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ABSTRACT

Forty normal children aged 3 and-one-half to 5 and-one-half were tested on the pronunciation of initial /-l/, /-r/, and /s-/ clusters in 120 words, occurring 36, 48, and 42 times, respectively; other phonemes in the cluster occurred from 6 to 18 times. Articulation errors of individual subjects were examined for evidence of (1) degree and type of consistency, including consistency in rate of error; (2) mispronunciation of a phoneme, unconditionally or in any cluster environment; (3) the articulatory feature changed in substitution errors, regardless of phoneme; and (4) the error made on a phoneme. Results showed that children typically made the same number of errors when retested on similar lists, but not on the same items. There was little evidence for consistency in making errors on particular phonemes or features. Few children mispronounced any phoneme more than 50 percent of the time; most missed a phoneme in initial or final position in a cluster only once. In the few instances in which children made more than one error on a phoneme, the error made was usually the same; that is, the subjects were consistent in the error made. Tables and references are included. (Author/VJ)

THE CONSISTENCY OF ARTICULATION ERRORS IN YOUNG CHILDREN

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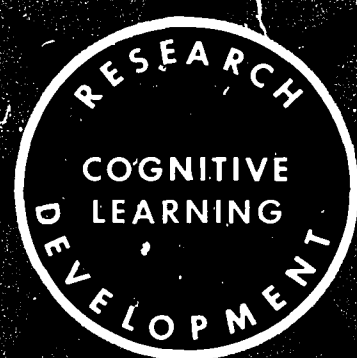

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THE CONSISTENCY OF ARTICULATION ERRORS IN YOUNG CHILDREN

Robin S. Chapman and Ai Chen Ting

Report from the Project on Reading and Related Language Arts
Basic Prereading Skills: Identification and Improvement

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Wisconsin Research and Development
Center for Cognitive Learning
The University of Wisconsin
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The Wisconsin Research and Development Center for Cognitive Learning focuses on contributing to a better understanding of cognitive learning by children and youth and to the improvement of related educational practices. The strategy for research and development is comprehensive. It includes basic research to generate new knowledge about the conditions and processes of learning and about the processes of instruction, and the subsequent development of research-based instructional materials, many of which are designed for use by teachers and other for use by students. These materials are tested and refined in school settings. Throughout these operations behavioral scientists, curriculum experts, academic scholars, and school people interact, insuring that the results of Center activities are based soundly on knowledge of subject matter and cognitive learning and that they are applied to the improvement of educational practice.

This Technical Report is from the Basic Prereading Skills: Identification and Improvement element of the Reading and Related Language Arts Project in Program 2, Processes and Programs of Instruction. General objectives of the Program are to develop curriculum materials for elementary and preschool children, to develop related instructional procedures, and to test and refine the instructional programs incorporating the curriculum materials and instructional procedures. Contributing to these Program objectives, this element has two general objectives: (1) to investigate ways to test for skill deficits and to overcome them and (2) to develop a kindergarten-level program, including diagnostic tests and instructional procedures, for teaching basic prereading skills. Tests and instructional programs will be developed for visual and acoustic skills, including letter and letter-string matching with attention to order, orientation and detail, and acoustical matching, segmentation, and blending.

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ABSTRACT

Forty normal children aged 3 1/2 to 5 1/2 were tested on the pronunciation of initial /-l/, /-r/, and /s-/ clusters in 120 words. The phonemes /l/, /r/, and /s/ occurred 36, 48, and 42 times, respectively; other phonemes in the cluster occurred from 6 to 18 times. Articulation errors of individual *S*s were examined for evidence of degree and type of consistency, including consistency in rate of error; mispronunciation of a phoneme, unconditionally or in any cluster environment; the articulatory feature changed in substitution errors, regardless of phoneme; and the error made on a phoneme.

It was found that children typically made the same number of errors when retested on similar lists, but not on the same items. There was little evidence for consistency in making errors on particular phonemes or features. Few children mispronounced any phoneme more than 50% of the time; indeed, most missed a phoneme in initial or final position in a cluster only once. In the few instances in which children made more than one error on a phoneme, however, the error made was usually the same; that is, *S*s were consistent in the error made.

The implications of these findings for test construction and clinical work with speech-defective children are discussed.

I
INTRODUCTION

Normative studies of articulatory development typically report the proportion of children pronouncing a sound or cluster correctly at each age level sampled (e.g., Templin, 1957). A given sound or cluster may be tested once in each word position (initial, medial, final) but seldom more often. An example of developmental data is presented in Table 1 for initial /-l/, /-r/, and /s-/ clusters for 3 1/2-, 4 1/2-, and 5 1/2-year-old children (computed from Templin, 1957).

The question arises of whether normative data reflect individual probabilities of mispronunciation; for instance, if 25% of an age group mispronounces a cluster, then the individual child's probability of mispronunciation could be estimated as .25. At the other extreme, the developmental data could reflect changing proportions of children who consistently mispronounced the cluster. Unfortunately, data from repeated testing of speech sounds are available only for children showing functional speech defects or disproportionately high error rates, rather than for random samples of each age group.

The study reported here represents an exploratory attempt to characterize the extent of error consistency in young normal children and to answer the question of whether the inference from group to individual error rates is warranted.

Error consistency may be defined arbitrarily with respect to the probability of mispronunciation. The criterion for error consistency may be as stringent as a 1.00 probability of error (a criterion frequently used in studies of functional speech defects) or as egalitarian as a .50 probability. In this paper an error occurring at least 50% of the time will be called consistent but the error rate intervals will be reported so that a differing definition may be applied by the reader.

Table 1

Probability of a Cluster Mispronunciation, Taken from Templin's 1957 Data[a]

	r-cluster:				l-cluster:				s-cluster:		
Age:	3.5	4.5	5.5		3.5	4.5	5.5		3.5	4.5	5.5
pr	.367	.267	.167	pl	.368	.072	.082	sp	.289	.200	.219
br	.333	.267	.133	bl	.254	.147	.076	st	.230	.111	.111
tr	.378	.205	.127	kl	.400	.167	.134	sk	.232	.194	.146
dr	.343	.205	.092	gl	.383	.217	.158	sm	.360	.272	.192
kr	.308	.237	.076	fl	.500	.283	.167	sn	.298	.169	.197
gr	.361	.205	.092	sl	.227	.095	.105	sw	.309	.230	.200
fr	.391	.151	.095								
θr	.722	.379	.197								

[a]Templin, M. *Certain language skills in children*. Minneapolis; University of Minnesota Press, 1957, p. 164 and pp. 167–68. The data here are based on absolute rather than relative error rate; the 5.5-year-old columns are the average of Templin's data for 5- and 6-year olds. Distortions were classified as errors in this data, in addition to substitutions, deletions, and insertions. The error rates reflect cluster, rather than phoneme, error rates.

In investigating whether individual children are consistent in making errors we will consider not only the probability of mispronouncing a given sound but also the probability of mispronouncing a sound in a specified phonetic environment, the probability of making the identical error each time the sound is missed, and the probability of changing the same articulatory feature each time a mispronunciation occ Finally, the degree to which children make the same total number of errors on similar tests will be examined.

The data to be reported come from repeated testing of the phonemes of the initial /-l/, /-r/, and /s-/ clusters listed in Table 1; a phoneme is tested from 6 to 48 times.

II
METHOD

STIMULUS MATERIALS

Two lists (A and B) of 60 words each and a pre-training list of three words were prepared. For each list, three high-frequency words were chosen for each of the 20 initial consonant clusters tested: /pr, br, tr dr, kr, gr, fr, θr, pl, bl, kl, gl, fl, sl, sp, st, sk, sm, sn, sw/. The three words selected for each initial cluster contained three different vowels identical for List A and List B except for clusters /tr, dr, bl/, and /kl/. The lists are presented in Table 2.

The two word lists were balanced for frequency according to three sources: a cumulative vocabulary list in Ginn's third reader (Russell, Clymer, Wulfing, & Ousley, 1967); the Thorndike-Lorge general word count (Thorndike & Lorge, 1944); and the Rinsland count of words appearing in children's essays and conversations (Rinsland, 1950). Fifty-two percent of the words for List A and 53% of the words for List B appeared in the Ginn vocabulary lists. The grade level at which a word was first ranked in the Rinsland count (1950) was assigned a corresponding rank (e.g., 1

Table 2

Test Words Grouped by Clusters

		(List A)				(List B)			
r cluster	1. pr	pray	present (n)	prize	1. pr	praise	press	price
	2. br	brave	breath	brother	2. br	break	breakfast	brush
	3. tr	try	trick	treasure	3. tr	tribe	trip	travel
	4. dr	drug	drive	dream	4. dr	drum	dry	drill
	5. kr	crab	crown	cross	5. kr	crack	crowd	crop
	6. gr	grape	groan	green	6. gr	gray	grow	grease (n)
	7. fr	froze	freeze	frog	7. fr	frozen	free	frost
	8. θr	thrill	throw	threaten	8. θr	thrills	throat	thread
l cluster	9. pl	place	plum	pleasure	9. pl	play	plus	pleasant
	10. bl	black	blank	bloom	10. bl	blacker	blanket	blue
	11. kl	clock	close (prep)	cloud	11. kl	club	clothes	clown
	12. gl	glass	glow	glue	12. gl	glad	globe	gloom
	13. fl	flowers	flag	fly	13. fl	flower	flash	flight
	14. sl	slice	sleigh	slip	14. sl	slide	slave	slide
s cluster	15. sp	speak	spade	spider	15. sp	speed	space	spy
	16. st	stay	story	stop	16. st	state	storm	star
	17. sk	scar	skate	skill	17. sk	scarf	scale	skip
	18. sm	smile	small	smoking	18. sm	smiling	smaller	smoke
	19. sn	snail	sneeze	snap	19. sn	snake	sneak	snack
	20. sw	sweep	sweat	swing	20. sw	sweet	swell	swim

for Grade 1) and a mean computed for each list: for both lists, the mean grade level of the words used is 1.5. The mean Thorndike-Lorge (1944) number was also computed for the lists (values of 60 and 55 were arbitrarily assigned to AA and A words). For List A, the mean number of occurrences per million is 43.6; for List B, 42.8.

Two randomizations of each list were prepared subject to the constraint that no cluster or vowel occurred twice in succession. The three pre-training words preceding each randomization of the list were *tree* (r-cluster), *clay* (l-cluster), and *school* (s-cluster).

PROCEDURE

Children were tested individually on both List A and List B. A child was assigned randomly to one of the four lists for the first test. The second test list, given one to two days later, was always the opposite list and order (e.g., a child receiving List A-2 for the first test received List B-1 for the second test).

All subjects were tested by one female experimenter (*E*), who pronounced each word for the *S* to repeat. Test sessions were recorded at 3 3/4 ips on one channel of an Ampex 1100 tape recorder with a Shure lavaliere microphone.

SUBJECTS

Three age groups of *S*s were tested. Twenty-three kindergartners were drawn from a middle-class school in Madison. The mean age of this group was 5 1/2 years. Eight 4 1/2-year-old pre-schoolers and nine 3 1/2-year-old children were drawn from two day-care centers in and around Madison. None of them had articulation or hearing problems.

DATA TRANSCRIPTION

Errors in pronunciation of the initial clusters were transcribed independently in broad phonetic notation (IPA) by two experienced transcribers; a third transcriber resolved the discrepancies of the first two transcriptions.

III
RESULTS AND DISCUSSION

PRELIMINARY ANALYSIS

The number of phoneme errors in initial clusters was computed for each *S* for each of the two stimulus lists. A 3 x 2 x 2 unequal *n* Anova with repeated measures on the third factor, Age Group (3-1/2, 4-1/2, 5-1/2) by Test Order (List A first; List B first) by List (A, B) was carried out with number of phoneme errors as the dependent variable. Only the main effect of Age Group was significant ($F(2, 34) = 7.33$; $p < .01$). The mean total of errors for the two lists were 26.11, 7.13, and 5.74 for 3 1/2-year-olds, 4 1/2-year-olds, and 5 1/2-year-olds, respectively. Post hoc Scheffé paired comparisons showed that each of the two older groups differed from the youngest group in error rate ($p < .05$).

The distribution of total error scores (List A and List B) among *S*s in each age group is shown in Table 3. Total error scores in the 5 1/2-year-old group ranged from 0 to 22 (240 would be a maximum for the two lists, excluding insertion errors), with a median score of 4. Among 4 1/2-year-olds, error scores ranged from 0 to 34 with a median score of 3.5. The range in the youngest group was 3 to 55, with a median score of 11.

The failure to find significant effects of testing order, list, or any interaction was expected; in the sections to follow, data from the two testing orders and two lists will be pooled unless so noted.

ERROR ANALYSES: A SEARCH FOR CONSISTENCY

A number of analyses were carried out on the error data to determine if *S*s made articulation errors consistently in any sense. The first question asked was whether *S*s made a comparable number of errors on the two lists; this was the question of *error rate consistency*, or test reliability. The second analysis was directed to the question of whether any *S* mispronounced a particular consonant phoneme at least 50% of the time; this type of consistent mispronunciation was called *unconditional error consistency*. An alternative possibility was that a phoneme was consistently mispronounced only in a particular phonemic environment; this possibility was termed *conditional error consistency*. Errors were examined for evidence of influence of the following vowel (*V*), preceding or following consonant (*C*), or the joint *C-V* or *-CV* environment.

Table 3

Number of *S*s Making Each Total Error Score in Each Age Group

Group	Error Score: 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15...19	...22	...32	...34	...50	...55
5 1/2 (n=23)	3	3	3	2	2	2	1	1	0	1	0	0	1	1	0	2	0	1	0	0	0	0
4 1/2 (n=8)	1	1	1	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
3 1/2 (n=9)	0	0	0	1	0	0	1	1	0	1	0	1	0	0	0	0	1	0	1	0	1	1

Table 4

Distribution of Error Rates for Each Consonant Phoneme Tested for 5 1/2 Year Olds, 4 1/2 Year Olds, and 3 1/2 Year Olds

Per Cent Error	PHONEMES (no. of instances in parentheses)													
	r (48)	l (36)	s (42)	p (18)	b (12)	t (12)	d (6)	k (18)	g (12)	f (12)	θ (6)	m (6)	n (6)	w (6)
5 1/2 Year Olds (n = 23)														
0	18	18	16	16	18	21	20	14	16	20	10	22	22	23
1- 9	4	4	7	6	5	1		3	5	2				
10-19		1		1			2	3	2	1	5	1		
20-29								3						
30-39						1					2		1	
40-49														
50-59							1				1			
60-69											2			
70-79														
80-89	1										1			
90-99														
100											2			
4 1/2 Year Olds (n = 8)														
0	4	4	5	7	5	6	8	8	2	7	6	7	8	8
1- 9	4	3	3	1	3	2			6	1				
10-19														
20-29											1	1		
30-39											1			
40-49		1												
50-59														
60-69														
70-79														
80-89														
90-99														
100														
3 1/2 Year Olds (n = 9)														
0	4	5	1	4	6	7	7	2	3	5	4	9	8	8
1- 9	3	1	5	3	1	2		4	4	2				
10-19	1	1	1	1	1		2	3	1	1			1	1
20-29				1										
30-39			2						1		1			
40-49														
50-59					1					1	1			
60-69	1	1									1			
70-79		1												
80-90											1			
90-99														
100											1			

A fourth type of error consistency, termed *mispronunciation consistency*, was defined as the identical mispronunciation of a phoneme (e.g., /w/ for /r/) at least 50% of the time that an error was made. Errors were also examined for consistency in the particular feature of the sound (e.g., place of articulation) which was changed in a substitution mispronunciation; this was termed *feature consistency*.

In the sections to follow, evidence for or against each of the five types of articulation consistency—*error rate consistency*, *unconditional error consistency*, *conditional error consistency*, *mispronunciation consistency*, and *feature consistency*—will be presented.

Error Rate Consistency

The Anova previously reported showed no significant difference in the number of errors made on List A and List B. The correlation of error scores on List A and B for all *Ss* (n = 40) was .88. Children are relatively consistent, then, in the number of errors made on lists testing the same sounds. Viewed in terms of articulation testing, this finding means that the articulation tests were relatively reliable according to a test-retest criterion. Reliability is attenuated, of course, when a narrower range of scores is obtained; thus, test-retest reliability is lowest for the oldest group (r = .50).

Unconditional Error Consistency

Very few *Ss* mispronounced any consonant phoneme more than 50% of the time. In only three cases was a phoneme mispronounced 100% of the time—/θ/, in each instance. This consonant is not only one of the latest to be mastered by children (Poole, 1934), but also one of the most difficult to identify in perceptual tasks (Skeel, Calfee, & Venezky, 1969).

The distribution of error rates for each phoneme is shown by group in Table 4. No mispronunciations or a 1 to 9% error rate were typical for most *Ss* on most consonants; averaged across phonemes, 88.7% of the 40 *Ss* fall into these two categories. More of the older children fall into the zero error category. Individual error rates 50% or higher were observed for only 6 of the 14 consonants: /ʊ/ (10 *Ss* out of 40), /l/ (2 *Ss*), /r/ (2 *Ss*), and /b/, /d/, /f/ (1 *S* each).

These findings indicate that normal children, like the speech-defective children studied, are inconsistent in making articulatory errors; indeed, most consonants are mispronounced less than 10% of the time. It is still possible, however, that the errors made by children are consistent for a phoneme in a particular phonemic environment, although the phoneme is not mispronounced in many contexts. This possibility is examined in the next section.

Conditional Error Consistency

Errors on consonant phonemes in clusters were examined separately, excluding those few cases in which the rest of the cluster or the following vowel was incorrectly pronounced. The distribution of *Ss'* error scores is shown in Table 5. The first prerequisite for conditional error consistency is that the *S* make at least two errors on the phoneme in question; it can then be asked whether these errors occur in the same phonemic context. Examination of Table 5, however, reveals that in every case of an initial consonant the majority of *Ss* made only a single error. With the single exception of /l/, this statement is true of non-initial consonants also. Thus the majority of *Ss* fail to show conditional phoneme consistency with respect to any of the phonemic environments which might be examined (*C-*, *-C*, *-V*, *C-V*, or *-CV*). Nor is there strong evidence for consistency with respect to any environment in the 43 instances in which an *S* made more than one error. There is some evidence that the phonemes /p, t, k/ are harder in initial position (before /l/ or /r/) than in non-initial position (following /s/), but again errors are too infrequent to indicate conditional consistency.

Mispronunciation Consistency

Although the 43 instances in which *Ss* mispronounced a phoneme more than once showed little evidence of conditional error consistency, the multiple errors made by a child on a phoneme were likely to be identical. The same substitution (or deletion, in a few cases) was made more than 50% of the time in 39 of the 43 instances; in 20 of those cases, the identical error was made every time.

Van Riper and Irwin (1958, p. 66) cite variable replacement errors, which would be the opposite of mispronunciation consistency, in our terms, as a favorable clinical sign in

Table 5

Number of Ss Making Zero, One, or More Errors on Each Phoneme in Initial and Final Position in the Cluster[a]

(5 1/2, n = 23; 4 1/2, n = 8; 3 1/2, n = 9)

		INITIAL (No. Occurrences in Parentheses)									FINAL (No. Occurrences in Parentheses)							
No. Errors	Group	s (42)	p (12)	b (12)	k (12)	g (12)	f (12)	θ[b] (6)	t[b] (6)	d[b] (6)	r (48)	l (36)	p[c] (6)	t[c] (6)	k[c] (6)	m[c] (6)	n[c] (6)	w[c] (6)
0	5 1/2	17	17	17	15	17	21	10	21	20	18	19	21	23	22	22	22	23
	4 1/2	5	7	6	7	4	7	6	6	8	5	5	8	8	8	7	8	8
	3 1/2	2	5	6	6	4	7	4	8	8	4	5	8	9	7	9	8	9
	All Ss	24	29	29	28	25	35	20	35	36	27	29	37	40	37	38	38	40
1	5 1/2	4	6	5	4	4	1	5	1	2	4	2	2	0	1	1	1	0
	4 1/2	3	1	2	1	4	1	1	2	0	1	0	0	0	0	1	0	0
	3 1/2	3	3	1	2	5	1	5	1	1	3	1	1	0	2	0	1	0
	All Ss	10	10	8	7	13	3	11	4	3	8	3	3	0	3	2	2	0
More	5 1/2	2	0	1	4	2	1	8	1	1	1	2	0	0	0	0	0	0
	4 1/2	0	0	0	0	0	0	1	0	0	2	3	0	0	0	0	0	0
	3 1/2	4	1	2	1	0	1	0	0	0	2	3	0	0	0	0	0	0
	All Ss	6	1	3	5	2	2	9	1	1	5	8	0	0	0	0	0	0

[a]A few instances in which a S mispronounced the following vowel or both sounds in the cluster are omitted.

[b]This phoneme occurred only before /r/.

[c]This phoneme occurred only after /s/.

speech-defective children. This may indeed be the case for older speech-defective children—those beyond the period of normal articulatory development. Our data, however, show invariant replacement errors to be typical of the younger, non-speech defective child; i.e., mispronunciation consistency is typical of the normally developing child. When speech therapy is begun with the child prior to age 7 or 8, then, some caution should be exercised in interpreting mispronunciation consistency as an unfavorable sign for therapy.

One could speculate that the invariant replacement error of the normally developing child represents an incorrect execution of a correct cortical command, while that of the older speech-defective child may represent both incorrect execution and incorrect central planning. Inspection of non-phonemic features of errors may, in some instances, demonstrate the former case. For instance, aspiration of voiceless stops can be examined when /s/- deletion errors occur in initial s-clusters, or vowel length may be examined when final stops or fricatives are devoiced. Evidence for correct planning of mispronounced sounds emerged in an unpublished study of normal 5 year olds pronouncing 30 initial s-cluster words, in which we found the following stop to be unaspirated in almost every case of s-deletion. The voiceless stop carried the phonetic feature appropriate to non-initial position in the cluster, although it was in initial position in the utterance.

Feature Consistency

The types of error made by the three age groups are given in Table 6. In each group, most of the errors were substitution errors; of the substitution errors, most resulted from the change of a single articulatory feature of the phoneme. Changes in the place of articulation constituted the most common error in the oldest children; younger children substituted one semivowel (/lrw/) for another even more frequently, usually /l/ for /r/ or vice versa. Place changes occurred for all stops and fricatives tested, with replacement of /θ/ by /f/ being the most common error.

When individual protocols were examined for consistency in the feature changed, no evidence for feature consistency was found. Errors for an individual were not confined to a single type of feature change; the less common changes (manner, voicing) were distributed among *S*s together with the more common changes.

SUMMARY AND CONCLUSIONS

Normal 3 1/2- to 5 1/2-year-old children were found to be consistent in the correct pronunciation of speech sounds in the initial /-l/, /-r/, and /s-/ clusters tested. Most phonemes were pronounced correctly at least 90% of the time. Conversely, the children were inconsistent in misarticulating a sound tested; even when a child made several errors, he seldom missed a sound as often as 50% of the time.

Thus in repeated testing on individual sounds, normal children show either consistently correct pronunciation of the sound or only occasional mispronunciation. The individual child's probability of mispronunciation is imperfectly reflected in the proportion of his age group mispronouncing a sound on a single testing, but not so seriously as it would be in the case of consistent individual errors.

Children did not miss a sound inconsistently in any of the environments examined. Individual consistency in the feature changed, across those phonemes missed, was not found. When a child made more than one error on a phoneme, however, the error was usually the same; that is, children are consistent in their mispronunciation of a phoneme.

Error rate consistency (i.e., test-retest

Table 6

Types of Errors Made by Three Age Groups

Groups	Types of Errors				
	Number of phoneme errors	Number of deletions	Number of insertions	Number of substitutions	Number of single feature substitutions
5 1/2	132	16	6	110	105
4 1/2	57	14	2	41	38
3 1/2	236	30	14	192	167

reliability) was high in this study, as in others in which odd-even reliability has been reported (Wellman, Case, Mengert, & Bradbury, 1936; Williams, 1937). The foregoing findings, however, mean that reliability is low in the sense of the child missing the same sound in the same context on two successive testings. Certainly, mispronunciation of a phoneme on a single test cannot be taken as evidence that the child will always—or even frequently—mispronounce the sound.

Thus tests designed to compare an individual child's performance on two occasions, or those designed to characterize the individual's performance in depth, should include multiple items testing each sound. (The phoneme error rates obtained in this study suggest that at least 10 test items be provided for a sound.) This finding is of particular importance to clinical diagnosis of speech defects and to longitudinal studies of normal articulatory development using few subjects.

For other purposes, only one or two items testing each sound may be necessary. Articulation tests used for screening children with high error rates relative to their age group are one such instance, since error rate consistency can be found in the absence of consistent errors on particular sounds. Similarly, only one or two items per sound are needed in large-scale normative studies focusing on error rates for a phoneme at several age levels, rather than individual error patterns. Indeed, the failure to find individual conditioning of errors by phonemic environment suggests that test word selection is not critical for /-l/, /-r/, and /s-/ clusters.

The essential point is that one should make a large number of observations with respect to the conclusion one wishes to draw. If one wishes to make statements about an individual's performance on a sound, then multiple items testing the sound should be used. If conclusions are to be drawn with respect to an individual's overall error rate, then it is the total number of items which should be large. Finally, statements about group error rates on a phoneme can be reliably made on the basis of a few items per sound if the number of subjects is large.

The fact that normal children are consistent in the replacement errors made for a phoneme implies that representative confusion matrices can also be constructed from limited—even single item—testing of sounds, as long as a large number of *Ss* is used. With respect to speech-defective children, the finding suggests that mispronunciation consistency need not be an unfavorable clinical sign in younger children.

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