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Phonetic Profiles of Toddlers With Specific Expressive Language Impairment (SLI-E)

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Spontaneous language samples of 30 24-month-old toddlers diagnosed with Specific Expressive Language Impairment (SLI-E) were compared with samples produced by an age-matched group of 30 typically developing toddlers. Vocalization patterns, phonetic inventories, and syllable formation patterns were compared. Toddlers with SLI-E vocalized significantly less often than their typically developing peers, had proportionately smaller consonantal and vowel inventories, and used a more restricted and less mature array of syllable shapes. Although the mean incidence of phoneme usage varied significantly in all comparisons, profiles of consonant usage were similar between the two groups for initial phoneme usage, but considerably different for final consonant closure. Such patterns of vocal and phonetic behavior confirm earlier reports of phonetic delay in SLI-E, and suggest that nongrammatical factors contribute to the development of expressive language deficits in toddlers. We further propose a bidirectional model for the expressive deficits in SLI-E, in which the child's limited phonetic capacity interacts with propensities in caretaker interaction to further reduce opportunities for expressive language learning and practice.

KEY WORDS: expressive language delay, SLI-E toddlers, phonetic development, phonetic repertoire

Approximately 5% of children demonstrate primary language disabilities (Silva, 1980; Stevenson & Richman, 1976; U.S. Department of Education, 1992). Currently, the basis of specific language impairment (SLI) is not well understood. The population of children who are specifically language-impaired is quite heterogeneous, and the underlying deficit in expressive language impairment has not yet been determined (Chapman, 1991; Curtiss, 1991; Johnston, 1991; Miller, 1991). Competing models of language impairment place the underlying deficit within limits on the child's information processing abilities (Curtiss & Tallal, 1991; Leonard, Sabbadini, Volterra, & Leonard, 1988; Tallal & Piercy, 1973, 1974), symbolic ability (Johnston, 1985; Roth & Clark, 1987; Terrell & Schwartz, 1988), and memory capacity (Kirchner & Klatzky, 1985), particularly for lexical items (Dollaghan, 1987; Rice, Buhr, & Nemeth, 1990).

Historically, evaluation of children with SLI was difficult until such children could complete standardized language tests, typically at age 3 or above (McCauley & Swisher, 1984). Despite the high incidence of children with SLI, younger children with Specific Expressive Language Delay (SLI-E, sometimes labeled "late talkers") have not been well studied. The lack of standardized early assessment tools has severely limited the study of language development in "slow" or delayed toddlers. Like the older SLI children who have been extensively studied (Miller, 1991), SLI-E children fail to achieve normal expressive language competence despite apparently normal development in nonlinguistic domains.

The recent development of parental vocabulary checklists (Capute et al., 1986;

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Coplan, Gleason, Ryan, Burke, & Williams, 1982; Dale, 1991; Dale, Bates, Reznick, & Morisset, 1989; Rescorla, 1989; Reznick & Goldsmith, 1989) has facilitated early identification of toddlers who are slow to talk. Recent studies of toddlers identified by parent report on a vocabulary checklist as having limited lexical ability and failure to combine words by age 2 indicate that such children typically score at least one standard deviation below age expectations on standardized language tests (Rescorla, 1989). At least half of such children will be identified as clinically language-disordered on conventional testing by age 3 or beyond (Fischel, Whitehurst, Caulfield, & DeBaryshe, 1989; Paul, 1989; Paul, Looney, & Dahm, 1991; Rescorla & Schwartz, 1990), thus justifying a discrete labeling of this population. Moreover, case studies of individual late-talkers reveal persistent expressive language disability and later academic failure, particularly in reading (Scarborough & Dobrich, 1990).

SLI-E can be clinically diagnosed by failure to achieve a 50-word vocabulary and 2-word combinations by age 2 (Rescorla & Schwartz, 1990; Scarborough & Dobrich, 1990). Rescorla & Schwartz (1990) and Paul, Looney, and Dahm (1991) estimate that up to half of late-talking 24-month-olds perform age-appropriately on standardized language protocols by 36 months; roughly similar "recovery" rates for more broadly defined SLI-E populations have been provided by Thal, Tobias, and Morrison (1991) and Fischel, Whitehurst, Caulfield, and DeBaryshe (1989). Conversely, roughly half of late talkers progress to clinically significant language delays at age 3 and beyond. Thus, closer study of the SLI-E population is critical to our understanding of the mechanisms underlying language delay and to the earlier and more accurate identification of language learning disability. Moreover, a better understanding of the precursors and correlates of expressive language delay may permit more efficacious treatment of SLI-E children.

Phonetic Development in SLI-E Children

As a population, SLI-E children are identified for failure to develop lexical and syntactic skills at normative rates. However, most studies of late-talking toddlers suggest that their articulation development falls below age expectations as well (Paul & Jennings, 1992; Ratner, 1994; Rescorla & Schwartz, 1990; Scarborough & Dobrich, 1990; Stoel-Gammon, 1989; Whitehurst, Smith, Fischel, Arnold, & Lonigan, 1991). This observation is of a rather general nature. Researchers have taken varying approaches to the description of the phonetic development of SLI-E children. Rescorla and Schwartz (1990) report an impression of "extremely poor intelligibility" in their SLI-E children on follow-up. Ratner (1994) found a reduced consonantal inventory and unusual sound preferences in a case study of a single SLI-E child. Scarborough and Dobrich (1990) found reduced "pronunciation accuracy" in the spontaneous speech of four SLI-E children followed from age 2 to age 7. Whitehurst, Smith, Fischel, Arnold, and Lonigan's (1991) retrospective finding that a limited babbling repertoire was correlated with severely language-delayed children's subsequent lexical and grammatical development raises the practical concern that early expressive language delay may be rooted in either speech motor or phonological limitations.

Stoel-Gammon (1989) retrospectively analyzed the babbles and early speech attempts of two toddlers from a larger sample of infants whose phonological development was tracked from 9 to 24 months. For the two children who met a diagnostic criterion of SLI-E at 24 months, observable differences in phonetic development were seen when compared to their normally developing peers. One child had a restricted babble inventory; the second displayed unusual sound preferences in babble. Both showed limited phonetic inventories and simpler syllabic configurations in speech at 24 months. However, Stoel-Gammon's children did not continue to display expressive language delay after age 24 months, when the study ended. This makes the drawing of inferences about the role of phonetic development in clinically significant language delay difficult.

In an effort to examine interactions between phonetic inventory characteristics, lexical naming attempts, and unusual phonological process behaviors in SLI, Leonard, Schwartz, Swanson, and Loeb (1987) elicited 24 nonsense word productions from 5 SLI children. The authors observed a high proportion of unusual productions on nonsense words, regardless of whether they had been constructed from the child's spontaneously observed IN, OUT, or ATTEMPTED phonological repertoire. They concluded that these SLI children demonstrated less systematic phonological systems than did their typically developing study peers.

Paul and Jennings' (1992) analysis of speech samples provided by late- and normally developing talkers suggests that 18–34-month-old SLI-E children display restricted phonetic inventories and a restricted array of syllable configurations in their vocalizations and early word attempts. The investigators analyzed single 10-minute parent-child interactions from 28 SLI-E and 25 normally developing toddlers; some of Paul and Jennings' SLI-E toddlers demonstrated receptive language delays in addition to those in expressive language. Both Stoel-Gammon (1989) and Paul and Jennings (1992) emphasize the uncertain nature of the association between restricted patterns of speech and language development: Restricted phonetic capacity may limit the child's ability to approximate linguistic targets; conversely, limited language capacity may provide little opportunity to practice speech articulation skills.

Whitehurst et al. (1991) suggest that more severely delayed SLI-E children display a history of less complex babbled speech. They suggest further that SLI-E may have its basis in limitations on speech production. Stoel-Gammon's (1989) two toddlers, despite concurrent limitations on phonetic and lexical output at 24 months, appeared to subsequently develop within normal limits in both domains. Paul and Jenning's (1992) finding of limitations in phonological performance in the spontaneous conversation of SLI-E toddlers between ages 2 and 3 more strongly suggests a relationship between continued expressive language delay and limitations on phonetic output. Taken together, the studies summarized above suggest that children who are diagnosed with either SLI-E or later SLI tend, as a group, to demonstrate delayed phonetic and phonological develop-

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ment concurrent with their delays in lexical and grammatical development.

How might phonetic ability relate to SLI-E? Research suggests a number of possibilities: that language deficits in SLI-E are grounded in the child's phonetic limitations in approximating words, that phonetic deficits and language deficits arise simultaneously in a number of children with expressive language delay, or, finally, that the underlying language deficit in SLI-E diminishes opportunities for a child to practice the phonetic repertoire.

The current investigation analyzes the vocal behaviors of a cohort of 30 children diagnosed with SLI-E at 24 months and their typically developing peers. In particular, we were interested in knowing whether toddlers with SLI-E manifested depressed phonetic profiles when compared with toddlers with normal language development. As Paul and Jennings (1992) observe, there are limitations to the use of naturalistic speech samples to estimate phonetic development, particularly in cases where output consists of a mixture of word-attempts and babble. However, we agree with Paul and Jennings that appraisal of the naturalistic speech samples of SLI-E children provides a strong exploratory basis for further analysis of the possible differences in phonetic capacity between groups of children with SLI-E and those who appear to be developing language at a normal pace. Further, this cohort is particularly interesting because the children were quite homogeneous in age, and all of the children with expressive language delay demonstrated receptive language skills well within the average range. Thus, their language deficits were limited to the expressive modality.

Method

Subjects

Subjects for this study were 30 children with a diagnosis of Specific Expressive Language Impairment (SLI-E), who were 24–31-months-old at the time of intake, and an age-matched comparison group of 30 children who evidenced normal expressive language development. The children were recruited through newspaper advertisements, notices to pediatricians, and a local infant lab. All of the children in the study except one came from intact two-parent families (one boy's mother was divorced). The children in both the SLI-E and comparison groups came from middle- to upper-middle-class white families. Twenty-eight of the 30 children with SLI-E were boys, as were all the comparison-group children. The families came from a mix of ethnic and religious groups. Seven of the late-talkers were first-born children, 17 were second-borns, 5 were either third- or fourth-borns, and 1 was a twin. In the comparison group, there were 14 first-borns, 11 second-borns, 4 third- or fourth-borns, and 1 twin. Thus, the late-talkers were less likely to be first-borns than the comparison children. Otherwise, the two groups were quite comparable in birth position. Maternal employment outside of the home was similar across the two groups. Ten mothers of late-talkers and 9 comparison-group mothers worked part-time outside the home; two mothers in the SLI-E group and one comparison-group mother worked full-time. The children with SLI-E constitute the majority of subjects from a longitudinally studied cohort of 40 toddlers who were originally described by Rescorla and Schwartz (1990). All of the toddlers were identified when they were between 24 and 31 months old as having significant expressive language delay despite normal nonverbal cognitive ability and age adequate receptive language skills. Subjects from the larger cohort whose intake audiotapes were inaudible or for whom equipment malfunctions occurred were excluded for the purposes of this research.

Criteria for admission to the cohort of children with SLI-E were an MDI score of greater than 85 on the Bayley Mental Development Scale (Bayley, 1969) and a score within 4 months of chronological age on the Reynell Receptive Language Scale (Reynell, 1977). Expressive language was required to be delayed at least 6 months below CA on the Reynell Expressive Language Scale. Comparison children met the same Bayley and Reynell Receptive Language Scale criteria and also were required to demonstrate a Reynell Expressive Language Scale score within 4 months of chronological age (CA). All but two of the children with SLI-E actually demonstrated receptive language abilities within 3 months of CA, whereas all but two children in the comparison group actually demonstrated expressive language within 3 months of CA expectations. Thus, intragroup profiles of children were very homogeneous.

Demographic information and test scores for the two subject groups appear in Table 1. As can be seen, the children with SLI-E and the comparison children were very closely matched in age and Hollingshead SES score (maximum of 66). The two groups were also equivalent in their total scores on the 19 Bayley Nonverbal items above the basal level (Bayley item #123). These 19 items tap such skills as constructing block towers, doing puzzles, drawing, and inserting pegs.

As the data in Table 1 also show, the two groups were significantly different in receptive language as measured by the Reynell Receptive Language Scale *z*-score ($t = -5.99$, $p < .0001$). Although the late-talkers had fully normal receptive language skills for their age (mean age level = 26.7 months), the comparison children were advanced in their receptive language abilities (mean age level = 30.3 months). As expected, there was a large difference in Reynell Expressive Language Scale *z*-scores between the two groups of children ($t = -15.88$, $p < .0001$). On average, the children with SLI-E scored more than 1.5 standard deviations below

TABLE 1. Intake measures for children with SLI-E and comparison children.

	SLI-E	Comparison group
Intake age in months.days (*SD*)	26.03 (2.22)	25.53 (1.37)
Hollingshead total	53.60 (12.63)	56.33 (8.83)
Bayley nonverbal items	13.43 (3.15)	14.26 (3.07)
Reynell Receptive Z	.16 (.53)	.97 (.53)*
Reynell Expressive Z	−1.62 (.44)	.29 (.53)*
Intake LDS[1] total words	22.77 (25.27)	224.9 (70.16)*

[1]Language Development Survey (Rescorla, 1989)
* = all comparisons, $df = 58$, $p < .0001$

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age level expectations in expressive language skills (age level = 17.3 months, or a lag of 8.77 months), whereas the comparison children were slightly advanced for their average age (age level = 26.63 months).

The children with SLI-E were also significantly delayed in expressive vocabulary development according to maternal report using the Language Development Survey (LDS) (Rescorla, 1989). The children with SLI-E had a mean reported vocabulary of 22.8 words, in contrast to a mean reported vocabulary of 225 words for the comparison-group children, a ten-fold difference ($t = -15.75$, $p < .0001$). Only 1 child in the SLI-E group had a reported vocabulary of more than 50 words (a 29-month-old), and only 4 of the children in this group produced word combinations more than once or twice, according to maternal report. All children in the SLI-E group met the combined LDS criterion of "fewer than 50 words or no word combinations" for clinically significant expressive language delay.

Procedure

Each child was seen for an intensive evaluation, which was videotaped. Procedures used for linguistic and developmental assessment are detailed in Rescorla (1989) and Rescorla and Schwartz (1990). Briefly, the parent of each child completed the Language Development Survey (Rescorla, 1989). Children's linguistic abilities were assessed using the Reynell Expressive and Receptive Language Scales. Naturalistic speech samples as well were gathered during a 10-min free-play session between each child and his/her mother, which was carried out in a carpeted lab room. Play materials were held constant for all play sessions. They included a basket of toys that included two dolls, two trucks, small animal and human figures, a pillow and blanket, a small bottle, blocks, and sticks. Each mother was instructed to play with her child as they normally would at home. The children played on the floor of a clinic room equipped with a wall-mounted free-field microphone positioned approximately 6 feet from the child's play area. The signal from this microphone was fed directly into the audio of the videotape recorder. As did Paul and Jennings (1992), we used the 10-min mother-child play sample as the data source for our phonological analyses.

Tape Analysis

The children's phonetic and vocal behaviors were transcribed from the videotapes of the parent-child play sessions. Four second-year graduate students in speech-language pathology acted as transcribers. The transcribers were not informed of the children's diagnostic labels; thus they were blind to subject group membership. Transcribers were assigned a roughly equivalent mix of children from both subject groups. Transcribers were trained together to review transcription procedures and jointly transcribed a sample interaction to develop procedural uniformity. Each was permitted to view the videotapes as often as required to transcribe vocalizations. Children's vocalizations were transcribed following procedures similar to those used by Stoel-Gammon (1989) and Paul and Jennings (1992), with the exception that no upper limit was placed on the number of vocalizations transcribed within the 10-min segment. Vocalizations were defined as productions on an egressive airstream that minimally consisted of a voiced vocalic element or voiced syllabic consonant. Cries, laughs, burps, and coughs were excluded from analysis, as were any vocalizations that occurred simultaneously with toy noise or the vocalizations of the mother. For the determination of vocalization units and syllable-structure patterns, vocalization boundaries were set as either the onset/offset of a recognizable approximation of an English word, 1 s silence, a breath, or terminal intonation contour.

Transcription was in broad IPA, with minimal phonetic detail. Because the transcription was performed considerably after the original sessions were recorded, and because it was often difficult to ascertain adult target forms for many children's vocalizations (particularly in the SLI-E group's output), no effort was made to estimate phonetic accuracy (percent consonants correct, or PCC). Rather, tallies were made of the following:

- mean number of vocalizations per subject group during free play
- frequency with which consonantal and vowel phones appeared in vocalization-initial, -medial, and -final position
- proportional use of the range of English phones over the vocalization patterns of the two groups of toddlers
- mean consonantal and vowel inventory size per subject group
- mean proportion of syllable shape configurations per subject group

Reliability

Reliability of the transcriptions was estimated by randomly assigning one SLI-E subject tape to each of the four transcribers. A SLI-E child's transcript was selected because it was felt that reliability of coding would be worst when adult language targets could not be determined (Stockman, Woods, & Tishman, 1981). Interrater reliability was estimated using the point-to-point interobserver method, in which each transcriber's version was compared to that of the other three. Interobserver agreement percentages for transcription of identical consonants within vocalizations ranged from 86% to 91.5% (mean = 88.7%), from 59% to 85% (mean = 72%) for vowels, and from 66% to 83% (mean = 76.5%) for syllable shapes. The original intake videotapes had not been made with the intent of subjecting the children's speech to phonetic analysis, and a proportion of the children's utterances were unglossable by the raters. Raters were most apt to disagree about the intelligibility of vocalizations. That is, one transcriber might find a vocalization unintelligible, whereas others heard an English phone sequence. The other primary sources of transcription differences were (a) tendencies to interchange individual vowels for their closest acoustical neighbor, and (b) interchangeable transcription of successive CV syllables as a reduplicated CVCV construction—a phenomenon of low incidence in both

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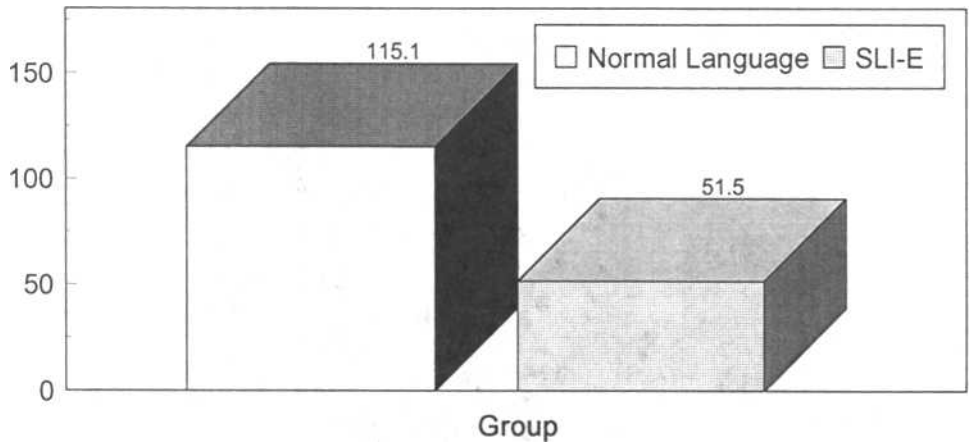

FIGURE 1. Mean number of vocalizations per 10-min mother-child play interaction, by group.

groups. As will be shown below, group differences, when they appeared, exceeded the margin of interobserver error (Cordes, 1994).

Results

Comparisons Between Subject Groups at 24–30 Months

Vocalization rate. As a group, children with SLI-E vocalized at approximately half the rate of typically developing toddlers (see Figure 1). During the 10-min play segments analyzed, children in the SLI-E group produced an average of 51.4 vocalizations (range = 3–117), whereas children who displayed normal language development profiles produced an average of 118.2 vocalizations (range = 27–249), or more than twice as many ($t = 5.475$, $df = 56$, $p < .0001$; $f = 4.537$, $p < .0001$). (For this and all subsequent comparisons, alpha was set at .05.) This difference in vocalization rate between groups is consistent with, though more extreme than, that noted by Paul and Jennings (1992). In particular, it suggested the need for many of the group comparisons to use data in which the rates of phone usage or syllable structure shape profiles were averaged over each group's mean number of vocalizations.

Mean phonetic inventory size. In calculating each child's phonetic inventory, a child was credited with having a phone in the inventory if it appeared at any time, in any position, within vocalizations. Using this rather lenient criterion for inventory inclusion, children with SLI-E displayed an average of 8.6 consonants and 7.3 vowels in their vocalization repertoires (ranges = 3–16; 3–13, respectively), whereas normally developing children displayed an average of 17.4 consonants and 12.4 different vowels/diphthongs (ranges = 10–22; 8–15, respectively). (See Figure 2) Unpaired *t*-test scores revealed the typically developing children's consonant and vowel/diphthong inventories to be significantly larger than those of the children with SLI-E (consonants: $t = 9.5071$, $p < .000$; vowels/diphthongs: $t = 5.0333$, $p < .000$).

Group profiles of specific phone usage. *Consonants.* We next calculated the number of consonants present in more than 50% of subjects' repertoires, by group. Fourteen consonantal phones appeared in initial position in more than half of the samples provided by typically developing children, whereas only 7 initial-position consonants appeared in more than half of the samples provided by children with a

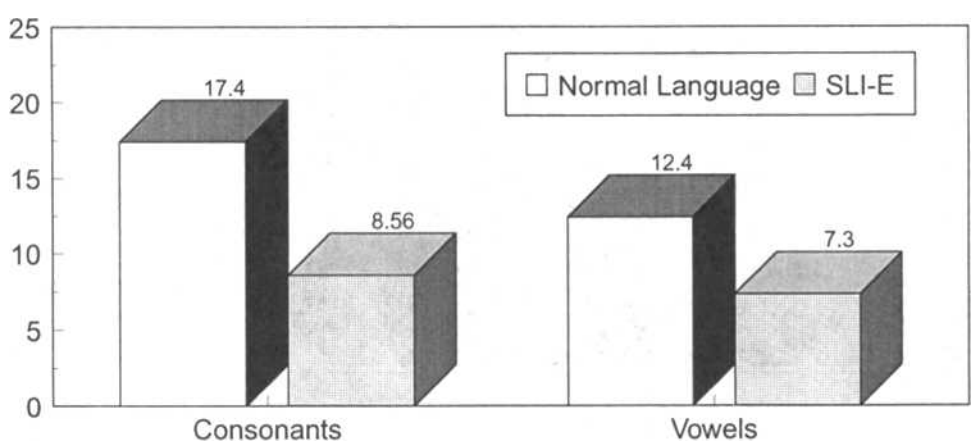

FIGURE 2. Mean consonant and vowel inventories observed in speech samples, by group.

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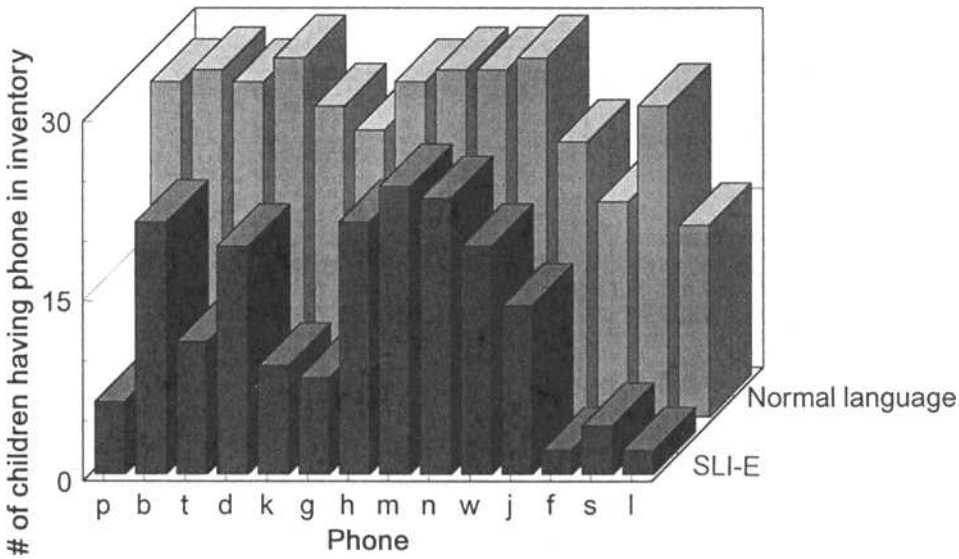

FIGURE 3. Number of children using consonants in vocalization-initial position.

diagnosis of SLI-E. *No* consonant appeared in more than 50% of the SLI-E children's samples in either medial or final position, whereas 8 consonants appeared in medial position in the samples of typically developing children, and 9 consonants appeared in final position for more than 50% of typically developing children's samples.

Conversely, only 1 consonant (ŋ) was absent in initial position of all typically developing children's inventories, as might be expected from the phonology of the English language, which prohibits it from that position (though one child with SLI-E used it on three occasions in this position). Similarly, only 1 consonant was never observed in medial position, and 2 were never observed in final position in any of the samples provided by the typically developing children. In contrast, for the total sample of children with SLI-E, no child produced initial [θ], 5 consonants were missing from all inventories in medial position, and 8 consonants were never observed in final position in any SLI-E child's repertoire.

Mann-Whitney comparisons were made of the number of children in each group who used all possible consonants of English in initial, medial, and final position. Comparisons reached significance for all three positions ($z = 3.085$, $p < .002$; $z = 3.2209$, $p < .0013$; $z = 3.2862$, $p < .001$, respectively), with more children in the comparison group demonstrating the consonant in their samples than children who were expressively language delayed.

The consonants most commonly seen in children's consonantal inventories are displayed in Figures 3, 4, and 5. In each figure, the number of children within each group ($N = 30$) who used the consonant in any vocalization is given on the Y-axis. As can be seen, no consonants appeared in more of the SLI-E children's inventories than in those of

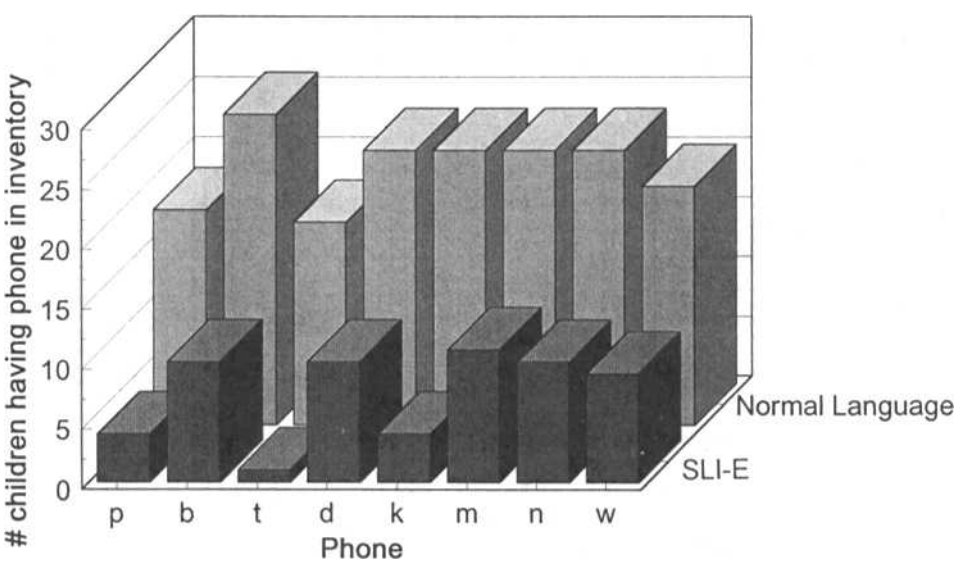

FIGURE 4. Number of children using consonants in vocalization-medial position.

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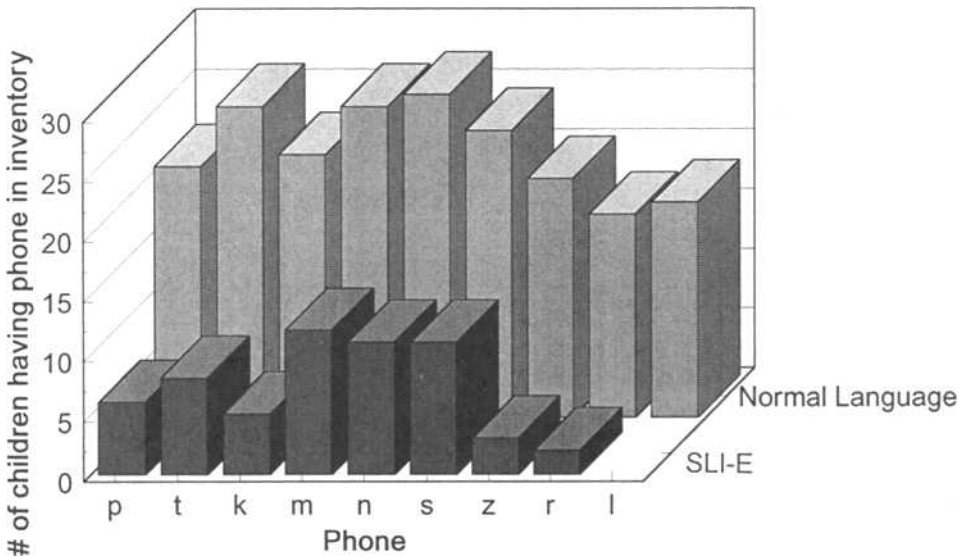

FIGURE 5. Number of children using consonants in vocalization-final position.

typically developing children. There was a uniform tendency for more children in the typically developing group to use a broader array of consonants in all syllable positions. Differences in group usage were least pronounced for initial consonants and most pronounced for final consonants. In particular, the consonants most likely to be observed in the inventories of children with SLI-E were the voiced stops [b,d], the nasals [m,n], the glides [w,j], and [h].

When all consonants are grouped together and considered by position, the proportional rate of consonant usage varied significantly by group (Figure 6). These numbers average frequency of occurrence for all consonants, and thus they average actual frequency of occurrence for all observed phones across the range of frequently and infrequently occurring phonemes for both groups in various positions. The children who are developing language at a normal pace show an initial rate of roughly 3.77%, whereas the children with SLI-E show an initial rate of 2.85%. This difference is significant ($t = 3.075$, $p < .005$). Large differences are seen in the average rate of final consonant closure in the vocalization samples, with typically developing children displaying a rate of final consonant usage that is more than three times that of the children with SLI-E ($t = 3.321$; $p < .003$). A trend of lesser magnitude, though still significant, was noted in the averaged incidence of medial consonant usage in the children's samples ($t = 2.213$, $p < .037$), primarily due to the relatively infrequent use of multisyllabic forms in both groups.

When group tallies of individual consonant usage are averaged over group vocalization rates, consonant use in initial position appears quite similar, though such an analysis blurs the distinction between children with SLI-E who use an array of initial consonants and those who do not. As can be seen in Figure 7, consonant preference in initial position

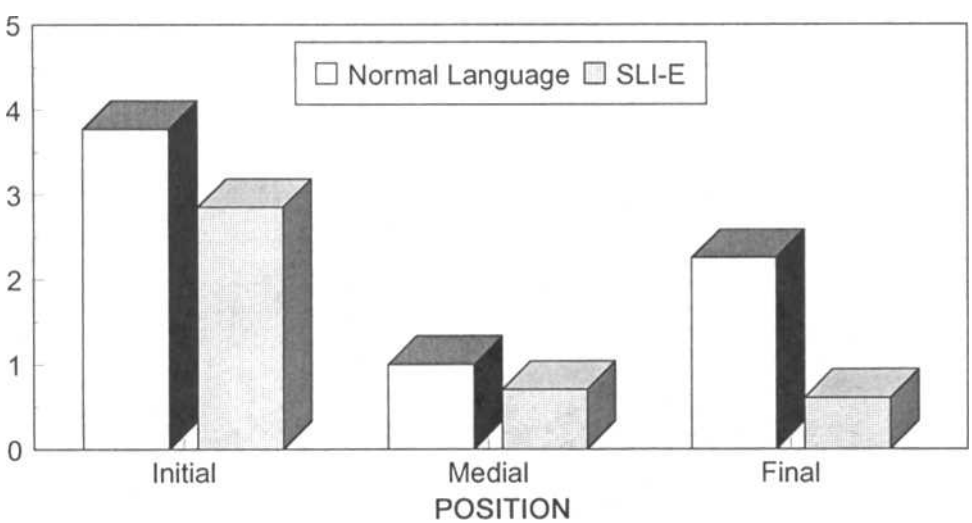

FIGURE 6. Average number of initial, medial, and final consonants per vocalization, by group.

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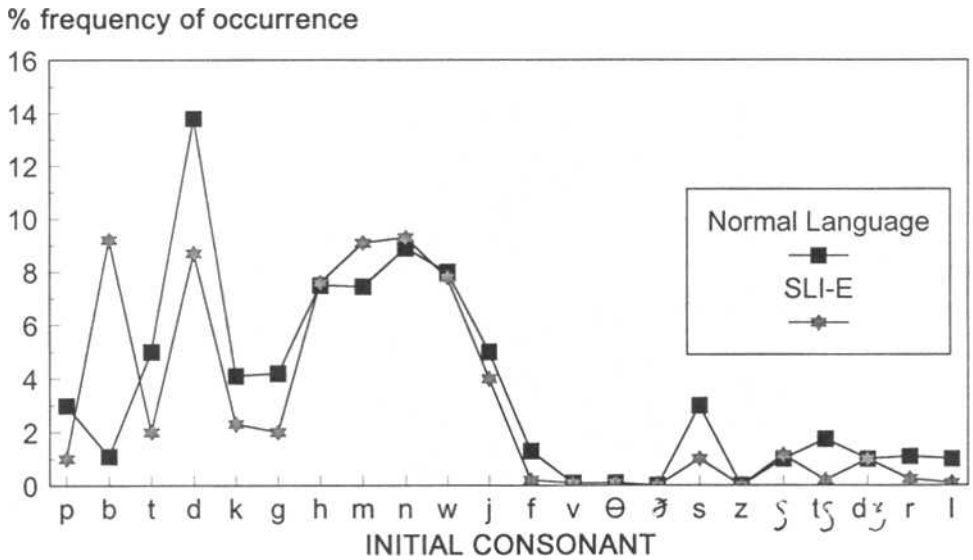

FIGURE 7. Initial consonant usage averaged over vocalization rate, by group.

tracks very similarly for typically developing children and those diagnosed with SLI-E, when vocalization rates are taken into account. In fact, the two profiles are highly correlated ($r = .9267$, $p < .000$).

More obvious differences between the two groups are seen in final consonant preference, although the group profiles are still rather highly correlated ($r = .6397$, $p < .002$). See Figure 8.

Vowels. The typically developing children display slightly higher mean rates of vowel usage over vocalizations because of their more frequent use of multisyllabic structures (see discussion under syllable-structure preferences). However, a vowel-by-vowel comparison of averaged rates reveals no significant differences in vowel usage by group ($t = .6312$, not significant), and the group preferences for particular vowel usage do not appear remarkably different (Figure 9). The correlation between average rates for individual vowels across the vocalization samples in the two groups is .9545, $p < .000$. The most frequently heard vowel for both groups was a schwa-like vowel, which may reflect either physiological anchoring of children's productions or perceptual anchoring by transcribers. As might be expected, both groups displayed relatively higher rates of point vowel usage ([i,a,u]) than other monophthong or diphthongized vowels.

Syllable-shape preferences. Rather than group syllable shapes into levels, as was done in Paul and Jennings (1992), we tallied mean use of the 14 most commonly observed syllable structures in the subjects' samples (see Appendix for explication of syllable-shape abbreviations). As can be seen in Figure 10, some syllable-shape configurations had

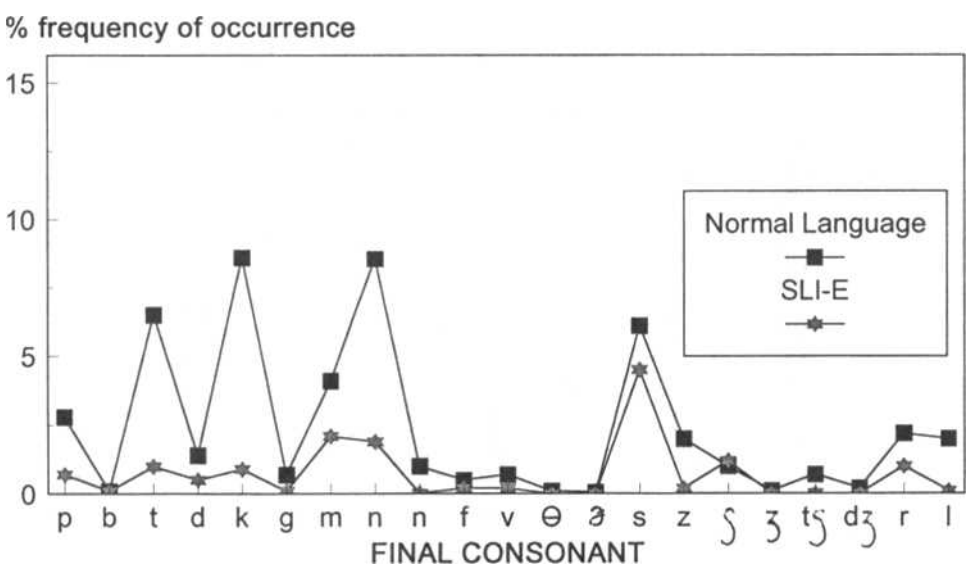

FIGURE 8. Final consonant usage averaged over vocalization rate, by group.

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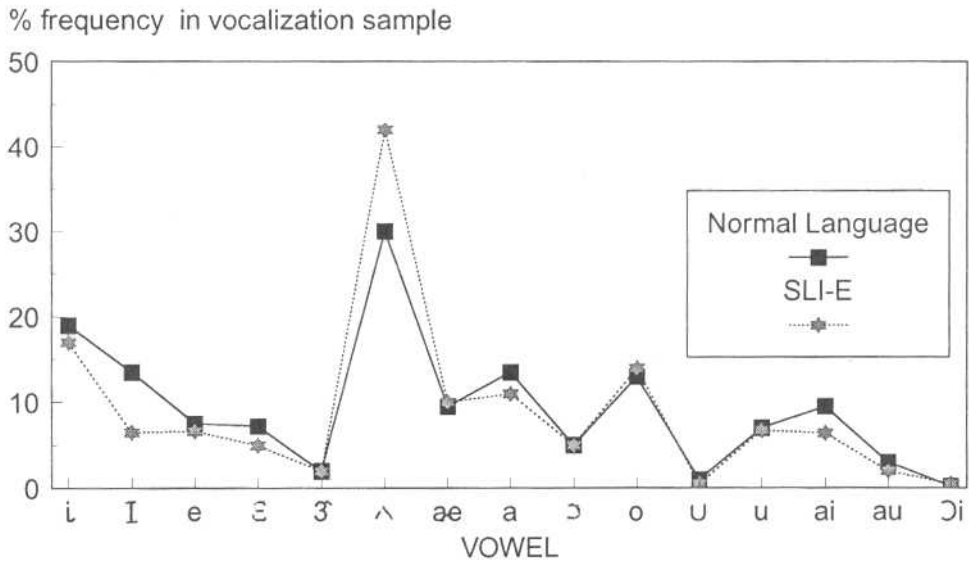

FIGURE 9. Individual vowel usage averaged over vocalization rate, by group.

relatively low incidences in both subject groups' data, with large differences between the groups for other syllable shapes. Children with SLI-E were much more likely to use single vowels or a CV syllable in their vocalizations. Typically developing children also displayed a high level of CV usage, but were also highly likely to produce CVC syllables in which the initial and final consonant differed (i.e., *top*). They also demonstrated a high rate of nonreduplicated two-syllable productions. If these data are grouped into the kinds of levels discussed in Paul and Jenning's (1992) analysis, there is a strong tendency for children with SLI-E to use Level I configurations, whereas the typically developing children use a high proportion of Level III configurations.

Discussion

Comparison of the intake language samples of 30 toddlers manifesting Specific Expressive Language Delay with language samples of 30 age-matched normally developing youngsters revealed many very striking phonological differences. Most of the major results reported here are consistent with the findings of Paul and Jennings (1992), Stoel-Gammon (1989, 1991), Stoel-Gammon and Herrington (1990), and Whitehurst et al. (1991). Moreover, the study extends previous findings by providing detailed phonological analysis of a large and homogeneous sample of late-talkers, namely children with significant expressive language

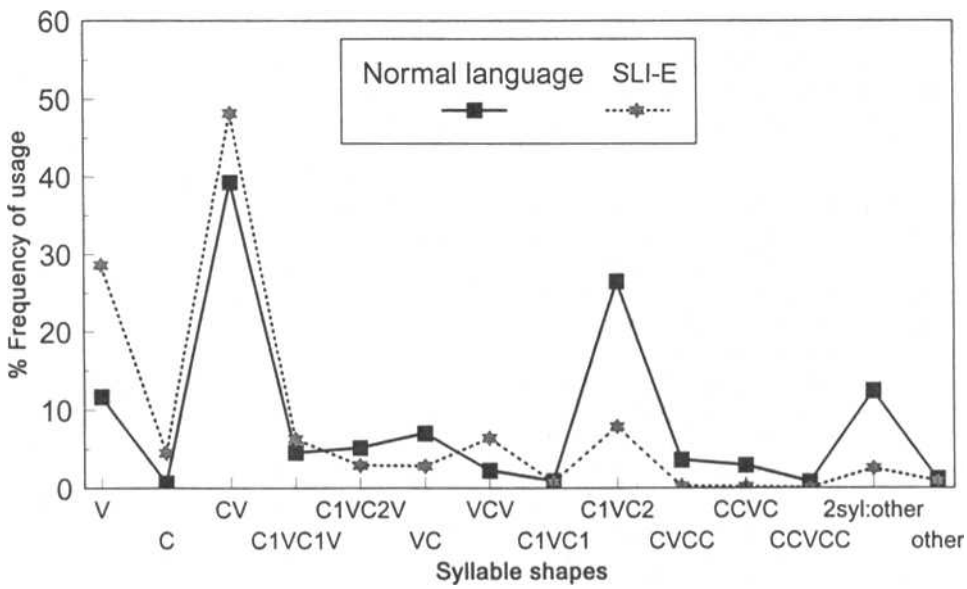

FIGURE 10. Syllable shape preferences averaged over vocalization rate, by group.

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delays, but with normal receptive language, all of whom are in the relatively young age range of 24–31 months.

A major finding of this study is that the two groups of children vocalize at different rates. Some portion of the difference in vocalization rates derives from the presence of multiword combinations in comparison-group children; however, both groups of children demonstrated a mix of speaker turns that consisted of single and multiple vocalizations. Because any vocalization that was not a cry, scream, noise, or cough was credited, it may not be the case that the late-talkers vocalized less simply because they had smaller vocabularies. That is, they could have vocalized as frequently as their normally developing peers by producing a variety of non-meaningful babbles or grunts, but they did not do so. Furthermore, it does not seem that motoric inadequacy alone can account for the fact that toddlers with SLI-E were quieter. In principle, the late-talkers could have vocalized as much as their peers by producing more of the simple, early-developing phonemes and syllable shapes seen in their repertoires. Neither one of these strategies typified either individual children or the SLI-E group as a whole.

As a final note regarding the lower observed-vocalization rate in the toddlers with SLI-E, were it simply the case that they were credited for fewer vocalizations because we could not identify multiple-word-combination attempts in their output, we would expect a higher frequency of complex syllabic shapes in the SLI-E group repertoire than the extremely low rate we actually observed. The children with SLI-E were simply much less vocal when engaged in play interactions with their mothers.

Given the fact that the toddlers with SLI-E had age-appropriate receptive language skills, it may be possible to speculate that these children perceived their relative inability to approximate adult-like targets in vocal interaction and chose to remain silent rather than to produce vocalizations for which they knew the adult could not provide interpretation. Under this assumption, a child who cannot approximate a particular lexical target (i.e., *truck*), chooses to "avoid" expressive labeling behavior by remaining silent, rather than offering a verbal attempt. Such phonological "avoidance" behavior has been noted in prior studies of young children (Schwartz & Leonard, 1982), but still begs the question of the deficit that leads to diminished phonetic capacity.

Another possible explanation for the low vocalization rate of the children with SLI-E is that they are not as socially engaged and interactive as their normally developing peers. Other studies of toddlers with SLI-E have noted a diminished drive for interpersonal interaction (Paul & Shiffer, 1991), particularly interaction involving joint attention. Rescorla and Fechnay (in press) analyzed mother-child communication and synchrony in many of the same dyads involved in the present research. They found no differences between the SLI-E and comparison toddlers in the proportion of times in which the child provided some type of social, communicative cue to the mother during dyadic interactions. Not surprisingly, the groups did differ significantly in the type of cue provided, with the comparison group primarily using clear verbalizations, whereas the children with SLI-E relied much more on unclear vocalizations, noises, gestures, and actions. Recent analyses of the mother-child play interactions for the same subjects used in the present study (Williams, 1995) indicated that the children with SLI-E communicated less overall, but did not differ from the comparison toddlers in the proportion of their communications that were for joint attention or that were initiations as opposed to responses. Of course, children with SLI-E relied more heavily on communicative gestures than did comparison toddlers. Thus, other research with this same subject group suggests that they interact less than their typically developing peers, although the quality of their interactions is very similar.

Study of normal children does suggest that volubility and language ability track in tandem (Camp, Burgess, Morgan, & Zerbe, 1987; Sullivan & Ratner, 1991). The children with SLI-E in this sample perform consistently in this regard and support a hypothesis that phonetic delay in children with SLI-E may be a function of limited vocal practice, though the limiting factor in diminished practice remains unclear. Locke (1992) proposes that "learning of speech . . . is facilitated by active articulatory practice and with auditory self-monitoring" (see also Locke, 1993), a belief echoed by Stoel-Gammon (1992). To the extent that toddlers with SLI-E vocalize less, they potentially perpetuate their expressive language delay by depriving themselves of opportunities for vocal practice. Thus, their reticence may further contribute to their limited phonetic, lexical, and syntactic development.

Research suggests bidirectional ways in which diminished vocal output may interact with caretaker behaviors to predict future language development. Snow (1989) reported that normally developing children who were less vocally imitative of their mothers at 14 months were observed to have smaller vocabularies at 20 months. Further, maternal imitativeness correlated well with child imitativeness. Veneziano (1988), in a complementary finding, noted that maternal echoing caused an increase in infant vocalizations. Thus, children's vocalizations tend to elicit maternal imitations, which in turn appear to feed infants' drive to vocalize further. In such a mutually reinforcing model, children who for whatever reason do not appear able or willing to vocalize frequently may wind up further handicapped in their progress toward language development. McCune (1992) observes that the child who "has the organic capacity and behavioral propensity" to say a CV provides grist for maternal attempts to establish verbal naming interactions that feed the initial lexicon.

Clearly, discriminating between "organic capacity" and "behaviorial propensity" is not a simple matter. In this regard, the current analysis of naturalistic interactions cannot distinguish between group *tendencies* and group *abilities*. Because the children in this study were not confronted with tasks that would have forced attempts at naming or structured vocalization, it is not possible to separate whether the differences observed in this sample reflect limitations on the SLI-E children's abilities or differences in their willingness to enter into vocal communication. Nor have we yet analyzed the possible contributions of the mothers' patterns of interactions to their children's conversational attempts. Children who are relatively nonverbal may

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have parents who make few conversational demands on their children either in parallel to their children's styles of interaction or in response to them. Murphy, Menyuk, Liebergott, and Schultz (1983) noted that mothers who believed that their children's vocalizations were word attempts had children who made more rapid progress in early lexical acquisition. Children who for whatever reason are less verbal and use a more restricted phonetic repertoire may thus encourage their parents to consider them less capable language users, with subsequent effects on their rate of linguistic progress. Although we are continuing to examine mother-child discourse patterns in this cohort of children with SLI-E, results thus far suggest that although the mothers of these children are very similar to mothers of the comparison-group children, they may also differ on some parameters. For example, Rescorla and Fechnay (in press) found very similar distributions of declaratives, questions, imperatives, and requests in the two groups of mothers and no differences between the groups on measures of maternal topic synchrony, or overall use of communicative cues. Similarly, Nova and Rescorla (1994) analyzed mother-child bookreading interactions taken for the SLI-E and comparison cohorts at intake and found no differences in the average number of maternal initiations or utterances. However, Nova and Rescorla (1994) did find that mothers of children with SLI-E requested fewer labels and echoed their children less than did mothers of comparison-group children. Apparently sensitive to their children's verbal limitations, mothers of children with SLI-E made more descriptive statements and more frequently requested that the child point to referents.

The profiles of phone usage seen in the two groups of toddlers seem reflective of a delayed, rather than deviant, patterning of phonological development in children with SLI-E. Toddlers with SLI-E had proportionately smaller consonantal and vowel inventories and a more restricted and less mature array of syllable shapes. However, the arrays of consonants, vowels, and syllable shapes used by the two groups of children were similar in nature, and the areas of greatest difference between them (final consonant usage, syllable-shape preferences) reflect well recognized developmental trends, with the SLI-E children using less mature phonological patterns.

It is not possible to trace the evolution of these phonological differences with the data available. Although mothers of many of the children with SLI-E reported that their children had rarely babbled, these retrospective data were not systematically collected as part of the research protocol. In the present report, we have also not attempted to trace the continuity between babble and word attempts within each SLI-E child's output. Although we have considerably more intake data yet to analyze, it is unlikely that there is a sufficient quantity of data gathered early enough in the language-acquisition process of the children with SLI-E to fully address the issue of continuity from babble to speech in this sample. However, because continuity of babble and early lexical forms has been found to characterize normal language development, and because Stoel-Gammon (1989) reported discontinuity between babble and early word-attempts in one of her two late-talkers, it would be interesting to examine this question in a cohort of expressively delayed children who were followed at briefer intervals and monitored with more sensitive audio-recording equipment.

When analyzing naturalistic interactions, as we did in this study, it is difficult to distinguish propensities from capacities. It is possible that during spontaneous speech, the children with SLI-E chose to speak less, to produce a smaller array of speech sounds, and to use simpler syllable shapes, but that they might perform differently when engaged in structured elicitation procedures. A variety of such elicitation procedures were used as part of the intake procedure for this study; these will be analyzed in a future report. However, preliminary analysis of these data suggests that children with SLI-E are as limited phonetically in elicitation situations as they are in spontaneous speech contexts.

In summary, the vocalizations of typically developing and expressively language-delayed children differ on a number of levels. The variables that most clearly distinguish 24–31-month-old children with SLI-E from typically developing children are vocalization rate, size of the consonantal inventory, and syllable-shape preferences. Children with SLI-E vocalize infrequently, use a restricted consonantal inventory consisting primarily of the voiced stops [b,d], nasals, glides, and [h], and primarily communicate using single vowels or CV syllable shapes. Their normally developing counterparts vocalize more freely and have much more extensive phonetic inventories, which they have learned to compile into a rather wide range of syllable shapes.

Bi-directional associations that have been noted in prior studies between child vocalization and lexical development, as well as between child vocalization and maternal interaction style, suggest that the phonetic predispositions of children with Specific Expressive Language Delay may contribute to their slow development of expressive speech. According to the model proposed here, children with some underlying phonemic inadequacy may elect to vocalize less, thus diminishing opportunities for the kind of vocal practice that fosters phonemic development. Similarly, children who vocalize rarely may also miss out on the kinds of conversational interactions that promote language acquisition. Conversely, children who verbalize early often have parents who imitate them and attribute lexical knowledge to them. These behaviors are in turn correlated with progress in infant language-acquisition. Children who vocalize little and use forms for which no lexical target is or can be attributed are less likely to elicit parental behaviors associated with language gains. Future research should examine both the earlier phonetic roots of depressed vocal behavior in late-talking toddlers, as well as bi-directional associations between parental and child conversational behaviors that may feed later patterns of lexical and syntactic development.

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Appendix

Syllable shape forms and their abbreviations

Symbol	Shape	Example
V	Vowel or diphthong	*eye,* [æ]
C	Syllabic consonant or continuant	[m], [s]
C_1VC_1V	Reduplicated syllables	[baba]
C_1VC_2V	Non-reduplicated syllables	*dolly,* [pebi]
VC	vowel + consonant	*up,* [lk]
VCV	vowel + consonant + vowel	[awu]
C_1VC_1	Identical initial, final C	*pup,* [ʃʌʃ]
C_1VC_2	Initial, final C differ	*pig,* [kaʃ]
CVCC	Final consonant cluster	*box*
CCVC	Initial consonant cluster	*black*
CCVCC	Initial & final clusters	*blocks*
2syll|other		*button,* [bæʃiʃ]
other	multisyllabic	*peekabo*

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