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Articulation Development in Children Aged Two to Four Years

Elizabeth M. Prather
Arizona State University, Tempe

Dona Lee Hedrick
University of Central Florida, Orlando

Carolyn A. Kern
Private Practice, Los Gatos, CA

The articulation skills of 147 children aged 24 to 48 months were tested and the results compared with earlier classical studies and distinctive feature development. The results of the present study indicate consistently earlier age levels for the correct sound and feature usage than the previous studies, though the general sequences of development are strikingly similar in all studies.

In investigating children's speech sound acquisition, two basic approaches to the study of normal articulation development have emerged. The classical approach has provided developmental ages at which specific sounds are mastered by a significant percentage of children selected from a normal population (Poole, 1934; Templin, 1957; Wellman, Case, Mengert, & Bradbury, 1931). More recently, with the increased interest in the child's development of phonological rules of language, developmental data have been analyzed in terms of correct usage of the distinctive features of sounds, implying that a regular sequence of feature acquisition exists.

The classical approach was used in three widely quoted studies. The first of these was conducted by Wellman et al. (1931), who tested 204 children from the University of Iowa Laboratory Preschools between the ages of 2 and 6 years. A total of 133 sound elements was tested in the initial, medial, and final positions of words uttered spontaneously by the children in response to questions or stimulus pictures, or repeated after the examiner. Of the 204 children tested by Wellman et al. (1931), only six 2-year-olds were completely tested on all sounds and 10 were tested on a subset of the test items. For a sound to be assigned to an age level, 75% of the children were required to have mastered it in all three positions.

Poole (1934) studied 65 children ranging in age from 2½ to 8½ years at the laboratory schools of the University of Michigan. She tested 23 consonants in the initial, medial, and final positions of words uttered spontaneously in response to questions about pictures, objects, or actions, or repeated after the examiner. In Poole's study, assignment of a sound to an age level necessitated its correct usage in all three positions by 100% of the children.

The most recent normative data on articulation development were reported by Templin (1957), who tested 480 children, 3 to 8 years of age, of representative socioeconomic backgrounds. The 176 sound elements were tested in the initial, medial, and final positions of words uttered in response to pictures, read aloud (with older children), or repeated. As in Wellman et al.'s (1931) study, Templin used the three-position 75% criterion in assigning developmental age levels. In a comparison of those data from the Wellman et al. and Poole (1934) studies with her own, Templin found considerable agreement in the age level assignments of sounds. The larger discrepancies among the studies occurred on those sounds that are among the most frequently misarticulated by children (Winitz, 1969). An orderly progression in sound development was therefore described, with the implication that performance of children at specific age levels could be judged according to established normative data.

In a recent publication Sander (1972) criticized the classical analysis of developmental data as "reflecting upper age limits rather than average performance" (p. 56) and suggested an alternative approach to the representation of normal articulation development. Rather than defining developmental levels in terms of sound mastery, that is, correct production of a sound in all three positions of a word, Sander suggested use of somewhat less stringent criteria: age of customary production, or correct production, in two of three positions in a word. He further contended that age summaries should include both the "average age of customary production and a measure reflecting the traditional upper age limits for sound acquisition" (p. 60). Using this method to analyze Wellman et al.'s (1931) and Templin's (1957) data, Sander demonstrated greater variability in acquisition of the different consonant sounds, which is not evident in the traditional age summaries.

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The distinctive feature approach to the study of normal articulation development was proposed by Menyuk (1968), who attempted to analyze available data on correct usage of consonants during early articulatory development in terms of phonology or feature acquisition. Menyuk compared American children aged 2½ to 5 years[1] and Japanese children aged one to three years concerning the development of the plus aspect of the following six features: + grave, + diffuse, + strident, + nasal, + continuant, and + voice. Her comparison was based on the "percentage of sounds containing a feature which was used correctly at various age levels during the developmental period observed." She concluded that there appeared to be a universal sequence of feature acquisition, a sequence which distinctly contrasts with the data available on the rank order of adult frequency of consonant feature usage (Irwin, 1947).

The earlier studies on articulation development included data on very few children below the age of 3 years. In view of a need for more current normative data and the paucity of complete information on very early articulation development, new information on the articulation skills of children two to four years of age has been analyzed, utilizing both the classical and distinctive feature approaches. This paper presents new data for comparison with established criteria for normal articulation development, recognizing the dangers of comparing statistics based on varying procedural designs. The data from the present study are compared with: (a) classical data from Templin (1957), Wellman et al. (1931), and Poole (1934); (b) Sander's (1972) presentation of the Templin (1957) and Wellman et al. (1931) data showing a range of correct production from 50 to 90% for each sound; and (c) Menyuk's (1968) presentation of Wellman et al.'s (1931) data showing correct feature usage at various age levels.

PROCEDURES

The articulation data used in these analyses were obtained as a part of the normative study for the Sequenced Inventory of Communication Development (SICD) (Hedrick, Prather, & Tobin, 1975). Articulation testing was attempted with 147 subjects between the ages of 24 and 48 months.

Subjects

The subjects for the SICD were selected along several dimensions to be representative of the general population of greater Seattle. Specific criteria included:

Age. Three discrete age levels per year were selected for study. These were 24 months, 28 months, 32 months, 36 months, and so on to 48 months, totaling seven age groups, 21 subjects per group. Each subject fell within one month of the given age level; that is, all children in the 24-month group ranged from 23 through 25 months.

Social class. An equal number of children (seven) in each age group were drawn from three social classes, as determined by an adaption of the Two Factor Index of Social Position (education and occupation) by Myers and Bean (1968).

Race and sex. Only Caucasian children were included as subjects. Although sex ratios were not rigidly controlled, there were similar numbers of boys and girls in each age group.

Language development. A child was excluded if his language development was judged abnormal by his parents or if he was from a home in which more than one language (English) was spoken.

Hearing acuity. Hearing screening was completed by a clinical audiologist in a sound booth. Whenever possible hearing was screened by means of play audiometry for the frequencies 500, 1,000, and 2,000 Hz, bilaterally at 30 dB HL, ANSI, 1969. For those children who did not respond to the above testing, a sound field assessment was used. Although there are no recognized norms for sound field assessment, children were required to respond to signals (a band of noise containing the above three frequencies) presented at 40 dB SPL.

Articulation Testing

Test instrument. Selected items from the Photo Articulation Test (Pendergast, Dickey, Selmar, & Soder, 1969) were used. Consonant sounds were tested only in the initial and final positions and vowels were tested in one context. The test was shortened because of a total test time factor and because our interest was mainly on the arresting and releasing productions. For the consonant sounds (the scope of this paper), a total of 44 pictures was used.

Examiners. Two speech pathologists served as examiners for each child. One elicited and recorded responses while the second served as an additional recorder. Either examiner could request repetition of a test item. Percentage of agreement for the correct-incorrect dichotomy was 97. When disagreement occurred, the judgment of the eliciting examiner was used, since the eliciting examiner was in proximity and perhaps better able to use significant visual and auditory cues. Responses were coded for computer programming according to the following system: 0 = item not tested; 1 = phoneme correctly produced; 2 = phoneme distorted; and 3 = phoneme replaced by another phoneme, with notation of the substituted sound.

Test administration. The articulation test followed all other testing required for the standardization study of the SICD. The child was encouraged to name each picture spontaneously and cues for identification were offered when needed. If the child still did not name the picture, the examiner first used a forced-choice type question ("Is that a fish or a dog?") and then the command, "Say fish." If the child again did not respond appropriately, the item was omitted. Table 1 shows the number of children who responded to each of the 44 consonant items at each of the seven age levels and the percentage of those children who correctly produced the item.

[1] Menyuk used Wellman et al.'s (1931) data, according to Winitz (1962) (personal communication with Menyuk).

TABLE 1. Number (*N*) of subjects responding on each sound in each position at each age level. The percentage columns show the percent correct productions among the responding children.

	Months														
	24		28		32		36		40		44		48		
Sound	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*Total Tested*
s-	10	50	17	71	18	67	20	90	20	75	21	91	21	91	127
-s	10	70	17	82	20	75	19	79	20	70	21	76	21	91	128
z-	12	25	16	56	19	42	19	42	20	55	21	62	21	67	128
-z	13	8	16	38	19	32	18	33	20	45	21	48	21	48	128
ʃ-	12	50	16	44	19	58	18	72	20	70	21	81	21	81	127
-ʃ	10	50	17	47	19	42	19	58	20	75	21	81	21	86	127
tʃ-	11	36	17	41	19	37	16	69	20	70	21	76	21	81	125
-tʃ	9	33	16	44	19	37	16	69	20	55	21	76	21	76	122
dʒ-	10	40	15	33	17	41	17	59	20	80	21	86	21	71	121
-dʒ	10	20	17	35	19	32	17	27	20	90	21	48	21	67	125
t-	11	82	15	86	17	94	18	100	20	100	21	100	21	100	123
-t	11	73	15	73	19	90	17	82	20	95	21	91	21	96	124
d-	12	58	14	86	19	84	18	94	20	95	21	100	21	100	125
-d	10	70	15	93	19	74	17	94	20	95	21	100	21	100	123
n-	11	91	14	93	18	94	18	100	20	100	21	100	21	100	123
-n	10	90	15	100	19	100	18	100	20	100	21	100	21	100	124
l-	8	38	14	36	18	50	18	72	20	85	21	71	21	86	120
-l	9	33	15	40	18	61	17	77	20	80	21	70	21	86	121
θ-	8	13	16	13	17	47	18	22	20	50	20	40	21	62	120
-θ	12	8	16	0	18	44	17	47	20	60	21	38	21	48	125
r-	11	9	15	27	18	39	18	39	20	75	20	85	21	62	123
-r	11	64	14	71	19	84	18	89	20	100	21	86	21	100	124
k-	9	89	15	93	19	95	17	100	20	100	20	100	21	100	121
-k	10	70	14	86	18	94	16	100	20	100	17	100	21	100	116
g-	7	86	14	100	18	94	18	100	20	100	20	100	21	100	118
-g	10	40	15	80	17	65	18	89	20	95	20	100	21	100	121
f-	9	67	15	80	18	83	18	89	20	95	21	90	21	100	121
-f	8	75	15	87	18	89	16	94	20	100	19	95	21	95	117
v-	8	25	14	29	17	47	18	28	20	35	20	50	21	57	118
-v	8	25	14	50	16	75	16	50	20	75	20	75	21	81	117
p-	8	75	15	93	15	93	17	100	20	100	20	95	21	100	116
-p	8	100	14	93	16	94	15	100	19	95	17	100	20	100	109
b-	9	100	15	93	16	94	18	94	20	100	20	100	21	100	119
-b	9	33	13	54	16	75	17	94	19	95	20	100	21	95	115
m-	9	89	15	100	17	94	18	100	20	100	20	100	21	95	120
-m	8	75	15	80	15	100	18	100	20	95	20	95	21	95	117
w-	6	100	15	73	15	87	18	88	20	90	20	95	21	91	115
hw-	6	33	15	60	16	63	17	65	20	70	20	60	21	52	115
ð-	3	20	12	25	14	46	16	33	19	67	20	71	20	74	104
-ð	4	0	7	29	13	46	9	44	11	9	14	36	17	77	75
h-	7	86	13	100	16	100	18	100	19	100	19	100	20	100	112
-ŋ	7	100	14	79	16	88	16	94	19	90	20	95	21	95	113
j-	4	75	9	89	12	91	14	100	15	100	19	95	19	95	92
-ʒ	5	0	6	67	11	27	9	44	14	36	10	70	19	79	74

RESULTS

The first analysis of the data was completed for comparison with the classical studies of Templin (1957), Wellman et al. (1931) and Poole (1934) (Table 2). In the present study a sound was assigned to an age level when 75% or more of the children tested correctly produced it in both the initial and final positions. Age levels for this study are reported in year plus four-month intervals. That is, 2–4 signifies two years four months and so on to four years. Reversals, age levels marked by the §, occurred on four sounds: /s/, /r/, /l/, and /dʒ/. A reversal was indicated when the criterion for appearance of a sound (at least 75% correct production) was achieved at an age level, but percentage correct dropped below 75% at a later age level. If the sound dropped below 75% for only one age level and if at that one age level it stayed above 70%, then reappeared above 75%, the earlier age level was reported (/s/, /l/, and /r/[2]); otherwise the later age level was indicated (/dʒ/).

By studying Table 2, it is apparent that the results from the SICD indicate consistently earlier age levels for correct

[2] r is somewhat of an exception to the rule, since it disappeared at 48 months and therefore did not have a chance to reappear. It was placed at the earlier level because of the consistency of high percentages up to 48 months.

TABLE 2. Comparison of the ages at which subjects correctly produced specific consonant sounds in the present study with those presented by Templin (1957), Wellman et al. (1931) and Poole (1934). The criterion used by SICD, Templin, and Wellman was 75% of the subjects; Poole used 100% of the subjects. In the SICD the percentage is the average of two positions, I and F; Templin, Wellman, et al., and Poole averaged the percentage of three positions, I, M, F (Templin, 1957, p. 53).

Sound	*SICD*	*Templin*	*Wellman*	*Poole*	*Sound*	*SICD*	*Templin*	*Wellman*	*Poole*
m	2	3	3	3–6	g	3	4	4	4–6
n	2	3	3	4–6	s	3§	4–6	5	7–6†
h	2	3	3	3–6	r	3–4§	4	5	7–6
p	2	3	4	3–6	l	3–4§	6	4	6–6
ŋ	2	3	°	4–6	ʃ	3–8	4–6	‡	6–6
f	2–4	3	3	5–6	tʃ	3–8	4–6	5	‡
j	2–4	3–6	4	4–6	ð	4	7	‡	6–6
k	2–4	4	4	4–6	ʒ	4	7	6	6–6
d	2–4	4	5	4–6	dʒ	4+°	7	6	‡
w	2–8	3	3	3–6	θ	4+°	6	°	7–6
b	2–8	4	3	3–6	v	4+°	6	5	6–6
t	2–8	6	5	4–6	z	4+°	7	5	7–6†
					hw	4+°	°	°	7–6

° Sound tested but not produced correctly by 75% of subjects at oldest age tested. Wellman: hw reached at 5 years but not 6. Medial ŋ at 3 years.
† Poole: s and z appear at age 5–6, but disappear later and return at age 7–6.
‡ Sound not tested or reported.
§ Reversal: Reported at earliest age level if only one reversal occurred and percentage at all older age levels exceeded 75%. See text.

sound productions than reported in the previous studies. Otherwise the general sequence of sound development is strikingly similar. Templin (1957) has already discussed the similarities and discrepancies in the data of the classical studies and considered procedural differences that might have been responsible for variation, such as socioeconomic and age-range differences, or sounds not tested.

In addition to these procedural differences, others seem applicable to the present comparison as well. For example, while each of the other investigators tested sounds in all three positions, we tested sounds in only two positions. This difference in itself might account for the lower age levels obtained in this investigation, and particularly some of the large discrepancies noted. The /t/ sound, for example, is reported at age 6 by Templin due to late appearance of the medial /t/. Despite these differences, there is no more than a 1-year discrepancy between the present results and those of Templin on 11 of the 25 consonant sounds tested. Of these 11 sounds, Templin assigned seven at the 3-year level, her youngest age level. These seven included /m/, /n/, /h/, /p/, and /ŋ/, all of which surpassed criteria at our 2-year level. We cannot necessarily consider these results discrepant in that her assignment at the 3-year level does not mean that these sounds might not have appeared at an earlier age level had they been tested. Five of the sounds (;dʒ/, /θ/, /z/, /v/, and /hw/) cannot be specifically compared, since they were never correctly produced by 75% of the children tested in the SICD up to the 4-year level. One can only conclude that these sounds appear at older age levels, levels that may be comparable to those indicated by the earlier classical studies. Two sounds (/ð/ and /ʒ/) that demonstrated large discrepancies (3 years) appeared in the present study at the 4-year level. One possible question is whether or not these sounds would have maintained consistently high criteria for correct production at older age levels. Large discrepancies also appear with the /t/ and /l/ sounds.

The late appearance of the medial /t/ in the earlier studies has already been discussed, and the /l/ in the SICD is marked by a reversal. One assumes here that Templin (1957) reported the first consistent appearance of the sound at 75%, while the present investigators used the earlier age level of appearance in this case. The remaining five sounds reveal discrepancies of from 1:2 to 1:8. Despite these differences, the general orderly pattern of sound development remains relatively consistent across all four studies. The major significant difference then between the SICD and the other three studies lies in the somewhat earlier age levels presented.

The second analysis of the data was designed for comparison with Sander's (1972) presentation of range of average performance. Sander used Templin's (1957) and Wellman et al.'s (1931) data to study average age estimates and upper limits of customary consonant usage. In reality this range of customary usage represents the ages at which correct production ranges from 50% to 90% or above. The percentage of correct production is determined by the combined average of the sound in all positions tested. When sounds exceeded 70% correct production at the youngest age level tested, 24 months, Sander showed earlier usage by placing the lower limit at less than 24 months. Figure 1 shows the comparison between Sander's analysis of the Templin and Wellman et al. data and our analysis of the SICD data. The bars represent the 50% to 90% correct production range from the studies. Again, the major difference shown by the comparisons is the earlier age levels reported in the SICD. While the lower age limits reported in the two analyses are quite similar for most sounds, it is

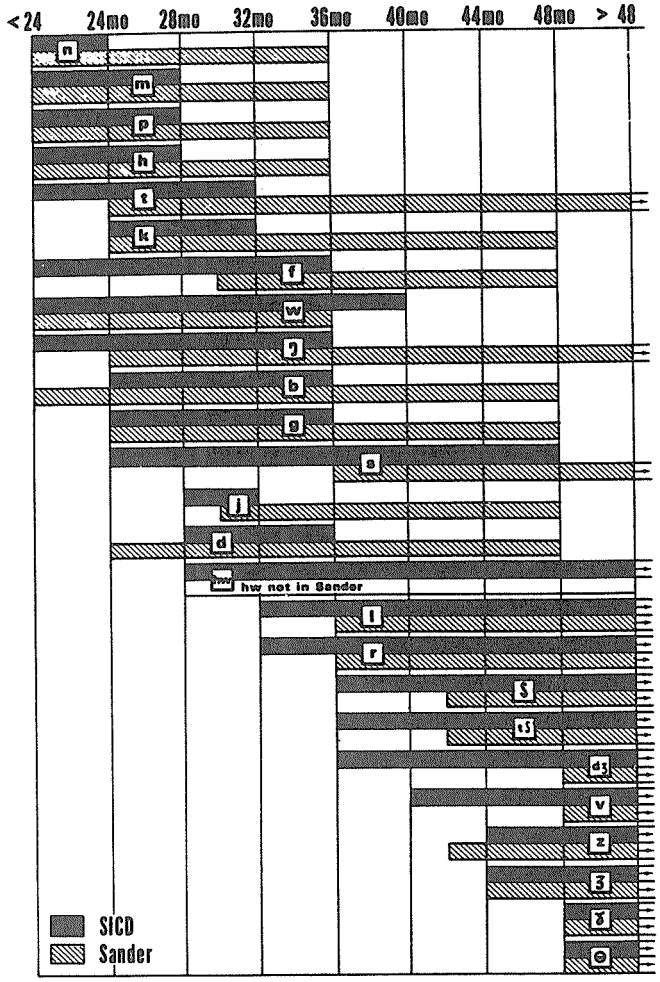

FIGURE 1. Comparison of SICD with Sander's (1972, p. 62) analysis of Templin (1957) and Wellman et al. (1931) data showing average age estimates (50%) and upper age limits (90%) of customary consonant production. When the percentage correct at 24 months exceeded 70%, the bar extends to the left <24. When the 90% level was not reached by 48 months, the bar extends to the right >48→.

the upper age limits that appear so much later in the classical studies for the first 14 sounds. The SICD children reached 90% correct production in two positions at earlier ages than the children tested by Templin (1972) and Wellman et al. (1931). Age levels for the last 11 sounds are remarkably similar when represented in this fashion (at least up to the 4-year level). Developmental data presented in this manner may allow for a more realistic reference; they provide an average age range for normal articulation development, rather than a single upper age limit. Certain sounds, for example /s/, reach the 50% level early, but develop over a fairly wide span of time. This type of analysis may be more helpful in judging the development of a child's progress in articulation skills than the typical upper limit chart so frequently referred to.

A third analysis of the data was used for comparison with Menyuk (1968) in terms of distinctive feature usage. To facilitate comparison, the data from the SICD were analyzed according to the distinctive feature system used by Menyuk (1968) based on Jacobson, Fant, and Halle (1963). As reported by Menyuk, data on correct production of consonant sounds were analyzed "by determining the percentage of sounds containing a feature which was used correctly at various ages during the developmental period observed" (p. 139). Figure 2 presents the graphs for correct usage of each feature compared to Menyuk (1968). Again, the patterns of development are strikingly similar, with the major difference involving earlier appearance of features in the present study. Order of appearance of + features for each study is as follows:

SICD: nasal, grave, diffuse, voiced, continuant, strident
Menyuk: nasal, grave, voiced, diffuse, strident, continuant

Consonant sounds containing the + nasal and + grave features appear early and develop rapidly, while the other features appear later and develop more gradually. It is of interest that six of the eight + strident sounds (/v/, /z/, /s/, /ʃ/, /ʒ/, and /f/) are also + continuant, while + continuant contains five sounds not included in + strident (/h/, /r/, /l/, /θ/, and /ð/). The largest discrepancy between the two results is

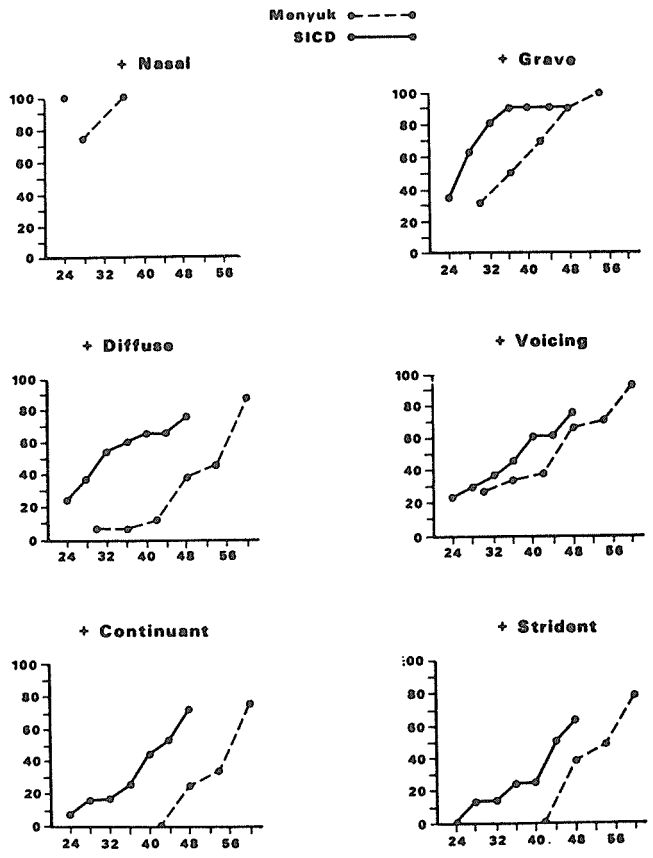

FIGURE 2. Comparison of Menyuk (1968, p. 140) and SICD analyses of correct plus feature usage for children 24 to 60 months of age. The vertical axis represents the percentage of correct productions of consonant sounds grouped according to the distinctive feature system of Jacobsen et al., (1963). The horizontal axis represents age in months.

evident in the analysis of the diffuse feature, which appears at much earlier age levels in this investigation.

Menyuk's analysis included only the plus feature in what is considered a binary system. In the present analysis, the minus feature usage of the same six features was analyzed. The developmental order is as follows: − continuant, − strident, − diffuse, − voice − nasal, − grave. Although close, the order of development of the minus feature is not an exact reversal of the plus feature usage. The plus/minus comparison is more clearly presented in Figure 3. Although the binary features of +/− nasal, grave, continuant and strident are contrasting, the +/− voiced and diffuse features develop along similar courses. It seems as Menyuk concluded, that the + nasal and + grave features appear early before their minus counterparts; and the + continuant and + strident features appear late, after the minus features. However, in viewing the present results, one can only conclude that the +/− features of voicing occur at almost the same time as do the +/− features of diffuseness.

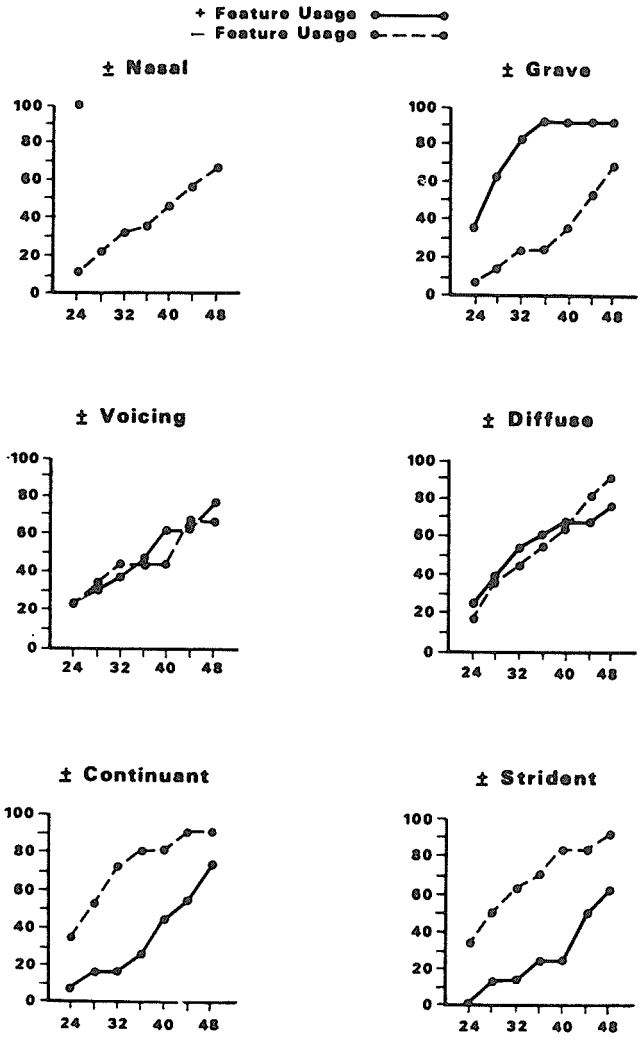

FIGURE 3. SICD data showing plus/minus feature contrasts for children 24 to 48 months of age. The vertical axis represents the percentage of correct productions of consonant sounds grouped according to the distinctive feature system of Jacobsen et al., (1963). The horizontal axis represents age in months.

DISCUSSION

The above results are considered straightforward accounts, needing little discussion, of articulation development in young children. The process of analysis yielded three chief areas of relevance, however, that we would like to discuss briefly.

First, our results indicate that children are producing more sounds correctly at earlier ages than would be suggested by the classical articulation research. We considered the number of subjects responding in the present study at age 24 months to be relatively small. The range was from three to 13 subjects, depending on the sound being tested. The small number contributes half again as many subjects tested at this age as were included in the Wellman et al. (1931) data; Templin (1957) did not include any subjects this age. The meagerness of the data has led to assumptions that correct production does not occur until approximately three years of age. It is our contention that future studies should be specifically designed to investigate production in children aged 18–30 months. Before definitive statements about early phonemic production can be made, studies designed to look at the effects of contextual influence, methods of recording and analyzing errors, and stimulability should be explored. Of particular importance, when obtaining information from children this young, is the procedure used. The age span of 18–30 months represents a difficult age for direct testing. Variations in procedures, or in the data assessed, such as production in spontaneous running speech rather than in isolated words, might well yield different results.

The second area of relevance concerns developmental trends other than correct production. When data are collected during ages of rapid change, between two and three years or three and four years, for example, and analyzed together, developmental trends may be obscured. In the present study, reversals were found on some sounds, indicating that these sounds were produced correctly by 75% of the children at an earlier age and then not maintained at older ages. Such reversals may, of course, represent sampling variations or the listening sets of the examiners. Whatever the case, the occurrence of such trends is obscured in studies that do not test small discrete age groupings.

A third area of discussion relates to the use of distinctive features in studying phonemic production. The data from the present study indicate similar developmental trends in acquisition of the plus distinctive feature to those reported by Menyuk (1968), except that, again, correct production occurs at earlier ages. Also of interest are the data showing contrasting feature usage, with only ± voicing and ± diffuse features showing highly similar developmental trends in correct production. The information about the development of contrasting features could theoretically be of particular interest in remedial programming. Suggestions for early programming would be + nasal, + grave, − continuant, and − strident features. There appears, however, to

be current questioning of the use of the concept of distinctive features in remedial work. Walsh (1974), for example, criticizes the use of a distinctive feature system that combines phonetic and acoustic information in broad categories and may obscure important production variations.

The present paper focused on the correct production of consonant sounds in very young children. Of equal interest is the analysis of the errors made in these productions. It seems probable that error patterns in normally developing children represent predictable changes, close in feature usage: early developing sounds for later developing ones, easy articulation for more complex neuromuscular patterns. Perhaps an important prognostic indicator of articulation deviancy is evident in the error patterns even at the age of 2 or 3 years. The error data from the present study are currently being analyzed for presentation in a later manuscript.

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