balloon
2) clown holding balloon
Subtest item: *A boy is holding* one *balloon. A clown is holding the* other *balloon.* This *is the balloon* ________.
(that the clown is holding, the clown has)**

*CYCLE-R and CYCLE-E © 1985 Susan Curtiss and Jeni Yamada. Full list of items is available from the authors.
**possible target responses