Emerging Phonetic-Phonological Skills in Three Children with Down Syndrome: A Longitudinal Study

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ABSTRACT

This study was structured to provide a longitudinal analysis of the emerging phonetic-phonological systems of three Down Syndrome children in the first fifty word stage of development. The three children, who at the onset of the investigation were between the ages of 3;0 and 3;2, were followed for a total of 12 months. At the beginning of the study all children had at least one but fewer than 12 spontaneous words. Play sessions which were audio-taped and simultaneously transcribed provided the data for analysis. All identifiable words were analyzed according to onset, nucleus, and coda sounds as well as syllable structures. In addition, phonemic oppositions were examined to see how the children were signaling meaningful contrasts. Over the 12 month timeframe both group similarities as well as individual variations emerged in all categories analyzed. These results are examined in detail.

1. INTRODUCTION

The speech of children with Down syndrome is often considered to be difficult to understand or unintelligible (Dodd and Thompson, 2001). Their other language skills, such as comprehension, are considerably better than their speech possibilities (Rondal and Edwards, 1997). Previous research has investigated the early speech development of children with Down syndrome in order to determine if there are any early indicators of atypical patterns (Brown-Sweeney and Smith, 1997; Kumin, Councill, and Goodman, 1994; Miller, 1988; Rondal and Edwards, 1997; Smith and Stoel-Gammon, 1983; Stoel-Gammon, 1980; 1981; 2001). Some investigators have noted that although phonological development is slow, the overall sequence appears to parallel development in normal children (Rondal, 1993). Others have argued that the speech of children with Down syndrome is disordered, i.e., it follows a developmental pattern that is different than that seen for children with normally developing speech and language (Stoel-Gammon, 1981). For example, Kumin et al. (1994) observed that the emerging phonemes in Down syndrome children did not follow the typical order of acquisition

This study examined the emerging phonetic-phonological systems of three children with Down syndrome which were documented over a one-year timeframe. Both consonant and vowel inventories were examined to determine if these children demonstrated delayed versus disordered system development.

2. METHOD

Subjects

Each of the three children had been diagnosed with Down syndrome at birth and had been subsequently referred to an early intervention program. The children (two males and one female) were recruited from two area early intervention programs based on their age, developmental level, and speech/language similarities. All three children were between the ages of 3;0 and 3;2 at the onset of the study. All children had passed a hearing screening within a month of the onset of the investigation. Based on developmental testing using the Early Learning Accomplishment Profile, the children achieved scores which were within 3 months of each other. At the beginning of the investigation all children had at least one, but less than 12 recognizable words. The number of utterances was documented by reports from the parents and observations by the speech-language therapist and the researchers. Throughout the duration of the study all children remained enrolled in the early intervention programs which were structured very similarly and provided the children with approximately the same type and amount of therapy each week.

Procedures

Three testing sessions at 6-6 ½ month intervals were used to gather data. Thus testing spanned a total of 12 to 13 months. Testing sessions were approximately 45 minutes in length and were conducted at the early intervention center. A natural setting with play objects was used to gather spontaneous speech. In addition, interaction with the caregivers was occasionally utilized to elicit emerging words. The children's speech was audio recorded using an Electro Voice Model 635A omnidirectional microphone and a Tascam 22-2 reel-to-reel tape recorder.

Simultaneous transcription was performed during the testing session. The tapes were also later transcribed by an independent professional. Interjudge reliability of broad transcription exceeded 90% accuracy.

 ISBN 1-876346-48-5

For all testing sessions the following parameters were established: (1) a gloss for each word with its actual realization transcribed using both broad and when indicated narrow diacritic markers, (2) syllable initiating and terminating sounds, (3) consonant and vowel inventories, (4) syllable shapes, and (5) phonemic contrasts based on minimally paired words.

3. RESULTS

Emerging Words

All children demonstrated a growth in recognizable words over the 12 month period. However, gains were very different from child to child. Child #1 S., (female) demonstrated 10 words at the original testing session. The number of distinct recognizable words had expanded to 50 at the final testing setting. Child #2 C., (male) showed comparable results, 10 words were documented originally versus 38 words approximately one year later. Vocabulary gains for Child #3, E., (male), however, were minimal. He produced 4 words at the original session and only 5 words one year later. If words were classified according to Nelson's (1973) classification, all three children produced the largest percentage of words that were primarily general nominals (ball, baby, cow, pig) followed by personal-social words (yes, hi, hello).

Syllable Initiating and Terminating Sounds

For each of the three testing times the number of syllable initiating versus terminating consonants was calculated. For each of the three children there was a larger inventory of sounds found in the word-initial versus the word-final position. If the results of this study are compared to longitudinal data presented by Stoel-Gammon (1985) for normally developing children, similarities can be noted. For example, word-initial inventories contained voiced stops prior to voiceless ones, while the reverse was true for word-final productions.

Vowel Inventories

For two of the children (Child #1 S. and Child #2 C.) vowel inventories were rather extensive from the initial testing period. Thus, both children's inventories contained front vowels ([i], [ɪ], [e], [ɛ], [æ], and [a]), back vowels ([ɑ], [ɔ], [ʊ], [u]), central vowels [ʌ] and [ə] and some diphthongs ([e^{ɪ}], [a^{ɪ}], [a^{ʊ}], [o^{ʊ}]). For these two children vowel inventories, with the exception of central vowels with r-coloring, were approaching completion by the final testing time. Child #3 E., who demonstrated minimal speech growth within this one-year timeframe also presented a very reduced vowel inventory. Front vowels [ɛ] and [æ] were the only two vowels produced in recognizable words during testing time number one. One year later E. had extended his vowel inventory to include the low-back vowel [ɑ], and the central vowel [ʌ]. It is interesting to note that Child #1 S., who had the largest growth in vocabulary during this period also produced the largest inventory of vowels during the final testing period.

Consonant Inventories

Early consonants produced at the initial testing period consisted of voiced and voiceless bilabial stops [p] and [b], coronal-alveolar stops [t] and [d], the voiced labial-velar approximant [w] and three fricatives. Child #1 S. produced [s] and [θ] while Child #2 C. and #3 E. had [f] in their consonant inventory. The nasals [m] and [n] were noted in the consonant inventory of only one of the three children (#2 C.) at the time of the initial recording. The consonants produced by these children were also frequently occurring initiating sounds that were found within the first fifty word vocabularies of children developing speech/language in a norm manner (Ferguson and Farwell, 1975; Leonard, Newhoff, and Mesalam, 1980; Shibamoto and Olmsted, 1978; Stoel-Gammon and Cooper, 1984; Vihman, Ferguson, and Elbert, 1986). At the time of the final recording the consonant inventories had expanded to include the nasals, voiced and voiceless postdorsal-velar stops [k] and [g] as well as [ð], [l], and [dʒ]. Distortions of s-sounds, dentalized productions, were also evidenced for Child #1 S. and #2 C. The consonant inventory for Child #3 E. did not show expansion over the year timeframe. Initially this child produced [d] and [f] at session number one, by session number two this had changed to [b] and [d] and remained the same for the third testing period.

Syllable Shapes

Open syllables (CVCV, CV) dominated the syllable shapes noted for all three children for the first testing period. However, by the third recording both Child #1 S. and Child #2 C. demonstrated a large array of closed syllables. Consonant clusters were also noted both initiating and terminating one-syllable words.

Phonemic Contrasts

Phonemic contrasts were analyzed using minimally paired words which differed in only one transcribed phonemic value. Child #1 S. was on target with most words and was using initiating and terminating sounds contrastively. The only word which used a vowel nucleus as a phonemic contrast was "baby" and "bye-bye". Vowels mirrored the norm production for each of these words. Child #2 C. used several vowels contrastively to signal different phonemic contrasts. For example, "bye" was [ba^{ɪ}] while "bike" was produced as [ba^{ə}]. This is further exemplified by "cow" [da^{ʊ}] versus "dog" [dɔ]. This child also used terminating consonants contrastively. For example "bus" was produced as [bʌs] while "brush" was [bʌʃ].

4. CONCLUSIONS

Child #1 S. showed the largest expansion of both vowel and consonant inventories. Within the time span investigated

her vowel inventory almost doubled, characterized by an expansion in the use of back vowels. When the consonant inventories were compared to those for normally developing children within the first 50 word stage (Stoel-Gammon, 1985) it is remarkable that S. did not demonstrate any nasals until the second testing.

Child #2 C. produced more consonants and vowels over time. He had nasals within his consonant inventory from the initial testing. In addition, he frequently used changes in vowel quality to signal phonemic contrasts.

Child #3 E. demonstrated little change over the 13 month period. Although one back vowel [α] was added to his inventory, the [f] coda which was noted during the initial testing was not evidenced later. E. did not display any nasals in his consonant repertoire. His syllable shapes remained relatively stable and were primarily marked by reduplicated open syllables.

Individual differences were the rule rather than the exception for these three children, each child demonstrating a rather characteristic developmental pattern. Although certain characteristics were clearly different than those demonstrated by children with norm speech/language development, for example the absence of nasals in two of the Down syndrome children at the onset of the testing, there were more similarities when compared to normal speech/language development. This study appears to support the notion of delayed, as opposed to disordered, speech development in these three Down syndrome children.

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 ISBN 1-876346-48-5

ISBN 1-876346-48-5