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AN ABSTRACT OF THE THESIS OF Lori Jean Griffith for the
Master of Science in Communication presented September 1,
1987.

Title: Normative Study of Phonological Process Patterns of
Preschool Children as Measured by the Assessment of
Phonological Processes-Revised

APPROVED BY MEMBERS OF THE THESIS COMMITTEE:

Mary E. Gordon, Chair

Joan McMahon

Pat Wetzel

Various methods of speech diagnosis have been
developed arising from a need for speech-language
pathologists to analyze articulation errors. Current
attention has focused on phonological process analysis.
This approach analyzes how a child simplifies an adult
target form of a word.

Much of the research concerning phonological processes

has focused on disordered articulation and various methods of analysis. Little research has been conducted on normal development. As a result, most phonological process tests are without norms. The Assessment of Phonological Processes - Revised (APP-r) developed by Hodson (1986) is one test of phonological process analysis and is without norms. The purpose of this study was to obtain normative data for children ranging from 3 to 5 years of age on their use of phonological processes as measured by the APP-r. The questions this study sought to answer were: Do normally developing children exhibit phonological process deviations; what is the frequency of occurrence of each phonological process deviation by age group; and does the number of phonological process deviations and the average total frequency of occurrence of phonological process deviations decrease as age increases?

Fifty subjects, ages 2-10 to 5-2 years participated in this study. Subjects were from preschools in the Portland metropolitan area.

The mean numbers of phonological process deviations exhibited by the 3,3-6, 4, 4-6, and 5-year age groups were 5.7, 3.6, 3.0, 2.0, and 1.7, respectively. The mean percentage of all phonological process deviations exhibited for each age group were 15.8, 8.0, 7.6, 7.3, and 3.6, respectively. A one-way analysis of variance revealed a statistically significant difference at the .05 level when

the number of ten basic process deviations exhibited was compared across age groups. In addition, a one-way analysis of variance comparing the average percentage of all phonological process deviations exhibited across age groups was statistically significant at the .05 level. As age increased, the use of phonological processes decreased.

The results of this study reveal that as age increases, the number of process deviations decrease. In addition, the average percentage of process deviations decrease as age increases. Liquid /l/, and liquid /r/, and strident deviations were most commonly exhibited across all age groups and prevocalic singleton omission, postvocalic singleton omission, and nasal deviation were rarely exhibited across all age groups. Although the number of subjects that participated in this study is limited, information gathered may be helpful in assessing disordered articulation with knowledge of expected performance.

NORMATIVE STUDY OF PHONOLOGICAL PROCESS PATTERNS
OF PRESCHOOL CHILDREN AS MEASURED BY
THE ASSESSMENT OF PHONOLOGICAL PROCESSES-REVISED

by

LORI JEAN GRIFFITH

A thesis submitted in partial fulfillment of the
requirements for the degree of

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in
SPEECH COMMUNICATION
with emphasis in
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1987

TO THE OFFICE OF GRADUATE STUDIES AND RESEARCH:

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CHAPTER I

INTRODUCTION AND STATEMENT OF PURPOSE

INTRODUCTION

Methods of speech diagnosis have developed from a need for speech-language pathologists to analyze speech errors. Various approaches include phonemic analysis; analysis of speech according to place, voice, and manner; distinctive feature analysis; and phonological process analysis. Historically most speech-language pathologists have conceived of disordered speech as the result of phonemic differences which involve describing error sounds in terms of omissions, substitutions, additions, and distortions. During the 1980's, phonological process analysis was developed to meet the need of assessing a child's phonological patterns. The phonological approach involves assessing a child's speech patterns or rules and differs from a phonemic approach in that the linguistic rules underlying speech production are analyzed as contrasted to single phonemic analysis.

Current attention has focused on phonological process analysis. The term phonological process deviation refers to "a regularly occurring deviation from standard adult speech patterns" (Elbert and Geirut, 1986). The analysis describes

the way a child simplifies an adult target form. An example of a process is "gliding" which is marked when glides (/w/ and /j/) are substituted for other phonemes (e.g., "rock" produced as /wak/).

Research concerning phonological process analysis has focused mainly on the deviations of child speech. Few studies have been conducted on normal development and suppression of phonological process deviations and as a result, most phonological process analyses are without age norms. Attention to developmental norms could serve as a foundation in the comparison of normal and articulation delayed children (Haelsig and Madison, 1986). Information regarding normal development could further an understanding of child phonology by adding to the already existing knowledge concerning appearance, productive duration, and disappearance of phonological process deviations in the critical preschool period (Haelsig and Madison, 1986).

The Assessment of Phonological Processes-Revised developed by Hodson (1986) is a widely used test and is easy to administer. However, this test is without developmental norms. Evaluating a child who is phonologically delayed requires an understanding of normal process development. Normative data could serve as a reference for assessing phonological performance.

STATEMENT OF PURPOSE

The purpose of this study was to obtain normative data on preschool children aged three years to five years on their use of phonological process deviations as measured by the Assessment of Phonological Processes-Revised (APP-r) developed by Hodson (1986). This investigation sought to answer the following questions:

1. Do normally developing children exhibit phonological process deviations?
2. What is the frequency of occurrence of each phonological process deviation by age groups?
3. Does the number of phonological process deviations decrease as age increases?
4. Does the average total frequency of occurrence of phonological process deviations decrease as age increases?

DEFINITION OF TERMS

The following terms are ten basic phonological process deviations which are analyzed by the Computer Analysis of Phonological Processes (CAPP) developed by Hodson (1985). For additional phonological process terms refer to Appendix A (Weiss, Gordon, and Lillywhite, 1987).

Consonant Sequence Reduction: occurs when any consonant in a sequence (not separated by a vowel) is omitted (e.g., /triŋ/ for "string").

Velar Deficiency: occurs whenever velar stops /k/ and /g/ are omitted or when some phoneme other than /k/ or /g/ is substituted (e.g., /ʌm/ or /dʌm/ for "gum").

Glide Deficiency: is scored when substitutions for /w/ or /j/ from other classes occur or when they are omitted (e.g., /atʃ/ or batʃ/ for "watch").

Liquid (l): is scored when /l/ is omitted or when some other phoneme is substituted (e.g., /if/ or /wif/ for "leaf").

Liquid (r): is scored when /r, ʀ/ is omitted or when some phoneme other than /r/ is substituted (e.g., /ak/ or /wak/ for "rock").

Nasal Deficiency: is scored when /m/, /n/, or /ŋ/ target phonemes are omitted or when nonnasal phonemes are substituted (e.g., /ouz/ or /douz/ for "nose").

Prevocalic Singleton Consonant Omission: is scored whenever a singleton consonant that initiates a syllable is deleted (e.g., /ou ou/ for "yoyo").

Postvocalic Singleton Consonant Omission: is scored whenever a singleton consonant omission that terminates a syllable is deleted (e.g., /wa/ for "watch").

Stridency Deletion: is scored whenever stridency is deleted either by means of a total omission of the target strident phoneme (e.g., /u/ for "shoe") or by substitution of a nonstrident phoneme (e.g., /tu/ or /wu/ for "shoe").

Syllable Reduction: is scored when an entire syllable nucleus is deleted in a stimulus word that has two or more syllables (e.g., /bæ/ for "basket").

CHAPTER II

REVIEW OF THE LITERATURE

The assessment of speech errors has many approaches with the most recent approach being phonological process analysis. This chapter presents a historical framework concerning analysis methods dating from Van Riper in the 1950's and continuing to the more current methods of phonological processes. Phonological development will also be discussed and particular emphasis will focus on Hodson's (1986) method of phonological process analysis to provide background information on why normative data are necessary.

APPROACHES TO THE ASSESSMENT OF ARTICULATION

One of the earliest approaches to articulation analysis was developed by Van Riper in the 1950's. This type of analysis is often labeled as "traditional" (Elbert and Geirut, 1986). Each speech sound is assessed according to its position in the word, i.e., initial, medial, and final. This phonemic analysis describes error sounds in terms of omissions, substitutions, and distortions. Each sound is considered separately from the others. Traditional analysis is still used today and may be appropriate for a

child who consistently misarticulates specific sounds or who has a phonetic, i.e., motoric articulation disorder.

A later type of analysis focuses on the relationship of error sounds with the phonemic systems of the place, voicing, and manner characteristics of production. Every sound is analyzed according to these three features and thus is distinguished from every other sound. for example, the feature combination of lingual-alveolar voiceless stop describes only the /t/ sound (Elbert and Geirut, 1986). An example of this type of analysis includes the Compton-Hutton Phonological Assessment (Compton and Hutton, 1978).

Finally, a type of analysis which gave rise to the current phonological process analysis is distinctive feature analysis. In contrast to other analyses, the distinctive feature approach gathers an extensive speech sample of multiple productions of each sound and studies which features are used correctly and which are used incorrectly (Elbert and Geirut, 1986). Each phoneme is analyzed as a "bundle" of distinctive features and is distinguished from all other phonemes by its unique combination of features (Stoel-Gammon and Dunn, 1985). The distinctive features approach groups phonemes into classes on the basis of shared features. For example, /m/, /n/, and /ŋ/ share the nasal feature and thus form a class of nasal consonants (Stoel-Gammon and Dunn, 1985). Examples of these phonemic systems

are included in the Chomsky-Halle Distinctive Feature Chart (Chomsky and Halle, 1968) presented in Table I.

Table I
Chomsky-Halle Distinctive Feature Chart

	r	l	p	b	f	v	m	t	d	θ	ð	n	s	z	tʃ	dʒ	ʃ	ʒ	k
Vocalic	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Consonantal	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
High	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+
Back	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Low	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Anterior	-	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-
Coronal	+	+	-	-	-	-	-	+	+	+	+	+	+	+	+	+	+	+	-
Round																			
Tense																			
Voice	+	+	-	+	-	+	+	-	+	-	+	+	-	+	-	+	-	+	-
Continuant	+	+	-	-	+	+	-	-	+	+	-	+	+	-	-	-	+	+	-
Nasal	-	-	-	-	-	+	-	-	-	-	-	+	-	-	-	-	-	-	-
Strident	-	-	-	-	+	+	-	-	-	-	-	-	+	+	+	+	+	+	-

	g	ŋ	h	i	u	eɪ	ou	aɪ	ɔɪ	ɪ	ʊ	ɛ	ʌ	ə	ɔ	w	j
Vocalic	-	-	-	+	+	+	+	+	+	+	+	+	+	+	+	-	-
Consonantal	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
High	+	+	-	+	+	-	-	-	-	+	+	-	-	-	-	+	-
Back	+	+	-	-	+	-	+	+	+	-	+	-	+	+	-	+	-
Low	-	-	+	-	-	-	-	+	+	-	-	-	-	-	+	+	-
Anterior	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coronal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Round				-	+	-	+	-	+	-	+	-	-	+	-	+	+
Tense				+	+	+	+	+	+	-	-	-	-	-	-	-	-
Voice	+	+	-														
Continuant	-	-	+														
Nasal	-	+	-														
Strident	-	-	-														

Note: +/- represent the presence or absence of the features of each phoneme.

(From: Chomsky, N., and Halle, M. (1968). The sound pattern in English. New York, NY: Harper and Row.)

PHONOLOGICAL PROCESSES

The most recent approach to the assessment of articulation is phonological process analysis. A phonological process deviation is a sound pattern that has

been observed in the speech of an individual. The underlying form of a word is generally considered to be the adult form of the word (Kahn, 1985).

Sound patterns or process deviations have been classified differently according to various authors. Hodson (1986) separates phonological process deviations according to omissions, major phonemic substitutes, assimilations which include sound deviations assuming a characteristic of another sound in a word (e.g., /kwʌk/ for "truck"), miscellaneous deficient patterns, idiosyncratic rules which include deficient patterns that do not fit into any of the classifications Hodson describes, epenthesis which includes adding a vowel or consonant in a word (e.g., /bəlæk/ for "black"), voicing alterations, vowel deviations, and nonphonemic alterations which may include tongue positioning and other structures of the speech mechanism apart from a target phoneme.

Another classification system was developed by Weiner (1979) and includes (a) syllable structure processes which involve changes in the make-up of the syllable of the adult form of the word, (b) harmony processes which include sound deviations that are influenced by other sounds in a word, and (c) features contrast processes which include sound substitutions without the influence of other phonemes. Harmony processes as described by Weiner are analogous to assimilation processes as described by Hodson (1986).

A classification system somewhat similar to Weiner's (1979) is Ingram's (1981) system which includes syllable structure processes, substitution processes, simplification of liquids and nasals, other substitution processes, and assimilation (or harmony) processes. Similarly, Elbert and Geirut (1986) describe three basic types of process deviations: processes that delete segments, processes that substitute segments, and processes that assimilate segments. Table II is a comparison chart developed by Kahn (1985) to describe phonological process deviations used by various phonologists.

TABLE II
Comparison of Types of Processes
Described by Various Authors

Weiner (1979)	Shriberg and Kwiatkowski (1980)	Hodson (1980)	Ingram (1981)	Khan and Lewis (1985)
		SYLLABLE STRUCTURE PROCESSES		
		Prevocalic Singleton Obstruent	Deletion of Initial Consonant	Deletion of Initial Consonant
Omission				
Final Consonant Deletion	Final Consonant Deletion	Postvocalic Singleton Obstruent	Final Consonant Deletion Nasals Voiced Stops Voiceless Stops Voiceless Fric	Deletion of Final Consonant
Weak Syllable Deletion	Unstressed Syllable Deletion	Syllable Reduction	Unstressed Syllable Deletion Reduction of Disyllable	Syllable Reduction
Cluster Reduction Init. Stop + Liquid Init. Fric + Liquid	Cluster Reduction	Cluster Reduction Obstruent Omission Sonorant Omission	Cluster Reduction Liquid Nasal /s/C	Cluster Simplification

Init. /s/ +				
Final /s/ +				
Stop				
Final Liquid +				
Stop				
Final Nasal +				
Stop				
Syllable Duplication			Reduplication	
ASSIMILATION PROCESSES				
Labial		Labial	Labial	
Alveolar	Progressive	Alveolar		Consonant
Velar	Regressive	Velar	Velar	Harmony
		Nasal		
Devoicing of		Postvocalic	Devoicing	Final
Final		Devoicing	of Final	Devoicing
Consonant			Consonant	
Prevocalic		Prevocalic	Prevocalic	Initial
Voicing		Voicing	Voicing	Devoicing
SUBSTITUTION PROCESSES				
Stopping of	Stopping	Stopping	Stopping	Stopping of
Fricatives			Init. Voiceless	Fricatives
			Fricatives	and Affricates
			Init. Voiced	
			Fricatives	
			Initial	
			Affricates	
	Palatal	Depalatalization	Palatal	Palatal
	Fronting		Fronting	Fronting
Fronting	Velar Fronting	Velar Fronting	Velar	Velar
			Fronting	Fronting
Affrication		Affrication		Stopping of
				Fricatives
Denasalization			Denasalization	
Vocalization	Liquid	Vowelization	Vocalization	Liquid
	Simplifi-			Simplification
Gliding of	cation	Gliding	Liquid Gliding	
Liquids		Omission		
Gliding of				
Affricates				
Glottal		Glottal		Glottal
Replacement		Replacement		Replacement
		Deaffrication	Deaffrication	Deaffrication
		Backing		Backing
		Stridency		Stridency
		Deletion		Deletion
		Nasal Omission		
		Palatalization		
			Apicalization	
			Labialization	
		Velar Omissions		
		Coalescence		
		Epenthesis		
		Metathesis		
		Vowel Deviations		

(From Kahn, L.M.: Basis of Phonological Analysis: A Programmed Learning Text, San Diego, CA, College-Hill Press).

It can be seen that the authors describe similar process deviations, but use a number of various terms to describe them.

PHONOLOGICAL PROCESS DEVELOPMENT

A number of studies have been conducted concerning normal phonological development. These studies have contributed to phonological process theory.

Smith (1973) studied his son Amahl from age 2-0 to 4-0 and postulated a set of ordered "realization rules" written in distinctive feature notation. These "realization rules" mapped the adult forms onto the child's surface forms. The surface form is the term used to identify the child's actual response.

A study by Edwards (1973) involved the acquisition of liquids. She postulated several "natural" phonetically possible phonological processes that could account for all the liquid substitutions and omissions in the speech of her six subjects. For example, surface substitutions of /w/ for /r/ were broken down into their constituent processes or components of each process (e.g., labialization process which causes a consonant to be rounded due to the influence of a preceding phoneme). In addition, Edwards also showed how the processes that she postulated were gradually limited and suppressed by the children in her study as their ages increased. Research with her subject Daniel lends an

example of this developmental sequence. Daniel at the age of 1-6 to 1-7 exhibited liquid loss relating to preconsonantal liquids (e.g., /mAk/ for "milk") and liquids after noncoronal consonants, (e.g., /kaka/ for "glasses"). Later, Daniel limited liquid loss as it related only to round liquids following a high back vowel, (e.g., /wuf/ for "wolf"), but liquids in other phonemic contexts were produced.

Oller (1973) obtained speech samples of five children with delayed articulation. He formalized "substitution rules" to describe the sound errors. He noted that all five of his subjects exhibited cluster reduction process deviations and some fricative and/or affricative substitution process deviations. For example, /f, θ, θ, / were replaced by /h/ in nonfinal positions. His results revealed that children whose speech was highly unintelligible had phonological systems which were as structured and regular as those children whose speech was developing at a normal rate. The children's speech resembled those of normal children at earlier ages.

Ingram (1974) agreed with Oller (1973), and stated that a number of "general" phonological rules are found in normal phonological development. He explained phonological rules and how they were related between the child and adult forms and noted that the use of phonological rules demonstrated the organizational and generalizing capacities of the child.

Ingram (1981) researched the phonological process deviations used by fifteen normal and fifteen language-delayed children with mean chronological ages of 1-9 and 5-4, respectively. Results revealed that many of the same process deviations were observed in both groups. Ingram also noted that some processes were unique for each group. This implies a need for more data reflecting normal development.

Leonard, Miller, and Brown (1980) researched the use of two process deviations, consonant assimilation and reduplication, in the speech of eight children with language delays with ages ranging from 3-8 to 4-10. Assimilation occurs when one consonant is influenced by another (e.g., /kok/ for "coat") and reduplication occurs when two syllables are produced identically or more similarly (e.g., /baba/ for "bottle"). It is postulated by various authors that normal children exhibit these process deviations in order to compensate for the inability to produce a more complex word and Leonard et al. (1980) sought to determine if children with language disorders did the same. The results revealed that assimilation allowed language disordered children to use words containing difficult target consonants without actually producing those consonants. Additionally, the language disordered children exhibited reduplication in attempting to produce nonreduplicated multisyllabic words, thus allowing them to produce

multisyllabic words. Thus, these results also indicated that reduplication may compensate for the inability to produce a difficult target phoneme and yet produce multisyllabic words.

Schwartz, Leonard, Folger, and Wilcox (1980) studied phonological development in three language-disordered ages ranging from 2-7 to 3-7 and three normal children, ages ranging from 1-7 to 1-9, respectively. In relation to phonological process deviations, they found that there were more similarities than differences between the two groups. The most frequently occurring process deviation for all of the language-disordered children and two of the normal children was final consonant deletion. They did find a difference between the two groups in the frequency of occurrence of particular process deviations. Reduplication was more frequently exhibited among the normally developing children than among the language disordered children. In addition, the researchers found that language disordered children did not exhibit a larger number of phonological process deviations than the normally developing children. They suggested that differences between the two groups may have indicated individual variation more than group differences.

Hodson and Paden (1981) researched the phonological process deviations of sixty intelligible and sixty unintelligible 4-year-olds. The main focus was to determine

which of the process deviations were operating in the unintelligible children. They also sought to determine what process deviations were being exhibited by the intelligible children and then compare the two groups. They discovered that the groups differed in their production of specific phonological process deviations. All sixty unintelligible children used stopping, cluster reduction, stridency deletion, liquid deviations, and assimilation in their speech. Other process deviations exhibited by the unintelligible children included velar deviations, final consonant deletion, syllable reduction, prevocalic voicing, and others. In contrast, the normal 4-year-olds produced very few process deviations. Process deviations included devoicing, liquid deviations, vowelization, gliding, and assimilations. The only process deviation which all intelligible children exhibited was devoicing. Hodson and Paden also noted that most of the process deviations exhibited by the unintelligible children did not occur in the speech of the intelligible children. They concluded that the process deviations produced by the sixty unintelligible children varied in the number and type of process deviations from those produced by the sixty intelligible children.

Preisser (1983) studied use of phonological process deviations for twenty children in three age groups ranging in age from 1-6 to 2-5. She administered the Assessment of

Phonological Processes-Revised and found that as age increased, the percentage of occurrence of phonological process deviations decreased. For example, children ranging from 1-6 to 1-9 exhibited cluster reduction 93 percent of the time and children ranging from 2-2 to 2-5 only produced cluster reduction 51 percent of the time.

Haelsig and Madison (1986) have recently studied the normal development of phonological processes in fifty children with ages ranging from 2-10 to 5-2 years. Their study involved administering the Phonological Process Analysis (PPA) developed by Weiner (1979) and making comparisons among age groups. They found that a decrease in the number of process deviations occurred as age increased. Fifteen out of the sixteen possible process deviations were exhibited by the 3-year-old age group whereas nine of the sixteen possible process deviations were produced by the 5-year-old group. Gliding of liquids was the most frequently occurring process deviation in the 3-0 and 3-6 year-old groups, whereas gliding did not occur in the 5-year-old group. No significant difference was found relative to the gender of the child. Many process deviations were rarely exhibited by the children, including prevocalic voicing, affrication, and denasalization. In addition, many children did not exhibit all of the phonological process deviations.

Hodson and Paden (1983), Kahn and Lewis (1985), and Weiner (1979) list phonological process deviations according

to a developmental sequence. Hodson lists the process deviations by severity levels; (a) 0 which includes omissions, (b) 1 which includes omissions, major place substitutes, glottal replacement, voicing alterations, miscellaneous patterns, vowel deviations, and idiosyncratic rules; (c) 2 which includes omissions, i.e., cluster reduction, and major phonemic substitutes, and (d) 3 which includes nonphonemic alterations, major phonemic substitutes, and voicing alterations. Kahn and Lewis list the process deviations according to (a) first, which includes deletion of final consonants, initial voicing, syllable reduction, palatal fronting, and deaffrication; (b) intermediate, which includes velar fronting, consonant harmony, and stridency deletion; and (c) last, which includes stopping of fricatives/affricatives, cluster simplification, final devoicing, and liquid simplification. Weiner lists phonological process deviations in three major categories; (a) syllable structure processes, which include deletion of final consonant, cluster reduction, weak syllable deletion, and glottal replacement; (b) harmony processes, which include labial assimilation, alveolar assimilation, velar assimilation, prevocalic voicing, and final consonant devoicing; and (c) feature contrast processes, which include stopping, gliding of fricatives, affrication, fronting, denasalization, gliding of liquids, and vocalization. Although some variability exists, the

developmental sequences of phonological process deviations listed by each author are in basic agreement. For example, Hodson, Kahn-Lewis, and Weiner agree that deletion of final consonants (prevocalic singleton omission), syllable reduction, and prevocalic voicing (initial voicing) are all produced early in phonological development. These developmental sequences also have implications for the course of articulation treatment.

Grunwell (1983) has identified various phonological process deviations and listed their approximate sequence in development (Figure 1). Shriberg and Kwiatkowski (1980) stated that between the ages of 1 and 4 years all phonological processes disappear except for a few residual occurrences. Table III represents process deviations that disappear by the age of 3 and process deviations that persist beyond age 3 as reported by Stoel-Gammon and Dunn (1985).

	2;0-2;6	2;6-3;0	3;0-3;6	3;6-4;0	4;0-4;6	4;6-5;0	5;0-
Weak syllable deletion							
Final consonant deletion							
Reduplication							
Consonant harmony							
Cluster reduction (initial) obstruent + approximant							
/s/ + consonant							
Stopping							
/t/							
/v/							
/θ/							
/ð/							
/s/							
/z/							
/tʃ, dʒ/							
Fronting /k, g, ŋ/							
Gliding /r/ → [w]							
Context-sensitive voicing							

Figure 1. Chronology of phonological processes (From Grunwell, P.: Clinical Phonology, Rockville, MD, Aspen Systems Corporation, 1983, p. 183).

TABLE III

Processes Disappearing by 3-0
and Persisting Beyond 3-0

Disappearing	Persisting
Unstressed syllable deletion	Cluster reduction
Final consonant deletion	Epenthesis
Doubling	Gliding
Diminutization	Vocalization
Velar fronting	Stopping
Consonant assimilation	Depalatalization
Reduplication	
Prevocalic voicing	

PHONOLOGICAL PROCESS ANALYSIS

In the early 1970's Ingram (1974) was interested in what was occurring when a child begins acquiring articulatory patterns. He suggested that it is necessary to look at the rule system of the child's phonological development, and his research contributed to the development of phonological process analysis.

As stated previously, a phonological process deviation is a regularly occurring deviation from a standard adult speech pattern. It is a descriptive rule or statement which accounts for errors of substitution, omission, and addition (Elbert and Geirut, 1986). In this type of analysis the child is viewed as attempting to produce all segments of the adult target, but for reasons related to immature motor,

cognitive, perceptual, or linguistic capabilities, the child simplifies the adult target (Elbert and Geirut, 1986).

A number of tests have been developed to describe these rule-governed process deviations. While each test differs in several respects, most of them are based on Stampe's (1969a) theory of natural phonology. According to Stampe (1969b) who first described these natural patterns or processes, there are certain innate tendencies to simplify speech production. Stampe (1969c) stated that the child's pronunciation is derived from his or her "mental representation" of adult speech. For example, Stampe (1972) stated that the process of depalatization "eliminates the fronted and raised tongue posture of / $\int$, 3/ in favor of a more neutral posture of alveolars /s, z/."

The PPA is an analysis procedure, without norms, for assessing the speech of unintelligible children ranging from 2 to 5 years. Approximately twenty process deviations are elicited using action pictures. Responses are elicited in single words and phrases. Each child's utterance is then transcribed and scored in the + or - column for the presence or absence of a phonological process deviation.

Another test, Shriberg and Kwiatkowski's (1980) NPA is different from most of the phonological process analyses. Instead of naming responses, a spontaneous speech sample is obtained from the child and only eight "natural" process deviations, i.e., final consonant deletion, velar fronting,

stopping, palatal fronting, liquid simplification, assimilation, cluster reduction, and syllable deletion, are analyzed. Scoring involves "coding" (identifying the processes) the words that are transcribed. Three coding sheets exist. Sheet A includes words containing nasals, glides, and liquids; sheet B is for oral stop consonants; and sheet C, for fricatives and affricates. This test is also without norms.

Ingram's (1981) Procedures for the Phonological Analysis of Children's Language consists of four procedures including phonetic analysis, analysis of homonymy, substitution analysis, and phonological process analysis. Phonological process analysis only will be discussed here. This procedure involves obtaining a speech sample and then calculating the percentage of occurrence of twenty-seven phonological process deviations (Table II). Ingram's analysis is without norms.

The KLPA is a phonological analysis in which the Goldman-Fristoe Test of Articulation (Goldman and Fristoe, 1969) is utilized. Responses are then transcribed on a score sheet for the KLPA which identifies twelve developmental and three nondevelopmental phonological process deviations. The KLPA does have developmental norms ranging from 2-0 to 5-11.

The APP-r is an analysis which obtains fifty elicited responses from a child naming three-dimensional objects.

The responses are transcribed and scored according to the percentage of occurrence of ten basic phonological process deviations and this test does not have norms. The Computer Analysis of Phonological Processes (CAPP) also developed by Hodson (1985) can be used to analyze the fifty responses. A one-page printout gives the percentage of occurrence for ten phonological process deviations, a phonological deviancy score, and one or more goal statements.

SUMMARY

A number of approaches exist in analyzing the speech of children. The most current analysis method is phonological process analysis.

Studies have been conducted using phonological process analyses of delayed articulation among children. Few studies have been conducted regarding normal development of phonological process usage. Those studies that have been conducted suggest more research needs to be done in order to determine at what ages phonological process deviations occur. some research in this area is in progress.

Since most phonological process tests are without norms, further research in this area is warranted. The APP-r by Hodson is one such test and will be the focus of this study.

CHAPTER III

METHODS AND PROCEDURES

METHODS

Subjects

Subjects were selected from preschools in the Portland, Oregon, metropolitan area. Fifty children aged 3 years to 5 years participated as subjects in the study. Of these subjects, ten children were chosen for each of five age groups: 3, 3-6, 4, 4-6, and 5.

The subjects met the following criteria:

1. The parent or guardian signed a release form giving permission to participate in the study (Appendix B).
2. The child was within ± 2 months of his/her designated chronological age group at the time of testing.
3. The child had no history of speech and/or language problems as reported by the parent.
4. The child had no history of chronic middle-ear infections as reported by the parent.
5. The child had no mental or neurological handicaps as reported by the parent and/or teacher.
6. The child passed a unilateral, pure tone audiometric screening test administered at 25dB HL for the frequencies of 500, 1000, 2000, and 4000 Hz.

Instrumentation

The Assessment of Phonological Processes - Revised (APP-r) by Hodson (1986) in conjunction with the Computer Analysis of Phonological Processes (CAPP) developed by Hodson (1985) is an instrument to evaluate a child's phonological skills. The test consists of fifty target words which are elicited as the child chooses and names three-dimensional objects. Hodson (1986) suggests that the examiner tape record the utterances for increased accuracy in transcribing. The utterances are transcribed and then examined to identify deviations between the child's productions and the adult target forms. These deviations are described according to the type of patterns or phonological process deviations that are exhibited. Phonological process deviations analyzed by the CAPP include syllable reduction, prevocalic singleton omission, postvocalic singleton omission, consonant sequence reduction, strident deviation, velar deviation, liquid (l) and liquid (r) deviations, nasal deviation, and glide deviation (Appendix D).

PROCEDURES

Test Administration

The screening and testing was performed at the preschools of the individual subjects. Each potential subject was brought into a quiet, well-lit room. The

investigator engaged the subject in conversation to establish rapport. Following conversation, audiometric screening was completed prior to administration of the APP-r. If the subject met selection criteria, the APP-r was administered.

During the testing situation, the subject and investigator were seated on the floor facing each other. The investigator emptied a box of fifty three-dimensional objects which represented the fifty target words. The investigator instructed the child to choose an object, name it, and put it in the box. She used verbal (social) reinforcement as necessary to keep the child on task. If the child said the wrong word, said "I don't know," or did not name an item spontaneously, the investigator said the stimulus word and then instructed the child to say the name of the stimulus word. Ideally, conversation was included before the child named the object. The investigator repeated the words after the child in the event of any unintelligible words. All responses were tape recorded. Misproductions were noted on the APP-r response form during the test situation (Appendix C).

Reliability

A random selection of five audiotapes, one from each age group, were transcribed and scored using the CAPP by two speech-language pathology graduate students. A Pearson Product Moment Correlation Coefficient (r) was computed to

examine interjudge reliability between the graduate students and investigator. Interjudge reliability among the judges and the investigator ranged from .93 to .99.

DATA MEASUREMENT AND ANALYSIS

Each subject's responses were transcribed and tape recorded on location. The APP-r manual guidelines for transcribing were followed. The CAPP was then used to score each child's responses. Symbols representing each child's response were typed into the computer. A one-page printout of the percentage of occurrence scores for ten phonological process deviations, a phonological deviancy score, and a goal statement was provided by the computer analysis program for each subject (Appendix D). The fifty target words of each subject were then analyzed using the CAPP to determine the percentage of occurrence of ten basic phonological process deviations including syllable reduction, prevocalic singleton omission, postvocalic singleton omission, consonant sequence reduction, strident deviation, velar deviation, liquid (l) and liquid (r) deviations, nasal deviation, and glide deviation. In addition, a one-way analysis of variance was computed to determine if a statistical difference among age groups existed in both the number and type of phonological process deviations observed. The Introductory Statistics Program for the Apple IIe Computer (Elzey, 1984) was used to analyze the data. An

alpha level of .05 was used in determining statistical significance.

CHAPTER IV

RESULTS AND DISCUSSION

The stated purpose of this study was to obtain normative data for the APP-r scores of children ranging from 2-10 to 5-2 years. The first question posed was: Do normally developing children exhibit phonological process deviations? The normal developing children ages 2-10 to 5-2 years in this study did exhibit phonological process deviations. Figures 2, 3, and 4 show the number of children from each age group that exhibited some of the ten basic phonological process deviations. Thirty-nine of the fifty subjects in this study exhibited at least one of the ten basic phonological process deviations. Eleven subjects did not exhibit any process deviations. The number of phonological process deviations produced by all children ranged from zero to eight, with a mean number of 3.24 and a standard deviation of 2.68 (Table IV).

All children in the 3-year-age group exhibited at least two basic phonological process deviations. The most frequently occurring phonological process deviations produced by this age group were consonant sequence reduction, strident deviation, liquid /l/, and liquid /r/.

Eight of ten subjects exhibited these four process deviations.

Figure 2. Number of Subjects Exhibiting Each Phonological Process Deviation

Figure 3. Number of Subjects Exhibiting Each Phonological Process Deviation

Figure 4. Number of Subjects Exhibiting Each Phonological Process Deviation

TABLE IV

x, SD, AND RANGE OF THE NUMBER OF PHONOLOGICAL
PROCESS DEVIATIONS EXHIBITED BY ALL CHILDREN

Age	n	$\bar{x}$	SD	Range
2-10 to 5-2	50	3.24	2.68	0 to 8

Seven subjects in the 3-6 year age group exhibited at least one basic phonological process. Strident deviation was the most frequently occurring process deviation in this age group. Seven of ten subjects exhibited strident deviation.

Nine subjects in the 4-year age group produced at least one basic phonological process deviation. The most frequently produced process deviations were strident deviation and consonant sequence reduction. Six of ten subjects exhibited these process deviations.

Six subjects in the 4-6 year age group produced phonological process deviations. Liquid /l/ deviation was the most frequently occurring process with five of ten subjects exhibiting this deviation.

Seven subjects in the 5-year age group exhibited some phonological process deviations. Liquid /r/ and strident deviations were the most frequently occurring process deviations. Only four of ten subjects exhibited these two process deviations.

The second question posed was: What is the frequency of occurrence of each phonological process deviation by age group (Table V)? Figures 5, 6, and 7 show the average percentage of occurrence of each phonological process deviation among age groups. Liquid /l/ deviation resulted in the highest percentage of occurrence among the 3-0, 3-6, and 4-0 year-old age groups. Liquid /r/ deviation resulted in the highest percentage of occurrence among the 4-6 and 5-0 year-old age groups.

TABLE V
MEAN PERCENTAGE OF THE FREQUENCY OF OCCURRENCE
OF EACH PROCESS DEVIATION BY AGE GROUP

PROCESS DEVIATION	AGE				
	3-0	3-6	4-0	4-6	5-0
Syllable Reduction	3.7	1.1	2.1	1.6	.5
Prevocalic Singleton Omission	1.1	0	0	0	.2
Postvocalic Singleton Omission	1.2	1.5	0	0	0
Consonant Sequence Reduction	20	12.6	4.8	1.6	.3
Strident Deviation	16.7	15.5	18.1	7.5	4.5
Velar Deviation	12.3	3.7	1.4	0	0
Liquid /l/ Deviation	44.6	27.3	24.6	21.8	9.1
Liquid /r/ Deviation	35.7	11.9	21	37.5	18.1
Nasal Deviation	2.7	.5	.5	.5	0
Glide Deviation	21	5	3	1	4

Figure 5. Average Percentage of Occurrence of Each Phonological Process Deviation

Figure 6. Average Percentage of Occurrence of Each Phonological Process Deviation

Figure 7. Average Percentage of Occurrence of Each Phonological Process Deviation

Prevocalic singleton omission, postvocalic singleton omission, and nasal deviation were rarely produced among all age groups. The average percentage of occurrence of phonological process deviation produced by all children ranged from 0 to 35 with a mean of 8.46 and a standard deviation of 8.69 (Table VI).

TABLE VI

$\bar{x}$, SD, AND RANGE OF THE AVERAGE PERCENTAGE OF
POSSIBLE PHONOLOGICAL PROCESS DEVIATIONS
PRODUCED BY ALL CHILDREN

Age	n	$\bar{x}$	SD	Range
2-10 to 5-2	50	8.46	8.69	0 to 35

The third question posed was: Does the number of phonological process deviations decrease as age increases? The mean number of phonological process deviations for the 3-0, 3-6, 4-0, 4-6, and 5-0 year-old age groups were 5.7, 3.6, 3.0, 2.0, and 1.7, respectively (Table VII).

TABLE VII

X, SD, AND RANGE OF THE NUMBER OF PHONOLOGICAL
PROCESS DEVIATIONS EXHIBITED BY
EACH AGE GROUP

Age Group	n	$\bar{x}$	SD	Range
2-10 to 3-2	10	5.7	2.45	0 to 8
3-4 to 3-8	10	3.6	2.37	0 to 8
3-10 to 4-2	10	3.0	2.36	0 to 6
4-4 to 4-8	10	2.0	1.70	0 to 6
4-10 to 5-2	10	1.7	1.70	0 to 4

A one-way analysis of variance comparing the number of phonological process deviations for each age group yielded an f-ratio of 4.502, which is significant at the .05 level (Table VIII). This indicates that as age increases, the number of phonological processes produced decreases.

The fourth question posed was: Does the average total frequency of occurrence of phonological process deviations decrease as age increases? The mean percentage of phonological process deviations for the 3-0, 3-6, 4-0, 4-6, and 5-0 year-old age groups were 15.8, 8.0, 7.6, 7.3, and 3.6, respectively (Table IX). A one-way analysis of variance comparing the average percentage of possible phonological process deviations for each age group yielded an f-ratio of 3.088, which is significant at the .05 level (Table X). This indicates that as age increases, the percentage of phonological process deviations also decreases.

TABLE VIII
ONE-WAY ANALYSIS OF VARIANCE COMPARING
THE NUMBER OF PHONOLOGICAL PROCESSES
PRODUCED FOR AGE GROUPS

Source	SS	MS	df	f	p
Between Groups	100.920	25.230	4	4.502	.01*
Within Groups	252.200	5.604	45		

*Significant at p .05.

TABLE IX
x, SD, AND RANGE OF THE AVERAGE PERCENTAGE
OF POSSIBLE PHONOLOGICAL PROCESS
DEVIATIONS FOR EACH AGE GROUP

Age Group	n	$\bar{x}$	SD	Range
2-10 to 3-2	10	15.8	11.60	1 to 35
3-4 to 3-8	10	8.0	7.80	0 to 25
3-10 to 4-2	10	7.6	5.46	0 to 15
4-4 to 4-8	10	7.3	7.79	0 to 20
4-10 to 5-2	10	3.6	6.08	0 to 19

TABLE X
ONE-WAY ANALYSIS OF VARIANCE COMPARING
THE AVERAGE PERCENTAGE OF POSSIBLE
PHONOLOGICAL PROCESS DEVIATIONS FOR
AGE GROUPS

Source	SS	MS	df	f	p
Between Groups	797.920	199.480	4	3.088	.025*
Within Groups	2906.500	64.589	45		

*Significant at p .05

DISCUSSION

Normally developing children in this study exhibited phonological process deviations. Thirty-nine of fifty children ranging from 2 to 5-2 years exhibited phonological process deviations. The process deviations of consonant sequence reduction, strident deviation, and liquid /l/ deviation most frequently occurred in the 3, 3-6, and 4-year old children. Liquid /r/ deviation was prominent in the 4-6 and 5-year age groups. Nasal deviations and prevocalic singleton omissions were rarely produced across all age groups.

Liquid /l/ and /r/ deviations (includes gliding) and consonant sequence reduction (or cluster reduction) were analyzed in this study. These process deviations persisted beyond the age of three, which duplicates with the results of Stoel-Gammon and Dunn (1985) as shown in Table III.

Postvocalic singleton omission (or final consonant deletion) was also analyzed in this study. The results of this study did not agree with Stoel-Gammon and Dunn (1985). In this study postvocalic singleton omission was exhibited among the 3, 3-6, and 4-6 year age groups. Stoel-Gammon and Dunn (1985) show that this process disappears by age 3; children in this study produced this process deviation less than four percent in these age groups.

The results of this study agree with the developmental sequence listed by Hodson and Paden (1983), Kahn and Lewis (1985), and Weiner (1979). For example, deletion of final consonants (postvocalic singleton omission) and syllable reduction were rarely exhibited by subjects in this study. Hodson, Kahn and Lewis, and Weiner consider these process deviations early developing. The subjects in this study are not early developing. Subjects younger than 3 years would be expected to exhibit these process deviations. Strident deviations and liquid deviations were common among all age groups in this study. Hodson, Kahn and Lewis, and Weiner consider these process deviations later developing.

The frequency of occurrence of each phonological process deviation varied across age groups. Liquid /l/ deviation resulted in the highest percentage of occurrence among the 3, 3-6, and 4-year age groups. Liquid /r/ deviation resulted in the highest percentage of occurrence among the 4-6 and 5-year age groups. Syllable reduction,

prevocalic singleton omission, postvocalic singleton omission, and nasal deviation occurred only 5 percent or less within all age groups. The percentage of occurrence of liquid /r/ and liquid /l/ minimally decreased and persisted throughout all age groups.

As previously stated, Grunwell (1983) has listed a chronology of most commonly occurring phonological process deviations in children's speech development and their approximate age of mastery (Figure 1). Comparing this list with the results of this study reveals similarities in speech development. According to Grunwell, final consonant deletion disappears by 3-3 to 3-6 years of age. The results of this study agreed with Grunwell's findings. Cluster reduction disappears approximately by age 4-0 as stated by Grunwell. In this study, consonant sequence or cluster reduction was still present at 4-6; however, the percentage of occurrence among children in this age group was less than 5 percent. Grunwell also stated that gliding of liquids may persist until 4-0 to 5-0 years. The results of this study are in agreement with Grunwell. Liquid /l/ and liquid /r/ deviations persisted throughout all age groups.

The number of phonological process deviations decreased as age increased in this study. The results reveal a statistically significant difference when the number of process deviations produced at each age group is compared (Table VIII). A significant decrease in the number

of phonological process deviations exhibited occurred at the 4-6 year level. For example, consonant sequence reduction and strident deviation occurred in eight subjects among the 3-year-old group and in only three subjects in the 4-6 year-old group. Velar deviation occurred in six subjects in the 3-year-old group and in no subjects in the 4-6 year-old group. Glide deviation occurred in seven subjects in the 3-year old group and in only one subject in the 4-6 year-old group.

The average total frequency of occurrence of phonological process deviations also decreased as age increased in this study. This study's results reveal a significant difference when the average percentage of occurrence of all phonological process deviations is compared across age groups. The 5-year-old group produced less than 10 percent of all possible process deviations except for liquid /r/ (Figures 5, 6, and 7). There was a dramatic decrease in the mean percentage of occurrence of phonological process deviations between 3-0 and 5-0 years (Table VIII). A significant decrease between 4-6 and 5-0 years also resulted.

The most frequently occurring phonological process deviation across all age groups was liquid (l) and the least frequently occurring process was prevocalic singleton omission (Table XI).

TABLE XI
 PHONOLOGICAL PROCESS DEVIATIONS IN ORDER
 OF FREQUENCY OF OCCURRENCE

Phonological Processes	% of Frequency of Occurrence
Liquid /l/	25.48
Liquid /r/	24.64
Strident Deviation	12.46
Consonant Sequence Reduction	7.92
Glide Deviation	6.80
Velar Deviation	3.48
Syllable Reduction	1.80
Nasal Deviation	.84
Postvocalic Singleton Omission	.60
Prevocalic Singleton Omission	.26

In summary, the mean numbers of phonological process deviations exhibited across age groups indicate a significant difference. As age increased the number of process deviations decreased. In addition, the percentage of occurrence of possible phonological process deviations exhibited across age groups differed significantly. As age increased the percentage of occurrence decreased. Although the number of subjects in this study is limited, the results of this study indicate that normative data can be obtained.

CHAPTER V

SUMMARY AND IMPLICATIONS

Various methods of speech diagnosis have been developed arising from a need for speech-language pathologists to analyze articulation errors. Current attention has focused on phonological process analysis. This approach analyzes how a child simplifies an adult target form of a word.

Much of the research concerning phonological processes has focused on disordered articulation and various methods of analysis. Little research has been conducted on normal development. As a result, most phonological process tests are without norms. The Assessment of Phonological Processes - Revised (APP-r) developed by Hodson (1986) is one test of phonological process analysis and is without norms. The purpose of this study was to obtain normative data for children ranging from 3 to 5 years of age on their use of phonological process deviations as measured by the APP-r. The questions this study sought to answer were: Do normally developing children exhibit phonological process deviations; what is the frequency of occurrence of each phonological process deviation by age group; and does the number of phonological process deviations and the average total

frequency of occurrence of phonological process deviations decrease as age increases?

Fifty subjects, ages 2-10 to 5-2 years participated in this study. Subjects were from preschools in the Portland metropolitan area.

The mean numbers of phonological process deviations exhibited by the 3, 3-6, 4, 4-6, and 5-year age groups were 5.7, 3.6, 3.0, 2.0, and 1.7, respectively. The mean percentage of all phonological process deviations exhibited for each age group were 15.8, 8.0, 7.6, 7.3, and 3.6, respectively. A one-way analysis of variance revealed a statistically significant difference at the .05 level when the number of ten basic process deviations exhibited was compared across age groups. In addition, a one-way analysis of variance comparing the average percentage of all phonological process deviations exhibited across age groups was statistically significant at the .05 level. As age increased, the use of phonological processes decreased.

The results of this study reveal that as age increases, the number of process deviations decrease. In addition, the average percentage of process deviations decrease as age increases. Liquid /l/, and liquid /r/, and strident deviations were most commonly exhibited across all age groups and prevocalic singleton omission, postvocalic singleton omission, and nasal deviation were rarely exhibited across all age groups. Although the number of

subjects that participated in this study is limited, information gathered may be helpful in assessing disordered articulation with knowledge of expected performance.

IMPLICATIONS

Research

Further research regarding phonological process development is warranted. A replication of this study could be conducted using a larger sample size, which would result in a more representative sample. In addition, other phonological process deviations beyond the ten basic phonological process deviations could be analyzed in this study.

Research using younger or older children could be conducted in order to obtain an overall description across ages. Other phonological process analyses could be utilized to assess a subject's normal speech development. For example, some phonological analyses utilize a spontaneous speech sample, as opposed to the single naming of words used here. Research could specify the differences that may exist between the two methods.

Particular emphasis on normal speech development at one-age level could also be investigated.

Clinical

Results of the current study may help to provide a framework for phonological process development. Normative data can be helpful in assessing whether a child's speech may be delayed or disordered. Grunwell (1983) states that early process deviations are usually exhibited in child speech disorders and that many of the patterns are similar to those observed in normal speech development. This suggests that a child who continues to produce developmental phonological process deviations could be identified using a framework on normative phonological process development.

Results from this study may serve in planning remediation with articulation disordered children. Most studies have been concerned with reporting the differences among normal and articulation disordered or normal and language disordered children. The results of this study are focused solely on normal developing children and add to the existing literature in creating a basic foundation regarding normal phonological speech development.

REFERENCES

- CHOMSKY, N., and HALLE, M. (1968). The sound pattern of English. New York, NY: Harper and Row.
- COMPTON, A.J. and HUTTON, J.S. (1978). Compton-Hutton phonological assessment. San Francisco, CA: Carosel House.
- EDWARDS, M.L. (1973). The acquisition of liquids, working papers in linguistics. In Edwards, M.L. and Shriberg, L.D., Phonology applications in communicative disorders. San Diego, CA: College-Hill Press.
- ELBERT, M. and GIERUT, J.A. (1986). Handbook of clinical phonology approaches to assessment and treatment. San Diego, CA: College-Hill Press.
- ELZEY, F.F. (1985). Introductory statistics: a microcomputer approach. Monterey, CA: Brooks/Cole Publishing.
- GOLDMAN, R., and FRISTOE, M. (1969). Goldman-Fristoe test of articulation. Circle Pines, MN: American Guidance Press.
- GRUNWELL, P. (1983). Clinical phonology. Rockville, MD: Aspen systems Publication.
- HAELSIG, P. and MADISON, C.L. (1986). A study of phonological processes exhibited by 3-, 4-, and 5-year old children. Language, Speech, and Hearing Services Schools, 17, 107-114.
- HODSON, B.W. (1986). The assessment of phonological processes - revised. Danville, IL: Interstate Printers and Publishers.
- HODSON, B.W. (1985). Computer analysis of phonological processes. Stonington, IL: Phonocomp.
- HODSON, B.W. and PADEN, E.P. (1981). Phonological processes which characterize unintelligible and intelligible speech in early childhood. Journal of Speech and Hearing Disorders, 46, 369-373.

- HODSON, B.W. and PADEN, E.P. (1983). Targeting intelligible speech. San Diego, CA: College-Hill Press.
- INGRAM, D. (1974). Phonological rules in young children. Journal of Child Language, 1, 49-64.
- INGRAM, D. (1981). Procedures for the analysis of children's language. Baltimore, MD: University Park Press.
- KAHN, L.M. (1985). Basis of phonological analysis: a programmed learning text. San Diego, CA: College-Hill Press.
- KAHN, L.M. and LEWIS, N. (1985). Kahn-Lewis phonological analysis. Circle Pines, MN: American Guidance Service.
- LEONARD, L.B., MILLER, J.A. and BROWN, H. (1980). Consonant and syllable harmony in the speech of language disordered children. Journal of Speech and Hearing Disorders, 45, 336-345.
- OLLER, D.K. (1973). Regularities in abnormal child phonology. Journal of Speech and Hearing Disorders, 38, 36-47.
- PREISSER, D. (1983). Unpublished doctoral dissertation, San Diego State University, CA.
- SCHWARTS, R.G., LEONARD, L.B., FOLGER, K.M., and WILCOX, M.J. (1980). Early phonological behavior in normal-speaking and language-disordered children: Evidence for a synergistic view of linguistic disorders. Journal of Speech and Hearing Disorders, 46, 197-204.
- SHRIBERG, L.D. and KWIATKOWSKI, J. (1980). Natural process analysis (NPA): a procedure for phonological analysis of continuous speech samples. New York, NY: John Wiley and Sons.
- SMITH, N.V. (1973). The acquisition of phonology: a case study. In Edwards, M.L. and Shriberg, L.D., Phonology applications in communicative disorders. San Diego, CA: College-Hill Press.
- STAMPE, D. (1969a). The acquisition of phonetic representation, Papers from the fifth regional meeting of the Chicago Linguistic Society. In Elbert, M., and

Gierut, J.A., Handbook of clinical phonology approaches to assessment and treatment. San Diego, CA: College-Hill Press.

STAMPE, D. (1969b). The acquisition of phonetic representation, Papers from the fifth regional meeting of the Chicago Linguistic Society. In Kahn, L.M., Basis of phonological analysis: a programmed learning text. San Diego, CA: College-Hill Press.

STAMPE, D. (1969c). The acquisition of phonetic representation, Papers from the fifth regional meeting of the Chicago Linguistic Society, (pp443-454). In Edwards, M. and Shriberg, L., Phonology applications in communicative disorders. San Diego, CA: College-Hill Press.

STAMPE, D. (1972). How I spent my summer vacation. In Edwards, M.L., and Shriberg, L., Phonology applications in communicative disorders. San Diego, CA: College-Hill Press.

STOEL-GAMMON, C. and DUNN, C. (1985). Normal and disordered phonology in children. Baltimore, MD: University Park Press.

WEINER, F.F. (1979). Phonological process analysis. Baltimore, MD: University Park Press.

WEISS, C.E., GORDON, M.E., and LILLYWHITE, H.S. (1987). Clinical management of articulatory and phonologic disorders. Los Angeles, CA: Williams and Wilkins.

APPENDIX A

PHONOLOGICAL PROCESS DEFINITIONS

Affrication: occurs when an affricate replaces a fricative (e.g., /tsʌn/ for "sun").

Articulatory Shifts: processes in which there are "minimal shifts" in place of articulation (e.g., frontal lisp).

Backing: occurs when a target sound is replaced with another sound whose place of articulation is posterior to it (e.g., /go/ for "toe").

Coalescence: the use of one consonant which shares the features of two consonants of a cluster (e.g., /ten/ for "plane").

Deaffrication: process of replacing an affricate with a nonaffricate (e.g., /ʃtʃ/ for "chair").

Depalatization: occurs when a palatal consonant is replaced by a nonpalatal (e.g., /mæs/ for "mash").

Diminuization: process of adding an /i/ or consonant plus /i/ to a word (e.g., /dagi/ for "dog").

Doubling: process of repeating a word (e.g., /baba/ for "ball").

Epenthesis: refers to the addition of a vowel to a word (e.g., /bəlæk/ for "black").

Fronting: occurs when a target phoneme is replaced with another sound whose place of articulation is anterior to it (e.g., /tau/ for "cow").

Gliding: use of a glide (/w,j/) for another consonant (e.g., /wen/ for "rain").

Glottal Replacement: process of substituting a glottal stop for a consonant (e.g., /bæ / for "bath").

Neutralization: occurs when several different phonemes are replaced by one sound (e.g., /jun/ for "sun" and /ju/ for "juice").

Metathesis/Migration: process of reordering or reversing a word (e.g., / - lənt/ for "elephant").

Prevocalic Voicing: refers to voicing an unvoiced consonant when it precedes a vowel (e.g., /big/ for "pig").

Postvocalic Voicing: changing a voiced obstruent at the end of a word to a voiceless obstruent (e.g., /liv/ for "leaf").

Stopping: occurs when fricatives, affricates, liquids, and glides are replaced by stops (e.g., /kit/ for "kiss").

Syllable Harmony: refers to the repetition of all or part of a syllable (e.g., /nudu/ for "noodle").

Vocalization: process in which a vowel is substituted for a syllabic consonant (e.g., /kau/ for "car").

Weak Syllable Deletion: occurs when the unstressed syllable of a multisyllabic word is omitted (e.g., /teto/ for "potato").

APPENDIX B

COLLEGE OF
GENERAL ARTS AND SCIENCES

DEPARTMENT OF
SPEECH COMMUNICATION
SPEECH AND
HEARING SCIENCES

PORTLAND
STATE
UNIVERSITY
P.O. BOX 751
PORTLAND, OREGON
97207
503/229-3533

Dear Parent or Guardian,

I am a graduate student at Portland State University in the Department of Speech Communication. Under the direction of Mary E. Gordon, Associate Professor, I am conducting a study on normal speech development in children ages three years to five years. This information will help speech-language clinicians identify and provide services to preschoolers and school-aged children who need speech intervention.

If your child participates in this study, he/she will be given a brief hearing screening and a test in which he/she will name toys and objects. Your child will be naming toys and objects because we want to observe how children pronounce words at this age. The testing session will last approximately 20 minutes. During the naming activity, your child will be tape recorded. Your child's name will not be used in reporting the results and audio tapes will be used only for a research study. You may withdraw your child at any time without consequence.

In addition to the testing session for your child, the study involves your completing a brief questionnaire regarding your child's speech and language development and medical history. Please complete this attached form and indicate your approval for your child to participate in this study and return it to the school as soon as possible.

Please call me if you have any questions (home - 653-9829 or school - 229-3533). Thanks for your cooperation.

If you have any problems that are the result of your participation in this study, please contact Robert Tinnin, Office of Graduate Studies and Research, 105 Neuberger Hall, Portland State University at 229-3423.

Sincerely,

Lori J. Griffith

PERMISSION FORM

CHILD'S NAME: _____

BIRTHDATE: _____ AGE: _____

1. Has your child had a history of speech and/or language problems? yes____ no____
2. Has your child had a history of ear infections?
yes____ no____
3. Has your child ever been diagnosed as demonstrating any of the following:

neurological impairment yes____ no____

mental retardation yes____ no____

developmental delay yes____ no____

I hereby give my permission for my child, _____
_____ to participate in this study. My
child may participate in a hearing screening and a speech
testing session at the Helen Gordon Child Development
Center.

I will complete the questionnaire and I understand that I
may withdraw my permission at any time during this study
without consequence.

SIGNATURE_____
RELATIONSHIP_____
DATE

APPENDIX C

THE ASSESSMENT OF PHONOLOGICAL PROCESSES—Revised
Barbara Williams Hodson

Name _____ Birthdate _____ Date _____ Examiner _____

1. basket 'bæskɪt	11. feather 'feðə	21. jump rope 'dʒʌmp,roup	31. Santa Claus 'sæntə,kloʒ	41. string striŋ
2. boats bəʊts	12. fish fɪʃ	22. leaf li:f	32. screwdriver 'skru,draɪvə	42. sweater 'swetə
3. candle 'kændl	13. flower 'flaʊwə	23. mask mæsk	33. shoe ʃu	43. television 'telə,vɪzən
4. chair tʃeə	14. fork fɔ:k	24. mouth maʊθ	34. slide slaɪd	44. thumb θʌm
5. cowboy hat 'kaʊbɔɪ,hæt	15. glasses 'glæsɪz	25. music box 'mjuzɪk,baks	35. smoke smouk	45. toothbrush 'tuθ,braʃ
6. crayons 7. three 8. black 9. green 10. yellow 'kreɪənz θri blæk grɪn 'jeɪləv	16. glove glʌv	26. nose noʊz	36. snake sneɪk	46. truck trʌk
	17. gum gʌm	27. page peɪdʒ	37. soap soʊp	47. vase veɪs
	18. hanger 'hæŋə	28. (air)plane pleɪn	38. spoon spun	48. watch wɒtʃ
	19. horse hɔ:s	29. queen kwɪn	39. square skweə	49. yoyo 'jəʊ jəʊ
	20. ice cubes 'aɪs,kjʊbz	30. rock ræk	40. star stɑ:ə	50. zipper 'zɪpə

APPENDIX D

Name of Client:
 Date of Birth: 4-3-83
 Date of Phonological: 3-1-87
 Age in Years: 3
 Examiner's Name: LORI GRIFFITH
 Diagnostic Information:

Phonological Analysis Summary

Pattern Deviations	Percentage of Occurrence
Syllable Reduction	0
Prevocalic Singletons	5
Postvocalic Singletons	3
Consonant Sequences	15
Stridents	9
Velars	77
Liquid (l)	91
Liquid (r)	5
Nasals	0
Glides	10

Average of Phonological Processes: 22
 Phonological Deviancy Score: 22

Severity Interval: Moderate

GOAL: To increase intelligibility by facilitating emergence of the following phonological patterns:

Velars
 Liquid (l)

COMPUTER ANALYSIS of PHONOLOGICAL PROCESSES
 Barbara Williams Hodson
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