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The Use of Traditional Articulation Tests in Phonological Analysis

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THE USE OF TRADITIONAL ARTICULATION TESTS

IN PHONOLOGICAL ANALYSIS

(TITLE)

BY

TERI L. MOSER

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ABSTRACT

Phonological analysis is an established, comprehensive, and effective means of assessing the speech patterns of unintelligible children. However, many practicing speech-language pathologists have not incorporated this procedure into their diagnostic batteries and continue to use traditional articulation tests because of convenience and familiarity of the tests (Garber, 1984). If articulation tests could be modified to assess phonological simplification processes, speech-language pathologists may be more likely to use this method of speech analysis. The purpose of this study was to determine if traditional articulation tests employing a phonological analysis procedure are a valid measure of phonological simplification processes.

This study compared results obtained on two traditional articulation tests, the Goldman-Fristoe Test of Articulation (Goldman and Fristoe, 1972) and the Fisher-Logemann Test of Articulation Competence (Fisher and Logemann, 1971), with those obtained on a phonological assessment tool, the Assessment of Phonological Processes (Hodson, 1980). The articulation tests were modified to analyze the phonological simplification processes found on Hodson's test (APP). Twenty-four phonologically delayed children, eight 3-year-olds, eight 4-year-olds, and eight 5-year-olds, served as subjects. Each of the three test instruments was administered to all 24 subjects. Composite Phonological Deviancy Scores were obtained for all tests and compared statistically using the Pearson Product Moment Correlation Coefficient. Correlations comparing the two articulation tests with the APP were computed for the entire group of subjects, as well as by age groups.

Results revealed high correlations between scores obtained on the Goldman-Fristoe and the APP for all age groups and between scores obtained on the Fisher-Logemann and the APP for all age groups at the .001 level of confidence. This indicates that traditional articulation tests can be used to analyze phonological simplification processes. Additional analysis of the data revealed the following: a) agreement between the tests increased as the subjects' ages increased; and b) agreement between the tests increased when miscellaneous and assimilation process points were excluded. It was also concluded that certain factors should be considered before using a traditional articulation test for phonological analysis: a) child interest; b) administration time; c) number of items on the test and its effect on the Composite Phonological Deviancy Score; and d) adequate representation of each process by the test items. Further research examining the use of articulation tests with phonological analysis procedures and scoring methods other than Hodson's is warranted.

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CHAPTER I - INTRODUCTION

Careful examination of a child's production of speech sounds is a vital factor in the remediation of disordered phonology (Meitus and Weinberg, 1983). In order to correct a child's faulty productions, a detailed description of his/her sound system must be made and compared to cultural norms. In recent years many speech-language pathologists have begun exploring new methods of assessing children's phonology to obtain a more comprehensive, systematic description of speech sound errors.

Traditionally, speech-language pathologists have employed standard articulation tests to elicit and analyze speech sounds. Phonemes on these tests are generally examined in each of three positions in a word--initial, medial, and final. Errors are recorded as omissions, substitutions, and distortions of the target phonemes. Although traditional articulation tests are convenient, quick, and easy to use (Goldman and Fristoe, 1972), many researchers feel they are inadequate for the assessment of unintelligible children (Meitus and Weinburg, 1983), i.e. those with multiple sound errors. Arguments include the failure of these tests to consider contextual variables (Bankson and Bernthal, 1983) and their inability to examine the underlying rules and systems of abnormal speech (Compton, 1970; Oller, 1973).

Many of those who are dissatisfied with traditional articulation tests advocate the use of distinctive feature analysis. This is based on a theoretical perspective which maintains that features such as continuancy and voicing, rather than individual phonemes, are the minimal units of speech (Chomsky and Halle, 1968; Jakobson, Fant, and Halle, 1951). This type of assessment yields error features, which are shared by various phonemes. Thus, therapy focuses on an entire class of sounds which are related by the error feature. Distinctive feature analysis has not been well-received by speech-language pathologists because of its highly theoretical and abstract nature (Ingram, 1976). It involves a time-consuming and complicated procedure, which has also hampered its popularity.

A second alternative to traditional articulation tests is phonological analysis. The basis for this procedure is the belief that children acquire the phonemes of a language by suppressing phonological simplification processes (Stampe, 1969). These processes are responsible for simplifying words into more easily produced forms (e.g. /rop/ becomes /wop/). Phonological analysis involves identifying those processes which a child uses at a level significant enough to warrant remediation. Like distinctive feature theory, a phonological approach focuses on classes of phonemes, rather than individual phonemes, which leads to more efficient therapy (Hodson and Paden, 1983). However, its popularity with practicing speech-language pathologists has also been somewhat limited. Many clinicians prefer their traditional articulation tests because they are quick, convenient, and familiar (Garber, 1984).

Currently, phonological analysis appears to be the most efficient and comprehensive means of assessing children with multiple sound errors. It examines many of the variables not considered in traditional articulation tests, and is more practical and less abstract than distinctive feature analysis. How can speech-language pathologists be persuaded to employ phonological analysis when assessing unintelligible children? If traditional articulation tests, with which speech-language pathologists are familiar and comfortable, could be used as phonological assessment tools, they may be more likely to incorporate this approach into their diagnostic procedures.

Little research has been done to compare traditional articulation tests employing phonological analysis with established phonological assessment tools. The present study has attempted to establish a relationship between the two types of tests by examining the scores obtained from phonologically delayed children on both phonological and traditional tools. A secondary purpose of the study was to determine if a child's age affects the accuracy of the traditional tests employing phonological analysis. Thus, the following research questions were posed:

1. Is there a significant correlation between the scores obtained on a phonological assessment tool and those obtained from two traditional articulation tests

employing a phonological analysis procedure?

2. Does the accuracy of an articulation test employing phonological analysis vary significantly according to the age of a child?

CHAPTER II - REVIEW OF THE LITERATURE

Overview

During the past two decades speech-language pathologists have witnessed a dramatic change in the procedures used to assess children with severe articulation disorders. Prior to this time, articulation tests had been the primary means of determining errors in a child's production of sounds. These tests generally consist of a set of pictures which the child must name. Each consonant sound is targeted once in the initial, medial, and final positions of words. Incorrect productions are recorded as omissions, substitutions, or distortions of the target phonemes. However, several researchers (Bankson and Bernthal, 1983; Shriberg and Kwiatkowski, 1980) have argued that this assessment technique is not appropriate for children with unintelligible speech. As a result, the field of speech and language professionals sought to develop new approaches to assessing disordered phonology.

One of these new approaches originated in the field of linguistics. Linguists, including Jakobson, Fant, and Halle (1951) and Chomsky and Halle (1968), introduced the concept of distinctive features. They demonstrated that acoustic and articulatory features, rather than phonemes, are the minimal units of speech. Therefore, distinctive features are able to relate phonemes to one another through shared features and at the same time discriminate between them through differing features. For example, the /ʃ/ and /tʃ/ phonemes share identical features except for that of continuancy, which distinguishes them as separate phonemes. Although this construct of describing human phonology was intended as an idealized, theoretical model, researchers in the field of speech-language pathology (McReynolds and Engmann, 1975; McReynolds and Huston, 1971; Pollack and Rees, 1972) adapted distinctive feature systems to be used in the assessment of children with articulation disorders.

Another approach to assessing disordered phonology was based on a theory proposed by Stampe in 1969. This theory, termed natural phonology, describes disordered speech in terms of simplification processes. According to Stampe, children are constantly attempting to produce the adult forms of words. However, a child has a set of innate processes that simplify a word to a level at which he/she is capable of producing that word. For example, a child may say /top/ for /sop/. Natural phonology's explanation for this error is that the child utilizes the process of stopping to simplify the phonology of the word /sop/ to a more easily produced form. Ingram popularized this theory in his 1976 publication Phonological Disability in Children. Along with phonological theory came a change in terminology. Children were no longer referred to as having "multiple misarticulations" or an "articulation disorder", terms which stress motoric production of sounds. Instead, the terms "phonologically delayed" and "phonologically disordered", which stress patterns and processes, were introduced. The goal of assessment under this philosophy is to identify phonological simplification processes which have not yet been suppressed by a child, and, consequently, are still present in the child's speech.

Speech-language pathologists now have several choices of assessment procedures to use when analyzing disordered phonology. They can utilize a traditional articulation test, perform a distinctive feature analysis, or assess phonological simplification processes via a phonological analysis. Are all of these methods effective means of assessing children with disordered phonology? Are they well-suited to the needs of speech-language pathologists? A brief survey of traditional articulation, distinctive feature, and phonological assessment devices would be beneficial in addressing these questions.

Traditional Articulation Tests

Assessment Tools

Many articulation tests are available on the market today. Three of them will be reviewed briefly.

The Templin-Darley Tests of Articulation (1969). First published in 1960, this was one of the earliest standardized measures of articulation available to speech language pathologists. The diagnostic portion consists of 141 items elicited spontaneously, i.e. nonimitatively, via a picture-naming task. The first 50 items can be used as a screening test. Errors are recorded as omissions, substitutions, or distortions of the target phonemes. Included in the Templin-Darley are nine "overlays", templates which can be placed over the scoring form to examine specific groups of sounds, such as clusters or vowel groups. A 141-item sentence form is also available with the test to be used with subjects who read.

Goldman-Fristoe Test of Articulation (1972). This instrument, first printed in 1969, is comprised of three subtests: the Sounds-in-Words Subtest, the Sounds-in-Sentences Subtest, and the Stimulability Subtest. Unlike most other sentence articulation tests, the Sounds-in-Sentences Subtest contains two sets of pictures for story retelling, rather than a list of sentences to be read. Also, the Sounds-in-Words Subtest represents a departure from most other picture-naming tests because more than one phoneme is examined in each of the 44 target words. This time-saving feature, along with large, colorful pictures, was intended by the authors to maintain the interest of the child throughout the administration of the test.

The Fisher-Logemann Test of Articulation Competence (1971). This articulation test was developed to apply linguistic methodologies to the phoneme testing done by speech-language pathologists. The authors describe it as a distinctive feature analysis at a more simplified and practical level. Productions of phonemes are recorded on a grid, which is used to analyze errors in terms of three features: voicing, place of articulation, and manner of formation. The purpose of the analysis is to examine areas of commonality between error phonemes. Included in the Fisher-Logemann are a screening test, a 109-item picture-naming diagnostic test, and a sentence-reading test.

Advantages of Traditional Articulation Tests

One of the advantages of articulation tests is that there is a wide variety of standardized instruments from which to choose, most of which are readily available to speech-language pathologists (Meitus and Weinberg, 1983). Also, these assessment tools are relatively quick and convenient to administer and score (Goldman and Fristoe, 1972). Many of them provide normative data with which a child's articulation skills may be compared with the skills of normally developing children (Meitus and Weinberg, 1983).

Disadvantages of Traditional Articulation Tests

According to Bankson and Bernthal (1983), traditional articulation tests tend to ignore relationships between segments of speech and the influence of the contexts in which they occur. Eliciting each phoneme in two or three positions in a word without considering surrounding phonemes cannot provide an adequate description of unintelligible speech. Another argument against the use of traditional articulation tests stems from the works of Compton (1970) and Oller (1973), which have indicated that abnormal speech is rule-governed and systematic. These rules and systems cannot readily be examined by traditional means. As Meitus and Weinberg (1983) stated, articulation tests do not provide enough information for an accurate, comprehensive diagnosis of unintelligible speech.

Distinctive Feature Analysis

Distinctive Feature Systems

There are many distinctive feature systems described in the literature. Only a few of the more widely known systems will be described here.

Jakobson, Fant, and Halle (1951). These men published what is considered to be the pioneer work in the area of distinctive features. Their system delineates eight features to describe English consonants and three features to describe the vowels. All of Jakobson, Fant, and Halle's features are binary, meaning that they are signified by a "+" if they are present in a phoneme or a "-" if they are absent in a phoneme. For example, the nasal/oral feature would be assigned as a "+" for /m/ (nasal), but as a "-" for /p/ (nonnasal or oral). Some features are assigned as neither "+" nor "-" if they are not relevant to a particular phoneme.

Miller and Nicely (1955). The Miller and Nicely distinctive feature system represented a significant departure from the system of Jakobson, Fant, and Halle in several ways. First, Miller and Nicely utilized only five features to describe consonants rather than eight. They did not include vowels in their analysis. Secondly, they replaced the +/- notation with numbers, "1" denoting the presence of a feature and "0" denoting the absence of a feature. Also they left no consonants unspecified as to the presence or absence of a feature, indicating that each feature plays a relevant part in the perception of all consonants (Singh, 1976). Finally, Miller and Nicely departed from binary markings on their "place" feature, with "0" signifying production in the front of the mouth, "1" signifying the middle of the mouth, and "2" signifying the back of the mouth.

Chomsky and Halle (1968). These two linguists outlined a distinctive feature system that has been frequently used in clinical studies (Grunwell, 1982). They utilized thirteen binary features to describe the consonants and vowels of English. Many of the features overlap with those of Jakobson, Fant, and Halle. However, Chomsky and Halle's distinctive features were defined within a syntactic context, rather than a phonemic one. They felt that phonemes could not be regarded as autonomous units because phonetic variations can occur within varying syntactic contexts.

McReynolds and Engmann (1975). In their book

Distinctive Feature Analysis of Misarticulation, McReynolds and Engmann attempted to formally adapt distinctive features as an articulation assessment tool for speech-language pathologists. Using Chomsky and Halle's distinctive feature system, they outlined procedures for analyzing speech samples to determine features to target in therapy. Whether the speech sample is conversational or elicited via an articulation test, phonological transcription is necessary to complete the analysis. McReynolds and Engmann also recommended that the sample be large enough so that each phoneme is tested at least ten times.

Advantages of Distinctive Feature Analysis

One of the major advantages of distinctive feature analysis is that it introduced the concept of determining regularities in a child's misarticulations by identifying specific patterns of errors (Grunwell, 1982). It also suggested a functional relationship between the various properties of phonemes (McReynolds and Engmann, 1975). Therefore, by analyzing distinctive features, one could show that speech errors are not random substitutions, but a systematic alteration of the properties that discriminate phonemes. McReynolds and Bennett (1972) stated that this type of analysis could lead to more effective therapy because the features trained and subsequently acquired in one phoneme generalized to other phonemes.

Disadvantages of Distinctive Feature Analysis

The primary argument against using distinctive features to analyze speech disorders is that the systems are too abstract and idealized and therefore are not well-suited to speech-language pathologists (Leonard, 1973; Walsh, 1974). As Walsh stated, distinctive features are "primarily concerned with the system and structure of phonological oppositions rather than with the concrete manifestations of human speech." (p. 42). McReynolds and Engmann (1975) admitted that Chomsky and Halle's system is a competence model (idealized representation), not a performance model (factors that determine the actual physical signal).

There are other factors which make distinctive feature systems an inadequate means to describe misarticulations. According to Walsh (1974), the features themselves are overgeneralized and encompass more than is phonetically accurate for speech analysis. For example, in Chomsky and Halle's system, glides are classified as non-consonantal, which implies that they are produced without a constriction in the vocal tract. This does not hold true when considering the actual physical characteristics of the phonemes. Other researchers, such as Leonard (1973), claimed that binary distinctive feature systems are inadequate to describe the actual production of speech. He stated that, at the phonetic level, features cannot simply be plus or minus, but varying degrees of plus and minus. Consequently, binary systems cannot accurately account for distortions of phonemes.

Distinctive feature systems have not been well-received by practicing speech and language clinicians (Ingram, 1976). Because of the highly theoretical nature and linguistic orientation of distinctive features, many speech-language pathologists feel they are not properly trained to do such an analysis. Also, a feature analysis requires considerably more time to perform than a traditional articulation assessment. Therefore, clinical application of the distinctive feature method has been limited.

Phonological Analysis

Assessment Tools

Several instruments to examine phonological simplification processes have recently been published. Four of them will be outlined here in terms of the type and size of the speech sample needed, the processes examined, and the analysis procedures.

Phonological Process Analysis (PPA). This procedure, developed by Weiner in 1979, was the first phonological process-based assessment tool to be published. It examines sixteen processes grouped into three major categories: Syllable Structure Processes, Harmony Processes, and Feature Contrast Processes. The test consists of 136 target words obtained twice using two different methods, delayed imitation (e.g. "This is a car. Uncle Fred is driving a

_____.") and sentence recall (e.g. "What is Uncle Fred doing?"). Pictures are provided to elicit the appropriate responses. The child's productions are transcribed phonetically, recorded, and analyzed on score sheets, one sheet per process. Results are compiled on a process profile to compare the number of times a process occurred with the number of possible occurrences. Also, a column labeled "Frequency of Nontest Processes" is included on the profile to indicate additional occurrences of processes when they were not specifically being tested. Decisions regarding which processes to target in therapy are left to the discretion of the examiner.

Assessment of Phonological Processes (APP). Hodson (1980) designed this test to examine 42 phonological simplification processes. They are grouped in the following manner: Basic Processes, Miscellaneous Processes, Sonorant Deviations, Assimilations, and Articulatory Shifts. Fifty-five target words are elicited via spontaneous naming of objects or pictures. The actual items or pictures are not provided with the test, but must be compiled by the examiner. Responses are transcribed phonetically and transferred to an analysis sheet, where the occurrence of processes are tallied. Percentage-of-occurrence scores can be calculated on an analysis summary sheet for Basic Processes and Sonorant Deviations. Hodson recommended that processes occurring at a level of 40% or higher be considered as possible targets for therapy.

Natural Process Analysis (NPA). This instrument, by Shriberg and Kwiatkowski (1980), was formulated to evaluate eight natural processes. In order to be considered "natural" by the authors, a process must be a simplification of a more complex articulatory structure and be attested in a number of sound change phenomena in natural languages. Shriberg and Kwiatkowski's natural processes include Final Consonant Deletion, Velar Fronting, Stopping, Palatal Fronting, Liquid Simplification, Regressive and Progressive Assimilation, Cluster Reduction, and Unstressed Syllable Deletion. Administration of the test involves eliciting a continuous speech sample, rather than a fixed set of stimuli. A 200 to 250 word sample should be transcribed, from which 80 to 100 different words can be derived. Data is entered and analyzed on coding sheets, then condensed onto a summary sheet. Each process is assigned one of the following labels: always occurs, sometimes occurs, never occurs, or no data available. There are no numerical scores involved; consequently, suggested cutoffs for therapy are not available.

Procedures for the Phonological Analysis of Children's Language (PPACL). Phonological process analysis is only one of four analyses described in this instrument by Ingram (1981). The other three--phonetic analysis, analysis of homonymy, and substitution analysis--will not be discussed here. The process analysis involves 27 "common phonological processes" grouped into the following categories: Syllable

Structure Processes, Syllable Deletion and Reduplication, Substitution Processes, Simplification of Liquids and Nasals, Other Substitution Processes, and Assimilation Processes. Any type of speech sample may be used for analysis, and a minimum number of words is not specified. Like the other tests, phonetic transcription is required. Data are recorded on a lexicon sheet, analyzed on a phonological processes sheet, and condensed onto a summary sheet. A frequency-of-occurrence score can be calculated for each process, which is then labeled as occurring never, infrequently, frequently, or always.

Comparison of Assessment Tools

Spontaneous Versus Imitated Production. All of the tests discussed except the PPA utilize spontaneous productions of words for analysis. Weiner (1979) chose to employ delayed imitation because of low intelligibility and/or possible vocabulary deficits present in phonologically disordered children. Although many studies have compared the use of direct imitation and spontaneous naming, few have considered the effects of delayed imitation on the "trueness" of a child's productions. As Edwards (1983) concluded, the use of delayed imitation in phonological analysis should be considered questionable until further research is done.

Single Words Versus Continuous Speech. The APP requires single word responses, as does the delayed imitation portion of the PPA. The sentence recall portion of the PPA targets the desired word within a phrase or clause. Shriberg and Kwiatkowski's analysis procedures use a continuous speech sample. Although any type of speech sample is acceptable for the PPACL, Ingram stated in a later publication (1982) that he prefers continuous speech for phonological analysis. The advantages and disadvantages of both single words and continuous speech have been suggested by many researchers (Bankson and Bernthal, 1983; Ingram, 1976; Shriberg and Kwiatkowski, 1980; Stoel-Gammon and Dunn, 1985). Advantages of single-word testing include the minimal amount of time involved and a basis from which comparisons can be made if the test is readministered. However, single words may not be an accurate reflection of the child's abilities in connected speech because of the influence of surrounding words in continuous speech. Also, desired words are not always easily identifiable in pictures, and many single-word tests contain complex words that may not normally appear in a child's speech.

Proponents of continuous speech samples have argued that conversational speech provides a more valid representation of a child's phonological abilities, allows for judgement of overall intelligibility, and provides opportunities for multiple productions of sounds to examine variability in a child's speech. Disadvantages include the time required to elicit and transcribe an adequate sample, the reluctance of some children to talk, the production of unintelligible speech for which the adult model is unknown, and the difficulty in obtaining a sample that is representative of all the sounds of English. There are additional arguments and counter-arguments which are beyond the scope of this paper. Bankson and Bernthal (1983) concluded that although there are significant differences in the number of errors that occur under each condition (single words and continuous speech), use of the two methods would lead to similar clinical decisions.

Quantitative Criteria. In a study by McReynolds and Elbert (1981), it was concluded that quantitative criteria for the identification of phonological simplification processes are necessary. When minimum criteria were imposed, the number of processes present, i.e. considered significant, in their subjects was reduced. Hodson (1980) provided the 40% figure as the suggested cutoff for remediation. Ingram (1981) arranged percentages on a frequency-of-occurrence continuum, but did not suggest a specific cutoff. Although the PPA also yields percentage scores, no additional guidelines for determining which processes to remediate are given. The NPA classifies processes into always, sometimes, or never occurring, but again does not specify a level at which a process is significant.

Processes Examined. It is obvious from the brief reviews of the four assessment tools that the types and numbers of processes examined in each are quite varied.

There is no research that indicates the optimal number and types of simplification processes that should be examined. Although each test has its own set of processes, all of the authors encourage the examiner to identify additional or idiosyncratic patterns that are not specifically outlined.

Time. Paden and Moss (1985) conducted a study comparing the APP, NPA, and PPACL. One of the variables examined was the time required for analysis, which included collection of the speech sample and the actual analysis and paper work. Average times for each test were as follows: PPACL--3 hours, 46 minutes; NPA--2 hours, 1 minute; APP--59 minutes. Although the PPA was not included in this study, Weiner (1979) stated that it can be performed in approximately 45 minutes with a cooperative child.

Advantages of Phonological Analysis

Like distinctive features, a phonological approach to speech analysis observes the regularities of disordered speech. It also examines the contexts in which errors occur to account for variability in phonemic productions. Phonological analysis not only provides rules to describe disordered speech, but also outlines processes to explain the occurrence of the rules. In addition, although linguistically based, phonological theory is better equipped to describe disordered speech than distinctive feature systems (Ingram, 1976). Because it employs articulatory, rather than linguistic terminology, it provides a more physiologically precise description of errors and therefore can be more readily understood by speech and language clinicians. Another advantage is that the therapy procedures associated with phonological analysis appear to be more efficient than traditional sound-by-sound remediation (Hodson and Paden, 1983).

Disadvantages of Phonological Analysis

A major disadvantage of phonological analysis is that it can be as time-consuming as distinctive feature analysis. Also, Garber (1984) reported that many clinicians continue to use traditional articulation procedures even though these methods cannot be as comprehensive as a phonological analysis. Some of the reasons he cited were familiarity, accessibility, and convenience of the traditional tests.

Summary

Traditional articulation methods are no longer thought to be an efficient or complete means of assessing children with multiple misarticulations. One alternative, distinctive feature analysis, has been found to be too impractical and time-consuming for speech-language clinicians. The other alternative discussed, phonological analysis, appears to be the most effective procedure at the present time. However, many practicing clinicians have not incorporated phonological analysis into their repertoire of assessment tools. Therefore, it must be made more attractive to them.

Speech-language pathologists are comfortable and familiar with traditional articulation tests. If these tests could be employed as phonological assessment tools, clinicians may be more apt to use the phonological procedure. Currently, there is no research which examines the validity of articulation tests used for phonological analysis of young children. This study will address this issue and thereby support or reject the use of traditional articulation tests as phonological assessment instruments.

CHAPTER III - METHODS

Subjects

Twenty-four phonologically delayed children from East Central Illinois schools, preschools, Headstart programs, and the Eastern Illinois University Speech and Hearing Clinic served as subjects for this study. Letters to recruit subjects (See Appendix A) were sent to speech-language pathologists, who provided the names of possible candidates for the study. The speech-language pathologists had identified these children as phonologically delayed through preschool or kindergarten screening, formal evaluation, and/or inclusion in therapy. A signed note of parental consent was required in order for a child to participate (See Appendix B).

The subjects were divided into three age groups, each comprised of eight children. See Table 1 for subject data.

TABLE 1 - SUBJECT DATA

	Age Range	$\bar{x}$ Age	Females	Males	Total
3-year-olds	3-2 to 3-10	3-7	2	6	8
4-year-olds	4-1 to 4-10	4-5	4	4	8
5-year-olds	5-0 to 5-11	5-5	2	6	8
Totals	3-2 to 5-11	4-5	8	16	24

Procedures

Equipment

The following equipment was employed in the testing procedures:

A Grason-Stadler GSI-27 Portable Auto Tymp was used to perform impedance testing.

The screening portion of the Assessment of Phonological Processes (Hodson, 1980) was administered to insure that the children included in the study demonstrated significant phonological delay. This screening instrument (See Appendix C) consists of twenty words which are elicited via a spontaneous picture-naming task. The stimulus items target the following six processes: Prevocalic Singletons, Prevocalic Clusters, Postvocalic Obstruents, Stridents, Velars, and Liquids.

The Assessment of Phonological Processes (APP) was administered to each subject. This particular phonological assessment tool was chosen because it utilizes a spontaneous naming task, provides quantitative data, and is relatively quick and easy to administer and score when compared with other phonological assessment devices (Paden and Moss, 1985). In order to be consistent with the two articulation tests being examined, color drawings, rather than objects, were used to elicit responses (See Appendix D). The drawings were compiled from several sets of articulation and language therapy cards (Elbert, Rockman, and Saltzman, 1980;

Lippke, 1974; Medlin, 1975; Opposite Concept Cards, 1981).

The Fisher-Logemann Test of Articulation Competence (Picture Form) by Fisher and Logemann (1971) and the Goldman-Fristoe Test of Articulation (Sounds-in-Words Subtest) by Goldman and Fristoe (1972) were also administered. They were selected for this study because they are well-established, widely used measures of articulation (Meitus and Weinberg, 1983). Drawings provided by these tests were used to elicit responses for their respective phonological analyses. Analysis grids and summary sheets for the Fisher-Logemann (F-L) and Goldman-Fristoe (G-F) were developed by the investigator and patterned after the APP (See Appendices E and F). However, certain processes found in the APP were not included on the summary sheets. These processes do not significantly affect intelligibility and are therefore not computed in the Composite Phonological Deviancy Score, as outlined in Hodson and Paden (1983).

Eligibility of Subjects

Impedance Screening. Each subject was required to pass an impedance screening test to insure adequate hearing for testing purposes. Criteria for passing consisted of a tympanogram with a pressure peak between -150 and +100 daPa and a stapedial reflex from 85 to 105 dB in at least one ear as recommended by the GSI-27 Instruction Manual (1983).

Phonological Screening. Each subject was required to demonstrate a significant level of phonological deviance on the screening portion of the APP. As the author of the test does not stipulate specific criteria for passing or failing, cut-off scores were established by the investigator. A 40% occurrence level in three or more of the six processes examined was required for inclusion in the study. The criterion of deviance in at least three processes was based on a study by Hodson and Paden (1981). They found that 100% of their subjects, unintelligible children ranging from three to eight years, demonstrated the use of Cluster Reduction, Stridency Deletion, and Liquid Deviations. All six deviant processes on the APP screening test were present in the speech of 66% of the children. The criterion of 40% occurrence is the level at which a process is considered significant, i.e. warranting therapy, by Hodson and Paden (1983).

Test Administration

Each subject was tested at the Eastern Illinois University Speech and Hearing Clinic or in a quiet area of his/her school or preschool. The APP, F-L, and G-F were administered to each child, via spontaneous picture-naming tasks. Color drawings were presented, along with appropriate directives, e.g. "What's this?", "What is she doing?" If a child was not able to name a particular item, the following prompt was given: "This is called __________. What is it called?" If the child still did not attempt the word, direct imitation was used: "Say __________." A token reinforcement system was employed to maintain a child's interest when deemed necessary by the examiner.

In an effort to control for practice effects, the order of test administration was randomized for each subject. Testing for each child was completed in one session. Short breaks between each of the three tests were taken at the discretion of the examiner when fatigue appeared to affect the child's performance.

All testing was performed by the investigator, who was experienced in the administration of the APP, F-L, and G-F. As Ingram (1981) recommended, broad phonetic transcription was used to complete the phonological analyses. This reduced the risk of interjudge differences that often occur when narrow transcription is used.

Analysis

Scoring

The scoring and phonological analyses for all subjects were performed by the investigator. Procedures outlined in the APP manual were used to tally production errors and analyze deviant processes. In addition, Composite Phonological Deviancy scores, as described in Hodson and Paden (1983), were computed for each of the three tests taken by each child. (See Appendix G). These scores, along with other pertinent test data, were transferred onto a subject information form kept on each child (See Appendix H).

Scoring Reliability

To assess scoring reliability, the investigator re-scored the phonological analyses of 10% of the children, and a second judge, highly trained in phonological analysis, scored the forms of 10% of the children. The analyses used for each reliability measure were chosen at random. The Pearson Product Moment Correlation coefficient was used to compute intrajudge and interjudge reliability. Results at the .001 level of confidence were as follows: intrajudge -- .9995; interjudge -- .9670.

CHAPTER IV - RESULTS

The purpose of this study was to determine whether traditional articulation tests employing a phonological analysis procedure are a valid measure of phonological simplification processes. Scores on the Assessment of Phonological Processes were obtained from 24 phonologically delayed children and compared with scores obtained on the Goldman-Fristoe Test of Articulation and the Fisher-Logemann Test of Articulation Competence, which were modified to assess phonological simplification processes. The subjects were then divided into three age groups (3-year-olds, 4-year-olds, and 5-year-olds) to determine whether a child's age affects the validity of the modified articulation tests as phonological assessment tools. Table 2 lists the individual scores for each subject.

Research Question #1: Is there a significant correlation between the scores obtained on a phonological assessment tool and those obtained from two traditional articulation tests employing a phonological analysis procedure?

Results: The Pearson Product Moment Correlation Coefficient was used to correlate the Composite Phonological Deviancy Scores obtained on the APP with those obtained on the G-F and those obtained on the F-L. Results are presented in Table 3. Scores for both the G-F and the F-L

TABLE 2 - TEST SCORES

3-year-olds	APP		G-F		F-L	
Subject	10 P*	CPDS**	10 P	CPDS	10 P	CPDS
AJ	44	52	41	46	41	51
DN	60	76	59	71	56	81
JM	49	60	45	56	45	58
BL	65	85	61	79	62	97
RD	25	35	26	29	20	29
SF	55	70	62	79	54	84
JK	49	62	47	59	47	71
SB	42	62	41	52	38	54

4-year-olds	APP		G-F		F-L	
Subject	10 P	CPDS	10 P	CPDS	10 P	CPDS
KH	57	71	49	60	49	63
CB	41	55	36	49	32	50
JM	36	56	32	48	31	53
RS	53	72	53	73	49	78
JH	61	80	62	78	58	84
BT	46	62	44	56	42	64
TD	46	59	42	54	40	51
BF	60	71	55	67	53	74

5-year-olds	APP		G-F		F-L	
Subject	10 P	CPDS	10 P	CPDS	10 P	CPDS
EL	49	69	51	71	47	75
MW	45	71	42	66	42	74
JS	29	43	35	47	31	46
ES	37	59	39	56	35	61
SH	48	69	49	67	46	69
CB	35	60	35	60	31	65
JF	74	94	79	97	68	94
BD	46	68	43	63	42	73

*10 P = mean of 10 basic processes
**CPDS = Composite Phonological Deviancy Score

were found to correlate significantly with the APP at the .001 level of confidence.

TABLE 3 - PEARSON PRODUCT MOMENT CORRELATION COEFFICIENTS COMPUTED FOR THE COMPOSITE PHONOLOGICAL DEVIANCY SCORES

	G-F	F-L
APP	.9483	.9401
	p=.001	p=.001

Research Question #2: Does the accuracy of an articulation test employing phonological analysis vary significantly according to the age of a child?

Results: The Pearson Product Moment Correlation Coefficient was used to correlate the Composite Phonological Deviancy Scores from the APP with scores obtained on the articulation tests for each age group. Table 4 lists the results. Correlations between all tests for all age groups were found to be significant at the .001 level of confidence.

TABLE 4 - PEARSON PRODUCT MOMENT CORRELATION COEFFICIENTS COMPUTED FOR THE COMPOSITE PHONOLOGICAL DEVIANCY SCORES BY AGE

		G-F	F-L
3-year-olds	APP	.9478	.9618
4-year-olds	APP	.9545	.9352
5-year-olds	APP	.9703	.9881
		p=.001	p=.001

Additional Statistics: Because of the nature of Hodson and Paden's (1983) scoring procedures and for the purpose of discussion, correlations were performed using the means of the ten basic processes on each child's tests, i.e. the scores before miscellaneous process and age compensatory points are added. This was done for the entire group of subjects, as well as by age. Results are presented in Tables 5 and 6. All correlations were found to be significant at the .001 level of confidence.

TABLE 5 - PEARSON PRODUCT MOMENT CORRELATION COEFFICIENTS COMPUTED FOR THE MEANS OF THE TEN BASIC PROCESSES

	G-F	F-L
APP	.9506	.9792
	p=.001	p=.001

TABLE 6 - PEARSON PRODUCT MOMENT CORRELATION COEFFICIENTS COMPUTED FOR THE MEANS OF THE TEN BASIC PROCESSES BY AGE

		G-F	F-L
3-year-olds	APP	.9575	.9964
4-year-olds	APP	.9579	.9764
5-year-olds	APP	.9737	.9910
		p=.001	p=.001

CHAPTER V - DISCUSSION

Interpretation of Statistical Data

Results of this study indicated that traditional articulation tests can be used in analyzing phonological simplification processes in young children. Composite Phonological Deviancy Scores obtained on both the Goldman-Fristoe Test of Articulation and the Fisher-Logemann Test of Articulation Competence correlated highly with scores obtained on the Assessment of Phonological Processes.

Age Differences

As Table 4 indicates, the correlations between the APP and the two traditional articulation tests remained significant across the three age groups involved in this study. Thus, the F-L and G-F were found to be valid measures of phonological simplification processes for 3-year-olds, 4-year-olds, and 5-year-olds. With the exception of the 4-year-olds' correlation between the APP and the F-L, the correlation coefficients increased slightly with increasing age. One possible explanation for this finding is that as a child matures, his/her use of simplification processes may stabilize. To illustrate this hypothesis, consider the following example. The target word /jɛlo/ is found on all three tests. Seven of the eight 3-year-old subjects produced this word differently on at least two of the three tests. For instance, one child responded with /jɛlo/, /jɛdo/, and /jɛl/. Therefore, different processes were identified in the three analyses. However, of the eight 5-year-olds, only one subject varied his production of this word during the administration of all three tests. Because the older children were more consistent in their productions and in the phonological processes they used, their performances across the three tests were more stable. This may account for the higher correlations found between the scores of the tests in the 5-year-old group. This hypothesis regarding process stabilization warrants further research.

Influence of Miscellaneous and Assimilation Processes

According to Hodson and Paden's (1983) scoring procedures, the use of each of their ten basic processes is represented by a percentage-of-occurrence score, whereas miscellaneous processes are represented by number-of-occurrence scores (one point for every three occurrences--see Appendix G. The phonological analysis summary sheets in Appendix F differentiate the basic processes from the miscellaneous and assimilation processes.). If more opportunities were provided for processes to occur, i.e. more test items, the scores for the ten basic processes should remain relatively stable since they are computed on a percentage-of-occurrence basis. However because the miscellaneous and assimilation process scores are based on the number of occurrences, they would increase proportionately with the number of opportunities provided. Thus, the miscellaneous and assimilation process scores would be considerably higher, assuming that the child would use the processes a greater number of times when given more opportunities.

The three assessment tools used in the present study vary significantly in the number of test items and in the number of opportunities for processes to occur. The _F-L_ consists of 109 items, the _APP_ has 55, and the _G-F_ has 44. The influence of the miscellaneous and assimilation process points was examined by computing correlations using the means of the ten basic processes only. Because the miscellaneous and assimilation process points were not included in the computation, the three tests were compared using data based on percentages only. This eliminated the influence of number of opportunities for occurrence. The correlations were performed for the entire group of subjects, as well as by age. When comparing the coefficients listed in Tables 5 and 6 with those listed in Tables 3 and 4, it is evident that the two articulation tests correlated more highly with the _APP_ without the influence of the miscellaneous and assimilation processes.

This finding has several implications. First of all, clinicians and researchers need to be wary of the Composite Phonological Deviancy Scores obtained from traditional articulation tests. If the number of items varies significantly from the APP, the miscellaneous process points may exert too great or too little influence on the final score. It may be wise to use the articulation tests strictly to identify deviant processes and not compute a "score". However, because scores are often useful in justifying caseloads, showing improvement, etc., developing a new method of computing the Composite Phonological Deviancy Score warrants further research.

Comparison of Tests

Throughout the administration and scoring of the APP, G-F, and F-L, several differences among the tests were noted by the researcher. These may be of interest when deciding which instrument to use when dealing with phonologically delayed children.

Child Interest

It is the subjective opinion of the examiner that of the three tests used in this study, the G-F was the most effective in attracting and maintaining the interest of the children in all three age groups. The stimulus pictures on the G-F are large, colorful, and easily recognizable. Maintaining a child's interest can be a very important factor when dealing with children who are easily distracted and/or have a poor attention span. It should be noted that the stimulus pictures (or objects) used for the APP will vary from examiner to examiner because they are not included with the test. Therefore, items compiled by other examiners may prove more attractive and interesting to children than those used in this study.

Time

The time necessary to administer a test is also an important consideration in choosing a test. Many speech-language pathologists must budget their time very efficiently to meet the needs of large caseloads. In addition, the more time necessary to administer a test, the more difficult it is to keep a child on task. Below are the mean times necessary to administer the three tests to the subjects in this study:

F-L	18 minutes, 29 seconds
APP	9 minutes, 55 seconds
G-F	7 minutes, 40 seconds

These figures are not surprising, considering the number of items on each test.

Adequacy in Examining Processes

A process-by-process analysis revealed that for nine of the ten basic processes, the APP, G-F, and F-L identified similar remediation targets. According to Hodson and Paden (1983), a process requires remedial attention if it occurs more than 40% of the time. Excluding glide deviations, the F-L identified the same processes requiring remediation as the APP for 88% (21) of the subjects, and the G-F agreed with the APP for 75% (18) of the subjects. When discrepancies occurred, they were usually due to percentages-of-occurrence that were close to the cutoff, i.e. between 30% and 50%.

However, some major discrepancies were found on the process of glide deviations. The APP consistently yielded a higher percentage of glide deviations. In several cases there was a difference of 50 or more percentage points between the APP and the other tests. The apparent explanation for this is the fact that five of the ten glides that appear on the APP are in the context of clusters. Only one of the eleven glides on the F-L and two of the six glides on the G-F are elements of clusters. Since most, if not all, phonologically delayed children demonstrate the use of cluster reduction, half of the glides on the APP may be omitted because they are parts of clusters, not because they are glides. This may result in deceivingly high percentages-of-occurrence of glide deviations. Speech-language pathologists should examine a child's productions carefully before determining whether or not that child demonstrates the use of glide deviations.

The G-F may also be misrepresentative of glide deviations. There are only six instances of glides on this test, which may not be a large enough sample to accurately determine a child's proficiency with this sound class. A small number of opportunities for a process to occur causes occurrences of that process to weight the Composite Phonological Deviancy Score too heavily. For instance, the occurrence of one glide deviation on the G-F raises the Composite Phonological Deviancy Score one to two points. Ingram (1976) recommends a process have at least ten opportunities to occur in order to be considered an adequate measure of phonological deviance. Speech-language pathologists using the G-F for phonological analysis may want to sample more words containing glides before making clinical decisions regarding glide deviations.

General Guidelines When Using Articuation Tests for Phonological Analysis

To summarize, the following guidelines should be considered before using a traditional articulation test for phonological analysis:

1. Choose an articulation test that is interesting and attractive to children.
2. Choose a test that can be administered in a practical amount of time, depending on caseload size, age of the child, etc.
3. Be wary of the number of items on the articulation test and how this factor can affect the weighting of miscellaneous processes on the Composite Phonological Deviancy Score.
4. Insure that each process examined is adequately

represented by the test items. This includes the number of opportunities for each process (ten are recommended) and the contexts in which the processes can occur.

Note: Although most articulation tests sample all of the phonemes, many do not include clusters.

Limitations of the Study and Implications for Future Research

After reviewing the purpose, procedures, and data involved in this study, the researcher has determined three major limitations: the number and age of subjects, the exclusion of children with middle ear involvement, and the use of only one method of phonological analysis.

Number and Age of Subjects

Twenty-four children served as subjects for this research, eight children in each of three age groups. A larger number of subjects may have resulted in a better representation of phonologically delayed children. However, this was not possible due to time constraints and difficulty in finding eligible subjects. The researcher also recognizes the fact that phonologically delayed children are not limited to the age range of 3-0 to 5-11. It would be beneficial to conduct further research in the area of articulation tests and phonological analysis with not only a larger group of subjects, but also a wider age-range of children.

Children with Middle Ear Problems

The subjects for this research were required to pass an impedance screening test. This prerequisite was imposed to insure that the children had adequate hearing for testing purposes, i.e. to eliminate those with significant hearing losses. However, this requirement resulted in the exclusion of children with middle ear pathologies, such as otitis media and retracted tympanic membranes. Research suggests a significant correlation between middle ear involvement and phonological delay (Stoel-Gammon and Dunn, 1985). Difficulties in recruiting eligible subjects for the present study support this finding. Because many children were excluded due to abnormal impedance results, the 24 children tested may not have been truly representative of the phonologically delayed population.

Use of One Analysis Method

For purposes of simplicity and consistency, only one method of phonological analysis, Hodson's method, was used to evaluate the subjects' performances on the G-F and F-L. However, as discussed in the literature review, other methods and procedures for analyzing deviant phonology exist (Ingram, 1981; Shriberg and Kwiatkowski, 1980; Weiner, 1979). The possibility of using the phonological processes and scoring methods described in these instruments in conjunction with articulation tests should not be overlooked. The Khan-Lewis Phonological Analysis procedure (Khan and Lewis, 1986) has been published to be used with the test items on the G-F. Further research could compare these analysis methods used with articulation tests to determine which is (are) the most efficient, effective, and practical.

By keeping the needs of practicing speech-language pathologists in mind, researchers can make phonological analysis more attractive and useful. Thereby, the ultimate goal of phonological research can be achieved, to better serve those children with handicapping phonological impairments.

APPENDIX A - LETTER AND FORM FOR SPEECH-LANGUAGE PATHOLOGISTS

Date

Name
School
Address
Address

Dear Speech-Language Pathologist:

I am a graduate student majoring in Speech Pathology at Eastern Illinois University. In order to complete research necessary for my thesis, I am in need of subjects ages 3-0 to 5-11 who have been diagnosed or are suspected to be moderately, severely, or profoundly phonologically delayed. This group would include children who may already be in therapy, who have been identified through screening, or who have been referred by parents or other sources. Research with these subjects will involve a brief phonological screening, an impedance screening, and the administration of two articulation tests and one phonological assessment tool.

I would appreciate your help in identifying any children who fit the above description. Please list the name(s) of such children on the enclosed sheet and return it to me by __________. Also, if these children are in your district, I would appreciate your assistance in determining the next step in obtaining the necessary permission from your school administration. I will also secure parental permission before any testing is initiated.

Thank you very much for your time and cooperation.

Sincerely,

Teri Moser

Child's Name______________________________ Age__________

Parent(s)______________________________

Address______________________________

____

Phone Number______________________________

Child's Name______________________________ Age__________

Parent(s)______________________________

Address______________________________

____

Phone Number______________________________

Child's Name______________________________ Age__________

Parent(s)______________________________

Address______________________________

____

Phone Number______________________________

Return to: Teri Moser
EIU Speech and Hearing Clinic
7th and Hayes Streets
Charleston, IL 61920
(217) 581-2712

APPENDIX B - PARENT LETTER AND CONSENT FORM

Date

Name
Address
Address

Dear Mr. and Mrs. _______:

I am a graduate student at Eastern Illinois University majoring in Speech Pathology. As part of my training in the field of speech and language disorders, I am conducting research with children between the ages of three and six who have moderate and severe speech problems. _____________, the speech pathologist at ___________________________, gave me the name of your child, _____, as a possible candidate for my study.

This study will involve a brief hearing test and four speech tests, one which is a quick screening tool and three which are more lengthy and in-depth. All four speech tests consist of pictures which the child must name so that I can listen to and record how he/she produces speech sounds. The entire process should take between one and one-and-a-half hours. I would prefer that the testing be done here at the E.I.U. Speech and Hearing Clinic in Charleston. However, if you do not wish to bring _____ to the clinic, the testing can be done at ___ school in _______.

Please consider allowing your child to participate in my study. Without the help of parents, my research will be impossible to perform. I would ask that you fill out the enclosed permission form and return it to me by ___________ in the self-addressed stamped envelope provided. If you decide to allow me to test your child, I will contact you to set up a time and place to do so. If you have any questions or concerns, feel free to contact me at the Speech and Hearing Clinic (581-2712) or at home (348-5290).

Thank you very much.

Sincerely,

Teri Moser

I grant permission for my child, ___________________________, to participate in the research study, "The Use of Traditional Articulation Tests in Phonological Analysis," conducted by Teri Moser, graduate student in the Department of Speech Pathology and Audiology, Eastern Illinois University, Charleston, Illinois.

____
Parent or Guardian

____
Date

____
Address

____
City, State

____
Phone

Return to: Teri Moser
EIU Speech and Hearing Clinic
7th and Hayes Streets
Charleston, IL 61920

APPENDIX C - SCREENING PORTION OF THE ASSESSMENT OF PHONOLOGICAL PROCESSES

THE ASSESSMENT OF PHONOLOGICAL PROCESSES
SCREENING

Name ______________________ Date __________ Examiner __________

Stimulus	Transcriptions	Pre. Sing.	Pre. Cl.	Post. Obs.	Stri.	Velar	Liquid	Other
1. crayons	kreɪ ənz		kr		z	k	r	
2. three	θri		θr				r	
3. black	blæk		bl	k		k	l	
4. red	rɛd	r		d			r	
5. yellow	jɛlo	j / l					l	
6. chair	tʃɛɚ	tʃ			tʃ		ɚ	
7. cups	kʌps	k		p	s	k		
8. fork	fɔɚk	f		k	f	k	ɚ	
9. gum	gʌm	g				g		
10. glasses	glæsɪz	s	gl	z	s / z	g	l	
11. hat	hæt	h		t				
12. leaf	lif	l		f	f		l	
13. shoe	ʃu	ʃ			ʃ			
14. soap	soʊp	s		p	s			
15. spoon	spun		sp		s			
16. string	strɪŋ		str		s	ŋ	r	
17. teeth	tiθ	t		θ				
18. thumb	θʌm	θ						
19. watch	wɑtʃ	w		tʃ	tʃ			
20. zipper	zɪpɚ	z / p			z		ɚ	

Prevocalic Singletons (17)
- Omissions ____
- Other ____

Prevocalic Clusters (6)
- Reductions ____
- Other ____

Postvocalic Obstruents (10)
- Omissions ____
- Other ____

Stridents (13)
- Omissions ____
- Non-strident Substitutions ____
- Total Stridency Deletion ____
- Other ____

Velars (7)
- Omissions ____
- Fronting ____
- Other ____

Liquids (11)
- Omissions ____
- Gliding ____
- Vowelization ____
- Other ____

Other Patterns

____

____

____

____

by

Barbara Williams Hodson

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Reorder No. 2127

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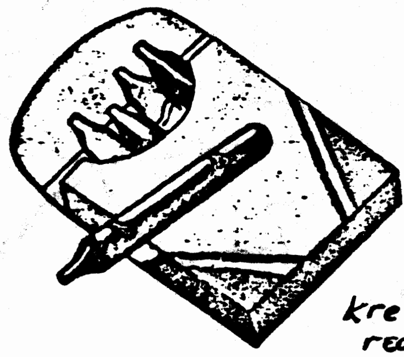

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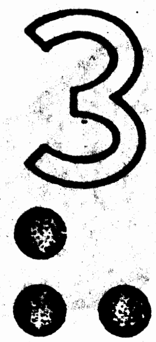

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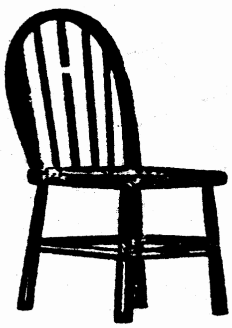

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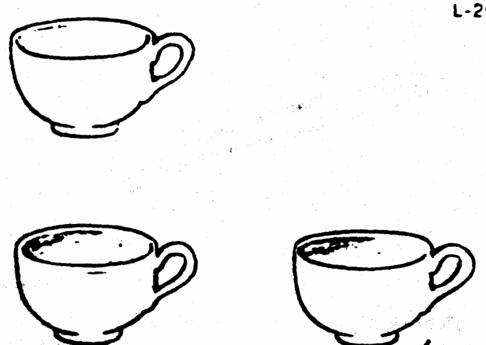

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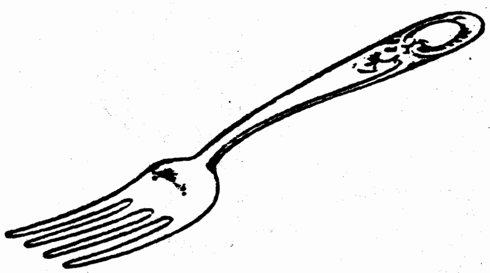

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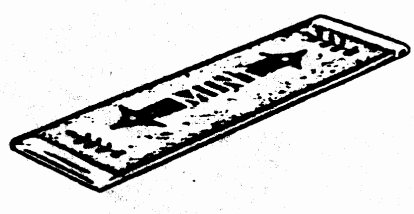

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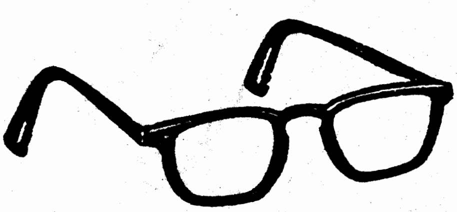

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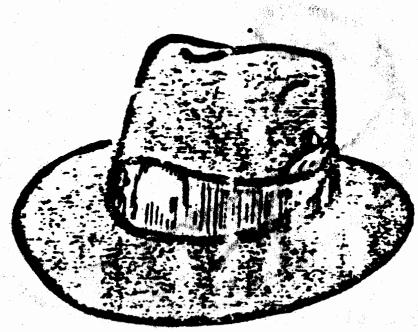

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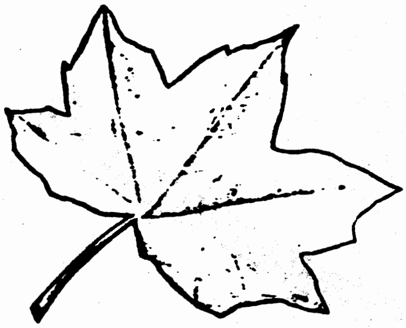

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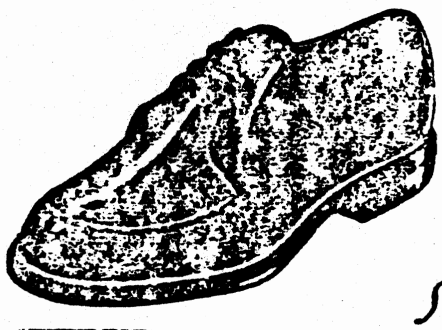

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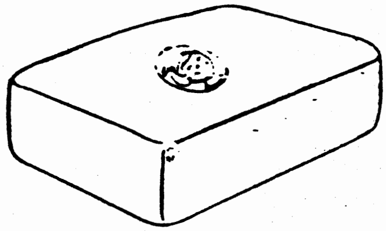

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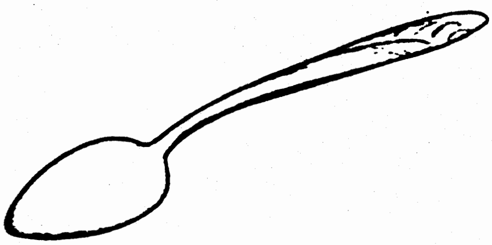

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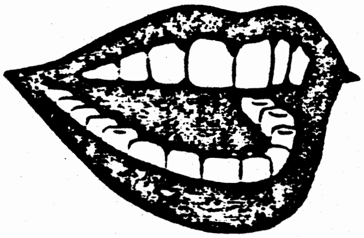

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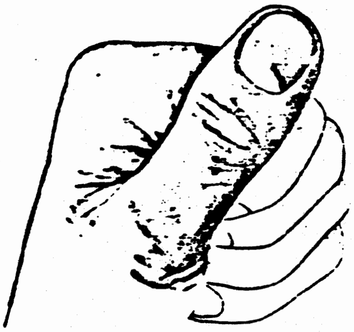

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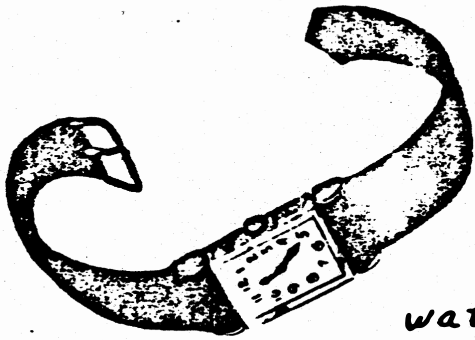

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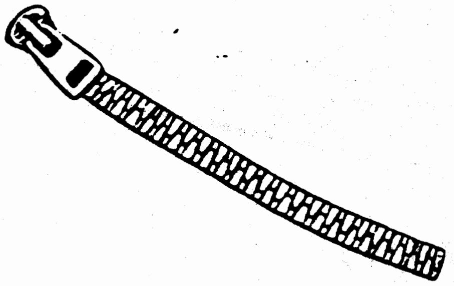
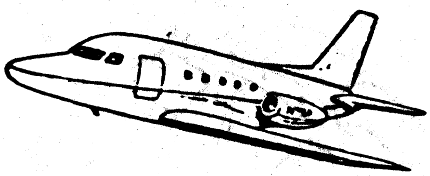


APPENDIX D - PICTURES USED FOR THE ASSESSMENT OF PHONOLOGICAL PROCESSES

379

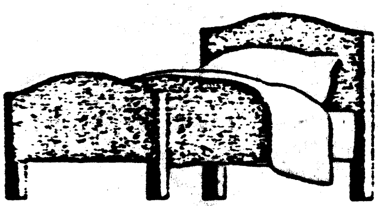


ɛɚplen

48-

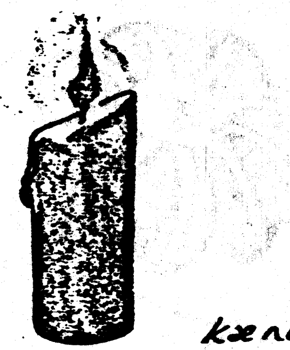
bæskɪt

30



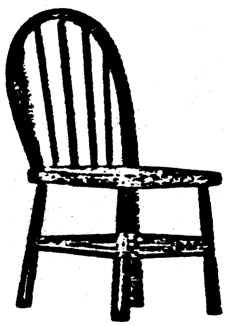
bɛd

475



kændl

347

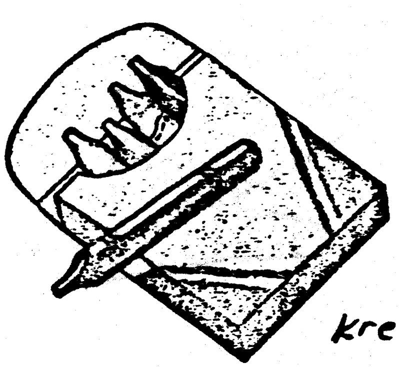


tʃɛɚ

476

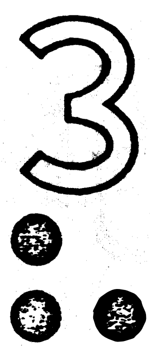
kaʊbɔɪ hæt

465



kreɪnz

L-188

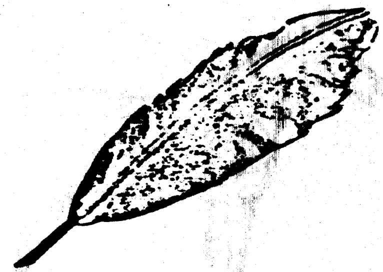


θri blæk

268

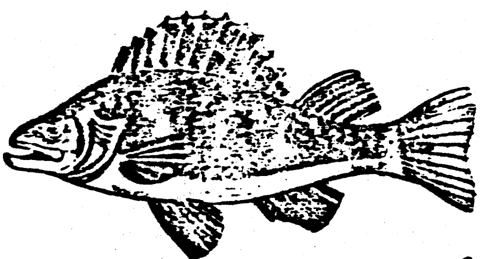
dal

185



fɛðɚ

440

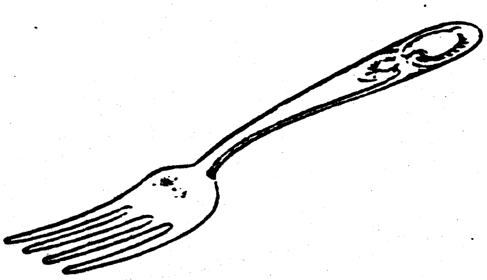


fɪʃ

10

flawɚ

113

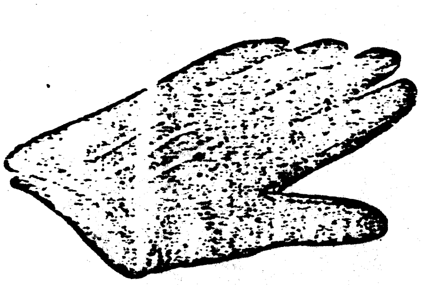


fork

307

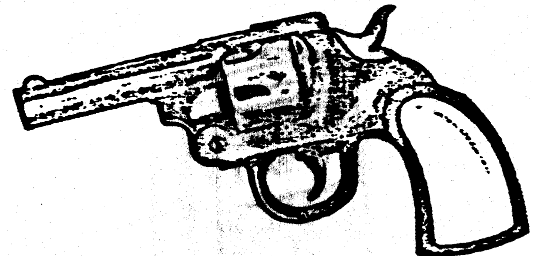
glæsɪz

150



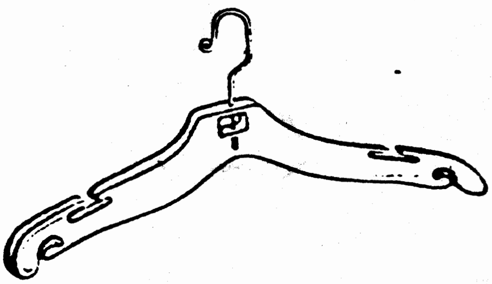
glʌv

503



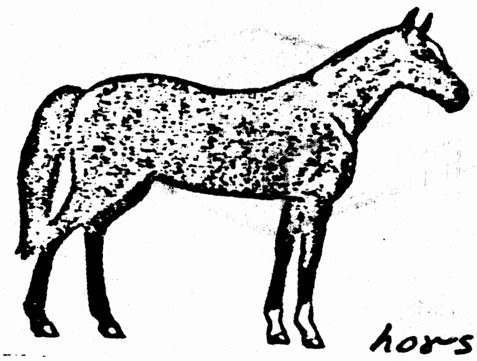
gʌn

524



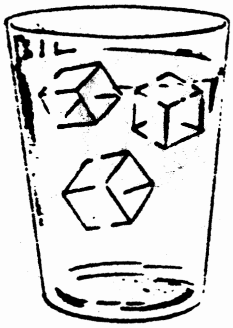
hæŋɚ

537



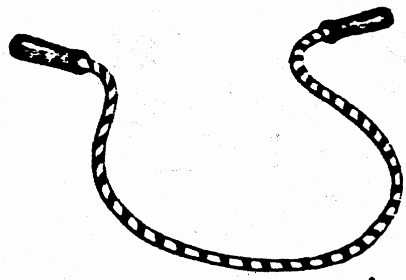
hɔrs

L-296



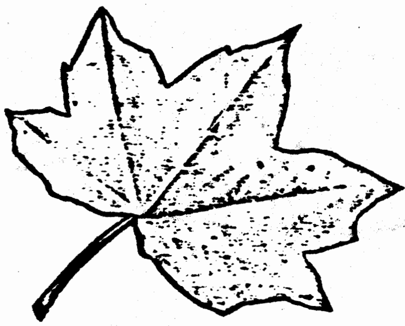
aɪskjubz

374



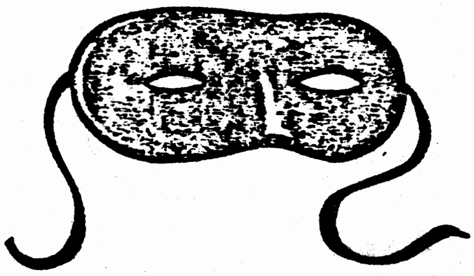
dʒʌmprɑp

125



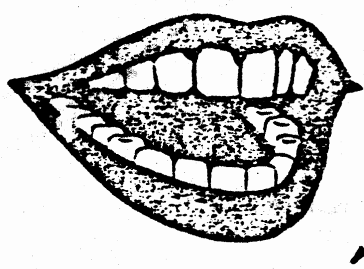
lif
grin

56



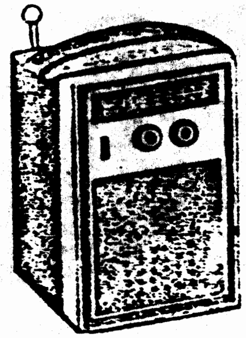
mæsk

179



maʊθ

400

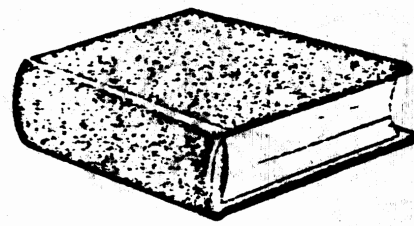


mjuzɪk
baks

342

noz

33



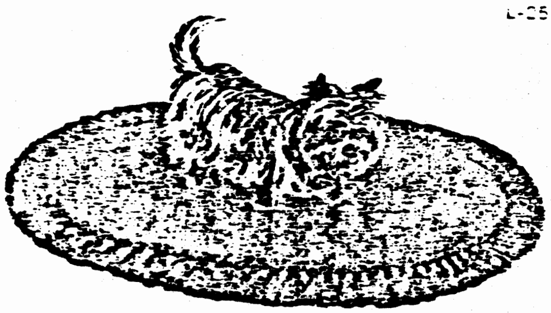
pedʒ

kwɔrtɚ

455

ruʒ

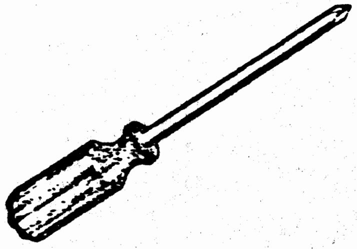
L-250



rʌg

339

sæntə klɔz

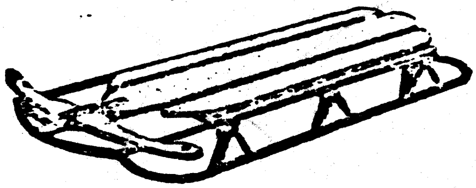


skrudraɪvɚ

423

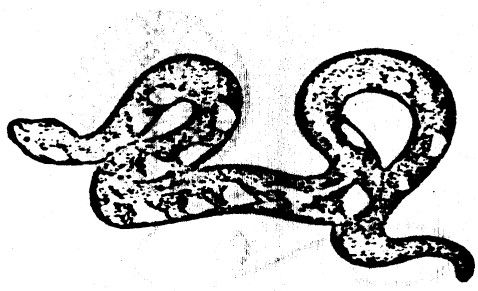
ʃu

237

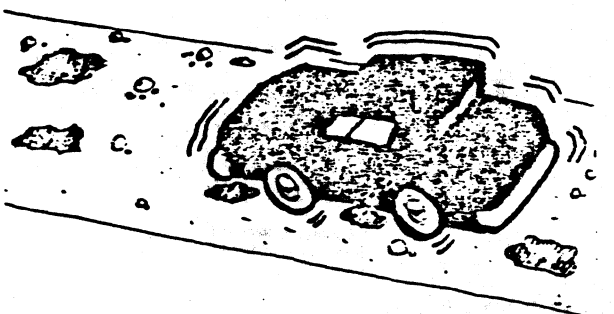


slɛd

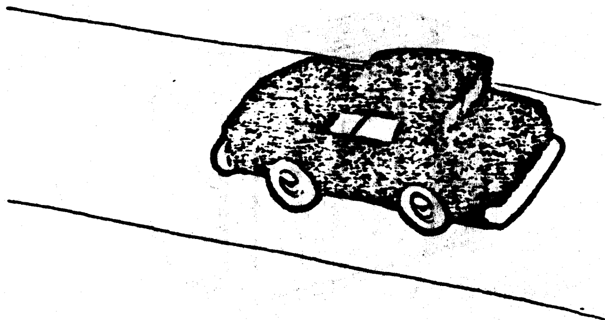
49?



snek

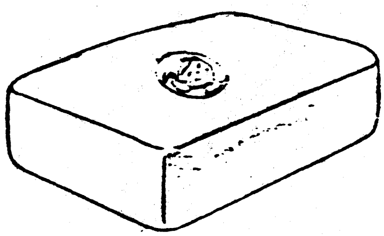


contrast for /smuʒ/



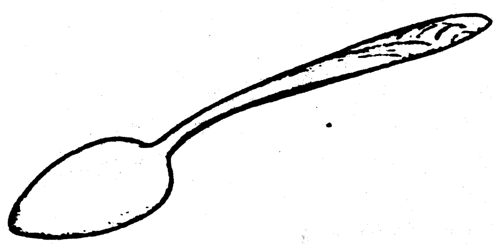
smuʒ

296



sop
jɛlo

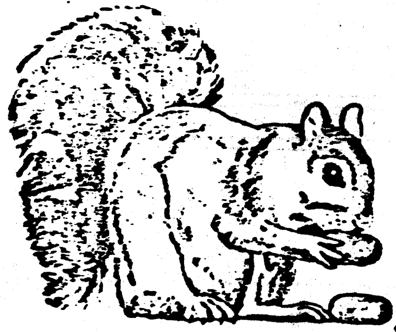
263



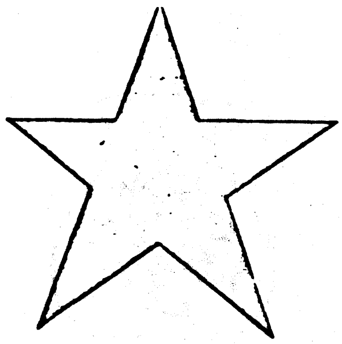
spun

sprɪŋ

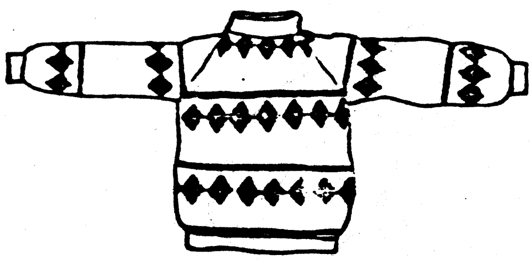
293

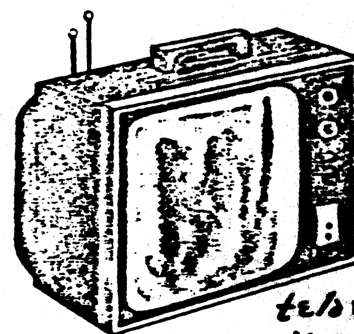


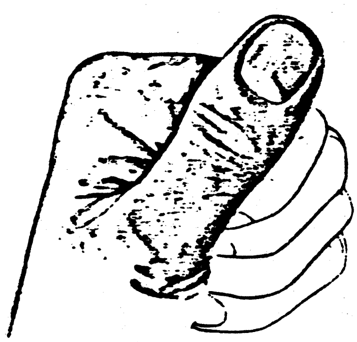
skwɝl

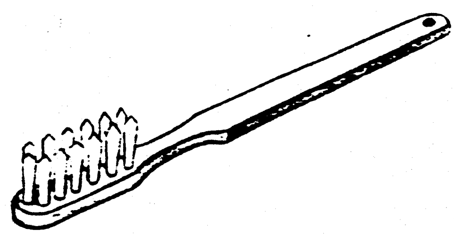

star

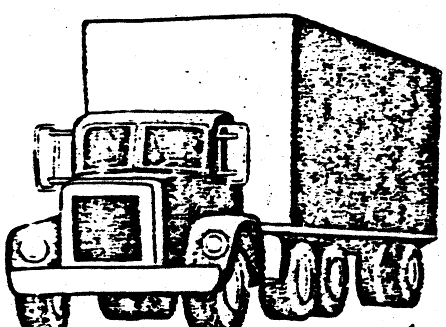

strɪŋ

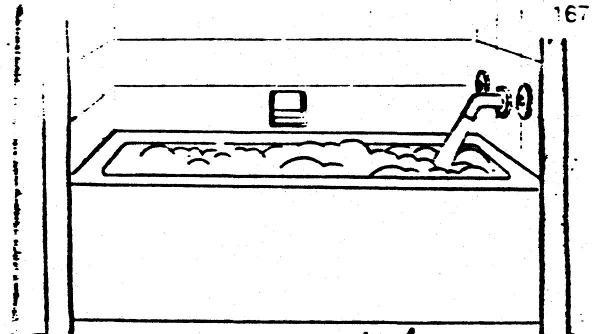

swɛtɚ


tɛləvɪʒən
sɛt

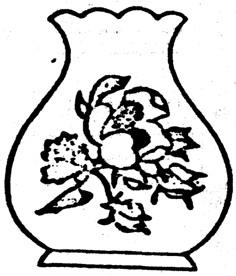

θʌm


tuθbrʌʃ

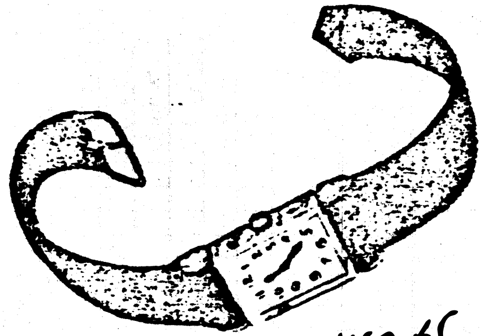

trʌk


tʌb

134

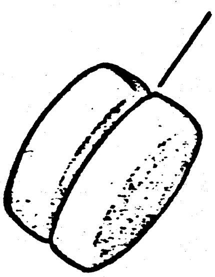


ves



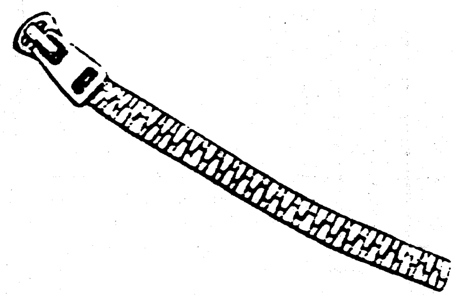
watʃ

463



jojo

324



zɪpɚ

APPENDIX E - PHONOLOGICAL ANALYSIS GRIDS

Phonological Analysis Grid for the Assessment of Phonological Processes

Target	Production	Basic Processes										Miscellaneous Processes								Assimilations				Other Patterns/ Preferences
		Syl Red	Cl Red	Pre → ∅	Post → ∅	Str Del	Vel Dev	/l/ Dev	/r,ɚ/ Dev	Nas Dev	Glide Dev	Pre → V	Post → D	Gl Re	Back	Stop	Epen	Meta	Vowel Dev	Nas → A	Vel → A	Lab → A	Alv → A	
1. ɛrplen																								
2. bæskɪt																								
3. bɛd																								
4. kændl																								
5. tʃɛr																								
6. kaʊbɔɪ hæt																								
7. krejanz																								
8. θri																								
9. blæk																								
10. grin																								
11. jɛlo																								
12. dal																								
13. fɛðɚ																								
14. fɪʃ																								
15. flaʊwɚ																								
16. fork																								
17. glæsɪz																								
18. glʌv																								
19. gʌn																								
20. hæmɚ																								
21. haʊs																								
22. aɪskjubz																								
23. dʒʌmprop																								
24. lif																								
25. mæsk																								
26. maʊθ																								
27. mjuzɪk baks																								
28. noz																								
29. pedʒ																								
30. kwɔrtɚ																								
31. ruʒ																								
32. rʌg																								
33. sæntə klɔz																								
34. skrudraɪvɚ																								
35. ʃu																								
36. slɛd																								
37. smuð																								
38. snek																								
39. sop																								
40. spun																								
41. sprɪŋ																								
42. skwɝl																								
43. stɑr																								
44. strɪŋ																								
45. swɛtɚ																								
46. tɛləvɪʒən																								
47. ðæt																								
48. θʌm																								
49. tuθbrʌʃ																								
50. trʌk																								
51. tʌb																								
52. vɛs																								
53. watʃ																								
54. jojo																								
55. zɪpɚ																								
	Totals																							

Phonological Analysis Grid for the Goldman-Fristoe Test of Articulation

		Basic Processes										Miscellaneous Processes								Assimilations				
Target	Production	Syl Red	Cl Red	Pre → Ø	Post → Ø	Str Del	Vel Dev	/l/ Dev	/r, ɚ/ Dev	Nas Dev	Glide Dev	Pre → V	Post → D	Gl Re	Back	Stop	Epen	Meta	Vowel Dev	Nas → A	Vel → A	Lab → A	Alv → A	Other Patterns/ Preferences
1. haʊs																								
2. tɛləfon																								
3. kʌp																								
4. gʌn																								
5. naɪf																								
6. wɪndo																								
7. wægən																								
8. wɪl																								
9. tʃɪkən																								
10. zɪpɚ																								
11. sɪzɚz																								
12. dʌk																								
13. jɛlo																								
14. vækjum																								
15. mætʃɪz																								
16. læmp																								
17. ʃʌvəl																								
18. kar																								
19. ræbɪt																								
20. fɪʃɪŋ																								
21. tʃɚtʃ																								
22. fɛðɚ																								
23. pɛnsəlz																								
24. ðæt																								
25. kɛrət																								
26. ɔrɪndʒ																								
27. bæθtʌb																								
28. bæθ																								
29. θʌm																								
30. fɪŋgɚ																								
31. rɪŋ																								
32. dʒʌmpɪŋ																								
33. pədʒæməz																								
34. plen																								
35. blu																								
36. brʌʃ																								
37. drʌm																								
38. flæg																								
39. sæntəklɔz																								
40. krɪsməstri																								
41. skwɚl																								
42. slipɪŋ																								
43. rɛd																								
44. stov																								
	Totals																							

Phonological Analysis Grid for the Fisher-Logemann Test of Articulation Competence

Target	Production	Basic Processes: Syl Red	Cl Red	Pre → ∅	Post → ∅	Str Del	Vel Dev	/l/ Dev	/r,ɚ/ Dev	Nas Dev	Glide Dev	Miscellaneous Processes: Pre → V	Post → D	Gl Re	Back	Stop	Epen	Meta	Vowel Chg	Assimilations: Nas → A	Vel → A	Lab → A	Alv → A	Other Patterns/Preferences
1. pɪn																								
2. pepɚ																								
3. sop																								
4. baks																								
5. bebɪ																								
6. bɪb																								
7. wɪsl̩																								
8. wil																								
9. watɚ (wadɚ)																								
10. flaʊwɚ																								
11. mæn																								
12. hæmɚ																								
13. drʌm																								
14. fɪŋgɚ																								
15. ɛləfənt																								
16. naɪf																								
17. væləntaɪn																								
18. vest																								
19. tɛləvɪʒən																								
20. ʃaɪv																								
21. θʌm																								
22. tuθek																								
23. maʊð																								
24. ʒæt																								
25. fɛðɚ																								
26. smuð																								
27. tap																								
28. lɛtɚ (lɛdɚ)																								
29. bot																								
30. dɔg																								
31. lædɚ																								
32. bɛd																								
33. lif																								
34. bəlunz																								
35. tel																								
36. noz																								
37. mʌnɪ																								
38. pɛn																								
39. sil																								
40. glæsɪz																								
41. θʌs																								
42. zibrə																								
43. sɪzɚz																								
44. tɔɪz																								
45. ʃu																								
46. dɪʃɪz																								
47. brʌʃ																								
48. mɛʒɚɪŋ kʌp																								
49. graʒ (gradʒ)																								
50. tʃɛɚ																								
51. mætʃɪz																								
52. watʃ																								
53. dʒʌmp																								
54. pedʒɪz																								
55. kedʒ																								
	Subtotals																							

Fisher-Logemann (cont.)

Target	Production	Basic Processes: Syl Red	Cl Red	Pre → ∅	Post → ∅	Str Del	Vel Dev	/l/ Dev	/r,ɝ/ Dev	Nas Dev	Glide Dev	Miscellaneous Processes: Pre → V	Post → D	Gl Re	Back	Stop	Epen	Meta	Vowel Dev	Assimilations: Nas → A	Vel → A	Lab → A	Alv → A	Other Patterns/ Preferences
56. jɛlo																								
57. jojo																								
58. rɛn																								
59. kɛrəts																								
60. kar																								
61. kot																								
62. rakɪt																								
63. bʊk																								
64. gɝl																								
65. wægən																								
66. ɛg																								
67. hægɚ																								
68. rɪŋ																								
69. hænd																								
70. bɪhaɪnd																								
71. spun																								
72. star																								
73. slaɪd																								
74. snek																								
75. sket																								
76. swɪŋ																								
77. smok																								
78. prɛzənt																								
79. brɛd																								
80. frut																								
81. fraɪɪŋpæn																								
82. θri																								
83. tri																								
84. drɛs																								
85. kraɪ																								
86. grin																								
87. slɛd																								
88. blu																								
89. plen																								
90. flæg																								
91. klaʊn																								
92. glæs																								
93. bat! (bad!)																								
94. ki																								
95. mɪtʌ																								
96. tebl̥																								
97. hɛl																								
98. hæt																								
99. sak																								
00. kʌp																								
01. ʃɪt																								
02. ȯɔl																								
03. fon																								
04. fʊt																								
05. tu																								
06. aɪ																								
07. haʊs																								
08. bɔɪ																								
09. ju																								
	Subtotals																							
	Totals																							

APPENDIX F - PHONOLOGICAL ANALYSIS SUMMARY SHEETS

PHONOLOGICAL ANALYSIS SUMMARY FOR THE ASSESSMENT OF PHONOLOGICAL PROCESSES

NAME______________________________ DATE__________ BD__________ CA__________

BASIC PHONOLOGICAL PROCESSES

	NUMBER OF OCCURRENCES	POSSIBLE OCCURRENCES	PERCENTAGE OF OCCURRENCE
Syllable Reduction	_________	21	_________
Cluster Reduction	_________	35	_________
Prevocalic Obstruent Omission	_________	38	_________
Postvocalic Obstruent Omission	_________	30	_________
Stridency Deletion	_________	44	_________
Velar Deviation	_________	24	_________
Liquid /l/ Deviation	_________	13	_________
Liquid /r,ɝ/ Deviation	_________	26	_________
Nasal Deviation	_________	19	_________
Glide Deviation	_________	10	_________
	MEAN OF 10 BASIC PROCESSES		_________

MISCELLANEOUS AND ASSIMILATION PROCESSES

	NUMBER OF OCCURRENCES
Prevocalic Voicing	_________
Glottal Replacement	_________
Backing	_________
Stopping	_________
Epenthesis	_________
Metathesis	_________
Vowel Deviations	_________
Nasal Assimilation	_________
Velar Assimilation	_________
Labial Assimilation	_________
Alveolar Assimilation	_________
Other Patterns/Preferences	
_________________________	_________
_________________________	_________

ADDITIONAL POINTS FOR OTHER PROCESSES _________

AGE COMPENSATORY POINTS _________

COMPOSITE PHONOLOGICAL DEVIANCY SCORE _________

PHONOLOGICAL ANALYSIS SUMMARY FOR THE GOLDMAN-FRISTOE TEST OF ARTICULATION

NAME______________________________ DATE__________ ED__________ CA__________

BASIC PHONOLOGICAL PROCESSES

	NUMBER OF OCCURRENCES	POSSIBLE OCCURRENCES	PERCENTAGE OF OCCURRENCE
Syllable Reduction	_________	27	_________
Cluster Reduction	_________	15	_________
Prevocalic Obstruent Omission	_________	43	_________
Postvocalic Obstruent Omission	_________	22	_________
Stridency Deletion	_________	35	_________
Velar Deviation	_________	18	_________
Liquid /l/ Deviation	_________	12	_________
Liquid /r,ɚ/ Deviation	_________	15	_________
Nasal Deviation	_________	27	_________
Glide Deviation	_________	6	_________
	MEAN OF 10 BASIC PROCESSES		_________

MISCELLANEOUS AND ASSIMILATION PROCESSES

	NUMBER OF OCCURRENCES
Prevocalic Voicing	_________
Glottal Replacement	_________
Backing	_________
Stopping	_________
Epenthesis	_________
Metathesis	_________
Vowel Deviations	_________
Nasal Assimilation	_________
Velar Assimilation	_________
Labial Assimilation	_________
Alveolar Assimilation	_________
Other Patterns/Preferences	
__________________________	_________
__________________________	_________

ADDITIONAL POINTS FOR OTHER PROCESSES _________

AGE COMPENSATORY POINTS _________

COMPOSITE PHONOLOGICAL DEVIANCY SCORE _________

PHONOLOGICAL ANALYSIS SUMMARY FOR THE FISHER-LOGEMANN TEST OF ARTICULATION COMPETENCE

NAME______________________________ DATE__________ BD__________ CA__________

BASIC PHONOLOGICAL PROCESSES

	NUMBER OF OCCURRENCES	POSSIBLE OCCURRENCES	PERCENTAGE OF OCCURRENCE
Syllable Reduction	_________	36	_________
Cluster Reduction	_________	37	_________
Prevocalic Obstruent Omission	_________	84	_________
Postvocalic Obstruent Omission	_________	47	_________
Stridency Deletion	_________	62	_________
Velar Deviation	_________	33	_________
Liquid /l/ Deviation	_________	26	_________
Liquid /r,ɝ/ Deviation	_________	33	_________
Nasal Deviation	_________	42	_________
Glide Deviation	_________	11	_________
	MEAN OF 10 BASIC PROCESSES		_________

MISCELLANEOUS AND ASSIMILATION PROCESSES

	NUMBER OF OCCURRENCES
Prevocalic Voicing	_________
Glottal Replacement	_________
Backing	_________
Stopping	_________
Epenthesis	_________
Metathesis	_________
Vowel Deviations	_________
Nasal Assimilation	_________
Velar Assimilation	_________
Labial Assimilation	_________
Alveolar Assimilation	_________
Other Patterns/Preferences	
________________________	_________
________________________	_________

ADDITIONAL POINTS FOR OTHER PROCESSES _________

AGE COMPENSATORY POINTS _________

COMPOSITE PHONOLOGICAL DEVIANCY SCORE _________

APPENDIX G - INSTRUCTIONS FOR COMPUTING THE COMPOSITE PHONOLOGICAL DEVIANCY SCORE (Based on Hodson and Paden, 1983)

1. Determine the percentage-of-occurrence for each of the ten basic processes.
2. Calculate the mean of the ten percentages from #1.
3. Add one point for every three occurrences of miscellaneous processes, assimilation processes, and idiosyncratic patterns.
4. Add age compensatory points:

   0 points for three-year-olds

   5 points for four-year-olds

   10 points for five-year-olds
5. The resulting score is the Composite Phonological Deviancy Score.

APPENDIX H - SUBJECT INFORMATION FORM

NAME	DATE OF TESTING
PARENT(S)	BIRTHDATE
ADDRESS	AGE

PHONE

RESULTS OF IMPEDANCE

	Left Ear	Right Ear
Pressure (daPa)		
Reflex (dB)		

APP SCREENING

Processes over 40% level of occurrence:

ORDER OF ADMINISTRATION AND COMPOSITE PHONOLOGICAL DEVIANCY SCORES

Test	Score	Time
1.		
2.		
3.		

TOTAL TIME OF TESTING

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