PHONOLOGICAL PROCESS ANALYSIS OF ARTICULATION SKILLS IN MENTALLY RETARDED ADOLESCENTS

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CHAPTER I

INTRODUCTION

Mental retardation, as defined by the American Association on Mental Deficiency, is characterized by ". . . subaverage general intellectual functioning which originates during the developmental period, associated with impairment of adaptive behavior" (Carter, 1978, p. xv). Of the developmental problems manifested in mental retardation speech and language difficulties are among the most prevalent and easily observable. Schiefelbusch, Copeland, and Smith (1967) point out that speech and language behavior is closely associated with both of the specified characteristics of mental retardation, subaverage functioning and impairment of adaptive behavior. They state that speech and language behavior and intelligence

> . . . seem to be similarly influenced by the same antecedent factors and are evaluated by largely the same test items. Similarly, adaptive behavior is governed largely by the same factors that have established communication behavior. There are apparently many functions that are common to both sets of behaviors. (p. v)

Schlanger (1977) also states that "the production of adequate speech and language is related to the intellectual ability of the mentally retarded" (p. 3). Spreen (1973)

has emphasized the development of speech and language ability as an important aspect of mental retardation, describing a relationship in which speech and language handicap becomes more severe as intelligence quotient decreases.

For many years speech-language pathologists have devoted efforts to the diagnosis, description, and remediation of articulation problems in mentally retarded individuals. From 1940 to 1960 interest in the communication problems of the retarded flourished, resulting in the publication of numerous studies, among them works by Bangs (1942), Karlin and Strazzulla (1952), Schlanger (1953), and Schlanger and Gottsleben (1957), which attempted to determine the incidence and characteristics of speech disorders among retarded individuals. All studies indicate a high incidence of speech disorders among the mentally retarded; Schlanger and Gottsleben report higher incidence figures for Down's syndrome individuals than for familial retardates (Jordan, 1967).

In describing the articulatory behavior of retarded children and adolescents Bangs, Karlin and Strazzulla, and Schlanger report specific phoneme errors present in articulatory patterns. The analysis framework utilized by these investigators reflects an approach to the description of articulation which speech-language pathologists have come

to regard as traditional. The traditional approach is sound-specific in nature, classifying speech sound errors according to type, such as substitution, omission, and distortion of sounds, and by place of occurrence within a word context, such as the initial, medial, and final positions of words (Van Riper & Irwin, 1958). The traditional approach, used as early as 1936 (Travis, 1936) as a strategy for classifying articulation errors, has been used extensively in describing the articulation skills of normally developing populations (Templin, 1957), of articulation-impaired populations (Morley, 1957), and of special populations such as the mentally retarded (Bangs, 1942).

The translation of Roman Jakobson's Child Language, Aphasia, and Phonological Universals (1968) has brought a new approach to the study of articulation. The introduction of the linguistic feature has resulted in a shift away from the phoneme as the smallest unit of meaningful speech and as the basis for articulatory analysis. As a result of Jakobson's ideas, emphasis has been placed upon the acquisition of distinctive features, within a larger linguistic context, as the foundation for development of articulatory behavior (Blache, 1978). Chomsky and Halle, through the publication of their work, The Sound Pattern of English

(1968), also have made significant contributions to the development of distinctive feature theory. Distinctive features may be defined as ". . . the physical (articulatory or acoustic) and psychological (perceptual) realities of the phoneme" (Singh, 1976, p. 5). Berko and Brown (1960) state that

> . . . the "distinctive features" of an individual phoneme would be those aspects of the process of articulation and their acoustic consequences that serve to contrast one phoneme from another. (pp. 525-526)

Linguists have suggested that all spoken languages can be described using distinctive feature systems (Jakobson, Fant, & Halle, 1952) and that the development of sound systems in children follows a specific pattern of distinctive feature acquisition (Jakobson, 1968).

Distinctive feature systems have been used increasingly in the description of normal phonological development (Crocker, 1969; Menyuk, 1968) as well as deviant phonological systems (McReynolds & Huston, 1971; Pollack & Rees, 1972). Fisher and Logemann (1971) and McReynolds and Engmann (1975) have devised articulation tests based upon feature systems (Lund & Duchan, 1978).

More recent developments in phonological theory have provided alternatives to distinctive feature theory. Phonologists have begun to examine closely the ordered,

rule-governed characteristics of child and adult language, and have begun to suggest that the pattern of phonological development extends beyond the distinctive features of language and involves rules designating the presence, absence, and combination of sound patterns in language (Ingram, 1976). A major contribution to the development of modern phonological theory has been provided by Stampe (Ferguson & Garnica, 1975), who has described child phonological development as a continual modification of the child's own innate system in an attempt to achieve adult pronunciation. Stampe relies heavily upon the concept of the phonological rule as the foundation of his theory of natural phonology. Stampe defines the phonological rule as a guideline for production that brings about a merger of ". . . a potential phonological opposition into that member of the opposition which least tries the restrictions of the human speech capacity" (Ferguson & Garnica, 1975, p. 170). Ingram (1974) sheds greater light on the nature of the phonological rule in stating that

> . . . phonological rules in the most general sense indicate a systematic relationship between the members of a language's sound system. More specifically they operate both in terms of selection of sounds and in their combination . . . . (p. 50)

Shriberg and Kwiatkowski (1979) make a distinction between phonological rules and phonological processes, terms which are used somewhat interchangeably by Stampe and Ingram.

Shriberg and Kwiatkowski describe phonological rules as descriptions of constraints on sound-making, stating that rules ". . . simply describe observed regularity in behavior. Rules provide the phonologist a means for organizing, analyzing, and discussing phonological data" (p. 8). Phonological processes, according to Shriberg and Kwiatkowski, move ". . . beyond description to an explanatory-level account of sound change" (p. 8). Shriberg and Kwiatkowski illustrate their distinction between rules and processes by explaining that a given phonological rule, such as /s/ → /t/ (the /s/ phoneme changes to /t/ at the surface level of production when /s/ is represented at the underlying phonological level), is represented within a process such as Stopping, in which fricatives are changed to stops. In this manner of organization processes can be seen as general characteristics of sound change which may encompass a multitude of specific phonological rules.

Ingram (1974, 1976) and Smith (1973) have used Stampe's theory as a basis for the description of specific phonological rules and processes which they demonstrate as occurring in the speech patterns of children. Kornfeld (Ingram, 1976) and Menn (Ingram, 1976) also have adapted phonological rule theory to the study of normal phonological development.

Phonological rule theory has been helpful not only in the description of normal sound development, but also in the investigation of deviant sound systems in children. Compton (1970), Bodine (1974), Edwards and Bernhardt (Ingram, 1976), and Lorentz (Ingram, 1976) are among those who have documented the use of phonological processes which are considered to be deviant, not part of the normal developmental sequence for children.

Most recently a small number of investigators have applied phonological rule theory to the articulation skills of special populations such as the mentally retarded. Ingram (1976) uses the data compiled in the early study of Bangs (1942) to suggest possible phonological rules present in the articulation patterns of mentally retarded individuals. Dodd (1976) makes a comparison of mental age matched normal, severely subnormal, and Down's syndrome children in an effort to confirm the hypothesis linking phonological development to mental development. Dodd's study presents data taken from mentally retarded subjects ranging in chronological age from 6.6 to 15.2, and ranging in mental age from 2.5 to 4.7. Bartolucci and Pierce (1977) compare the phonological systems of normal, autistic, and mentally retarded subjects, primarily for the purpose of describing the process patterns of the autistic population.

The Bartolucci and Pierce study presents data taken from mentally retarded subjects having a mean chronological age of 10.5 and a mean mental age of 6.0.

As phonological rule theory relates to the articulation patterns of the mentally retarded, relatively few studies are available, and the data are limited. As demonstrated above, the existing phonological studies designed to describe the articulation of the retarded have focused primarily upon children. Therefore, there is a need for an investigation of the phonological systems of mentally retarded adolescents, who may present more complete or stable phonological systems than mentally retarded children. The present investigation was directed toward meeting such a need. The study was designed to describe the phonological processes of adolescent Down's syndrome subjects as well as mentally retarded adolescents not having the syndrome. The study utilized nonstandardized description of processes used by the subjects. Descriptive studies seem best suited to the investigation of phonological processes; Bloom and Lahey (1978) state that nonstandardized, descriptive elicitations are preferred when an investigator wishes to observe specific aspects of a child's behavior rather than to compare the child with normative data. Weiner (1979) advocates the use of descriptive tools, stating that they are

". . . not to be used to determine whether a speaker meets some basic standard. Instead [they are] designed to provide a clearer understanding of the speech patterns of children with communication problems" (p. 1). Weiner further states that the establishment of normative data on phonological process use would be extremely difficult, considering the infinite number of possible process combinations. To date, no standardized tests of phonological development are available. In designing the present descriptive study it was thought that information gathered through the study would contribute to a broader understanding of the phonological problems of the retarded and would lead to more effective therapeutic management of phonological disability among mentally retarded individuals.

CHAPTER II

REVIEW OF THE LITERATURE

The communication problems of mentally retarded individuals have been of interest to speech-language pathologists for many years. Articulation problems of the retarded have comprised a significant part of this interest. Existing techniques for the analysis of articulation reflect three major approaches to the study of articulation, which include the traditional method, the distinctive feature method, and the phonological process method. The purpose of this study was to utilize phonological process analysis in describing the articulation of mentally retarded adolescents. This chapter is composed of a review of literature pertinent to the development of phonological rule theory and to the analysis of articulation skills in mentally retarded individuals. The literature reviewed in relation to phonological theory will include a review of current major phonological theories, a description of the development of phonological terminology, and characteristics of normal and deviant phonological development in children. The literature reviewed in relation to articulation skills of the mentally retarded will include an

outline of traditional studies and a discussion of phonological studies.

Theories of Phonological Development

Phonology has been described as a study of ". . . the way in which the sounds and prosodic features defined by phonetics are actually used in natural languages" (Sommerstein, 1977, p. 1). The development of the phonological system is one of a large number of areas of investigation which comprise the organizational structure of phonology. Phonological theories are many and varied in their approaches to the study of sound in languages. As a guide to the evaluation of phonological theory Ferguson and Garnica (1975) state criteria necessary for the construction of a complete phonological theory:

> A theory of phonological development that is both comprehensive and explanatory must meet at least the following four requirements. It must account for the development of all the characteristics of an adult phonology as specified by a given phonological theory. It must account for known facts of phonological development that are not included in the characterization of adult phonology by existing theories. It must be consistent with a broader theory of language development and be relatable to theories of other aspects of child development. It should make principled predictions that can be empirically verified. (p. 155)

Ferguson and Garnica discuss four types of phonological theory in relation to these criteria. They are the behaviorist theory of Mowrer, the structuralist theory of

Jakobson, the naturalist theory of Stampe, and the prosodic theory of Waterson.

Behaviorist Theory

Mowrer's theory, referred to by its originator as the "autism" theory, was developed in the late 1940s and remains a well-known theory of sound acquisition among speech-language pathologists and psychologists. The theory places strong emphasis upon learning theory and establishment of a positive relationship between a child and his caretaker. Mowrer describes the initial step in sound development as the identification of the child with his caretaker. The child then pairs vocalizations made by the caretaker with reinforcers such as food, hugging, or patting. Next, the child's own vocalizations provide reinforcement because of their similarity to those of the caretaker. The child then selectively reinforces those sounds which are most like those of the caretaker. It is due to the concept of the child's self-reinforcement that Mowrer selected the term "autism" to describe his theory (Ferguson & Garnica, 1975).

Though the theory lacks support from empirical data, and in fact indirectly conflicts with data provided by Lenneberg, Rebelsky, and Nichols (Ferguson & Garnica, 1975), it still enjoys popularity, probably

because of its ties with a theory of learning which has been used to explain the development of other nonspeech skills (Ferguson & Garnica, 1975).

Variations of Mowrer's theory are found in the works of Murai and of Olmstead (Ferguson & Garnica, 1975). Murai contributes to the autism theory (a) the belief that the psychological systems for early comprehension and production are disparate and (b) the theory that a child's early vocalizations represent actions or objects. Olmstead expands Mowrer's theory by adding two ideas: (a) the reinforcing power of a particular sequence is relative to its frequency of utterance by the speech model and (b) the particular sounds which are perceived more easily by the child are learned earlier than those perceived with greater difficulty. Olmstead reports empirical verification for his amendments to Mowrer's theory (Ferguson & Garnica, 1975).

Structuralist Theory

Jakobson has been credited with being the first to originate a phonological theory based on structural linguistic laws governing sound development. Jakobson's theory describes two discontinuous periods in childhood sound development--the babbling period and the acquisition of meaningful language, during which the child learns the

sound contrasts present in his language. Jakobson differentiates between sounds used during the babbling period, having no linguistic value, and those used during language development, "possessing distinctive linguistic value" (Ferguson & Garnica, 1975, p. 163). The learning of sound contrasts begins with sounds of maximal contrast, such as the labial consonant /p/ and the wide vowel /a/. The child's repertoire of contrasts then expands to include more subtle and more specific contrasts, until the contrast inventory is completed. The Jakobsonian model describes only sound contrast acquisition and does not deal with other aspects of speech, such as stress and intonation.

Those who have supported Jakobson's theory include Ferguson and Farwell (1975), Velten (Ferguson & Garnica, 1975), and Schvaklin (Ferguson & Garnica, 1975). However, criticism of the theory has been voiced by Blount (Ferguson & Garnica, 1975) and Cruttenden (1970), who disagree with Jakobson's separation of the babbling period and the language acquisition period. Blount and Cruttenden argue that a gradual transition takes place between the two periods.

Another theory which may be considered as structural is that of Moskowitz (1970). Moskowitz modified the Jakobsonian model of phonological acquisition and incorporated ideas from Chomsky and Halle's theory (1968) into

her theory. The Moskowitz theory describes a child's phonological development as beginning with the mastery of sentence intonation during the babbling period. After mastering this aspect of speech the child directs his attention to smaller units of speech. He learns to represent words using syllables made up of consonants and vowels (CV), vowels and consonants (VC), and vowels alone (V). Initially, all syllables are CV types. The child expands his use of the syllable through the process of reduplication (CVCV) and begins to combine various consonant and vowel phonemes in his reduplication patterns; i.e., /kiti/, /mami/. In this way the child distinguishes the phone as a unit of sound and learns distinctions between consonant and vowel sounds. The child develops his phonetic inventory rapidly and in the order prescribed by Jakobson (Ferguson & Garnica, 1975).

Naturalist Theory

The naturalist theory of phonological development expressed in the work of Stampe (Ferguson & Garnica, 1975) reflects influences of the generative theory of Chomsky and Halle (1968). Stampe's natural phonology theory is based upon a system of innate, universal rules which govern sound production of the post-babbling period. These innate rules reflect the natural restrictions of the human speech

mechanism; that is, the innate rules result in the production of sounds which are least stressful and most efficient for the speech mechanism. Through exposure to adult speech the child begins to modify his innate system to allow the production of sound sequences which are more taxing to the speech mechanism. The child modifies or revises his system by totally suppressing processes, by limiting processes to specified phonemes or specified sound contexts, and by ordering processes, so that one process may have priority over another, or one process may be used only in the absence of another. According to Stampe, the innate system of the child and the three ways of modifying it (total suppression, limitation, and ordering of processes) account for all stages of sound development in children and can explain all the steps in sound development outlined by structuralists such as Jakobson. Stampe disagrees with Jakobson's idea of a unique phonological system for children, believing that children develop sound systems by continually attempting to achieve adult phonology.

Prosodic Theory

Waterson's prosodic theory (1971) places emphasis upon the early period of sound development in children, which takes place before age two. Prosodic theory assumes that sounds are perceived selectively according to their

degree of perceptual salience. It also assumes that speech input to the child plays a major role in the sounds he develops. General characteristics of the theory include the following:

1. The child attends to adult utterances having high degrees of perceptual salience. He does not perceive subtle phoneme variations.

2. The child perceives utterances as complete units, not breaking them down into individual segments, or phonemes. He may not perceive phonetic features in the sequence in which they occur.

3. The child uses particular phoneme combinations and syllable structures to represent many adult words having similar perceptual features.

4. As the child develops his production skills, he tends to use most frequently those sounds already in his phonetic inventory, or those most strongly or frequently articulated in adult utterances.

5. Children develop many like sounds early in the acquisition process because those sounds are motorically more easy to produce; however, variety in the order of sound acquisition occurs among children due to the variety of sound environments to which children are exposed.

The prosodic theory is attractive to phonologists because it offers explanation for the variety in a child's subsitutions, and for the child's omission or replacement of sounds in certain contexts which he uses properly in other contexts. Limitations of the theory include a lack of predictions concerning order of sound acquisition or sound errors, and a limited data base (Ferguson & Garnica, 1975).

Development of Phonological Terminology

The term "phonological rule" was first used by Chomsky and Halle in The Sound Pattern of English (1968) as part of a general theory of grammar. The Chomsky and Halle theory regards phonemes as abstract psychological concepts which exist within man's phonological system at a deep, underlying level of meaning and also at a surface level of representation from which the phonemes are transformed into the physical and acoustical realities of the speech signal. Chomsky and Halle's phonological rule is responsible for the changing of the deep, underlying form of a phoneme into its surface structure representation. The phonological rule is comparable in function to Chomsky and Halle's grammar rule, which transforms the underlying linguistic meaning of an utterance into its surface

representation. Chomsky and Halle's phonological rule functions as part of the adult phonological model.

In contrast, Stampe (Ferguson & Garnica, 1975) uses the term "phonological rule" to designate a key aspect in a childhood production model. His phonological rules state the conditions under which various phonemes may be produced by the child. Stampe also uses the word "process" to describe the phonological rule. This apparent equation of the terms "rule" and "process" may also be observed in the work of Ingram (1974, 1976). Ingram uses the terms interchangeably on various occasions to describe patterns in child phonology.

Shriberg and Kwiatkowski (1979) make a distinction between phonological rules and phonological processes. They describe rules as specific descriptions of sound change and processes as general categories under which many rules may be organized. They state that processes "capture similarities in otherwise dissimilar surface behaviors" (p. 11).

Ingram adopts the naturalist viewpoint of Stampe, combined with some of the structuralism of Jakobson (1968), to describe a set of phonological processes for children. He organizes the processes according to certain tendencies, or regular patterns, which the child may use in producing

words. These include syllable structure tendencies, assimilation tendencies, and substitution tendencies.

Syllable structure tendencies are those which simplify adult syllables into sound configurations which are compatible with the child's system, and therefore are more easily produced. The following processes are among those used to simplify syllable structure.

Deletion of final consonants: A common and early-occurring process is that of deleting final consonants in words, especially in CVC syllables, resulting in easily-produced CV syllables.

Deletion of unstressed syllables: This process is also referred to as Weak Syllable Deletion (Weiner, 1979). It describes the child's omission of unstressed syllables in words of two or more syllables.

Reduplication: The reduplication of a syllable (/mama/, /baɪbaɪ/) is a process which occurs early in the acquisition process. Total reduplication and partial reduplication may occur.

Consonant cluster reduction: Children frequently attempt to simplify syllables by deleting one or both of the phonemes in a consonant cluster (block → /bɑk/ or /ɑk/). In reducing clusters the child usually deletes the marked

member of the cluster, that is, the phoneme which is the more difficult of the two to produce.

Assimilation processes, sometimes referred to as harmonization processes (Weiner, 1979), achieve the effect of making syllables within words more similar. Assimilation, or harmony, takes place when a phoneme substitution is influenced by the sound environment of the phoneme being substituted, i.e., tiger → /gaɪgr̩/, the substitution of /t/ being determined by the later-occurring /g/. In this way syllable harmony is accomplished. Assimilation can occur in relation to place of articulation, as illustrated above, and also in relation to manner of articulation, where a stop may become a fricative, as in bush → /vʊʃ/, or to voicing, as in the case of devoicing of final consonants, pig → /pɪk/ (Ingram, 1976).

Substitution tendencies are realized by processes which result in substitutions not influenced by sound environment (Ingram, 1976). Weiner (1979) describes these processes as feature contrast processes, emphasizing the classification of context-free substitutions according to the contrast in distinctive features used. Some frequently-used substitution processes, according to Ingram, include the following:

Stopping: substitution of a stop for a sound produced in a contrasting manner (shoe → /tʊ/).

Fronting: velar and alveolar sounds are replaced with sounds produced more anteriorly (duck → /dʌt/).

Denasalization: nasal sounds are replaced by homorganic denasal sounds (moon → /bud/).

Gliding of Liquids: liquids are replaced by glides (red → /wɛd/).

Vocalization: consonants, especially syllabic /r/ and /l/ phonemes, are replaced by vowels (table → /tebo/).

Neutralization: all vowels are replaced by a single vowel, frequently one of the neutral vowels, /ʌ/ or /ə/.

Deletion: reflects omission of sounds regardless of context or location in words. Ingram states that children frequently delete sounds before attempting them.

Although the substitution processes listed above are frequently-occurring ones, they describe only a limited number of possibilities for substitution. Potentially, as many substitution processes are possible as are contrasts among distinctive features.

An alternative set of phonological processes is proposed by Shriberg and Kwiatkowski (1979), who describe

their processes as "natural," meaning that they meet the following criteria:

1. a relatively more complex underlying structure becomes a less complex surface structure;

2. the process exists as a phonological phenomenon in the various natural languages used throughout the world; and

3. the process involves only those sounds that are phonemic (used to signify meaning) in the language of the child exhibiting the process.

Because of these stringent criteria, a relatively small number of processes make up the set:

1. Final Consonant Deletion
2. Velar Fronting
3. Stopping
4. Palatal Fronting
5. Liquid Simplification
6. Assimilation
7. Cluster Reduction
8. Unstressed Syllable Deletion

The phonological systems of Ingram and of Shriberg and Kwiatkowski attempt to describe phonological behavior in children. However, the adequacy of these descriptive systems is as yet unproven and will depend upon further

research, particularly of a longitudinal nature, for validation.

The present study draws upon ideas from both descriptive systems. The phonological process as used in this study corresponds with Shriberg and Kwiatkowski's idea that the process is a general category of sound change encompassing numerous specific phonological rules. Ingram's syllable structure, assimilation, and substitution tendencies are used to organize processes.

Normal Phonological Development in Children

In recent years a number of phonological studies have been completed which describe the sound acquisition process of normally developing children. These studies discuss many aspects of the acquisition process, from the earliest utterances of infants to the refinement of speech in pre-adolescents. Ingram (1976) has divided the phonological acquisition period into several stages which will be used here to lend organization to the description of the acquisition process and to the literature discussed. Ingram's stages describe (a) the babbling period; (b) the first 50 words; (c) the simple morpheme; (d) completion of the phonetic inventory; and (3) morphophonemic development.

The Babbling Period

The early sound development of children begins with babbling, a stage in phonological development which is considered to be highly controversial (Ingram, 1976). Jakobson's sound acquisition theory separates the babbling period from other stages of phonological development, claiming that it does not contribute to later sound acquisition. Although conclusive data are still unavailable, the studies of Blount (Ingram, 1976); Irwin (Ingram, 1976); and Oller, Weiman, Doyle, and Ross (Ingram, 1976) suggest that babbling may be both structured and purposeful and may influence the development of later phonological patterns.

The First 50 Words

Ingram defines the period of the first 50 words based upon the observation of Nelson (Ingram, 1976) that at about the age of one year the child acquires a vocabulary of approximately 50 words which remains stable in size for about a six-month period, then expands rapidly. Jakobson (1968) and Jakobson and Halle (1956) provide the most complete description of this period, based on analysis of diary studies. Jakobson describes the period as having the following characteristics:

1. The first words are composed of CV or CVCV syllables.

2. Labial consonants, commonly /p/ and /m/, are used prior to other consonants.

3. Alveolar consonants, such as /t/, are acquired next, followed by velars, such as /k/.

4. The early acquisition of vowels begins with /a/, with the subsequent addition of /i/ and /u/.

5. Early consonant acquisition includes fricatives only if stops produced in the same place of articulation have been acquired (Ingram, 1976).

Studies completed since the publication of Jakobson's work have added some additional characteristics to the acquisition pattern. Ferguson and Garnica (1975) add that /h/ and /w/ are often acquired early, and that in addition to the use of labials, some children exhibit preference for velar sounds. Ingram notes that VC structures are also found among early syllables, with occasional use of CVC. He also states that dental sounds, such as /t/, /d/, and /s/, are often used as early as labials.

Ferguson and Farwell (1975) emphasize the importance of individual vocabulary items in a child's phonological development. They claim that the pattern of acquisition in a given child may be greatly influenced by the particular words he learns. They also state that the converse is true for some children. That is, vocabulary

acquisition may be influenced by a child's preference for words containing certain sounds.

In general, Jakobson's predictions about sound acquisition during the period of the first 50 words has been found to be fairly accurate. Subsequent studies have suggested that individual differences among children are very important factors in sound acquisition, and that structural laws such as those reported by Jakobson are better regarded as general tendencies.

The Simple Morpheme

The period of development of the simple morpheme, ages 1.6 to 4.0, begins with a rapidly expanding vocabulary and the onset of two-word utterances. It culminates in the development of complex sentences and the mastery of syntax. It is during this period that the child experiences a great deal of phonological growth and transition as he molds his immature phonological system into a more mature one (Ingram, 1976).

The status of phonemic perception during this period is not entirely known. Certain investigators (Edwards, 1974; Garnica [Ingram, 1976]; Schvaklin [Ingram, 1976]; Waterson, 1971) maintain that phonemic perception is gradually acquired, its acquisition taking place throughout the course of sound acquisition, generally preceding

production. Other investigators are of an opinion which currently enjoys greater popularity, that perception is completed at an early age (Berko & Brown, 1960; Smith, 1973). The subject of phonemic perception remains a debatable one at present (Ingram, 1976).

During the period of development of the simple morpheme, a multitude of phonological processes are acquired, used, and then discontinued by the child. The number and description of these processes are as unlimited as the children who use them, but certain common characteristics among processes can be observed. Processes usually function to accomplish syllable structure simplification, assimilation, or substitution. Processes may be seen to correspond with specific age groups, manifested in evolutionary fashion. Early-occurring processes are active for a time, subsequently giving way to later-occurring ones. Eventually the later-occurring processes evolve into what is considered to be adult articulation (Ingram, 1976).

Ingram describes several syllable structure processes which are apparent in the phonological systems of normal children. These are Deletion of Final Consonants, Weak Syllable Deletion, and Consonant Cluster Reduction. Final consonants are deleted early in this developmental

period, actually as a continuation of the CV trend in the previous period, that of the first 50 words. Ingram records final consonant deletion as spanning a period from age 1.6 to about 3.0.

Weak Syllable Deletion is another early process which normal children display. Smith (1973) describes its use in his son's phonological development from about age 1.0 to age 3.0.

Greenlee (Ingram, 1976) observes that Consonant Cluster Reduction is employed in normal phonological patterns, beginning around the age of 2.0 with total elimination of the cluster, i.e., green → /in/. At about age 2.4 to 2.7 or 2.8 (Smith, 1973) partial reduction may be seen, i.e., green → /gin/. Greenlee describes substitution for a member of the cluster then follows at about 2.7 to 3.0; for example, green → /gwin/. The member to be substituted is usually a marked, or more difficult to produce member, although unmarked members are sometimes deleted (Ingram, 1976). After the age of 3.0 clusters tend to be produced with greater accuracy.

Normally developing children may also exhibit processes of assimilation, or harmonization. According to Ingram, assimilation may be either contiguous, meaning that a consonant or vowel effects the substitution of another

consonant or vowel next to it, or noncontiguous, meaning that a consonant or vowel effects the substitution of another consonant or vowel which is not next to it.

Contiguous assimilation processes such as Final Consonant Devoicing (the devoicing is considered to be influenced by the silence following the final consonant) and Provocalic Voicing are demonstrated by Velten (Ingram, 1976) as occurring early in the simple morpheme period, at about 1.9 to 2.0. Leopold (Ingram, 1976) reports an occasion of a consonant being influenced by a back vowel, resulting in soap → /ok/, occurring at about 1.10. Other assimilatory processes include the weakening of stops, harmonization with labial glides in examples such as truck → /fwʌk/, and nasalization of vowels, such as sun → /sʌ̃/, both occurring before age 3.0 (Ingram, 1976).

Noncontiguous assimilation occurs in normal phonological development most frequently as Back Assimilation, referred to by Weiner (1979) as Velar Assimilation and by Smith (1973) as Velar Harmony, and Labial Assimilation. In Back Assimilation a non-back phoneme, usually alveolar, harmonizes with a velar phoneme, resulting in patterns such as tiger → /gaɪgr̩/. Labial Assimilation involves a back phoneme becoming like a front phoneme, i.e., bottle → /bɑbl̩/. Noncontiguous assimilatory processes are usually early-occurring processes.

Substitution processes also make up normal phonological development. These sound changes not influenced by neighboring sounds usually begin at about age 1.5 with total deletion of sounds. In the development of obstruents, sounds which are produced by obstruction of the outgoing breathstream, a process of Stopping of Fricatives is frequently the next step after total deletion. This process, along with Gliding of Fricatives, tends to occur around 2.2 to 2.5 (Smith, 1973). Fronting may also be seen in conjunction with Stopping. Fronting may be used as early as 1.5 (Ingram, 1976) or as late as 3.0 to 3.5 (Smith, 1973). The child may then substitute sounds within feature classes, and then develop correct pronunciation. The evolution of obstruents is a process which may require several years to accomplish (Ingram, 1976).

Nasals may also be affected by substitutions. Although an infrequently-occurring process which many children never use, denasalization may occur, resulting in the substitution of nasal sounds by homorganic denasal sounds.

Edwards (Ingram, 1976) demonstrates the treatment of liquids by normal children. She describes the substitution of liquids in three aspects: Stopping of Liquids, Gliding of Liquids, and Replacement of one liquid for

another. Ingram shows Gliding of Liquids to occur at about 1.9 to 2.2; Smith shows Replacement at about 2.5. Other substitutions described by Velten (Ingram, 1976) include occasional, early Frication of Glides, Vocalization, and Neutralization.

Syllable structure processes, assimilation processes, and substitution processes are active during the period of the simple morpheme. Combinations of several processes may also be seen during this period (Ingram, 1976).

Completion of the Phonetic Inventory

Ingram describes the period from 4.0 to 7.0 as a period in which refinements in the sound system take place, along with completion of the phonetic inventory. Most of the phonological processes active in the previous period are no longer active. However, errors still occur in the correct sequencing of sounds in longer words.

Morphophonemic Development

Morphophonemic development is described by Ingram as the learning of sound changes necessary for the combination of morphemes. Examples of morphophonemic development include the vowel shifts necessary in changing the word "conceive" to "conception," and the consonant changes

brought about in changing the word "benefit" to "beneficial." Research by Atkinson-King (Ingram, 1976) and Moskowitz (Ingram, 1976) shows that this development begins about age 5.0, with a rapid period of development between the ages of 7.0 and 12.0. Therefore, it can be seen that phonological development is a complex process which may require as many as 12 years for completion.

Deviant Phonological Development

A number of studies have described deviant phonological systems in children. These include the works of Compton (1970), Edwards and Bernhardt (Ingram, 1976), Haas (1963), Lorentz (Ingram, 1976), Oller (1973), and Pollack and Rees (1972). The findings reported in these studies demonstrate that the term deviance may be manifested in several ways. Ingram (1976) states that a deviant child's phonological system may differ from a normal child's in terms of the specific processes used, the frequency or duration of their use, the order in which processes appear, and the use of sounds as contrasts.

Ingram states three possible positions on phonological deviance; these are:

1. Deviant children use the same types of processes as do normal children, but at a slower rate;

2. Deviant children use the same processes as normal children, but use them differently; certain processes persist long after they normally would be expected to have disappeared, and other processes which are considered to be uncommon in normal children show common use by deviant children; and

3. Deviant children use some of the processes reported for normal development along with some which are not seen in normal children; deviant children use certain processes persistently, or past the time of expected disappearance.

Much of the literature concerning phonological deviance is regarded as supportive of the second position in regard to the type and use of processes. Edwards and Bernhardt and Oller state that the phonological rules used by the deviant children in their studies appeared to be much the same as those used by normal children. Edwards and Bernhardt further state that infantile processes (such as Prevocalic Voicing) may be seen to coexist along with other, more mature processes in the phonological systems of the deviant children studied, so reflecting persistent use of normal processes. Edwards and Bernhardt, Lorentz, Oller, and Pollack and Rees demonstrate the common use of uncommon processes such as lateral fricatives, and nasal

and fricative preferences. Compton also demonstrates the persistent use of processes in deviant phonological systems.

In describing the characteristics of deviant systems, Edwards and Bernhardt and Lorentz reach opposing conclusions concerning number and consistency of processes. Edwards and Bernhardt conclude that deviant children exhibit more processes than do normal children, with a great deal of inconsistency. Conversely, Lorentz finds that deviant children show consistent use of a few processes. Ingram reconciles the two positions by pointing out that the Edwards and Bernhardt study used children whose speech was highly unintelligible. Lorentz used children who were relatively more intelligible. Ingram suggests that the number and consistency of processes used is related to intelligibility; that is, the child with greater intelligibility will display a few consistent processes, while the child with poor intelligibility will use many inconsistent processes. Further research will provide more conclusive resolution to the descrepancy of these opposing views.

The use of sounds as contrasts has been described by Ingram as a difference in normal and deviant phonological systems. For example, normal children who display

deletion of final consonants may distinguish between two words such as pig → /pɪ/ and pick → /pɪ/ by using a lengthened vowel to denote voicing in the word "pig." The lengthened vowel may be said to have contrastive value. Ingram reports evidence of this ability in normal phonological development. However, deviant children do not appear to demonstrate the ability to use sounds as contrasts effectively. The result of such inability is that numerous homonyms frequently occur in deviant phonological systems, wherein numerous words are represented by a single form: butter, letter, ladder → /dado/ (Ingram, 1976). Use of homonyms in this manner by deviant children is reported by Ingram (1976) and by Edwards and Bernhardt (Ingram, 1976).

Articulation Skills of the Mentally Retarded

Traditional Studies

Numerous studies have been conducted in order to determine the incidence and characteristics of articulation disorders in the mentally retarded. Among these are studies by Bangs (1942); Irwin (1972); Karlin and Strazzulla (1952); Schlanger (1953); Schlanger and Gottsleben (1957); Martyn, Sheehan, and Slutz (1969); and Wilson (1966). Incidence figures range from 38% to 79%, depending

on the ages, intelligence level, or number of subjects used, or upon the setting or the type of clinical subgroup, such as Down's syndrome, used (Keane, 1972). These studies employed a single-phoneme approach to the analysis of articulation skills.

Bangs (1942) reports the phonemes (θ, l, d, dʒ, r, k, s, t, v, ʃ, and tʃ) as being among the most frequently misarticulated by the mentally retarded children he studied. The Bangs study concludes that mentally retarded children display more final omissions than do normal children, and occasionally show some bizarre substitution patterns. With the exception of these findings the study concludes that the errors presented by mentally retarded children are not unlike those of normal children.

Karlin and Strazzulla (1952), using subjects with chronological ages between 3 and 14 years, and Schlanger (1953), using subjects between the chronological ages of 8 and 16, also describe articulation errors of the mentally retarded. They report that the most frequent errors made by the group were made for fricatives and liquids.

Irwin (1972) tested mentally retarded individuals between the chronological ages of 3 and 16 and found that among educably mentally retarded and trainably mentally retarded subjects the educably mentally retarded subjects

made more substitution errors, and the trainably mentally retarded subjects made more omission errors. Irwin's findings are supportive of Bangs' statement that final omission errors are a significant part of the articulation problems of the mentally retarded. Irwin states that the articulation of the educably mentally retarded group is similar to the normal population, but the trainably mentally retarded group differs from the normal group quantitatively and qualitatively.

Matthews (1971) points out that Irwin's study is alone among traditional studies in claiming that the articulation problems of the mentally retarded are different from the nonretarded population. He states that all other studies lend support to the theory that mentally retarded individuals have articulation problems similar in kind to the nonretarded population, differing only in the incidence of errors, which is higher for the retarded population.

The authors of traditional studies are in general agreement that the articulation errors of mentally retarded individuals are not significantly different from articulation errors made by the normal population. The omission of final consonants appears to be a recognizable trend in the articulation patterns of the retarded, accompanied by

the occasional use of bizarre substitutions. The frequency of errors is reportedly higher for the retarded population than for the nonretarded population.

Phonological Studies

Two recent studies have attempted to describe the articulation skills of mentally retarded individuals in terms of phonological processes. These are the investigations of Dodd (1976) and of Bartolucci and Pierce (1977).

Dodd completed a study comparing the phonological systems of mental age matched normal, severely subnormal, and Down's syndrome children and young adolescents. The mentally retarded subjects used in the study had chronological ages between 6.6 and 15.2 and mental ages between 2.5 and 4.7. Dodd organized the subjects' spontaneous and imitative responses to picture stimulus items in terms of cluster reduction processes, consonant harmony processes, and systematic simplification processes. Her findings indicate that for initial-trial spontaneous responses the nonsyndrome subjects performed comparably to normal subjects in realization of most processes. Down's syndrome subjects, however, performed much more poorly than either of the other two experimental groups. The syndrome subjects made significantly more errors, and displayed more error types than the other groups, which Dodd interprets

as greater inconsistency in errors. Dodd also reports that syndrome subjects performed better on imitation tasks than on spontaneous naming tasks.

Bartolucci and Pierce (1977) compared normal, autistic, and mentally retarded subjects. The mentally retarded subjects in their study were identified as children having intellectual abilities within the mildly retarded range (IQ scores 52-67). The mean chronological age for the retarded subjects was 10.52, and the mean mental age was 6.08. In compiling production data the examiners administered a picture naming task to each subject. The production data reveals that the mentally retarded subjects made a greater number of errors on fricatives and affricates than on stops, nasals, and liquids. The investigators conclude that their data concerning phoneme class mastery are compatible with normative data (Bartolucci & Pierce, 1977).

The findings of these studies describe the mentally retarded population as producing a greater number of articulation errors than the normal population, but not as having phonological systems significantly different from normally developing children of like mental ages. The exception is found in Dodd's data concerning Down's syndrome subjects, whom she describes as producing a greater

number of error types and, therefore, more inconsistent errors than normal or nonsyndrome retarded subjects.

CHAPTER III

RESEARCH DESIGN

The purpose of this study was to examine, by means of phonological process analysis, the articulation patterns of eight moderately mentally retarded adolescent males classified by a traditionally-based articulation test as being severely articulation-impaired. The eight subjects, four of whom presented Down's syndrome and four of whom did not present a syndrome, were administered the Arizona Articulation Proficiency Scale--Revised (AAPS-R), a test instrument based on a single-phoneme, sound-specific approach to articulation problems. Two examiners used the results of the AAPS-R administration to classify each of the subjects tested according to degree of articulatory impairment. The eight subjects, all of whom received a severe rating from the AAPS-R administration, were administered the Phonological Process Analysis (PPA), a descriptive tool which aids in the analysis of phonological processes. Results of the PPA analysis of each child's articulation patterns were compared to determine the existence of specific phonological processes and to discuss possible similarities and differences in processes among the patterns sampled.

Research Questions

The following research questions were formulated:

1. What specific phonological processes can be identified within the articulation patterns of moderately mentally retarded adolescents classified by a traditionally-based articulation test as being severely articulation-impaired?

2. What phonological process similarities and differences can be identified among moderately mentally retarded individuals presenting Down's syndrome and individuals presenting moderate mental retardation without any specific syndrome?

3. What comparisons can be made among the phonological processes identified for mentally retarded adolescent subjects and processes associated with normal and deviant phonological development as reported in current literature?

Subjects

Eight moderately mentally retarded adolescent males, ranging in chronological age from 14.5 years to 20.10 years and ranging in mental ages from 6.4 years to 12.3 years, were used in the study. Intelligence quotients (based upon recent administration of the Wechsler Intelligence Scale

for Children--Revised [WISC-R], the Wechsler Adult Intelligence Scale [WAIS], or the Stanford-Binet Intelligence Scale [SBIC]) ranged from 36 to 59. (A listing of chronological ages, mental ages, intelligence quotients, and AAPS-R scores for all subjects is included in Table 1.) Four subjects presented Down's syndrome and four did not. No subjects presented gross motoric or sensory abnormalities, and all were free of significant hearing loss. All subjects attended the Garland Cooperative Training Center, Garland, Texas.

Tests

The Arizona Articulation Proficiency Scale--Revised (AAPS-R) (Fudala, 1974) was used to confirm degree of articulatory impairment of the subjects. The AAPS-R is a numerical scale of articulation proficiency, based on frequency of occurrance of sounds in American speech. The AAPS-R, a sound-specific test, elicits single-word naming responses to picture stimulus items and evaluates single phonemes in initial and final positions of words.

The Phonological Process Analysis (PPA) (Weiner, 1979), a descriptive tool, was used to aid in describing phonological processes present in each subject's speech. The PPA elicits articulatory responses from action pictures, not from pictures of objects. The PPA samples responses in single-word and sentence contexts, using delayed imitation

TABLE 1

CHRONOLOGICAL AGE (CA), MENTAL AGE (MA), INTELLIGENCE QUOTIENT (IQ) AND ARIZONA ARTICULATION PROFICIENCY SCALE--REVISED (AAPS-R) SCORES FOR SUBJECTS

Subject	CA	MA[a]	IQ[b]	AAPS-R[c]
Down's syndrome				
1	17.8	6.4	36 (WISC-R)	63.5
2	14.5	6.5	45 (WISC-R)	66.5
3	18.6	8.5	46 (WISC-R)	67.0
4	17.6	7.3	42 (SBIC)	70.5
Nonsyndrome				
5	16.3	8.0	49 (WISC-R)	68.5
6	20.10	12.3	59 (WAIS)	66.0
7	18.8	8.4	45 (WISC-R)	77.0
8	19.1	8.6	45 (WISC-R)	69.0

[a]Mental ages were derived by ratio IQ formula.

[b]Abbreviations in parentheses indicate intelligence test used to compute IQ: Wechsler Intelligence Scale for Children--Revised (WISC-R), Wechsler Adult Intelligence Scale (WAIS), or Stanford-Binet Intelligence Scale (SBIC).

and sentence recall, and organizes stimulus items according to phonological process, not according to individual sound.

Examiners

Two examiners recorded articulatory data during test administration. The primary examiner, a graduate-level speech-language pathology student, administered the AAPS-R and the PPA. The second examiner, a holder of the Certificate of Clinical Competence awarded by the American Speech-Language-Hearing Association, transcribed responses during administration of the AAPS-R and the PPA for the purpose of establishing reliability.

Transcription

In administration of the AAPS-R individual phoneme errors were marked as they occurred within the stimulus items. Examiners used the International Phonetic Alphabet to transcribe selected subject responses to the PPA. Broad (phonemic) transcription, i.e., pooling all allophonic variations (Singh & Singh, 1976), was used in PPA recording except on occasions when allophonic variation was considered by the examiners to be an important component of the response being transcribed. On such occasions narrow (phonetic) transcription, i.e., distinguishing all allophonic variations of a phoneme (Singh & Singh, 1976), was employed.

Test Procedure

Eight moderately mentally retarded adolescent males, ranging in chronological age from 14.5 to 20.10 years, and ranging in mental age from 6.4 years to 12.3 years, were selected by the staff speech-language pathologist at the Garland Cooperative Training Center as suitable candidates for the study, meeting preliminary articulation and language requirements. That is, all subjects could produce word combinations, and all presented poor articulation skills.

The primary examiner administered the AAPS-R to each of the subjects as a means of (a) subject articulatory classification and (b) verification of the staff speech-language pathologist's judgment of articulatory severity. The subjects provided single-word naming responses to picture stimulus items; both examiners recorded phoneme errors as they occurred. The errors were counted and an AAPS-R severity score was computed for each subject. The subjects, all of whose scores fell within the severe range of articulatory impairment on the AAPS-R scale (according to mental age), were administered the PPA.

In PPA administration responses may be elicited from subjects using any of four response modes: single-word naming, sentence completion, whole sentence repetition,

and imitation. The recommended procedure for administration of the PPA includes sampling stimulus items in sentence-completion and whole-sentence contexts. The examiners modified the procedure in the present study, eliciting responses using any of the four available response modes. The examiners recorded the subjects' first transcribable responses, regardless of elicitation mode or number of trials. However, regarding the subjects' initial responses as most indicative of their phonological systems, the examiners endeavored to record for analysis all first responses to the stimulus items. Although response mode was not a controlled variable, it was noted that a large majority of responses were obtained through sentence completion. The examiners avoided the use of imitation, using it only in the event that subjects produced no other type of response.

Analysis Procedure

Analysis of the data centered around description of the following: (1) processes used by the group as a whole; (2) processes used by individual subjects; (3) similarities and differences in processes among Down's syndrome subjects and nonsyndrome subjects; and (4) a comparison of the subjects' processes to normal and deviant phonological development.

The data used for analysis included PPA responses transcribed identically, with respect to consonants, by the two examiners. The PPA is organized into the phonological tendency headings of Syllable Structure tendencies, Harmonization tendencies, and Feature Contrast tendencies, under which various processes are categorized. In the present study Weiner's phonological tendency headings were used, along with some of the processes which make up the PPA. Additional process categories were added to the description to accommodate the patterns in the subjects' responses. The phonological process categories used in the study are listed below. Those processes incorporated from Weiner's classification system are denoted by an asterisk (*).

Syllable Structure Tendencies

* Deletion of Final Consonants
* Consonant Cluster Reduction
  Nasalization of Single Consonants
  Syllable Reduplication
* Vocalization
  Nonfinal Vocalization
* Weak Syllable Deletion
  Deletion of Nonfinal Consonants
* Glottal Replacement

Harmonization Tendencies

* Labial Assimilation
* Alveolar Assimilation
* Velar Assimilation
  Glide Assimilation
  Liquid Assimilation
* Prevocalic Voicing
* Final Consonant Devoicing

Feature Contrast Tendencies

* Gliding of Liquids
* Gliding of Fricatives
  Liquidization of Fricatives
  Liquidization of Glides
* Stopping of Fricatives
  Stopping of Liquids
  Stop-Gliding of Fricatives
  Frication of Stops
  Frication of Affricates
  Frication of Liquids
* Affrication
  Rounding of Liquids
  Nasalization of Liquids
* Fronting
  Backing
  /h/ Replacement

Several descriptive categories were not organized into the above groups and were placed under the heading of Use of Nonstandard Phones. They are listed below.

Use of Nonstandard Phones

/s/ Distortion

/ʃ/ Distortion

Lateralized /s/

Use of /ç/ for Fricatives

Use of /ç/ for Stops

/h/ Addition of Clusters

Use of [θ]

Use of [ŋ]

Shriberg and Kwiatkowski (1979) consider sound distortions and use of nonstandard phones to reflect processes that operate below the phonological level at a sensory-motor, articulatory level. They attribute these errors to articulatory imprecision rather than to phonological deviance. Conversely, Ingram (1976) regards the systematic use of phoneme distortions as phonological phenomena. The viewpoint reflected in the present study is that of Ingram.

Reliability

Tester reliability for the AAPS-R was established by simultaneous and independent transcription of all

stimulus items by both examiners. The two examiners achieved 99% agreement in the identification of error phonemes.

In order to insure tester reliability for the PPA, both examiners recorded responses simultaneously and independently. Responses used in data analysis included those for which the examiners recorded identical consonant phonemes. Thirteen items, or 1% of the sample, were excluded from data analysis because of conflicting transcription between the two examiners.

Summary

This study has involved analysis of data compiled in the following manner:

Eight moderately mentally retarded adolescent males, ranging in chronological age from 14.5 years to 20.10 years, having mental ages between 6.4 years and 12.3 years, with intelligence quotients of 36 to 55, were used in the study. Four subjects presented Down's syndrome and four did not; no subjects presented gross motoric or sensory abnormalities; all were free of significant hearing loss. All subjects attended the Garland Cooperative Training Center, Garland, Texas.

As a classification procedure the subjects were administered the Arizona Articulation Proficiency Scale--

Revised (AAPS-R), a diagnostic tool evaluating individual phonemes in initial and final positions or words, and yielding a numerical indication of articulatory severity. The subjects, all of whose scores fell within the severe range of impairment on the AAPS-R scale, also were administered the Phonological Process Analysis (PPA), a descriptive tool used to aid in describing phonological processes in existence within each subject's speech. Results of the analysis of each subject's responses to the PPA were used to describe phonological processes and to discuss possible similarities and differences among the processes described.

CHAPTER IV

RESULTS AND DISCUSSION

Results

The Phonological Process Analysis (PPA) (Weiner, 1979) was administered to eight moderately mentally retarded adolescent males to sample their articulation patterns. In analysis of the data collected, the investigator attempted to answer the following research questions:

1. What specific phonological processes can be identified within the articulation patterns of moderately mentally retarded adolescents classified by a traditionally-based articulation test as being severely articulation-impaired?

2. What phonological process similarities and differences can be identified among moderately mentally retarded individuals presenting Down's syndrome and individuals presenting moderate mental retardation without a specific syndrome?

3. What comparisons can be made among the phonological processes identified for mentally retarded adolescent subjects and processes associated with normal and

deviant phonological development as reported in current literature?

The phonological data were first organized into descriptive categories as follows: Deletion of Final Consonants, Consonant Cluster Reduction, Nasalization of Single Consonants, Syllable Reduplication, Vocalization, Nonfinal Vocalization, Weak Syllable Deletion, Deletion of Nonfinal Consonants, Glottal Replacement, Labial Assimilation, Alveolar Assimilation, Velar Assimilation, Glide Assimilation, Liquid Assimilation, Prevocalic Voicing, Final Consonant Devoicing, Gliding of Liquids, Gliding of Fricatives, Liquidization of Fricatives, Liquidization of Glides, Stopping of Fricatives, Stopping of Liquids, Stopping of Glides, Stop-Gliding of Fricatives, Frication of Stops, Frication of Affricates, Frication of Liquids, Affrication, Rounding of Liquids, Nasalization of Liquids, Fronting, Backing, /h/ Replacement, /s/ Distortion, /ʃ/ Distortion, Lateralized /s/, Use of /χ/ for Fricatives, Use of /χ/ for Stops, Use of [θ], and Use of [ŋ]. These categories were then grouped according to phonological tendencies described by Weiner (PPA): <u>Syllable Structure</u> tendencies, <u>Harmonization</u> tendencies, and <u>Feature Contrast</u> tendencies. Additionally, the descriptive categories which could not be organized into the above

groups were categorized under the heading of Use of Non-standard Phones. It should be noted that some of the process categories were obtained from the PPA but other process categories were added to accommodate the patterns in the subjects' responses.

The phonological process categories used in the study are listed below. Those processes obtained from the PPA are denoted by an asterisk (*).

Syllable Structure Tendencies

*Deletion of Final Consonants (DFC)

*Consonant Cluster Reduction (CR)

*Initial Stop + Liquid (IS + L)

*Initial Fricative + Liquid (IF + L)

*Initial /s/ Cluster (I/s/CL)

*Final /s/ + Stop (F/s/ + ST)

*Final Liquid + Stop (FL + ST)

*Final Nasal + Stop (FN + ST)

Nasalization of Consonants (NC)

Nasalization of Single Consonants (NSC)

Syllable Reduplication (SR)

*Vocalization (V)

Nonfinal Vocalization (NV)

*Weak Syllable Deletion (WSD)

Deletion of Nonfinal Consonants (DNC)

*Glottal Replacement (GR)

Single Final Consonants (SFC)

Consonant Clusters (CL)

Nonfinal Consonants (NC)

Harmonization Tendencies

*Labial Assimilation (LA)

*Alveolar Assimilation (AA)

*Velar Assimilation (VA)

Glide Assimilation (GA)

Liquid Assimilation (LQA)

*Prevocalic Voicing (PV)

*Final Consonant Devoicing (FCD)

Feature Contrast Tendencies

*Gliding of Liquids (GL-LQ)

*Gliding of Fricatives (GL-FR)

Liquidization of Fricatives (LQ-FR)

Liquidization of Glides (LQ-GL)

*Stopping of Fricatives (ST-FR)

Stopping of Liquids (ST-LQ)

Stopping of Glides (ST-GL)

Stop-Gliding of Fricatives (SG-FR)

Frication of Stops (FR-ST)

Frication of Liquids (FR-LQ)

Frication of Affricates (FR-AF)

*Affrication (AF)

Rounding of Liquids (R-LQ)

Nasalization of Liquids (N-LQ)

*Fronting (FR)

Backing (BK)

/h/ Replacement (/h/-C)

Use of Nonstandard Phones

/s/ Distortion (/s/ DIST)

/ʃ/ Distortion (/ʃ/ DIST)

Lateralized /s/ (LAT /s/)

Use of /ʂ/ for Fricatives (/ʂ/-FR)

Use of /ʂ/ for Stops (/ʂ/-ST)

Use of [θ] (/θ/ USE)

Use of [ŋ] (/ŋ/ USE)

Description of Phonological Processes by Subject Groups

Tables 2-4 present phonological processes identified in the articulation patterns of one or more subjects. Processes of syllable structure, harmonization, and feature contrast are presented for each subject. The percentage figures used in Tables 2-4 reflect the relationship between the frequency of process occurrence in the speech sample and the total number of possible occurrences of the processes.

TABLE 2

USE OF SYLLABLE STRUCTURE PROCESSES BY SUBJECTS

Process	Total n[a]	Number of Errors/Percentage of Total Possible Process Use							
		Down's Syndrome				Nonsyndrome			
		1	2	3	4	5	6	7	8
DFC	118	19/16	24/21	7/6	15/13	63/53	14/12	1/.8	24/20
WSD	9	2/22	1/13	2/25	2/22	1/11	--	1/11	3/33
CR: IS + L	10	2/12	2/20	1/10	1/10	3/30	10/100	--	1/10
CR: IF + L	8	2/25	5/63	5/71	--	1/13	7/88	--	4/50
CR: I/s/CL	12	9/75	--	2/17	--	3/25	12/100	5/45	10/83
CR: F/s/ + ST	5	4/100	5/100	4/80	4/80	5/100	5/100	5/100	5/100
CR: FL + ST	5	2/40	3/60	2/40	2/40	5/100	2/40	3/60	3/60
CR: FN + ST	6	3/50	2/33	4/66	2/33	4/66	5/83	4/66	6/100
CR: NC	5	--	--	--	2/40	2/40	--	1/20	--
Total CR	51	22/43	17/33	18/35	11/22	23/45	41/80	18/35	29/57

TABLE 2--Continued

Process	Total n[a]	Number of Errors/Percentage of Total Possible Process Use							
		Down's Syndrome				Nonsyndrome			
		1	2	3	4	5	6	7	8
NSC	25	3/13	1/4	1/4	2/8	11/44	3/14	3/14	7/28
V	52	22/43	16/31	20/43	23/44	21/40	25/48	22/42	22/42
NV	5	2/40	3/60	2/40	3/60	1/20	3/60	4/80	2/40
DNC	171	2/1	11/7	4/3	2/1	10/6	4/2	1/.6	6/4
SR	51	--	--	--	--	1/2	--	--	--
GR: SFC	103	--	5/5	12/12	10/10	2/2	3/3	--	14/14
GR: CL	46	--	2/4	5/12	5/11	--	--	3/7	2/4
GR: NC	171	1/.6	2/1	1/.6	4/2	--	4/2	5/3	1/.6
Total GR	320	1/.3	9/3	18/6	19/6	2/.6	7/2	8/3	17/5

[a]Total number of possible errors. Individual totals may vary; because of tester reliability requirements some responses were excluded from analysis.

TABLE 3

USE OF HARMONIZATION PROCESSES BY SUBJECTS

Process	Total n[a]	Number of Errors/Percentage of Total Possible Process Use							
		Down's Syndrome				Nonsyndrome			
		1	2	3	4	5	6	7	8
LA	66	--	4/6	--	--	--	--	--	1/2
AA	91	3/3	1/1	1/1	2/2	5/5	--	2/2	1/1
VA	45	9/21	1/2	7/16	--	2/4	2/4	--	1/2
GA	7	--	1/17	1/14	1/14	2/29	--	--	--
LQA	44	1/2	--	--	2/5	--	--	1/2	--
DV	78	18/24	9/12	5/7	--	--	2/3	2/3	1/1
FCD	22	10/46	4/19	6/29	11/50	--	10/46	5/23	4/18

[a]Total number of possible errors. Individual totals may vary; because of tester reliability requirements some responses were excluded from analysis.

TABLE 4

USE OF FEATURE CONTRAST PROCESSES BY SUBJECTS

Process	Total n[a]	Number of Errors/Percentage of Total Possible Process Use							
		Down's Syndrome				Nonsyndrome			
		1	2	3	4	5	6	7	8
GL-LQ	49	16/33	7/15	20/44	17/35	12/22	10/20	11/23	22/45
GL-FR	82	1/1	2/3	--	--	--	--	1/1	--
LQ-FR	82	--	1/1	--	--	--	1/1	--	--
LQ-GL	7	--	--	--	--	1/14	1/14	3/43	--
ST-FR	82	43/49	7/9	10/14	5/6	7/9	6/7	--	4/5
ST-GL	7	--	1/17	--	--	--	--	--	--
ST-LQ	49	--	--	--	--	1/2	--	1/2	--
SG-FR	42	7/17	--	--	--	--	--	--	--
FR-ST	134	--	--	2/2	2/2	--	23/17	2/2	5/4
FR-LQ	49	--	--	--	--	--	--	--	1/2
FR-AF	4	--	1/33	2/50	--	--	1/25	1/25	--

TABLE 4--Continued

Process	Total n[a]	Number of Errors/Percentage of Total Possible Process Use							
		Down's Syndrome				Nonsyndrome			
		1	2	3	4	5	6	7	8
AF	42	4/10	--	--	4/10	--	--	--	--
R-LQ	49	--	--	--	--	--	4/8	--	--
N-LQ	40	--	--	2/5	--	--	--	--	--
FR	222	7/3	--	2/1	6/3	6/3	5/2	2/1	11/5
BK	238	9/4	6/3	11/5	--	5/2	5/2	2/.8	2/.8
/h/-C	202	1/.5	13/7	--	--	14/7	--	--	1/2

[a]Total number of possible errors. Individual totals may vary; because of tester reliability requirements some responses were excluded from analysis.

A number of nonstandard phones are also found to be part of the articulatory patterns of the subjects. Table 5 depicts Use of Nonstandard Phones. Although the standard symbols [θ] and [ŋ] are used, the ways in which they were produced by subjects in the study were non-English variations of these sounds.

Inspection of Table 6 reveals that a number of processes are present in the phonological systems of all of the eight subjects. Of these processes eight are syllable structure processes, and one is a feature contrast process. Three cluster reduction processes, Final /s/ + Stop, Final Nasal + Stop, and Final Liquid + Stop, rank highest in mean percentages for the group as a whole, and each is used in over 50% of total possible use.

Table 7 shows processes used by six or more (75% or greater) of the subjects. Of these 23 processes, 14 are syllable structure processes, four are harmonization processes, four are feature contrast processes, and one is a nonstandard phone. The processes with the highest mean percentages for the group as a whole (i.e., each used in over 50% of their total possible use), include the cluster reduction processes of Final /s/ + Stop, Final Nasal + Stop, Initial /s/ Cluster, Final Liquid + Stop, and Initial Fricative + Liquid.

TABLE 5

USE OF NONSTANDARD PHONES BY SUBJECTS

Process	Total n[a]	Number of Errors/Percentage of Total Possible Process Use							
		Down's Syndrome				Nonsyndrome			
		1	2	3	4	5	6	7	8
/S/ DIST	34	--	--	2/6	16/47	1/3	15/44	--	9/28
/ʃ/ DIST	10	--	1/10	7/88	1/10	1/10	4/40	2/20	7/70
LAT /s/	34	--	1/3	--	--	--	--	--	--
/ç/-FR	82	--	--	--	--	2/2	2/2	--	1/1
/ç/-ST	134	--	--	--	--	4/3	--	--	2/2
[ŋ] USE	268	--	--	25/10	--	--	--	--	--
[θ] USE	241	--	30/13	--	--	--	--	--	7/3

[a]Total number of possible errors. Individual totals may vary; because of tester reliability requirements some responses were excluded from analysis.

TABLE 6

PROCESSES USED BY 100 PER CENT OF SUBJECTS

Process	Mean Percentage ($\bar{X}$%) of Total Possible Errors			
	$\bar{X}$% All Subjects	$\bar{X}$% Down's Syndrome	$\bar{X}$% Nonsyndrome	Tendency[a]
CR: F/s/ + ST	95	90	100	SS
CR: FN + ST	62	46	79	SS
CR: FL + ST	55	45	65	SS
NV	50	50	50	SS
V	42	40	43	SS
GL-LQ	30	32	28	FC
DFC	18	14	22	SS
NSC	16	7	25	SS
DNC	3	3	3	SS

[a]Tendency column reflects phonological tendency realized by process: Syllable Structure Tendency (SS), Harmonization Tendency (H), Feature Contrast Tendency (FC) or Nonstandard Phones Use (NP).

TABLE 7

PROCESSES USED BY 75 PER CENT OR MORE OF SUBJECTS

Process	Mean Percentage ($\overline{X}$%) of Total Possible Errors[a]			
	$\overline{X}$% All Subjects	$\overline{X}$% Down's Syndrome	$\overline{X}$% Nonsyndrome	Tendency
CR: F/s/ + ST	95	90	100	SS
CR: FN + ST	62	46	79	SS
CR: I/s/CL	57.5	46	63.3	SS
CR: FL +ST	55	45	65	SS
CR: IF + L	51.6	53	50.3	SS
NV	50	50	50	SS
V	42	40	43	SS
/ʃ/DIST	35.4	36	35	NP
FCD	33	36	29	H
GL-LQ	30	32	28	FC
CR: IS + L	27.4	13	46.6	SS
WSD	19.6	20.5	18.3	SS

TABLE 7--Continued

Process	Mean Percentage ($\overline{X}$%) of Total Possible Errors[a]			
	$\overline{X}$% All Subjects	$\overline{X}$% Down's Syndrome	$\overline{X}$% Nonsyndrome	Tendency
DFC	18	14	22	SS
NSC	16	7	25	SS
ST-FR	14.1	19.5	7	FC
PV	8.3	14.3	2.3	H
VA	8.2	13	3.3	H
GR: SFC	7.6	9	6.3	SS
DNC	3	3	3	SS
FR	2.6	2.3	2.8	FC
BK	2.5	4	1.4	FC
AA	2.1	1.8	2.6	H
GR-NC	1.4	1.1	1.9	SS

[a]Mean percentages reflect means of the number of subjects who used the processes.

Processes used by two or fewer subjects (25% or less) are presented in Table 8. Eight of these 14 processes are feature contrast processes, four are nonstandard phones, one is a syllable structure process, and one is a harmonization process. Of these processes, Stop-Gliding of Fricatives, Stopping of Glides, Affrication, and [ŋ] Use comprise the greatest mean percentages of total possible errors for these subjects. Liquidization of Fricatives, Syllable Reduplication, Stopping of Liquids, and Frication of Liquids reflect the smallest mean percentages of possible use for these subjects.

Table 9 lists percentages of total subject errors comprised by each process for each subject. From the data in Table 9, mean percentages of errors accounted for by each of the phonological tendencies may be computed for the subjects as a group. The percentage of syllable structure processes range from 36.0 to 70.0, with a mean percentage of 51.9 for total subjects. The percentage of feature contrast processes ranges from 22.8 to 42, with a total subject mean of 27.9. Harmonization percentages range from 4.0 to 21.5, with a mean percentage of 10.0 for total subjects. Nonstandard phones account for a mean of 10.0% of total subject errors, with a range of percentages from 2.0 to 19.0.

TABLE 8

PROCESSES USED BY 25 PER CENT OR LESS OF SUBJECTS

Process	Mean Percentage ($\overline{X}$%) of Total Possible Errors[a]			
	$\overline{X}$% All Subjects	$\overline{X}$% Down's Syndrome	$\overline{X}$% Nonsyndrome	Tendency
SG-FR	17	17	0	FC
ST-GL	17	17	0	FC
AF	10	10	0	FC
[ŋ] USE	10	10	0	NP
R-LQ	8	0	8	FC
[θ] USE	7.5	13	3	NP
N-LQ	5	5	0	FC
LA	4	6	2	H
LAT /S/	3	3	0	NP
/ʕ/-ST	2.5	0	2.5	NP

TABLE 8--Continued

Process	Mean Percentage ($\overline{X}$%) of Total Possible Errors[a]			
	$\overline{X}$% All Subjects	$\overline{X}$% Down's Syndrome	$\overline{X}$% Nonsyndrome	Tendency
SR	2	0	2	SS
ST-LQ	2	0	2	FC
FR-LQ	2	0	2	FC
LQ-FR	1	1	1	FC

[a]Mean percentages reflect means of the number of subjects who used the processes.

TABLE 9

PERCENTAGE OF TOTAL ERRORS ACCOUNTED FOR BY INDIVIDUAL PROCESSES FOR EACH SUBJECT

	Percentage of Total Errors for Each Subject							
	Down's Syndrome				Nonsyndrome			
Process	1	2	3	4	5	6	7	8
Syllable Structure (SS)								
DFC	9	14	4	10	32	7	1	13
WSD	1	.6	1	1	.5	-	1	2
CR: IS + L	1	1	.6	.7	2	5	-	.5
CR: IF + L	1	3	2	-	.5	4	-	2
CR: I/s/CL	5	-	1	-	2	6	6	5
CR: F/s/ + ST	2	3	2	3	3	3	6	3
CR: FL + ST	1	2	1	1	3	1	3	2
CR: FN + ST	1	1	2	1	2	3	4	3
DR: NC	-	-	-	1	1	1	1	-
Total CR	11	10	10	8	12	22	19	15
NSC	1	.6	.6	1	6	1	3	4
V	11	10	11	16	11	13	24	11
NV	1	2	1	2	.5	1	4	1
DNC	1	6	2	1	5	2	1	3
SR	-	-	-	-	.5	-	-	-
GR: SFC	-	3	7	7	1	2	-	7

TABLE 9--Continued

Process	Percentage of Total Errors for Each Subject							
	Down's Syndrome				Nonsyndrome			
	1	2	3	4	5	6	7	8
SS, continued								
GR: CL	-	1	3	4	-	-	3	1
GR: NC	1	1	.6	3	-	1	6	.5
Total GR	.4	5	10	13	1	4	9	9
Total SS	36	48.2	38.8	51.7	70	50	63	58
Harmonization (H)								
LA	-	2	-	-	-	-	-	.5
AA	2	.6	.6	1	3	-	2	.5
VA	5	.6	3	-	1	1	-	.5
GA	-	.6	.6	.7	1	-	-	-
LQA	.5	-	-	1	-	-	1	-
PV	9	5	3	-	-	1	2	.5
FCD	5	2	3	8	-	6	5	2
Total H	21.5	10.8	10.2	10.7	5	8	10	4
Feature Contrast (FC)								
GL-LQ	8	4	11	12	6	5	12	11
GL-FR	.5	1	-	-	-	-	1	-
LQ-FR	-	.6	-	-	-	.5	-	-

TABLE 9--Continued

Process	Percentage of Total Errors for Each Subject							
	Down's Syndrome				Nonsyndrome			
	1	2	3	4	5	6	7	8
FC, continued								
LQ-GL	-	-	-	-	.5	.5	3	-
ST-FR	21	4	6	4	4	3	-	2
ST-GL	-	.6	-	-	-	-	-	-
ST-LQ	-	-	-	-	.5	1	1	-
SG-FR	3	-	-	-	-	-	-	-
FR-ST	-	-	1	1	-	12	2	3
FR-LQ	-	-	-	-	-	-	-	.5
FR-AF	-	.6	1	-	-	.5	1	-
AF	2	-	-	3	-	-	-	-
R-LQ	-	-	-	-	-	2	-	-
N-LQ	-	-	1	-	-	-	-	-
FR	3	-	1	4	3	3	2	6
BK	4	4	11	-	3	3	2	1
/h/-C	.5	8	-	-	7	-	-	-
Total FC	42	22.8	32	24	24	30	24	23.5
Nonstandard Phones (NP)								
/s/ DIST	-	-	1	11	.5	8	-	5

TABLE 9--Continued

Process	Percentage of Total Errors for Each Subject							
	Down's Syndrome				Nonsyndrome			
	1	2	3	4	5	6	7	8
NP, continued								
/ʃ/ DIST	-	.6	4	.7	.5	2	2	4
LAT /s/	-	.6	-	-	-	-	-	-
/ʧ/-FR	-	-	-	-	1	1	-	.5
/C/-ST	-	-	-	-	2	-	-	1
[ŋ] USE	-	-	14	-	-	-	-	-
[θ] USE	-	17	-	-	-	-	-	4
Total NP	0	18.2	19	11.7	4	11	2	14.5

It is shown in Table 9 that a large number of processes are used by the subjects, but many processes are used infrequently. The distribution of errors is scattered across a large number of processes.

Data from Table 9 provide comparison to data from Tables 2-5. Processes which demonstrate high percentages of occurrence in the speech sample (Tables 2-5) may be shown to comprise only small portions of total error counts for individual subjects (Table 9). For example, in Table 2 subject 1 shows 100% use of the process, Cluster Reduction: Final /s/ + Stop, in relation to the total number of times he could have used it in the sample. However, Table 9 shows that the same process comprises only 2% of the total errors subject 1 made.

Comparison of Processes in Down's Syndrome Subjects and Nonsyndrome Subjects

Data found in Tables 2-5 illustrate the similarities and differences in the processes of Down's syndrome subjects and of nonsyndrome subjects. Data from these tables illustrate that the two subgroups show similarity in processes used. As shown in Tables 4 and 5, only the processes of Liquidization of Glides, Stopping of Fricatives, Affrication, Use of /ç/ for Fricatives, and Use of /ç/ for Stops show use by a majority of one subgroup with

an absence of use by the other subgroup. With the exception of these processes, however, a general pattern of frequent use by both subgroups or infrequent use by both subgroups is apparent. For example, as described earlier, Tables 6 and 7 show that many syllable structure processes are used by greater than 75% of the subjects.

As illustrated in Table 9, the subgroups also show similarity in the processes used in relation to percentage of total subject error counts. All subjects show relatively higher percentages for Deletion of Final Consonants, Cluster Reduction, Vocalization, and Gliding of Liquids. All subjects show little or no uses of processes such as Syllable Reduplication, Glide Assimilation, Stopping of Glides, and Liquidization of Fricatives, among others. Additionally, to test the linearity of the data, computation of the Pearson r correlation coefficient revealed high positive correlations of the scores of Down's syndrome subjects and nonsyndrome subjects for all processes and within the tendency categories of syllable structure, harmonization, and feature contrast. For all processes considered together, without regard to tendency category, $r = .834$, $P < .0010$. For syllable structure processes, $r = .919$, $P < .0010$. For harmonization processes, $r = .941$, $P < .0016$, and for feature contrast

processes, $\underline{r}$ = .748, P < .0010. However, for the use of nonstandard phones, $\underline{r}$ = .258, P < .5766. Therefore, for all categories except the use of nonstandard phones, Down's syndrome subjects and nonsyndrome subjects show strong concomitant relationships at high levels of significance. For the use of nonstandard phones, no covariance was shown between the two subgroups.

As shown in Tables 6-9, differences in process use may be seen among Down's syndrome and nonsyndrome subjects. Tables 6 and 7 show that although cluster reduction processes are used by 75% or more of all subjects, they are used more frequently by nonsyndrome subjects than by syndrome subjects. Nonsyndrome subjects also show greater use of other syllable structure processes, such as Deletion of Final Consonants and Nasalization of Single Consonants.

Down's syndrome subjects show greater use than nonsyndrome subjects of processes such as Stopping of Glides, Stop-Gliding of Fricatives, Affrication, Labial Assimilation, [θ] Use and [ŋ] Use. Mean percentages of overall tendency use as computed from Table 9 show that syllable structure processes are more frequent in the errors of nonsyndrome subjects than of syndrome subjects. The mean percentage of syllable structure processes is 60 for nonsyndrome subjects and 43.6 for syndrome subjects.

Feature contrast, harmonization, and nonstandard phones are more frequent in the errors of Down's syndrome subjects than nonsyndrome subjects. The mean percentage of feature contrast processes is 30.2 for syndrome subjects and 25.5 for nonsyndrome subjects. The mean percentages for harmonization are 13.3 for syndrome subjects and 6.75 for nonsyndrome subjects; for nonstandard phone use the percentages are 12.2 for syndrome subjects and 7.8 for nonsyndrome subjects.

Table 10 compares certain of the processes used by the subjects with an order of acquisition suggested for normal children by Weiner (1979). The processes compared are listed within their respective tendency categories in ascending order of mean total subject error for each subgroup. The subjects show some similarity between the subgroups in ordering of the processes according to frequency, but neither of the subgroups' ordering of processes corresponds to Weiner's order of acquisition.

Other Phonological Observations

Other phonological observations are found in further analysis of the data. These observations include Confusion of Liquids, /h/ Addition, Prevocalic Devoicing, CV tendency, sequencing problems, and context sensitivity.

TABLE 10

WEINER'S[a] SUGGESTED ORDER OF ACQUISITION OF CERTAIN PROCESSES AS COMPARED WITH MEAN FREQUENCY OF TOTAL SUBJECT ERRORS

Weiner's Order		$\bar{X}$% DS	$\bar{X}$% NS
Syllable Structure Processes			
1	DFC	WSD	WSD
2	GR	GR	GR
3	WSD	DFC	DFC
4	CR	CR	CR
Harmonization Processes			
1	PV	LA	LA
2	FCD	AA	VA
3	VA	VA	PV
4	LA	PV	AA
5	AA	FCD	FCD
Feature Contrast Processes			
1	ST-FR	(DN-none)	(DN-none)
2	AF	GL-FR	(AF-none)
3	GL-FR	FR	GL-FR
4	FR	AF	ST-FR
5	DN[b]	GL-LQ;ST-FR	FR
6	GL-LQ		GL-LQ
7	V	V	V

Note. $\bar{X}$% ages are listed in ascending order.

[a]Suggested order of acquisition is taken from Phonological Process Analysis (Weiner, 1979).

[b]The abbreviation (DN) denotes the process Denasalization. This process was not observed in any subjects in the study.

Confusion of Liquids, perhaps best regarded as an intra-feature contrast, is characterized by substitution of /l/ for /r/ in one syndrome subject and in one nonsyndrome subject. /h/ Addition, used by one nonsyndrome subject, is characterized by the addition of the /h/ phoneme before a single liquid to form nonstandard clusters: (log → /hlɔg/, razor → /hre hri/). Prevocalic Voicing occurs in the patterns of six of eight subjects--three Down's syndrome subjects and three nonsyndrome subjects. This pattern is characterized by the devoicing of stops and fricatives before vowels.

Several subjects demonstrate a CV tendency when producing multisyllabic words having initial syllables of VC composition. For example, umbrella → /mʌmʌlʌ/, and elephant → /lʌlʌfʌn/. Subjects also display occasional sequencing problems for words having consonant clusters (milk → /mlɪok/) and for multisyllabic words (envelope → /bɛpəlo/, flashlight → /hwæwæʃ/).

Context sensitivity plays an important role in some of the subjects' treatment of sounds, especially consonant clusters. In some cases the determination of the deleted or substituted member of a cluster is dependent upon the combination of sounds used in the cluster; for example,

fly → /blaɪ/, whereas fruit → /rut/; in the same manner, ski → /gi/, whereas sleep → /blip/.

Phonetic Inventory

Examination of the raw data shows that phonetic inventories may be incomplete for all of the subjects in the study. Most subjects show a lack of fricative and affricate sounds; the subjects and sounds not used in any responses to the PPA stimulus items are listed below:

Subject 1: /f, v, θ, ð, z, ʃ /

Subject 2: /tʃ, dʒ, v, s, z/

Subject 3: /l, tʃ, dʒ, v, θ, ð , z/

Subject 4: /v, θ, z/

Subject 5: /v, θ, z/

Subject 6: /dʒ, θ, ð , z/

Subject 7: /θ, ð , z, tʃ/

Subject 8: /j/

Discussion

The discussion of results is organized around three areas of inquiry reflected in the research questions. These areas include the processes used by the subjects, the similarities and differences in processes used by the two subgroups, and a comparison of the processes used by the subjects to normal and deviant development.

Processes Used by the Subjects

It may be observed from the results of the study that the subjects use a large number of phonological patterns which may be organized as syllable structure processes, feature contrast processes, harmonization processes, and nonstandard phones. The tendency to simplify syllable structure is regarded as the strongest and most common pattern for both subgroups. Feature contrast tendency is also a strong pattern, although there are a large number of feature contrast processes having very small percentages of total subject errors. Harmonization and nonstandard phones are present in some subjects and not in others, contributing to a lesser degree to the phonological characteristics of the subjects as a group.

The comparison of Tables 2-5 with Table 9 demonstrates a worthwhile consideration in phonological analysis, that is, the importance of considering several measures and looking at a number of aspects of articulatory behavior in making an analysis. For example, the measure of total possible errors, illustrated by Tables 2-5, gives perspective concerning the absolute frequency of the processes in the sample; however, a consideration of the frequency of process occurrence in relation to the subjects' individual error totals, illustrated by Table 9, is also valuable.

This measure illustrates the relative importance of each process in a particular phonological system. Both of these measures are valuable components of the analysis procedure.

Comparison Between Down's Syndrome Subjects and Nonsyndrome Subjects

The two subgroups show strong similarities in the use of processes, both groups showing preference for specific processes such as Cluster Reduction, Gliding of Liquids, and Vocalization. The two groups also show strong concomitant relationships among the ranking of processes, meaning that the processes which tend to be ranked highly by one subgroup are also ranked highly by the other subgroup. Statistical analysis fails to show a concomitant relationship for the use of nonstandard phones. A number of factors possibly could have influenced this result, among them a small sample size, and variation in the data. Another possibility is that the nonstandard phones do not constitute phonological processes at all, but are merely idiosyncratic behaviors of individual subjects. If this were the case, it would reasonably follow that no pattern of concomitance could be described.

Differences in the process patterns of the two subgroups are evident in the relative use of the phonological

tendency categories. Nonsyndrome subjects use syllable structure processes as part of their phonological systems to a greater degree than do syndrome subjects. Feature contrasts, harmonization, and nonstandard phones are more important to the phonological systems of syndrome subjects than to nonsyndrome subjects.

Comparison to Normal Development and Deviant Development

As shown in Table 10, Weiner suggests an order for normal phonological development. If the subjects were following normal developmental patterns, it might be expected that, because of their mental and chronological ages, they would be using predominantly later-acquired processes. However, it may be observed that the subjects do not consistently use higher-level processes. Instead, they use processes of early acquisition along with those of later acquisition. The persistence of early processes and their coexistence with later-acquired processes are documented by Ingram (1976) as characteristic of deviant phonological development. It may be suggested that the phonological systems of the subjects studied are not merely delayed, but are distinctly deviant in nature.

Edwards and Bernhardt (Ingram, 1976) and Lorentz (Ingram, 1976) describe deviant phonology in terms of

consistency of process use and intelligibility. However, Edwards and Bernhardt find that deviant systems are less consistent, and Lorentz finds them to be more consistent. Ingram (1976) suggests that both statements may be true, with consideration to intelligibility. While Edwards and Bernhardt's subjects were very unintelligible, Lorentz's subjects were relatively more intelligible. Thus, Ingram believes that more inconsistent systems will be more unintelligible, and more consistent systems will be more intelligible. A problem with this explanation is that Ingram does not explicitly state what he defines consistency to be. Consistency may mean similarity in subsequent repetitions of the same response by a subject. On the other hand, it may mean the degree to which a subject uses a particular process to represent sounds. However, in both senses of the word, the subjects of the present study may be described as inconsistent. Their subsequent repetitions of stimulus items during testing were frequently dissimilar, and they show a wide variety in processes used to represent sounds. Because the articulation patterns of the subjects are also very unintelligible, the present study suggests that Ingram's conclusions are valid.

The occurrence of sequencing problems and CV tendency are important to consider in relation to the developmental pattern of the subjects. Both behaviors denote a breakdown in the phonological system when attempting forms beyond its capabilities. It appears that when confronted with difficult phonological patterns, the subjects may revert to more primitive or earlier-learned strategies for sound production.

Completion of the phonetic inventory is described by Ingram (1976) as taking place in the period between ages 4.0 and 7.0. It might be expected that the subjects in this study would have neared, or accomplished, completion of the phonetic inventory. However, as shown earlier, each of the subjects lack one or more phonetic elements. The subjects show a great deal of similarity in nonacquired sounds, the large majority of which are fricatives and affricates. Liquids and glides are also found to be missing for a few subjects. Down's syndrome subjects show a greater number of nonacquired sounds than do nonsyndrome subjects.

Comparison with Recent Studies

The data from this study provide interesting comparison to results of previous phonological studies. As described earlier, Bartolucci and Pierce (1977) report

more fricative and affricate errors than errors in stops, liquids, and nasals for Down's syndrome subjects. Dodd (1976) reports systematic simplification, inconsistent substitutions and omissions, cluster reduction, weak syllable deletion, gliding of liquids, vocalization, and deletion of final consonants for nonsyndrome subjects. For Down's syndrome subjects Dodd reports more errors than for nonsyndrome subjects, the errors being characterized by cluster reduction, consonant harmony, vocalizaiton, weak syllable deletion, omission of final consonants, and gliding of liquids. Both studies conclude that the development of phonology in nonsyndrome retardates proceeds in a manner similar to normal development.

The findings of this study are similar in many ways to those of Bartolucci and Pierce and of Dodd, especially in the enumeration of processes used. However, this study emphasizes the use of syllable structure simplification by nonsyndrome subjects more than by Down's syndrome subjects, and a relatively greater use of feature contrast, harmonization, and nonstandard phones by syndrome subjects than by nonsyndrome subjects. The increased amount and type of errors for Down's syndrome subjects were not found to be major trends in this study. The two groups of subjects were found to be different not

so much in number of errors, but in the phonological tendencies realized by those errors. The present study also differs from the previous studies in that it suggests that mentally retarded subjects do not follow the normal course of phonological acquisition exactly.

The similarities in the phonological systems of older mentally retarded adolescents and those of younger mentally retarded adolescents and children lead to an important implication. These similarities imply that the phonological systems of the older mentally retarded adolescents may have become stabilized, or static, in their developmental progression.

In summary, the phonological process patterns of Down's syndrome and nonsyndrome subjects are found to be largely similar, Down's syndrome subjects exhibiting slightly greater use of feature contrasts, harmonization, and nonstandard phonemes, and nonsyndrome subjects demonstrating greater use of syllable structure simplification, particularly cluster reduction. The subjects are also found to use processes in a somewhat inconsistent manner.

During the course of this examination of the phonological systems of mentally retarded adolescents, certain limitations, or restrictions, existed. One of these restrictions was that the sample size was small. The

task of finding subjects of like sex, IQ range, age group, and articulatory severity was difficult, as reflected in the restricted size of the sample.

Several limitations within the testing procedure existed. The elicitation mode was not a controlled variable in this study, making it impossible to compare response mode to response type. Also, the difficulty in transcribing initial responses affected the examiners' sampling of the most spontaneous responses. Repetition of responses by the subjects often resulted in varying phonological representations of stimulus words.

A methodological restriction of the study was that the investigation involved only one observation of the phonological systems of the subjects. It is unknown from this study whether or not the systems of the subjects are still in transition or have reached an end in phonological development.

Further research is needed to answer questions which were beyond the scope of the present investigation. Longitudinal research is needed to determine the degree of stability and consistency over time of the phonological systems of retarded adolescents. In depth investigation is needed to examine closely the effect of context sensitivity upon the articulatory behavior of retarded subjects.

Further research is also needed to compare the phonological systems of individuals differing in degree of retardation. Information gathered in studies of this nature will contribute to more complete understanding of phonological development in mental retardation.

CHAPTER V

SUMMARY AND CONCLUSIONS

The purpose of this study was to describe by means of phonological process analysis the articulation patterns of eight moderately mentally retarded adolescent males classified as having severe articulation problems. The study was conducted in an effort to describe the phonological processes present in the articulation patterns of the subjects, to compare the processes of Down's syndrome subjects and nonsyndrome subjects, and to compare the processes of the subjects to normal and abnormal phonological development as reported in current literature.

Eight moderately mentally retarded adolescent males were selected from among students at the Garland Cooperative Training Center, Garland, Texas. The subjects were administered the Arizona Articulation Proficiency Scale--Revised (AAPS-R) (Fudala, 1974) as a means of articulatory classification and as confirmation of preliminary articulatory severity judgment. The subjects were also administered the Phonological Process Analysis (PPA) (Weiner, 1979), a tool which aids in the description

of phonological processes. The results of the PPA were analyzed, producing the following results.

The articulation patterns of the subjects generally reflected phonological tendencies of syllable structure, simplification, harmonization, feature contrast, and use of nonstandard phones. The nonsyndrome subjects showed abundant use of syllable structure processes, particularly Consonant Cluster Reduction, use of feature contrasts, and minimal use of harmonization and nonstandard phones. The syndrome subjects showed similar patterns, employing greater use of feature contrasts and less use of syllable structure simplification than the nonsyndrome group. The process patterns of the subjects could not adequately be described as corresponding to a suggested order of phonological acquisition for normal children.

The study was limited by a small sample, use of variable response modes, difficulty in obtaining initial, spontaneous responses, and a lack of longitudinal data. Further research is needed to determine the stability and consistency over time of the phonological systems of the subjects. In depth studies are needed to explore the effect of sound context sensitivity upon phonological systems. Research is also needed to compare the

phonological systems of individuals having differing degrees of mental retardation. The completion of such investigations may provide more complete descriptions of the phonological systems of the retarded, leading to more effective management of phonological disability in retarded individuals.

REFERENCES

Bangs, J. L. A clinical analysis of the articulation defects of the feebleminded. Journal of Speech and Hearing Disorders, 1942, 7, 343-356.

Bartolucci, G., & Pierce, S. J. A preliminary comparison of phonological development in autistic, normal, and mentally retarded subjects. British Journal of Disorders of Communication, 1977, 12, 137-147.

Berko, J., & Brown, R. Psycholinguistic research methods. In P. H. Mussen (Ed.). Handbook of research methods in child development. New York: Wiley, 1960.

Blache, S. E. The acquisition of distinctive features. Baltimore: University Park Press, 1978.

Bloom, L., & Lahey, M. Language development and language disorders. New York: John Wiley & Sons, 1978.

Brown, R. W. A first language: the early stages. Cambridge, Mass.: Harvard University Press, 1973.

Carter, C. H. Medical aspects of mental retardation (2nd ed.). Springfield: Charles C. Thomas, 1978.

Chomsky, N., & Halle, M. The sound pattern of English. New York: Harper & Row, 1968.

Compton, A. J. Generative studies of children's phonological disorders. Journal of Speech and Hearing Disorders, 1970, 35, 315-319.

Crocker, J. R. A phonological model of children's articulation competence. Journal of Speech and Hearing Disorders, 1969, 34, 203-213.

Cruttenden, A. A phonetic study of babbling. British Journal of Disorders of Communication, 1970, 5, 110-117.

Dodd, B. A comparison of the phonological systems of mental age matched, normal, severely subnormal and Down's syndrome children. British Journal of Disorders of Communication, 1976, 11, 27-42.

Edwards, M. L. Perception and production in child phonology: the testing for four hypotheses. Journal of Child Language, 1974, 1, 205-219.

Ferguson, C. A., & Garnica, O. Theories of phonological development. In E. Lenneberg & E. Lenneberg (Eds.), Foundations of language development. Paris: UNESCO Press, 1975.

Ferguson, C. A., & Farwell, C. B. Words and sounds in early language acquisition. Language, 1975, 51, 419-439.

Fisher, H. B., & Logemann, J. A. The Fisher-Logemann test of articulation competence. New York: Houghton-Mifflin, 1971.

Fudala, J. B. Arizona articulation proficiency scale--revised. Los Angeles: Western Psychological Services, 1974.

Haas, W. Phonological analysis of a case of dyslalia. Journal of Speech and Hearing Disorders, 1963, 28, 239-246.

Ingram, D. Phonological rules in young children. Journal of Child Language, 1974, 1, 49-64.

Ingram, D. Phonological disability in children. New York: Elsevier, 1976.

Irwin, O. C. Communication variables of cerebral palsied and mentally retarded children. Springfield: Charles C. Thomas, 1972.

Jakobson, R. Child language, aphasia, and phonological universals. The Hague: Mouton, 1968.

Jakobson, R., Fant, C. G. M., & Halle, M. Preliminaries to speech analysis. Cambridge, Mass.: MIT Press, 1952.

Jakobson, R., & Halle, M. Fundamentals of language. The Hague: Mouton, 1956.

Jordan, T. E. Language and mental retardation: a review of the literature. In R. L. Schiefelbusch, R. H. Copeland, & J. O. Smith (Eds.), Language and mental retardation: empirical and conceptual considerations. New York: Holt, Rinehart & Winston, Inc., 1967.

Karlin, I. W., & Strazzulla, M. Speech and language problems of mentally deficient children. Journal of Speech and Hearing Disorders, 1952, 17, 286-294.

Keane, V. E. The incidence of speech and language problems in the mentally retarded. Mental Retardation, 1972, 10, 3-8.

Lund, N. L., & Duchan, J. F. Phonological analysis: a multifaceted approach. British Journal of Disorders of Communication, 1978, 13, 119-126.

Martyn, M., Sheehan, J., & Slutz, K. Incidence of stuttering and other speech disorders among the retarded. American Journal of Mental Deficiency, 1969, 74, 206-211.

Matthews, J. Communication disorders in the mentally retarded. In L. E. Travis (Ed.), Handbook of speech pathology and audiology. New York: Appleton-Century-Crofts, 1971.

McReynolds, L. V., & Engmann, D. L. Distinctive feature analysis of misarticulations. Baltimore: University Park Press, 1975.

McReynolds, L. V., & Huston, K. A distinctive feature analysis of children's misarticulations. Journal of Speech and Hearing Disorders, 1971, 36, 155-166.

Menyuk, P. The role of distinctive features in children's acquisition of phonology. Journal of Speech and Hearing Research, 1968, 11, 138-146.

Morley, M. The development and disorders of speech in childhood. London: Livingstone, 1957.

Moskowitz, A. I. The two-year-old stage in the acquisition of English phonology. Language, 1970, 46, 426-441.

Oller, D. K. Regularities in abnormal child phonology. Journal of Speech and Hearing Disorders, 1973, 38, 36-47.

Pollack, E., & Rees, N. S. Disorders of articulation: some clinical applications of distinctive feature theory. Journal of Speech and Hearing Disorders, 1972, 37, 451-461.

Schiefelbusch, R. L., Copeland, R. H., & Smith, J. O. Language and mental retardation: empirical and conceptual considerations. New York: Holt, Rinehart & Winston, Inc., 1967.

Schlanger, B. B. Speech examination of a group of institutionalized mentally handicapped children. Journal of Speech and Hearing Disorders, 1953, 18, 339-349.

Schlanger, B. B. Mental retardation. Indianapolis: Bobbs-Merrill Educational Publishing, 1977.

Schlanger, B. B., & Gottsleben, R. H. Analysis of speech defects among the institutionalized mentally retarded. Journal of Speech and Hearing Disorders, 1957, 22, 98-103.

Shriberg, L. D., & Kwiatkowski, J. Procedure for natural process analyses (NPA) of continuous speech samples: NPA applications manual. Prepublication draft, University of Wisconsin-Madison, 1979.

Singh, S. Distinctive features: theory and validation. Baltimore: University Park Press, 1976.

Singh, S., & Singh, K. S. Phonetics: principles and practices. Baltimore: University Park Press, 1976.

Smith, N. V. The acquisition of phonology: a case study. Cambridge: Cambridge University Press, 1973.

Sommerstein, A. H. Modern phonology. Baltimore: University Park Press, 1977.

Spreen, O. Language functions in mental retardation: a review. I. Language development, types of retardation and intelligence level. American Journal of Mental Deficiency, 1965, 69, 482-494.

Templin, M. Certain language skills in children: their development and interrelationships. Institute of Child Welfare Monograph 26. Minneapolis: The University of Minnesota Press, 1957.

Travis, L. E. A point of view in speech correction. Quarterly Journal of Speech, 1936, 22, 57-61

Van Riper, C., & Irwin, J. V. Voice and articulation. Englewood Cliffs: Prentice-Hall, Inc., 1958.

Waterson, N. Child phonology: a prosodic view. Journal of Linguistics, 1971, 7, 179-211.

Weiner, F. F. Phonological process analysis. Baltimore: University Park Press, 1979.

Wilson, F. B. Efficacy of speech therapy with educable mentally retarded children. Journal of Speech and Hearing Research, 1966, 9, 423-433.