LEXICALIZATION AND SOUND DEVELOPMENT

by

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A THESIS

IN

SPEECH PATHOLOGY AND AUDIOLOGY

Submitted to the Graduate Faculty
of Texas Tech University in
Partial Fulfillment of
the Requirements for
the Degree of

MASTER OF SCIENCE

IN
SPEECH PATHOLOGY AND AUDIOLOGY

Approved

Accepted

May, 1980

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ACKNOWLEDGMENTS

My sincere respect and appreciation are extended to Dr. Michael D. Smith for his guidance and encouragement during the preparation of this thesis. I would also like to thank Dr. John R. Muma for serving on my committee and giving his time and suggestions.

Special thanks are expressed to Dr. Curt E. Hamre and Dr. Earlene T. Paynter for their helpful comments and support.

I am especially grateful to the three children who served as subjects and to their parents for their cooperation and assistance.

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CHAPTER I

CHILD PHONOLOGY: THE STATE OF THE ART

Introduction

A child who is in the process of acquiring a first language is confronted with the enormous task of learning to deal with many lexical and phonological elements, as well as the relationships among these elements, which in large part will come to constitute the grammar of the particular language he is learning (Ferguson and Farwell, 1975). Researchers have abstracted various units from child speech in their attempts to study the processes of language development. These units have included distinctive features, phonemes, syllables, morphemes, inflectional categories, and many more. Although the usefulness and validity of these various units may be questioned, it is necessary to attempt to break child speech down into analyzable parts so that some understanding of linguistic abilities at each stage of development may be reached.

Children who are in the process of acquiring an initial lexicon and are at the fringes of acquisition tend to exhibit great variation in the sounds they produce and in the words they choose to say. Ingram (1976a, 1976c) has cautioned that early sound production and initial lexical acquisitions, especially as related to the first 50 words, may not constitute a natural unit of phonological acquisition. The reason for such caution is that children frequently seem to change their strategies of language learning around the time the fiftieth lexical item is

acquired. Although the period of acquisition of the first 50 words has been discussed in the literature as a stage of phonological development, the actual number of lexical items acquired is relative based on individual differences. The rapid growth of vocabulary and the onset of two-word utterances, which occur at the end of this period, are more significant indices of transition into the next stage of phonological acquisition than is the specific number of lexical items acquired. It is crucial to point out early on that due to the high level of variation of word forms and phonetic contrasts used by children during this period, Ferguson and Farwell (1975) have suggested that it would be more instructive to study individual paths of language learning than to attempt to identify universal tendencies.

In the present study, the early language development of three children was examined in terms of the phonetic variants of sounds produced in relation to lexical items selected. The procedures of analysis used by Ferguson and Farwell (1975) served as a basis for the design of this study. Shibamoto and Olmsted (1978) also employed Ferguson and Farwell's procedures, expanding them to include the analysis of all consonants within words rather than initial consonants only. The present study dealt with the analysis of the initial consonant variants of monosyllabic words and of the initial consonant variants of the first and second syllables of bisyllabic words.

The purpose of this introductory chapter is to provide background information on phonological theory upon which this study was based. Current issues and controversies in child phonology are discussed as well as requirements for a theory of phonological acquisition. General stages of early phonological development are outlined in relation to

cognitive stages; and methods of phonological analysis, particularly as related to lexical development, are reviewed.

Current Issues in Child Phonology

The study of phonology may have begun as far back as the second millennium, B.C. This was the approximate time of the creation of the first alphabetic writing system in the Mediteranean area. Ferguson (1977) suggested that such inventions reflected the principal goals of phonology which are:

> (1) to achieve a better way to characterize or represent particular sound systems, showing how any one particular sound system differs from another or all other sound systems; and
> (2) to characterize sound systems in general, that is, the nature of sound systems in human language, the universal constraints on them, their universal properties, and so forth. (p. 284)

For written evidence that people were actively studying phonology, history takes us back to a phonologist of the fifth century, B.C., Panini. He may not have been the first to explicitly study phonology, but he was probably among the first. He was interested in how the sound system of language works, especially Sanskrit (Ferguson, 1977).

The study of phonology is a recently renewed area of interest as compared to other areas of language such as syntax and semantics. With some exceptions, few phonological theorists in the past have taken into account data from children (Ferguson and Garnica, 1975). Ingram (1976a) pointed out that most of the research in child phonology has been done in languages other than English and that many of the early English studies in phonology used very poor phonetic transcription. In the last decade, renewed interest in phonology, child phonology in particular, has taken place. The available literature on the acquisition of

phonology is abundant but reveals much variation in approach. Most existing approaches are inadequate as they are based on adult phonology and the notion of fully developed oppositions in the child's language.

Several major controversies have developed from the various theories of phonological acquisition. One such issue deals with whether the child has his own phonological system or whether he initially possesses an adult system upon which phonological processes operate. Another relevant issue which has been referred to as the "abstractness controversy" (Braine, 1974) deals with the admissibility of "imaginary" representations, (i.e., phonological segments that are never phonetically realized). Related to this issue is the question of whether or not the phoneme (or any other phonological unit of processing) has psychological reality. The following is a brief discussion of the major theories of phonological acquisition and the primary issues which a viable theory must address.

Theories of Phonological Acquisition

Structuralist Theories. The major goal of structuralist theories is to account for the acquisition of phonological structure and to specify a universal order of acquisition. Child Language, Aphasia, and Phonological Universals by the European linguist Roman Jakobson (1941, English translation 1968) represents one of the most influential theories of phonological development, as witnessed by Blache's (1978) recent treatment and extension of Jakobson's proposals. Ingram (1976c) used the term "taxonomic phonemics" to describe approaches to the study of sound patterns of languages which were in vogue in the 1940's and 1950's and of which Jakobson's theory is an example. Taxonomic phonemics

refers to specific ways languages use contrast to distinguish meanings in language; the emphasis is on classification. For example, in English, /p/ and /b/ are contrasting phonemes such that the word "pit" is semantically different from "bit."

Jakobson viewed the prelanguage babbling period and the acquisition of true speech as discontinuous periods of phonological development in that the sounds produced by the child during babbling are random, unstructured, and unrelated to productions of the following period (Ferguson and Garnica, 1975). Jakobson claimed that language develops through the establishment of a predictable series of contrasts (Ingram, 1976a). The notion of contrast is used to predict an order of sound acquisition, (e.g., the first sounds to appear are those of maximal contrast, Ingram, 1976c). Jakobson posited that from the first real utterances of the child (the onset of true speech as opposed to babbling), his phonology is structured exactly the same as the adult's phonology (Ferguson, 1977). This implies that the child initially does not have a phonological system of his own. N. V. Smith (1973) agreed that the child does not have his own system. Rather, collections of realization rules which may emerge at various stages of phonological development account for the differences between the adult's input and the child's output. Ferguson (1977) disagreed with this position as he suggested that the child operates on the basis of his own phonological organization out of which he actively "constructs," rather than passively acquires, a phonological system.

Jakobson considered a child's phonological system to be a "stratified" system, composed of universal and invariable layers superimposed on one another. Phonological oppositions, or contrasts between sounds

and features of sounds, are used to distinguish lexical items according to Jakobson's theory. Variations are considered to be conditioned by the phonological environment in both child and adult phonologies (Ferguson, 1977).

In line with Jakobson's proposed universal order of acquisition is his claim that mistakes made by a child as he approaches adult phonology are systematic and rule-governed such that patterns can be identified for individual children, as well as for whole languages and even all languages. Jakobson also claimed that the time when a particular sound or opposition is acquired by a child is related to the distribution of that sound or opposition among languages of the world. He further claimed that sounds or oppositions are lost in the reverse order from that by which they are acquired in the case of aphasia. One set of underlying principles, called "Laws of Irreversible Solidarity" by Jakobson are responsible for the universal order of acquisition and dissolution as well as the distribution of sounds in the world's languages (Ferguson, 1977).

Ferguson and Garnica (1975) discussed several criticisms of Jakobson's theory. First, the outline he proposed for a universal order of acquisition is merely skeletal, and he made no statements concerning the interrelationship between consonant and vowel development. However, it should be noted that Blache (1978) has extended and refined Jakobson's model to deal with such issues. Jakobson did not consider evidence from other studies which have shown that sound distinctions may initially appear in a particular position in a word. Moskowitz (1970) investigated the two-year-old stage in the acquisition of English phonology basically in a Jakobsonian framework and found marked differences

in the acquisition of distinctive features in various word positions within and between subjects. Jakobson also did not deal with prosodic features of language (Ferguson and Garnica, 1975). Other issues with which he did not deal include the acquisition of clusters, perception versus production, and specifications for determining when a sound or opposition is "acquired" (Ferguson, 1977).

The issue of strict discontinuity between babbling and later language development has been strongly disputed. Other researchers (e.g., Blount, 1970, and Cruttenden, 1970) have observed a more restrictive phonetic range during babbling than that proposed by Jakobson and some relationship between sounds produced in babbling, particularly in the later stages, and those produced in stages of development of true speech.

Despite the problems mentioned above, Ferguson (1977) felt that Jakobson's theory had strong points that are provocative. For example, Ferguson holds that there is a considerable amount of order in the acquisition of phonology which largely reflects the order proposed by Jakobson, in spite of individual differences. Also, there does seem to be a relationship between the order of acquisition and notions of frequency of occurrence in the world's languages.

Generative Theories. Chomsky and Halle (1968) provided an extensive treatise on generative phonology in their book, The Sound Pattern of English. Ingram (1976c) discussed two basic aspects of this theory. The first point, which was introduced by Jakobson, was the use of features in describing language, or the act of breaking sounds down into their component parts, a practice that has been widely adopted in research with both normal and deviant children. Secondly, various

formal devices are used to describe sound patterns of English, including restrictions on how rules are written and ways that rules may follow one another (Ingram, 1976c).

In his book, The Acquisition of Phonology: A Case Study (1973), N. V. Smith studied the phonological development of his son from the age of 26 months to four years. Using a generative phonology framework, Smith described the child's performances by means of rules. Realization rules were proposed as the means by which words are mapped into representations in terms of the child's own phonemes. Phonetic rules were used to map the child's realization rules into phones that compose positional variants of the child's phonemes. Phonological development was analyzed by taking each rule and considering necessary changes at each stage, including the disappearance and addition of rules. Although Smith stated that there is no psychological reality to the child's own system, Braine (1976) felt that Smith did implicitly acknowledge the psychological reality of the child's phonemes by providing a linguistic level for them: the child's phonemes are simultaneously the output of the realization rules and the input to the phonetic rules.

Olmsted (1977) criticized Smith's theory on several points. First, Olmsted emphasized the variability of children's sound substitutions in the period before mastery, whereas Smith proposed that changes in the child's output occurred simultaneously to phonologically defined classes and not singly to individual lexical items. Secondly, Olmsted refuted Smith's view that mastery is something that happens all at once based on the evidence that children continue to make errors even after they begin to pronounce a unit correctly. Finally, Olmsted objected to

Smith's implication that the mapping of rules constitutes a theory about the data. Olmsted attributed less status to rules. He said they are an adequate descriptive device, but they are merely an alternative method of cataloguing errors and successes relative to productions of the model.

Joos (1950) stated that linguistic structure and linguistic change are not affected by probabilities and frequency. For the most part, structuralists and generativists have agreed with him. Only recently have linguists such as Bell (1971) provided evidence which disputes Joos' claim. Bell found that the high frequency of certain syllable structures in the world's languages, such as CV, could be explained by the high probability of processes leading to them or by the high probability of processes leading away from less favored syllable structures (Ferguson, 1977). For example, deletion of final consonants and cluster reduction are processes which lead to CV syllable structures and also away from more complex syllable shapes such as CCVC.

Natural Phonology Theories. The major goal of natural phonology is to identify phonological processes that account for language change through time and for child phonological development (Ferguson and Garnica, 1975). Stampe (1969) proposed a theory of natural phonology, which assumed that the child has at his disposal a finite set of innate processes that operate to simplify adult speech at the level of production alone.

Stampe did not predict a universal order of acquisition per se as Jakobson did. He proposed, however, that the child progressively learns to suppress or limit his natural processes until he achieves the adult phonology. Contexts in which speech sounds occur cause adaptive changes to take place in the speech sounds. For example, assimilation

as a form of adaptiveness occurs when a sound undergoes a change which makes it more like a neighboring sound.

One claim made by natural phonology theorists is that the child hypothesizes abstract phonological representations based on the adult phonetic output he has observed. In support of this claim is the observation that when a child revises his system in some way, he pronounces newly acquired segments in appropriate morphemes without rehearsal, and old substitutions do not reappear (Ferguson and Garnica, 1975).

The main hypothesis of natural phonological theory is that addition, generalization, and unordering of processes result directly from the child's failure to fully exploit the available mechanisms for resolving contradictory processes. The child's forms are innovations and differ from the standard form due to production limitations which take on the form of phonological processes. This theory does not support the hypothesis that the child has a phonemic system of his own. Instead, it assumes that the child produces modified versions of his adult-like internalized forms. Adult pronunciation is eventually achieved through successive modifications of those forms through various suppression processes (Ferguson and Garnica, 1975).

Prosodic Theories. The prosodic theory of phonological acquisition, originally proposed by Firth in 1948, is primarily concerned with the explanation and prediction of individual differences as opposed to a universal order of acquisition. The theory emphasizes the selective function of perception and the role of the unique speech input to a given child. It deals mainly with early stages of phonological development, approximately through the age of two. Major features of the prosodic theory are summarized below, as discussed by Ferguson and Garnica (1975).

The first point deals with the child's selective attention to certain regular, nondeviant adult forms that recur frequently in the same kinds of situations. The child attends to particular highly salient utterances and does not perceive minor variations in pronunciation. Secondly, the child perceives an utterance as a whole unit and may perceive specific features without awareness for their location in an utterance or relationship to other sounds or features. The child identifies a "schema" which consists of a particular set of features selected from sets of features shared by several adult forms. Another aspect of the prosodic theory is that the child perceives and produces most clearly features already in his repertoire and features that are strongly articulated. Finally, phonological patterns for different children learning the same language are different due to different language input.

Criticims of the prosodic theory include the observations that it does not attempt to make predictions about (1) order of acquisition, (2) the relation of an order of acquisition to the distribution of features or oppositions among different languages,or (3) the overall nature of errors. In spite of these problems and the fact that most of the research in this area has been drawn from a very limited data base, the theory has some strong points. It deals with why a child may use different substitutions in different situations and why he may omit or replace some adult sounds in particular contexts that he is capable of making.

An Elaboration of the Major Issues

Does the child have his own phonological system? Three versions of the claim that the child has his own system were suggested by Ingram (1976a). The strong version states that "the child has a system of

contrasts that occur in adult speech" (p. 19). This position, which has not been advocated in the literature, seems unrealistic as it makes the claim that the child's language develops independently from the language being learned.

A weaker version of the position that the child has his own system states that "the child's use of sounds contrastively will occasionally be unrelated to segments in the adult words" (Ingram, 1976a, p. 19). A still weaker version states that "the child will use sound to contrast meaning, and occasionally sounds will be used for contrasts that differ from those used in the adult models" (Ingram, 1976a, p. 19). Some research has provided examples of minimal pairs produced by children which are not obviously predictable from adult words. Certain specific examples have even been used by different researchers in support of opposing positions on this issue based on different interpretations.

The notions of assimilation and accommodation imply the existence of the child's own system. According to Piaget (1952), the child continually works toward achieving a balance between what he knows and what is new in the environment. One dimension of this interaction between the child's mind and reality has been called assimilation, whereby aspects of the world are conformed to the structure of the child's mind (Ingram, 1976c). Nelson (1973) hypothesized that the child acquires his first productive words by matching environmental labels to his own concepts. Lexically, the child expresses only features that are relevant to him. For example, change (dynamic attributes) is typically a basic defining characteristic. Static attributes such as color, size, and shape are rarely the basis for the child's earliest concept definitions.

Nelson (1973) also hypothesized that after the child acquires n

words (between 10 and 100) that match his concepts, he may reverse the process and build concepts to match the usage of the environment. He may even differentiate old concepts so that they correspond more to the environmental usage. This process has been called accommodation, whereby the child's structure changes to conform to reality (Ingram, 1976c).

Ingram (1976c) discussed assimilation and accommodation in terms of the human function he proposed of organization. In acquiring phonology, Ingram suggested, the child imposes structure on a basic portion of the adult sound system. Assimilation and accommodation interact between the child's system and the environment throughout development. The child may initially assimilate (give structure to) a word. As his ability increases, it is necessary for him to accommodate or change the word to be more like the adult model.

Ingram (1976c) supported the position that the child has his own system. He claimed that the majority of studies involving linguistic analyses of children with phonological disabilities revealed the systematic nature of the child's speech. Grunwell (1977) took issue with that statement and argued that those studies instead revealed a systematic relationship between the child and adult pronunciations. Further research into the way children change adult words to fit into their own speech is needed before this issue can be resolved (Ingram, 1976a).

Basic Units of Processing. One of the major issues of the "abstractness" controversy as discussed by Braine (1974) is concerned with the psychological or perceptual reality of phonological units of processing. A concrete position does not accept phonological segments that are never perceptually realized; rather, it requires segmental units with direct auditory or phonetic reality. Sapir (1949) supported a more

abstract position in that he viewed the phoneme as a unit used in underlying representations. What has been called "Sapir's restriction" (Braine, 1974) refers to the practice of isolating contrasting perceptual units in language and guaranteeing that only these units appear in the lexicon. Sapir argued for the psychological reality of the phoneme based on clearly perceptual units which were judged to be equivalent by his subjects.

Braine (1974) proposed a weaker form of Sapir's restriction whereby learning processes comprise auditory differentiation and articulatory analysis of auditory units. He suggested that phonemes are auditory gestalts and that acquisition involves a progression toward an analysis of how to make these gestalts. At each stage of development, a certain degree of control over features is accomplished. This is the sense in which rules influencing the control of features have psychological reality, according to Braine (1974).

While Braine basically accepted the generative phonology claim of psychological reality for the feature, he did not accept that as evidence against the phoneme as a unit with psychological reality. In fact, he said that it is reasonable to assume that there may be more than one real psychological unit; the syllable is a good candidate as well. The phoneme, and possibly even the syllable, may have some "gestalt properties" which are not predictable from its component features. In generative phonology, the feature is an articulatory unit rather than auditory and is not directly perceptible auditorally as a phoneme is.

Revising Jakobson's claim that language develops through the establishment of a series of phonological contrasts within sound segments, Ferguson (1977) proposed that at the outset of acquisition, phonological

oppositions are not central but words are. The child learns words as whole phonetic shapes in early stages and makes hypotheses about phonology. As acquisition proceeds, the words are phonologically analyzed in a gradual fashion by the child as he perceives phonological regularities in the words he is learning. This seems to imply that the phonemes or sound segments initially have no psychological reality for the child, but they gradually take on a reality of their own as learning progresses. Consequently, according to Ferguson (1977), words may initially be the only unit of psychological reality for the child.

Each of the theories discussed in this section has strong and weak points, and each has made contributions to the present state of the art of the study of phonology. Many of the models of phonology that were mentioned have grown out of needs or shortcomings of other theories; hence, their worth cannot be denied as they often provide a starting point from which new dimensions may be explored. Ferguson (1977) referred to human phonologies as "fascinatingly complex" and "impressive." He said that the more we study phonology, the more complexity we will discover. The several models and theories of phonology continually reveal more aspects of this complexity and supply notions which warrant more research attention.

Stages of Early Phonological Development

Ingram (1976a) characterized stages of phonological development in relation to syntactic and cognitive development. He attempted to demonstrate how phonological stages correlate with Piaget's stages of cognitive development and with general linguistic stages. In a review of Ingram (1976c), Grunwell (1977) questioned the credibility of these

correlations. Corrigan (1978) and Folger and Leonard (1978) also suggested that the relationship between cognitive and linguistic development is not as close as has been advocated. Nonetheless, Ingram (1976a) provided some convincing evidence that cognition plays a role in language acquisition, phonological development in particular. Although individual differences account for great variation in the development of individual children, Prutting (1979) argued that stages are useful for abstracting central tendencies about development. Thus, the stages proposed by Ingram (1976c) and Jakobson (1968) should not be viewed as indisputable truths but rather as flexible general guidelines for acquisition allowing for individual differences. As the present study deals with young children (ages 1;6[1] to 2;0), only those stages which bear direct relevance to early language learning will be discussed.

Cognitive Prerequisites to Language Development

During Piaget's sensorimotor stage (birth to 1;6), the child develops his senses and motor abilities (Ingram, 1976a). He learns to represent the world to himself through interactions with the environment. During this time, he acquires several important cognitive skills which facilitate language development (Cromer, 1976). Primary among these skills is object permanence, which is the ability to understand that an object still exists when it is not in view. By the end of the sensorimotor period, the child realizes that he is distinct from the objects around him. This awareness allows for differentiation between himself and others, thus permitting the development of communication (Sinclair, 1969). It is also around this time that the child acquires the ability to represent reality. Cromer (1976) stated that cognitive

skills acquired during the sensorimotor period have certain structural properties (organization, categorization, etc.) which enable the child to begin to comprehend and produce language. According to Slobin (1973), the pacesetter in linguistic growth is the child's cognitive growth; hence, language may be used to express only what the child already knows. Slobin also suggested that the acquisition process involves the assimilation of information to existing structures and the accommodation of those structures to new input.

In relation to the development of lexical items, Ricks (1975) suggested that the child, as an active organism, seems to attempt only those words which express concepts he is able to handle cognitively. Also, the child is likely to imitate only words referring to these concepts. Phonologically, we might expect the ability to classify sounds or features and to form and store representations of phonological units in memory to be related to the development of cognitive skills.

Phonological Stages

During the latter months of the sensorimotor period, which encompasses the approximate ages of 1;0 to 1;6, the child acquires a small vocabulary (approximately 50 words at about 1;6) and uses primarily one word utterances and single word sequences. Ingram (1976c) suggested that the phonological aspects of the first 50 words are in many ways qualitatively different from later phonological developments. Panagos and Hofmann (1971) and Prutting (1979) in general characterized early child phonology as follows: the first syllable shapes to appear are usually CV and CVCV reduplications with the earliest consonants being /p/, /m/, then /t/ and /k/. Ferguson and Garnica (1975) added /h/ and

/w/ to the list of early appearing consonants. The first vowels used by the child generally include /a/, /i/, and /u/, a point also made by Jakobson (1968) and Blache (1978). A sudden increase in vocabulary and the onset of two-word utterances are behavioral (or linguistic) changes which mark the end of this stage (Ingram, 1976c).

The Period of Concrete Operations is Piaget's second period of cognitive development and covers an age range of 1;6 or 2;0 to 11 or 12. The ability to represent reality through the use of linguistic signs (consequently, the onset of language) is the major accomplishment of this period (Ingram, 1976c).

Preconceptual Thought is the first subperiod of the Concrete Operations period and lasts from 1;6 or 2;0 to 4;0 or 4;6. This subperiod marks the beginning of the development of symbolic behavior. This is a phonologically active period during which the phonological system begins to develop in order to handle the increasing demands of vocabulary acquisition. The child continually adds new sounds to his system; and phonological processes operate on adult words, converting them to shapes and sounds which the child can handle (Ingram, 1976c). Prutting (1979) suggested that the following phonological processes are characteristic of the child between 1;6 and 2;0: assimilation, substitution, multiple processes, and processes affecting syllable structure (reduction of syllables).

The next two subsections of this section deal in more detail with the phonology of two successive stages of development: the period of acquisition of the first 50 words and the period of acquisition of simple morphemes. Possible qualitative differences between the two are explored.

Phonology of the First 50 Words. This period is generally considered to range in time from approximately age 1;0 to 1;6. According to Piaget, true linguistic development, characterized by a wide range of symbolic behavior, does not begin until the end of this period. Based on the notion that the child's cognitive ability from 1;0 to 1;6 represents a different level from that of the following period, the nature of the child's phonology at this time may also be expected to differ from that which follows (Ingram, 1976a).

The use of progressive idioms is one way in which the child's phonology may differ from later stages (Moskowitz, 1970). Progressive idioms are forms which initially are produced with accuracy and only later become inaccurate as phonological processes intervene. It has been suggested that the pronunciation of these forms will stabilize to a form consistent with the child's phonological capabilities once the linguistic system begins to develop (Ingram, 1976a). For example, Leopold's Hildegard was observed initially to produce the adult form "pretty" accurately, but later pretty was transformed to reflect her developing phonological system (e.g., /prIti/ became /pIti/).

According to Ferguson and Farwell (1975), the presence of progressive phonological idioms indicates that the child's perception and production abilities are more advanced than his phonological system. This suggests that the child's phonological system is quite immature in that constraints or processes are not operating on all forms to which they might apply. Determining which forms are progressive implies the prior determination of a phonological system (Ferguson and Farwell, 1975).

Also observed during this period is that phonological processes

which characterize later speech sometimes are not available to the child. The application of a phonological rule implies a systematic relationship between members of a language's sound system (Ingram, 1974b). If the child's linguistic system has not begun to develop at this stage, then phonological rules would not be expected to operate.

Ferguson and Farwell (1975), in their analysis of the first 50 words of three normal children, reported evidence in support of the possibility that children may not be productively using sounds to contrast meaning. A great deal of variation was noted in the acquisition of particular contrasts between two (or more) sounds. In relation to a particular contrast, they found that the children studied used one sound or the other in some words; but in other words, free variation between the sounds was observed. They also observed that variable forms often had more advanced canonical shapes or contained more difficult sounds, and they suggested that variable forms and partial contrasts may correspond to sound changes in progress.

Ferguson and Farwell (1975) argued for lexical primacy in early phonological acquisition. In other words, the acquisition of specific patterns and sounds may be greatly influenced by words the child selects to say. Children seem to exercise selectivity in deciding which words they will try to produce. While the production of some items may be quite stable, the production of others may be quite variable as previously mentioned. This is another reason that Ferguson and Farwell insisted that specific lexical items must be examined. Shibamoto and Olmsted (1978) conducted an analysis similar to Ferguson and Farwell's involving consonants in all syllable positions rather than initial only. They agreed that lexical selectivity may have the most primary effect on

the initial phone of a word, but they felt that phonological, rather than lexical processes accounted for the remaining phones of the word.

Strategies, according to Nelson (1973), are processing mechanisms which mediate between the environment and the child's internal structure. They are methods of controlling and manipulating information which may influence the rate or direction of language development. Nelson stated that the child's strategies reflect his cognitive structures as well as parental strategies and the effects of early interactions with people and objects in his environment. Ingram (1974a) reported that distinctive patterns of phonetic production may cause children with similar phonetic inventories to produce quite different versions of a given lexical item.

The child's selectivity in choosing words to attempt is closely related to what Ferguson and Farwell (1975) call saliency rules and avoidance rules. For example, when a particular contrast (e.g., /p~b/) is absent in a child's speech, he will be highly discriminatory and will select only /b/ (or /p/) words to say. Often a preference or salience for particular classes of sounds or syllable shapes has been observed, such as for labial and alveolar stops. Frequently noted in the literature is a general avoidance of difficult sounds, multisyllabic words, or words with consonant clusters.

Individual differences of development may be accounted for in terms of different input, different conditions, and different strategies. Every child has unique individual strategies, preferences, and an idiosyncratic lexicon (Ferguson and Farwell, 1975). Nelson (1973) suggested that variations in preverbal cognitive organization in language, in family patterns, and in the physical environment will interact to produce

a variety of different acquisition patterns in terms of direction and rate. For whatever reasons these differences may occur, they are worthy of attention in the study of children's phonological development.

A shift in phonological behavior has been observed at the end of this stage, that is, the phonology of the first 50 words (Ingram, 1976c). It generally occurs around the time the fiftieth lexical item is acquired although considerable variation and individual differences between children influence the timing of this shift. The period of acquisition which follows has been called the stage of the phonology of simple morphemes. During this stage, several cognitive and linguistic changes have been observed.

Phonology of Simple Morphemes. Around the ages of 1;6 to 2;0, several of the changes which occur in the child's language suggest the appearance of representational behavior. These changes include the onset of two word utterances, the child's participation in dialogue, his ability to refer to past and future events, a rapid acquisition of vocabulary, and the act of symbolic play (Ingram, 1976a). According to Nakazima (1975), the symbolic functions of words become operative by the end of the second year. Another characteristic of phonological development during this period is that the child's perception of adult forms improves (Ingram, 1976a). This period continues until the age of 4;0.

The child's underlying form, according to Ingram (1974b), includes his mental representation of the adult model as well as his organizational principles. There may be dissimilarities between forms at the following four levels: the adult's spoken form, the child's perceived form, the child's underlying form, and the child's spoken form (Priestly, 1977). The most significant is probably the difference between the

child's underlying form and the child's spoken form, which Ingram (1970) accounted for in terms of adaptation features. The presence of features of this type in the child's phonology implies some sort of system which is capable of dealing with features and making hypotheses.

Another characteristic of this period is the acquisition of a substantial part of the phonetic inventory of English. The child quickly masters the production of vowels; his consonant productions improve; and consonant clusters emerge. By the age of 4;0, most consonants, except for some fricatives, are acquired.

Also during this period, phonological processes begin to operate to simplify speech. These processes tend to be systematic and recurring and may include syllabic structure processes, assimilatory processes, and substitution processes (Ingram, 1976a). Ingram (1974b) discussed substitution rules as being segment and place specific and context-free; neighboring sounds do not influence the change. An example of a substitution process is "stopping" whereby fricatives and sometimes other sounds are replaced with a stop consonant (e.g., "seat" /tit/, Ingram, 1976a). Phonotactic rules, according to Ingram (1974b) are context-sensitive; a segment that would appear does not because of the influence of neighboring sounds. A child's word may have a certain syllable structure due to the syllable structure of the adult word as well as to constraints of his own system. For example, the selection of elements to produce may be determined by stress patterns of the adult as in weak syllable deletion (e.g., "banana" /nænə/). Assimilatory processes are also context-sensitive, as in the devoicing of final consonants (e.g., "big" /bIk/).

During this period of phonological acquisition, more than one

process may apply in a child's word. For example, in the pronunciation /gIk/ for "tick," both prevocalic voicing and velar assimilation influenced the production of the initial phoneme. The operation of multiple processes has been proposed in some cases, but it is questionable whether children really apply so many processes simultaneously (Ingram, 1976a).

As in the acquisition of the first 50 words, perceptual salience is important in determining particular sounds and canonical shapes produced by the child during this period. Priestly (1977) gave the example of salience for stressed syllables, which could lead to the deletion of unstressed syllables. He also suggested that vowel stress rather than vowel position is sometimes influential in determining the child's canonical underlying form.

Markedness also plays a role in sounds produced by children during this stage. According to Edwards (1974), a marked sound is distinguished from a corresponding unmarked sound by the presence of an additional feature. In the acquisition of an unmarked/marked opposition, Edwards hypothesized that the unmarked member would substitute for the marked member at some point. The results of her study of perception and production of two- and three-year-olds revealed that sound substitutions they made were usually less marked than the model, although details varied greatly.

In exploring an idiosyncratic strategy employed by a particular child to deal with certain polysyllabic words between the ages of 1;10 and 2;2, Priestly (1977) discussed the child's choice of strategy in terms of avoidance. The child's strategy was to use the syllable shape CVjVC (e.g., /pijat/ for "peanut"). Possible reasons that certain word

forms were handled by this strategy were suggested by Priestly. First, the number of polysyllabic words to which the child was exposed may have become overwhelming. Secondly, his strategy may have developed from a more normal process, the substitution of glides for liquids as in /pijal/ for "pillow." Finally, particular phonetic problems of some polysyllabic words may have proved to be too difficult a barrier for him. The particular shape may have been influenced by familiarity and/or ease of articulation. In regard to familiarity, the child heard many words with medial /j/ in his parents' speech. The optimal medial segment for a bisyllabic form that would require the least articulatory effort would be a glide.

Ingram (1974a) discussed fronting as a general process of phonological development that children follow in varying degrees. As it is not a specific process but rather a combination of other processes, it may be considered as a strategy. In fronting, sounds in a word are ordered from front to back suggesting a relationship between the initial and final consonant.

Braine (1974) discussed two types of phenomena in phonotactic development. The first, primitive phonotactic patterns, deals with types of sound sequences that are salient for the child. Examples of this type of pattern include syllable structure constraints and assimilatory tendencies by which feature changes within a word are held at a minimum. Learned rules, the second phenomenon, are concerned with what kinds of sequences of sounds occur in particular syllable environments of the language. Braine suggested that the learning of mature phonological rules is unnecessary for the most part because these rules develop naturally as primitive tendencies are unlearned.

Moskowitz (1970) examined the phonological strategies of three two-year-olds. She suggested that the child is confronted with two very different tasks during phonological acquisition: phonetic representation (pronunciation) and phonological representation (development of a system). She stated that future research "must find ways of differentiating these two types of learning" (Moskowitz, 1970, p. 441).

Ferguson and Farwell (1975), on the other hand, felt that a model of phonological development should de-emphasize the separation of phonetic and phonemic development while maintaining the notion of contrast. Important aspects of such a model would focus on individual variation as well as universal phonetic tendencies resulting from characteristics of the speech physiology and central nervous system. The notion of "phonological rule" would refer to sound change affected by classes of sounds, lexical items, or grammatical boundaries. Labov and Labov's (1978) data on their daughter's phonological development during the second year of life supported Ferguson and Farwell's claim that the separation of phonetics and phonology should be de-emphasized. The close interrelationship between these two types of learning can be shown by an observation made by Labov and Labov. They stated that their daughter's phonetic realizations were the product of her perception of their fit with adult forms, her own syllable shapes, matches between articulation and meaning, and her perception and recognition of forms.

The following section deals with the necessary components of a theory of phonological acquisition. Methods of analysis which have been utilized historically in the study of child phonology are also discussed.

Requirements for a Theory of Child Phonology and Analysis

According to Ferguson and Garnica (1975), a theory of phonological development must meet the following four requirements:

> (1) It must account for the development of all the characteristics of an adult phonology as specified by a given phonological theory.
> (2) It must account for known facts of phonological development that are not included in the characterization of adult phonology by existing theories.
> (3) It must be consistent with a broader theory of language development and be relatable to theories of other aspects of child development.
> (4) It should make principled predictions that can be empirically verified. (p. 155)

A theory of phonology, particularly of child phonology, should have means of obtaining information about children's linguistic abilities including perception and production abilities. It should also be capable of accounting for progression in the child's phonology (i.e., how he moves closer to the adult system and what processes and strategies influence progressive changes). Means of measuring these abilities and changes in abilities as well as additional phenomena in child language which must be accounted for are discussed in what immediately follows.

Child Phonology

Chomsky (1968) discussed three kinds of evaluation procedures. The first, observational, merely describes facts in a grammar without attempting generalization. In phonology, this involves descriptions of the child's observable behavior, namely production. Descriptive adequacy, the second procedure makes generalizations about linguistic phenomena beyond observable behavior. Explanatory adequacy is a procedure which relies on general linguistic theory which is independent of

any particular language. Using this procedure, languages look much alike in their underlying forms.

Ingram (1970) proposed an additional measure for use in the study of child phonology, that of developmental adequacy. This index should account for how the child moves closer to the adult system to which he is continually exposed. It provides a means of marking the instability of certain forms. Ingram discussed three ways that the child may deal with adult forms: reduction of canonical forms, omission of sounds which he comprehends but cannot yet produce, and adaptation of sounds he hears to others in his system. This third type was discussed in terms of adaptation features. An example provided by Ingram illustrated this point for a particular child's use of the vowel /æ/. The child produced /kækæ/ for "cracker" and /mæmæ/ for "mamma." Note that the adult model has two vowels: /æ/ and /a/ while the child used only one. In other word forms, the child produced the vowel /a/ as in his production of /da/ for "doll." It was assumed that the vowels /æ/ and /a/ had a different status in the child's competence and that the child's production of /æ/ would change at some point. Based on the fact that the vowel /a/ occurred in the child's system in some words, Ingram proposed that the child's underlying representation for /a/ was basically that of the adult's in terms of features with one additional feature which he called [+adaptive]. The [+adaptive] feature in this case would be [-back] thus converting /a/ into /æ/.

One problem with which an acquisition theory should deal is how children acquire the usage of redundant or nondistinctive features of language. For example, varying amounts of aspiration are used in English on the voiceless stops /p,t,k/ depending upon their placement in

syllables and their relation to stressed and unstressed vowels. Subtle sound differences of this nature are nondistinctive in English, and errors in the pronunciation of these differences in children are not corrected by adults (Ferguson and Garnica, 1975).

A second issue discussed by Ferguson and Garnica deals with progressive phonological idioms as discussed previously in this chapter. Often it seems that the pronunciation of these forms regresses as they more closely conform to the child's phonology. Of interest to a developmental theory of phonology is how these forms are perceived, remembered, and produced counter to the child's current operative constraints.

The "fis phenomenon," a perception-production discrepancy noted by Roger Brown (1973) is another issue with which developmental phonologists must deal. Based on observations in child speech, it seems that a child can perceive a particular adult sound difference and can even assign respective sounds to appropriate lexical items, but cannot make the distinction himself and may not even be aware of the lack of it in his own pronunciation.

Also mentioned previously is the apparent discrepancy in what the child produces spontaneously as opposed to imitatively. This refers to Smith's (1973) example of a child who produced /pʌgəl/ and /pʌdəl/ for "puddle" and "puzzle", respectively. The child was producing the correct form /pʌdəl/ in an inappropriate context.

The following subsection consists of a discussion of methods which have been utilized in the study of child phonology along with an evaluation of their merits and deficiencies. A more detailed discussion and comparision of the two major studies which influenced the design of this project then ensues.

Phonological Analysis

Methods. Historically, the research in child phonology can be divided into three major periods: Diary Studies (1876-1929); Large Sample Studies (1930-1957); and Linguistic Studies (1958-present) (Ingram, 1976a). Each period is characterized by a primary method of data collection. Diary studies typically consisted of observations of a child's speech over a period of time by a parent. The primary advantage of these studies is the raw data they provide which may be analyzed in various ways by others. During the period of Large Sample Studies, short samples of speech were collected from a cross-section of large numbers of children. Many of these studies were designed with the establishment of norms for language acquisition as a goal. Longitudinal linguistic studies have represented an attempt in recent years to combine the strengths of the two above methods. With this method, several children are selected and are systematically visited at predetermined intervals. In addition to looking at the child's output, attempts have been made to determine rule behavior and to construct theories of phonological development. Acquisition is viewed as the gradual suppression or elimination of processes or tendencies which simplify the adult model or change it in some way.

Ferguson (1977) has identified four methods of collecting phonological data from children, and he felt that each method has merit. Introspection is the first method in which "you say it to yourself and try to figure out what is going on" (Ferguson, 1977, p. 295). Although this approach lacks some sophistication, Ferguson stated that it has provided some valuable information in the area of phonology. The second method is elicitation by which the experimenter tries to get the child

to respond to various stimuli. Even though the situation is unnatural and the data obtained may be distorted, it is still a way of obtaining a great deal of data. Naturalistic observation is the third method. This is a means by which real (spontaneous) language in actual use is observed and recorded in a reliable form. The major issue of concern regarding the elicitation versus the naturalistic observation methods is "whether children imitate a word differently than they produce it spontaneously" (Ingram, 1976a). This issue will be discussed in more detail later in this section. The last method discussed by Ferguson (1977) is carefully designed experimentation, which is designed to obtain data in such a way that even nonlinguists would accept it.

A Comparision of Two Studies. Ferguson and Farwell (1975) examined the development of initial-consonant production in three children from approximately age 1;0 until their recorded lexicons reached 50 or more words. Words and word-initial consonants were the units of analysis from which phone classes and phone trees were constructed for each child. The term "phone class" referred to "a class of phonetically similar speech sounds believed to contrast with other such classes, as shown by lexical identifications" (Ferguson and Farwell, 1975, p. 425). For each testing session, all variants of the initial consonant of a given word were grouped together; also, all words beginning with the same phone or set of phones were grouped together. The phone classes consisted of the set of initial consonant variants of each of those two groups. Phone trees were used to diagrammatically represent and connect corresponding phone classes of successive stages.

Shibamoto and Olmsted (1978) analyzed phonological development in lexical terms based on Ferguson and Farwell's (1975) study. They carried

their analysis a step further by constructing phone classes for consonants in all positions of words rather than initial position only. They attempted to determine the following: (1) whether the sets of phone classes in all positions were the same; (2) whether differences from position to position were primarily within the phone classes at each level in the tree; and (3) what effect phone position in the syllable had on the appearance and composition of phone classes. Three of the four children who participated in this study were the same children analyzed by Ferguson and Farwell. The words and phonetic variants of each child were recorded and analyzed from approximately age 1;0 to the time when the fiftieth word was noted. This time span ranged from 13 weeks to eight months.

Two methodological differences between Ferguson and Farwell's (1975) study and Shibamoto and Olmsted's (1978) study warrant consideration at this point. The first deals with their treatment of imitations in their data. Several researchers have suggested that imitations may be more phonetically accurate than the same forms produced spontaneously. Another potential problem with the inclusion of imitations in linguistic analyses is that they may add lexical forms, phones, or phone categories that would not otherwise be present.

Leonard, Schwartz, Folger, and Wilcox (1978) stated that imitations are subject to the same production constraints as spontaneous utterances but not to the same selection and avoidance rules. However, they found that when a child's imitation was unsolicited, characteristics of the consonants and syllable shapes did not vary significantly from phonological characteristics of the child's spontaneous speech. Based on this finding, they recommended the inclusion of imitative

utterances for the analysis of productive characteristics.

Researchers who exclude imitations from their analyses generally do so "in order to maximize the number of utterances processed by the child's phonological system, rather than by a separate imitative ability" (Ferguson and Farwell, 1975, p. 422).

In spite of the problems with imitations, Ferguson and Farwell (1975) did not exclude imitations from their analysis for the following reasons. First, a lot of what a one-year-old says is imitated, leaving very little purely spontaneous data. Also, Ferguson and Farwell observed that a separation of spontaneous and imitated forms did not really correspond to a separation of different forms of the same word. Finally, a definition of imitation is not simple as even very young children can imitate things said by adults after some time has elapsed, possibly five minutes or more, despite intervening speech.

Shibamoto and Olmsted (1978), on the other hand, chose to exclude imitations from their analysis. They emphasized the importance of imitations in phonological acquisition in introducing new elements to a system. However, their reasons for excluding imitations included: (1) the notion that they add elements not otherwise present, and (2) the uncertainty of how similar or different they are from spontaneous forms. Although they analyzed only spontaneous forms, they recommended the analysis of spontaneous utterances and imitations separately first. After this had been done, Shibamoto and Olmsted suggested that a combined analysis might be useful in determining the nature of the relationship between them.

A second methodological difference between the two studies deals with what Shibamoto and Olmsted (1978, p. 422) refer to as the

"proliferation of phone classes." They claimed that Ferguson and Farwell failed to provide adequate guidelines for the grouping of phones into classes. As one of Ferguson and Farwell's aims was to identify as few phone classes as possible, Shibamoto and Olmsted felt that they had grouped sets of variants together even if only some phones for each lexical item were the same. Consequently, Ferguson and Farwell (1975) separated their phone classes at points where the variability found did not seem to be accidental. Shibamoto and Olmsted questioned how they determined whether or not variability was accidental. Presumably, the answer lies in phonemic contrasts of the adult model. Shibamoto and Olmsted, in their attempt to avoid "a priori" judgment about the relationship between the child's productions and the adult's phonemic system, chose to rely exclusively on the lexical parameter. They suggested that this might lead to an undesirable "proliferation of phone classes," but they justified their procedure by saying that "the relationship of the phones produced to the lexical items selected to utter remains unclouded by considerations of the adult phonology" (Shibamoto and Olmsted, 1978, p. 422).

Both studies reported a high level of variation of word forms. Ferguson and Farwell (1975) also noted great selectivity on the child's part in choosing words to attempt. Shibamoto and Olmsted (1978) observed that some forms were quite stable while others were more variable. Their data revealed that far more phone classes were produced in the syllable-initial position than syllable-final, partially due to phonological processes affecting final consonants. Far less continuity in lexical items and phones produced from session to session was observed for final consonants.

Information gleaned from Shibamoto and Olmsted's analysis was as follows: (1) sets of phone classes for each child were not the same in each position; (2) there were significant differences between syllable-initial and syllable-final phone trees; (3) slight differences were noted between first and second syllable-initial positions; (4) differences occurred in the number, distribution, and composition of phone classes. The authors suggested that syllable position might be an important factor in phonological productions.

Some tentative suggestions toward a model of phonological development as proposed by Ferguson and Farwell (1975) were mentioned in a previous section. One of the major points stressed in Ferguson and Farwell's study was the primacy of lexical items in the early stages of phonological development while phonological factors may be more significant in later stages. Shibamoto and Olmsted (1978) suggested a weaker version of Ferguson and Farwell's hypothesis of lexical primacy as their analyses demonstrated that phonological processes operate from the child's earliest productions, at least in non-initial consonants. They proposed a restatement of the hypothesis as follows: "Lexical selectivity operates on the first phone to determine whether the child will attempt the word or not; thereafter, phonological rather than lexical processes shape the remainder of the word" (Shibamoto and Olmsted, 1978, p. 454).

Purpose

The primary purpose of this study was to examine the relationship between sounds produced and lexical items attempted in the speech of young children learning English. Of interest was the determination of strategies employed by individual children for dealing with language

and how these strategies were changed or modified following the acquisition of the first n words, n representing a number between 10 and 100 (Nelson, 1973). Schwartz and Folger (1977, p. 9) suggested that "it may not be appropriate to credit the child with either a system of sound contrasts or a set of processes which may be applied systematically" prior to the emergence of representational ability. Thus, a lexically based approach to the description of the earliest stages of sound acquisition as employed by Ferguson and Farwell (1975) may be more reasonable. Following the acquisition of representational abilities, a phonological analysis may provide a better description of sound change in the child's system.

The variability in production of specific lexical items served as an index for determining what aspects of the sound system the child was working on and what strategies he was utilizing. A production variability ratio was computed for each child for each session by dividing the number of different productions by the number of words attempted (Schwartz and Folger, 1977). The prediction was that as the child acquires representational abilities (after n lexical items have been acquired), variability in production will decrease.

CHAPTER II

DESCRIPTION OF THE STUDY

Based on Ferguson and Farwell's (1975) and Shibamoto and Olmsted's (1978) studies, phonological development in lexical terms was investigated. Analyses of initial consonants of monosyllabic words and of initial consonants of the first and second syllables of bisyllabic words were performed for three children between the ages of 1;6 and 2;0 over a period of three and a half months. Additionally, the development of phonological processes over time was observed and analyzed. The amount of variability in sound production was studied to isolate particular aspects of sound systems currently being acquired by very young children.

Subjects

The subject population consisted of one male and two female monolingual children who were between the ages of 1;6 and 1;8 at the beginning of the study. All three subjects were judged to be developing language normally based on parental reports and analyses of speech samples obtained during the initial sessions of this study.

Jenny, who was 1;6 at the beginning of the study, was a first child with no siblings at the time of this study. She spent almost all her time with her mother who conscientiously worked to teach and develop Jenny's language skills. Jenny was highly verbal and demonstrated a willingness to imitate almost any word she heard, seemingly without concern for the syllable shape or the sound contained in the word. Jenny's

mother had kept lists of Jenny's words until approximately one month before this study began at which time she wrote that "Jenny says anything we say." The large majority of Jenny's utterances throughout the period of data collection consisted of one word, with occasional two-word utterances.

Jason, who was 1;8 at the beginning of the study, had a younger sister, aged three months. While he spent a large part of his time with his mother and sister, he went to a day care center two days a week. Although he was a very sociable child, he imitated only infrequently at the outset. However, he seemed to change his strategy to one which employed considerable amounts of imitation around the age of 1;10. The majority of his utterances consisted of one word throughout the study.

Allison, who was 1;8 at the beginning of the study, was a second child; her older sister was five years old. On weekdays, Allison stayed at a babysitter's house with several other children ranging in age from infancy to preschool age. Allison had a history of otitis media beginning at approximately two months of age. She also had P.E. tubes inserted twice in one ear and three times in the other. She was nine months old when the tubes were inserted the first time and eighteen months old the most recent time. Based on periodic audiological evaluations, her hearing acuity ranged from low normal to normal. As reported by her mother, Allison became almost nonverbal during bouts of otitis media. After each infection cleared up, Allison seemed to lose some of her previously acquired language skills and had to "start over" in a sense after the illness. In the analysis and discussion of Allison's productions, the history of otitis media will be considered. Allison was by far the least verbal child in this study and was very cautious

and selective in the words she chose to imitate or produce spontaneously. Pivot-type syntax (Braine, 1976), especially with the word "see," became a predominant feature of her speech around the age of 1;10. Although she was considerably less talkative than the other two subjects, Allison used more two-word utterances than did the others.

Data Collection Procedures

Mothers were initially contacted by phone or in person and were asked to participate in a study investigating the development of sound production in early language learning. They were asked questions regarding the amount of verbalization in which their children typically engaged and the approximate number of words their children knew. Project goals and procedures were explained to the mothers, and consent forms allowing the child's participation in the project were signed by each mother. The subject consent form appears in Appendix A.

Each child was visited at home for approximately 30 to 45 minutes per session. During the first two months of the study, each child was visited once a week. During the last month and a half of the data collection period, each child was seen twice a week as it was felt that data from successive sessions with shorter intervening time periods would be more sensitive to small changes in variability. Occasionally, longer periods of time elapsed between sessions due to illness and short family vacations.

The age range and number of sessions for each child reported here are shown in Table 1.

Table 1. Age Range and Number of Sessions for the Three Subjects

Subject	Age Range	No. of Sessions
Jenny	1;6;0 -- 1;9;14	17
Jason	1;8;1 -- 1;11;12	22
Allison	1;8;5 -- 1;11;20	24

One parent, usually the mother, was present at most sessions. During the latter portion of the study, Allison was seen once a week at home with her mother and once a week at her babysitter's home without her mother present. The babysitter occasionally participated in these sessions. The siblings of Allison and Jason were also frequently present during the sessions.

During each individual session, the observer along with a parent attempted to elicit from a child as many words as possible through the use of familiar objects and picture books. Basically, the parent and/or observer interacted naturally with the child in a play situation. The primary activities during the sessions were reading from books and playing with a variety of toys. During reading, the child was encouraged to respond by naming pictures or answering questions posed by the adult. In addition to play and reading activities, the child was frequently observed as he participated in daily routines such as eating, dressing, and "helping" his mother in the kitchen. The parent and/or observer were on most occasions actively involved with the child during the sessions.

The sessions were tape recorded using portable tape recorders. Three different tape recorders were used during the course of the

project due to accessibility of the recorders. The three recorders used were General Electric model 3-5105-G, Panasonic model RQ 332S, and Marantz model C-204. Low noise 60-minute recording tapes were used in the cassette tape recorders.

Notes were kept by the observer, and they included transcriptions of the child's utterances as well as the probable adult equivalents. In line with the procedures of Ferguson and Farwell (1975) and Schwartz and Folger (1977), utterances were included for analysis if an adult equivalent could be identified for the child's word form(s) and if there was consistency in reference or accompanying action. The children's utterances were transcribed using the techniques of Wise and Morgan (1973). Broad, as opposed to narrow, transcription was utilized in order to avoid extensive and meaningless proliferation of phone classes (to be defined below).

Imitations

Based on the plausibility of the arguments presented by Ferguson and Farwell (1975) supporting the inclusion of imitative forms, such forms have been included for analysis in this study. Their arguments focused on the scarcity of purely spontaneous utterances in the speech of very young children as well as on various problems involved in clearly distinguishing between imitations and spontaneous utterances. Ferguson and Farwell specifically found that "a separation of imitated from spontaneous forms, where the two can be compared, does not correspond in any straightforward way to a separation of different forms of the same word" (Ferguson and Farwell, 1975, p. 422).

Problematic Forms

Certain kinds of data have been excluded due to the problems they present for analysis. Ferguson and Farwell (1975) suggested the exclusion of exclamations, onomatopoeic words, and marginal forms such as "uh-huh" and "ah-oh". These forms have been excluded from the data of all three subjects in this study as they frequently did not conform to characteristics of segmental phonology.

Ferguson and Farwell also discussed various problematic forms which they included in their data analysis. These forms are described below and have been included for analysis in this study.

(1) Backgrounding is a term which refers to a case in which "the word-initial consonant is deleted or drastically reduced when the child is 'working on' another part of the word" (Ferguson and Farwell, 1975, p. 423). An example from Jason X is /aʒs/ for "doors".

(2) Assimilation (phonetic) occurs when a particular sound is affected by another sound in a word and takes on the appearance of a phonological process or phonological rule. Syllable deletion may also affect certain sounds in a child's words. Examples of assimilation and syllable deletion from the data of this study include Jenny IX /gaIg/ for "slide" and Allison V /weI/ for "raisin".

(3) Prosodic phenomena, such as the treatment of a whole word or phrase as a phonological unit, may also influence production. An example from the data is Jenny XIII /mamə/ for "another one".

Isolation of Phone Classes and Phone Tree Construction

For the purposes of this study, in line with Ferguson and Farwell (1975), the term "phone class" was used to refer to the set of phonetic variants in a given syllable position of all words beginning with the same phone or set of variant phones. For example, a phone class /b~p/ for monosyllabic forms in syllable initial position consisted of the initial consonants of all words in a given session whose initial consonant varied between /b/ and /p/. The term "phone tree" referred to a graphic representation of phone classes from successive sessions and the relationships they enter into with each other. A portion of Jenny's phone tree for syllable initial consonants in monosyllabic forms is illustrated in Figure 1. The discussion which follows details its construction.

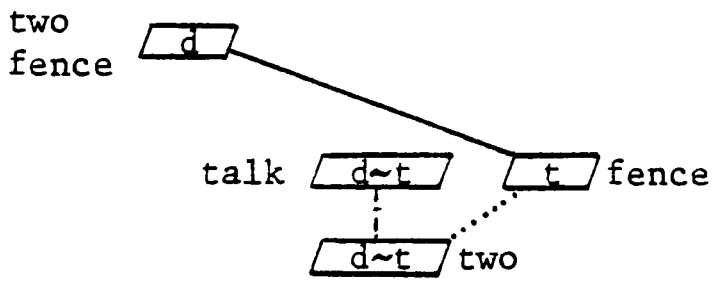

Figure 1. Phone Tree Construction

Phone classes were represented by the appropriate phonetic symbols enclosed in boxes or between vertical lines. Horizontally arranged rows represented all of the phone classes with respect to a particular syllable position produced by one child during a single session. In successive sessions, vertical lines connected phone classes of different sessions which were related in one of three ways as described below. Solid lines indicated a direct match or lexical overlap between phone classes; they connected phone classes of different sessions which

contained the same word. Dotted lines, indicating a secondary match between phone classes, connected phone classes which did not contain the same word but which were connected to a class from a previous session which did. Alternating dot-and-dash lines connected phone classes which were phonetically identical and stable although they did not contain the same word and were not connected to a class which did; hence, there was no direct match between lexical items, but the sound segments were identical.

Ferguson and Farwell (1975) described procedures for the construction of initial consonant phone trees. Shibamoto and Olmsted (1978) expanded Ferguson and Farwell's procedures to include the analysis of consonants in all syllable positions within words. They analyzed monosyllables and polysyllables separately in order to investigate the effects of syllable structure on phonological development. Ferguson and Farwell's (1975) basic procedures for phone tree construction were employed. Procedures used by Shibamoto and Olmsted (1978) for phone tree construction for monosyllabic and polysyllabic word forms were also incorporated. As syllable-initial consonants were by far the more productive for all three subjects, the following three types of phone trees were constructed and analyzed for each child:

(1) Monosyllabic, syllable initial

(2) Bisyllabic, first syllable, syllable initial

(3) Bisyllabic, second syllable, syllable initial

Shibamoto and Olmsted (1978) criticized Ferguson and Farwell's (1975) method of analysis in that they grouped sets of variants together if some, but not all, phones for each lexical item were the same, separating phone classes where it seemed "reasonable" to do so or where

the variability found was "not accidental." For example, in Jenny IX, the following three phone classes which contained /dl/ in the initial position of monosyllabic forms were identified as follows:

/dl/ sock, clothes /d~dl/ dress /dl~l~g/ slide

According to Ferguson and Farwell's procedures, these three phone classes would have been grouped together as all words in the classes were produced with an initial /dl/ although each word was not produced with all the variant phones of the class. The class would have been identified as follows: /d~dl~l~g/. Hence, their procedure required only partial overlap rather than complete overlap.

Since Ferguson and Farwell's criteria were not carefully specified and seemed to be based on "a priori" judgments concerning the relationship between a child's utterance and the probable adult equivalent, Shibamoto and Olmsted relied exclusively on the lexical parameter, grouping together only those lexical items which shared all the variants of a particular phone class. In other words, complete overlap between lexical items and the variant phones of the phone class was required. As this procedure seemed to allow for more precision in identifying variation in the production of individual lexical items, it was employed in this study.

Variation

In the analysis of variation in sound production, both the nature and the amount of that variation were determined. In order to determine the nature of variation, phone tree constructions and analyses were used to identify productive phone spaces for each child for each syllable position anaylzed (i.e., the initial position of monosyllabic

words and the initial position of both syllables of bisyllabic words). By definition, a productive phone space consisted of a cluster of sounds which appeared to be related based on variation between members of the cluster and which were used by the child in most sessions. For example, for initial consonants in monosyllables, Allison's productive phone spaces were bilabial (/b,p,m,w/), alveolar (/d,t,n/), and glottal[2] (/h,s/). Most monosyllabic words she produced began with these sounds or varied in production between members of a particular phone space. Some variation also occurred between members of different phone spaces. Points of variation between and within phone spaces were isolated in the phone trees and were analyzed.

Following Schwartz and Folger's (1977) procedures for analyzing the phonological behavior of very young children, variability analyses were performed to determine the amount of variation for each child. Variability was computed for each session in the form of a ratio obtained by dividing the total number of different productions by the total number of words attempted. For example, if 75 different productions were obtained during a session representing 50 different words, the child's variability ratio for that session would be 1.5. A ratio greater than 1.0 indicated the presence of variability in production, with larger ratios representing greater variability. The nature and amount of variation found for each subject will be presented in the results section of this study, Chapter III.

Processes and Strategies

Recently, many authors have focused on individual differences and the utilization of specific strategies in the acquisition of a sound

system (Ingram, 1974a, 1974b; Ferguson and Farwell, 1975; Vihman, 1976; Compton and Streeter, 1977; Priestly, 1977; and Shibamoto and Olmsted, 1978). In the discussion of the results of this study, Chapter IV, specific strategies and the processes that they seem to reflect will be isolated and subsequently used to trace each child's sound and lexical development. Individual differences will be noted as the subjects' performances and strategies are analyzed and compared.

Reliability

Following the procedures of Ferguson and Farwell (1975) and Shibamoto and Olmsted (1978), a substantial degree of built-in reliability was implicit in the design of this study based on the fact that broad phonetic transcription was used. Had narrow transcription been used, finer discriminations and more rigorous reliability measures would have been required.

CHAPTER III

RESULTS

Following suggestions made by Shibamoto and Olmsted (1978), concise attempts were made in the data analysis to avoid "a priori" judgments based on adult phonology. The child's point of view was the focus of the data analysis, the assumption being that when the child begins to acquire a sound system, he is initially confronted with raw phonetic space. The position taken here is that the child is active (as opposed to passive) in the acquisition process; his task is to problem-solve phonetic space and to determine significant points within that space.

In this chapter, detailed subject-by-subject analyses of the data will be presented. Productive phone spaces for each subject will be identified from their phone tree diagrams. In general, productive phone spaces consisted of clusters of points within phonetic space that each child seemed to be focusing on during the course of this project. (The phone tree diagrams for each child for the initial position of monosyllabic forms, the initial position of the first syllable of bisyllabic forms, and the initial position of the second syllable of bisyllabic forms have not been included here but are available upon request from the departmental library, Communication Disorders Department, Texas Tech University.) Next, variation within and across phone spaces will be discussed. To illustrate this variation, specific lexical items showing minimal and maximal variation for each child will be traced through time. Throughout the results and discussion sections, an effort will be made

to maintain as neutral a position as possible regarding the relationship between child forms and adult models. In what follows then, the overall analysis and interpretation of the data will be based solely on the data obtained. Inferential statements about the development of a child's sound system will be guarded such that they largely reflect the data and, in turn, shun knowledge of adult phonology.

Jenny's Phone Spaces

The productive phone spaces identified from Jenny's phone trees were bilabial (/b,p,m,w/), alveolar (/d,t,n/), and liquid (/l/) varying with l-blends and occasionally the glide /j/. The latter two phone spaces were closely related. While many of Jenny's words consistently began with a singleton alveolar consonant (e.g., "door," "duck"), the initial consonants of several words varied between /d/ or /t/ and various l-blends. Thus, the separation between those two phone spaces was somewhat nebulous.

Monosyllabic Forms: Variation within Phone Spaces

In the initial position of monosyllabic words, the greatest amount of variation observed within a phone space involved the bilabial consonants. Jenny's productions of the initial consonant of the word "blanket" varied between /b/, /w/, and /bw/. The words "milk," "bib," and "pen" were also interesting although they were produced in only two or three sessions. The initial consonants of "milk" and "bib" varied between /b/, /p/, and /m/. Presented in Table 2 is a list of these words, the sessions in which they were produced, and the phone classes to which they were assigned in each session.

Table 2. Jenny: Monosyllabic, Syllable Initial: Most Variation within Phone Spaces

Word	Session	Phone Class	Word	Session	Phone Class
blanket	I	b	rock	II	w
	II	b~bl		VI	b~w
	VII	b		IX	w
	IX	b		XI	w
	XIV	bw		XII	w
	XV	b~bw		XIII	bw~w
				XVI	w
pen	V	m	write	V	b~w
	VIII	b~p		VIII	b~bw
	X	b		X	b
bib	VII	b	milk	VIII	b~m
	IX	b~m		XIV	b~m

The least amount of variation in the initial position of monosyllabic words within phone spaces involved the nasal consonant members of the bilabial and alveolar phone spaces, namely /m/ and /n/. In Jenny's /m/ class, the following words were among several which were always produced with an initial /m/: "mine," "man," "more," "one," "Mom," "Mickey," and "move." In her /n/ class, "no," "snow," "night," and "nap" were among the words always produced with an initial /n/.

Monosyllabic Forms: Variation across Phone Spaces

The greatest amount of variation in the initial position of monosyllabic words across phone spaces generally involved l-blends alternating with alveolar and velar consonants. The best examples were the words "clothes" and "slide." Jenny's productions of "clothes" varied between initial /d/, /dl/, /tl/, /kl/, and /j/. Her productions of "slide" varied between initial /d/, /dl/, /tl/, /kl/, /l/, /ts/, and /g/.

Her production with initial /g/ was /gaIg/ where the initial /g/ may have been influenced by the final /g/. Jenny's initial consonant productions of the word "fence" varied between the bilabial and alveolar classes (i.e., /b/, /p/, /d/, and /t/). "Shoe" was a word which exhibited little variation in production of the initial consonant during the major portion of the data collection period as it began with /d/ until Session XIV when her productions began to vary between /dʒ/, /tʃ/, /t/, and /s/. It seemed that she was gradually incorporating or accommodating the features of stridency and voicelessness. Presented in Table 3 is a list of these words, the sessions in which they were produced, and the phone classes to which they were assigned in each session.

Table 3. Jenny: Monosyllabic, Syllable Initial: Most Variation across Phone Spaces

Word	Session	Phone Class	Word	Session	Phone Class
clothes	II	d~tl~kl~j	slide	V	tl~kl
	III	kl		VI	d~dl~tl
	VII	kl		VII	d~dl
	IX	dl		VIII	d~dl~l
	XI	dl		IX	dl~l~g
	XIII	kl		X	d~dl
				XI	l~ts
				XIII	d~dl
				XIV	d~dl
shoe	V	d		XV	d
	VI	d		XVI	kl
	VII	d			
	IX	d	fence	VIII	d
	XI	d		X	t
	XIV	dʒ		XI	p
	XVI	dʒ		XII	b~t~d
	XVII	t~s~tʃ		XVII	d

The least amount of variation in the initial position of monosyllabic words across phone spaces involved the bilabial phone space. While

exceptions may be noted (e.g., "fence," See Table 3), words which began with bilabial consonants either varied between members of the bilabial phone space or remained constant in that they were always produced with the same phone. The words listed in Table 2 are exemplary of words which varied within the bilabial phone space. Jenny's /p/ class was relatively unstable as it occurred as an independent class in only three sessions. When produced, /p/ usually varied with /b/, was produced as the blend /pw/, or occasionally alternated with alveolar stops. Many words were produced with stable /b/, /m/, and /w/ forms. For instance, the words "book," "bye," "button," and "read" were consistently produced with initial /m/; and "work," "walk," "round," and "way" were consistently produced with initial /w/.

First Syllable of Bisyllabic Forms: Variation within Phone Spaces

In the initial position of the first syllable of bisyllabic forms, the greatest amount of variation within a phone space again involved the bilabial consonants. The word "water" was the best pure example, as Jenny's initial consonant productions of this word varied between /b/ and /w/ in different sessions. The initial consonant productions of the proper name "Missy" varied between /b/ and /m/, but it was produced in only three sessions. Jenny's productions of the words "Weebles" and "Snoopy" were interesting as the initial consonants generally varied between members of the bilabial classes with only occasional crossover to alveolar phones. The initial consonant productions of "Weebles" varied between /b/, /bw/, /w/, and /d/. The initial consonant productions of "Snoopy" varied between /b/, /m/, /d/, and /n/. Presented in Table 4 is a list of these words, the sessions in which they were produced, and the phone classes to which they were assigned in each session.

Table 4. Jenny: First Syllable of Bisyllabic Forms: Most Variation within Phone Spaces

Word	Session	Phone Class	Word	Session	Phone Class
water	III	b	Missy	II	b~m
	VII	w		IV	m
	VIII	w		VI	m
	IX	b			
	XV	w	Snoopy	I	m
	XVI	w		II	m~d
				III	m
				V	m
Weebles	V	b~bw~w		VI	b~m
	VI	b		VII	b
	VIII	b~w		X	b
	IX	bw~w		XI	b
	X	b~bw~d		XII	b
	XI	b~bw~w		XIII	b
	XII	b~w		XVII	b~n

As with monosyllabic words, the least amount of variation in initial consonant production of the first syllable of bisyllabic words within phone spaces involved the nasal members of the bilabial and alveolar phone spaces. "Amanda" and "minute" are examples of words which were consistently produced with initial /m/. "Mommy," the most frequently produced /m/ word, was also very consistent, but the initial consonant was omitted during one production in one session. Bisyllabic words which were consistently produced with initial /n/ included "night-night," "Nanny," and "Nonny."

First Syllable of Bisyllabic Forms: Variation across Phone Spaces

The greatest amount of variation in Jenny's initial consonant production of the first syllable of bisyllabic words across phone spaces usually involved l-blends alternating with /l/, /j/, /d/, /t/, and /g/. Occasional crossover between these sounds and bilabial consonants was

also observed as in Jenny's productions of the name "Susan." Initial consonants of this word varied between /d/, /l/, /j/, /dl/, /gl/, and /b/. The only word that Jenny produced in every session was her own name. During the first half of the data collection period, her productions of "Jenny" varied between /d/, /n/, and /j/. However, around the age of 1;8, Jenny began to experiment with the affricate /dʒ/ and alternated between /d/ and /dʒ/ during the remaining sessions. "Grover" and "Casey" are examples of words that primarily alternated with l-blends with some crossover to the singleton consonants /d/ and /l/. Jenny's initial consonant productions of "Grover" varied between /d/, /dl/, /tl/, and /gl/, while her productions of "Casey" varied between /d/, /t/, /l/, /dl/, and /gl/. Presented in Table 5 is a list of these words, the sessions in which they were produced, the the phone classes to which they were assigned in each session.

Since the alveolar stops frequently combined or alternated with l-blends, the least amount of variation in the initial position of the first syllable of bisyllabic words across phone spaces occurred with the bilabial phone space. Notable exceptions included the words "Pinocchio" and "windmill"; the initial consonants of those two words varied between /m/ and /n/. As with monosyllabic forms, Jenny's /p/ class was quite unstable, and she rarely began words with a /p/. Other members of the bilabial phone space (e.g., /b/, /m/, and /w/) were relatively stable, and word forms either alternated between these consonants or were consistently produced with one of them. Examples of those words whose initial consonant Productions varied between members of the bilabial phone space are located in Table 4.

Table 5. Jenny: First Syllable of Bisyllabic Forms: Most Variation across Phone Spaces

Word	Session	Phone Class	Word	Session	Phone Class
Susan	I	d	Jenny	I	d
	III	j		II	n~j
	IV	l		III	j
	V	d~gl		IV	d~n
	VIII	d		V	n
	IX	d~l		VI	n
	X	d		VII	n
	XI	d~l		VIII	d~n~dʒ
	XII	dl		IX	d
	XIII	d		X	d~dʒ
	XIV	b~d		XI	d~dʒ
	XV	d		XII	d~dʒ
	XVI	d		XIII	d~dʒ
				XIV	d~dʒ
				XV	d~dʒ
				XVI	d~dʒ
Casey	VI	l		XVII	d~dʒ
	IX	d~j			
	XI	d~dl	Grover	VIII	dl
	XII	d~dl		X	d~dl
	XIV	d~dl		XII	d~dl
	XV	dl		XIII	dl~gl
	XVII	t~gl		XVI	tl

Second Syllable of Bisyllabic Forms: Variation within Phone Spaces

In the initial position of the second syllable of bisyllabic word forms, the greatest amount of variation within a phone space was between the bilabial consonants. Jenny's productions of the initial consonant of the second syllable of the words "happy" and "Opal" varied between /b/ and /p/. Her productions of "Snoopy" varied between /b/, /p/, and /m/ with occasional crossover to alveolar phones. Some variation between the alveolar stops /d/ and /t/ was also present in infrequently produced proper names such as "Carol" and "Leta." Presented in Table 6 is a list of these words, the sessions in which they were produced, and the phone classes to which they were assigned in each session.

Table 6. Jenny: Second Syllable of Bisyllabic Forms: Most Variation within Phone Spaces

Word	Session	Phone Class	Word	Session	Phone Class
Opal	II	b	Snoopy	I	m
	IX	p		II	m~n
	X	b~p		III	m
	XI	b		V	m
	XV	b		VI	b~m
	XVI	p		VII	b~p
	XVII	b~p		X	b~p
				XI	p~t
happy	XII	p		XII	b
	XIII	b~p		XIII	b~p
	XIV	b		XVII	p
	XVI	b~p			
	XVII	b~p			

The least amount of variation in initial consonant production of the second syllable of bisyllabic words within phone spaces involved the voiced stop /d/ and the nasals /m/ and /n/. Words consistently produced with initial /d/ of the second syllable included "Daddy," "dirty," and "Grandad." Words consistently produced with initial /m/ included "Mommy," "Amy," and "hammer." "Barney," "Donald," and "night-night" were examples of words consistently produced with initial /n/ of the second syllable.

Second Syllable of Bisyllabic Forms: Variation across Phone Spaces

The most amount of variation in Jenny's initial consonant production of the second syllable of bisyllabic words across phone spaces generally involved a crossover between bilabial and alveolar classes ("bottle") or between alveolar and l-blend classes ("Casey" and "Susan"). The word "kitty" was interesting as the production of /t/ as the initial segment of the second syllable was constant until the last session when

/t/ alternated with /d/ and /dʒ/. This seemed to indicate a sudden interest in experimenting with the production of that particular lexical item. On the other hand, Jenny's productions of the word "lady" were variable at first, alternating between /j/, /l/, and /gl/. The form stabilized to a /d/ production in subsequent sessions, suggesting mastery of that sound segment for that word. Presented in Table 7 is a list of these words, the sessions in which they were produced, and the phone classes to which they were assigned in each session.

Table 7. Jenny: Second Syllable of Bisyllabic Forms: Most Variation across Phone Spaces

Word	Session	Phone Class	Word	Session	Phone Class
bottle	I	b	Susan	I	d
	II	b~p		III	j
	VIII	b~d		IV	l
	IX	d		V	d~gl
	X	p~d		VIII	d
				IX	l
Casey	VI	l		X	d
	IX	dl~k		XI	d~l
	XI	d~dl		XII	l
	XIV	d~dl		XIII	d
	XV	d~t		XIV	d
	XVII	d~t		XV	d
				XVI	d~l
lady	III	j~l			
	IV	l~gl			
	XII	d	kitty	X	t
	XIII	d		XV	t
	XV	d		XVI	t
	XVI	d		XVII	d~t~dʒ

The least amount of variation in the initial position of the second syllable of bisyllabic words across phone spaces was between the bilabial and /l/ classes. In fact, only one example in all of Jenny's phone trees was noted, that being the word "pillow." The initial

consonant of the second syllable was produced as /b/ in Session VIII, as /d/ in Session IX, and as /l/ in Session XIII. Close to equal amounts of variation were noted between the bilabial and alveolar classes and between the alveolar and /l/-l-blend classes.

Overall Patterning of Phone Spaces

In monosyllabic forms as well as in both syllables of bisyllabic forms, the greatest amount of variation within phone spaces involved the bilabial phones. These sounds also participated in the least variation across phone spaces. It appeared then that the bilabial phones were treated as a cluster of sounds which were separable from other phones. At the same time, bilabial productions were not stable within their phone space as marked variation occurred in all syllable positions analyzed. The nasal consonants /m/ and /n/ were least variable. Variation between nasal consonants and other sounds either within or across phone spaces was rare by comparison to the variability noted elsewhere. Jenny's productions of l-blends generally participated in the most variation across phone spaces as they frequently alternated with alveolar and velar stops. This suggested some instability in the production of l-blends.

One interesting aspect of Jenny's phone tree analysis was the presence of individual lexical items whose consonant productions were relatively stable at first but began to vary at later points in time (e.g., "shoe" in Table 3 and "kitty" in Table 7) or vice versa (e.g., "lady" in Table 7). Stable productions before a period of variation may indicate initial cognitive assimilation of the adult model to conform to the child's system followed by a gradual departure from his system as he

attempts to accommodate more features of the adult sound. Productions which initially exhibit variation may also represent an attempt on the child's part to accommodate features of the adult model to his own system. When variation begins to subside and productions stabilize, it may be that the child has decided on a pronunciation that provides the greatest degree of match with the adult model even if it is not identical to the adult pronunciation.

The consistency of patterns of variation found in all three syllable positions analyzed suggested that Jenny's acquisition of sounds may be closely tied to selection strategies for particular syllable shapes. This notion will be discussed in more detail in the final chapter.

Jason's Phone Spaces

The phone spaces identified from Jason's phone trees were bilabial (/b,p,m,w/), alveolar (/d,t,n/), alveolar and palatal fricative/affricates (/s,z,ʃ,ʒ,tʃ,dʒ/), and velar stops (/k,g/). A glottal (/h/) class was also fairly active in monosyllabic words and in the first syllable of bisyllabic words. It was necessary to identify more phone spaces from Jason's data as he was more productive across more different sound classes than the other two subjects.

Monosyllabic Forms: Variation within Phone Spaces

In the initial position of monosyllabic words, the greatest amount of variation observed within a phone space involved the fricative/affricate phone space. Examples of words which varied between members of this group included "sing" and "chair." Variation also occurred between members of the bilabial phone space as in the words "spilled" and "break." Presented in Table 8 is a list of these words, the sessions in which they

were produced, and the phone classes to which they were assigned in each session.

Table 8. Jason: Monosyllabic, Syllable Initial: Most Variation within Phone Spaces

Word	Session	Phone Class	Word	Session	Phone Class
sing	V	s	chair	VIII	ʃ~tʃ
	VI	s~ts		XII	ʃ
	VII	s~ts~sw~tsw~sr		XIII	s
				XIV	ʃ~tʃ
	VIII	s		XV	s~ʃ
	X	s~ʃ		XIX	s~ʃ~tʃ~dʒ
	XI	s		XX	t~ʃ~tʃ
	XII	s			
	XIV	ʃ			
	XV	s			
	XVI	s			
	XIX	ʃ			
	XX	s			
	XXI	ʃ			
	XXII	ʃ	break	I	b
				II	b
spilled	X	p		IV	w
	XI	p		V	b
	XIII	p		VI	b
	XVI	p		IX	b
	XVII	b		X	b~bw
	XIX	p		XVI	bw
	XX	b		XX	b~bw
	XXII	b~p		XXI	bw

The least amount of variation in the initial position of monosyllabic words within phone spaces involved the alveolar and glottal classes. Minimal variation was noted between /d/ and /t/ as in the words "tape," "dark," and "close." Most words beginning with /h/ in Jason's productions were fairly stable, sometimes alternating with an omission as in the words "hot," "on," "off," "hand," "hole," and "hair."

Monosyllabic Forms: Variation across Phone Spaces

The greatest amount of variation in the initial position of monosyllabic words across phone spaces involved alternations between alveolar and velar stops (and occasionally palatal fricatives) and between the glottal, velar, and alveolar classes. The words "talk," "stuck," and "close" were exemplary of this variation. Jason's productions of the word "light" revealed consistent articulation with a /d/ throughout most of the sessions. Toward the end of the data collection period, his /d/ production for "light" began to alternate with /l/, /j/, and /w/, indicating a sound change in progress. Also, Jason's productions of the initial consonant of the word "face" changed from bilabial to labiodental fricative articulation. Presented in Table 9 is a list of these words, the sessions in which they were produced, and the phone classes to which they were assigned for each session.

The least amount of variation in the initial position of monosyllabic words across phone spaces was between the glottal class and other classes of sounds although the exception, "talk" (See Table 9) was significant. Jason's productions of the words "cup" and "hot" also varied between the glottal and velar stop classes. However, the variation between the glottal phone space and other phone spaces was minimal when compared to that between other phone spaces.

First Syllable of Bisyllabic Forms: Variation within Phone Spaces

In the initial position of the first syllable of bisyllabic forms, the greatest amount of variation within a phone space involved the fricative and affricate sounds; the best example of this variability was the proper name "Susan." Jason's productions of the initial consonant of

"water" varied primarily between members of the bilabial phone space, occasionally crossing over to a velar stop consonant. Likewise, his productions of the word "cookies" varied mainly between the velar stops /g/ and /k/, but crossed over to a /t/ production during one session. Presented in Table 10 is a list of these words, the sessions in which they were produced, and the phone classes to which they were assigned in each session.

Table 9. Jason: Monosyllabic, Syllable Initial: Most Variation across Phone Spaces

Word	Session	Phone Class	Word	Session	Phone Class
close	IX	d	stuck	V	d~g~k
	X	g		VI	g
	XI	k		VII	d~g
	XII	k		IX	g
	XIV	g~k		X	ʃ~g
	XV	d~g		XIII	g
	XVI	k		XIV	g~k
	XVII	g~k		XV	g
	XVIII	d~k~kw		XVII	g
	XIX	d~t			
	XX	k			
	XXI	k~kw			
	XXII	kw	talk	I	h
				II	d~h
light	II	d		III	h
	III	d		IV	k~h
	IV	d		VII	k
	V	d		VIII	t~k
	VII	d		X	k~h
	VIII	d		XII	k
	IX	d		XV	t~g~k
	X	d		XVIII	k
	XII	d			
	XIII	d			
	XV	d			
	XVIII	d~l	face	IX	p~w
	XX	d~j~l		XV	f
	XXI	d~j		XVI	hw~f
	XXII	w~j		XXI	f

Table 10. Jason: First Syllable of Bisyllabic Forms: Most Variation within Phone Spaces

Word	Session	Phone Class	Word	Session	Phone Class
water	IX	b~w~g	Susan	III	z~s
	X	w		VIII	s~ʃ
	XI	w		X	s
	XII	w		XI	s~dʒ
	XIII	w		XII	s
	XIV	w		XIV	s~ʃ
	XVI	w		XVI	s
	XVII	w		XVII	s~ʃ
	XVIII	w		XVIII	s
	XX	b~w		XIX	s~ʃ~sj
	XXII	w		XX	s~ʃ
				XXI	s
cookies	I	g~k		XXII	s~ʃ
	VI	t~k			
	VIII	g			
	XII	k			
	XIII	k			
	XVI	k			

The least amount of variation in initial consonant production of the first syllable of bisyllabic words within phone spaces involved the alveolar phone space. Bisyllabic word forms beginning with /d/, /t/, and /n/ were relatively stable. Occasional variation between /d/ and /t/ was observed, as in the words "Sesame Street" and "tractor."

First Syllable of Bisyllabic Forms: Variation across Phone Spaces

The greatest amount of variation in Jason's initial consonant production of the first syllable of bisyllabic words across phone spaces involved alternations between members of the glottal or velar classes with members of other phone spaces. Presented in Table 11 is a list of exemplary words, the sessions in which they were produced, and the phone classes to which they were assigned in each session.

Table 11. Jason: First Syllable of Bisyllabic Forms: Most Variation across Phone Spaces

Word	Session	Phone Class	Word	Session	Phone Class
finger	XIX	w	coffee	IX	p
	XX	w		XV	h
	XXI	f~h		XIX	k
record	XI	w~k	cycle	VII	h
	XII	w		VIII	s
				XII	s~h
				XIV	s
Trigger	XIII	g			
	XVII	hw	jacket	XI	g
	XXII	d~dʒ		XVIII	b~d~g

The least amount of variation in the initial position of the first syllable of bisyllabic words across phone spaces involved alternations between the fricative/affricate phones and other sound classes. Notable exceptions included the words "Trigger" and "zipper" (/d~dʒ/); "cycle" (/s~h/); and "Alicia" (/d~ʒ~ʃ~ø/). On the whole, however, there was much less interaction between the fricative/affricates and other phone spaces than between the other groups.

Second Syllable of Bisyllabic Forms: Variation within Phone Spaces

Considerably less variation both within and across phone spaces was present for the second syllable of bisyllabic word forms than for monosyllabic or bisyllabic, first syllable initial consonants. In the initial position of the second syllable of bisyllabic words, the greatest amount of variation within phone spaces occurred in the bilabial and fricative/affricate phone spaces. Jason's productions of the initial consonants of the second syllable of the words "apple" and "open" provided examples of variation within the bilabials. An example of

variation in the fricative/affricate phone space was the word "Susan." Presented in Table 12 is a list of these words, the sessions in which they were produced, and the phone classes to which they were assigned in each session.

Table 12. Jason: Second Syllable of Bisyllabic Forms: Most Variation within Phone Spaces

Word	Session	Phone Class	Word	Session	Phone Class
apple	II	b	Susan	III	z
	X	b~p		VIII	s~ʃ
	XX	p		X	s
	XXII	b~p		XI	ʒ~dʒ
				XII	s
				XIV	s~ʃ
open	XVI	b~p~ø		XVI	s
	XVII	p		XVII	s~ʃ
	XVIII	b~p		XVIII	z
	XIX	p		XIX	z~s
	XX	b~p		XX	z~ʃ
	XXI	p		XXI	z
	XXII	b~p		XXII	z~ʃ

The least amount of variation in initial consonant production of the second syllable of bisyllabic words within phone spaces involved the alveolar and velar phone spaces. Some variation occurred between /d/ and /t/ as in the words "Daddy," "Sesame Street," and "tractor." Minimal variation was also observed between /g/ and /k/ in words such as "tickle" and "Trigger." However, variation between members of these phone spaces was considerably less than between members of the other phone spaces.

Second Syllable of Bisyllabic Forms: Variation across Phone Spaces

Only two word forms actually crossed phone space boundaries in Jason's productions of the initial consonants of the second syllable of

bisyllabic word forms, those being the words "coffee" and "water." The productions of the word "coffee" varied between /p/ and /f/, while the productions of the word "water" varied between /d/, /j/, /t/, and null (∅). These forms are presented in Table 13 along with the sessions in which they were produced and the phone classes to which they were assigned in each session.

Table 13. Jason: Second Syllable of Bisyllabic Forms: Most Variation across Phone Spaces

Word	Session	Phone Class	Word	Session	Phone Class
water	IX	d~j	coffee	IX	p
	X	d		XI	p
	XI	d		XV	p
	XII	d		XIX	f
	XIII	t			
	XIV	d			
	XVI	d			
	XVII	d			
	XVIII	d			
	XX	d~∅			
	XXII	j			

Since only two word forms showed variation between phone spaces, it may be assumed that most phone spaces were fairly stable. This appeared to be the case, and the most stable phone classes seemed to be the /m/, /n/, and /k/ classes, each of which showed only minimal variation between members of its own phone space.

Overall Patterning of Phone Spaces

Jason did not exhibit as much consistency in variation patterns across monosyllabic and bisyllabic forms as Jenny did, indicating a difference in acquisition strategies between the two children. However, there was a fairly consistent pattern of variation within phone spaces

with the fricative/affricate sounds participating in the most variation among themselves. The least amount of variation within phone spaces involved the glottal and velar phones although exceptions were noted. In bisyllabic forms, the least amount of variation across phone spaces involved the fricative/affricate phones. As with Jenny's bilabial phone space, Jason's fricative/affricate phones seemed to be treated as a cluster of sounds separable from phones in other phone spaces while participating in considerable variation among themselves.

A discrepancy arose in variation patterns for monosyllabic and bisyllabic forms across phone spaces. In bisyllabic forms, the greatest amount of variation across phone spaces involved the glottal and velar phones alternating with phones outside of their own phone spaces. In monosyllabic forms, on the other hand, the members of the glottal phone space participated in the least variation across phone spaces. The greatest amount of variation across phone spaces in monosyllabic forms involved the velar and alveolar stops. This difference between monosyllabic and bisyllabic forms may also reflect a sound acquisition strategy related (or tied) to syllable structure.

In line with Jenny's data, examples of individual lexical items which demonstrated consecutive time periods of stability followed by variability in production were extracted from the data. The most notable example was the word "light" which was initially produced consistently with an initial /d/. This stable production at first suggested that cognitive assimilation was being used to conform the adult model to match his current system of constraints. During the last few sessions, Jason's productions of the initial segment of the word "light" began to

vary between the /d/, /l/, /j/, and /w/ phones, indicating an attempt to accommodate features of the adult sound into his productions.

Allison's Phone Spaces

The phone spaces identified from Allison's phone trees were bilabial (/b,p,m,w/), alveolar (/d,t,n/), and glottal (/h,s,ʃ/). The rationale for grouping the sounds in Allison's glottal phone space together was based on her production of those sounds and the extensive variation between members of the group. Her articulation of these sounds was not adult-like, as her fricative sounds (primarily /s,ʃ/) were produced with a more open vocal tract than occurs in mature pronunciation. Likewise, her production of the glottal /h/ was somewhat restricted in terms of the openness of the vocal tract in adult pronunciation of the sound. Therefore, her productions of these sounds were very close in terms of manner of articulation.

Monosyllabic Forms: Variation within Phone Spaces

In the initial position of monosyllabic words, the greatest amount of variation within a phone space involved the glottal class. Variation was also observed within the bilabial and alveolar phone spaces (e.g., "broke" and "stuck"), but not nearly as much as within the glottal phone space. Examples of monosyllabic words whose initial consonant productions varied between members of the glottal phone space included the words "see," "shoe," and "soft." Presented in Table 14 is a list of these words, the sessions in which they were produced, and the phone classes to which they were assigned in each session.

The least amount of variation in the initial position of monosyllabic words within phone spaces involved the alveolar class. Variation

occurred between /d/ and /t/ (e.g., "cry," "star," "talk," and "train") and occasionally between /d/ and /n/ (e.g., "nose"). However, the variation between members of this phone space was limited as compared to the bilabial class and especially as compared to the glottal class.

Table 14. Allison: Monosyllabic, Syllable Initial: Most Variation within Phone Spaces

Word	Session	Phone Class	Word	Session	Phone Class
see	I	h	shoe	IV	ʃ~hj
	IV	ʃ~h~ø		VI	ʃ
	V	s~ʃ~h		VIII	h
	VI	s~h		XII	ʃ
	VII	s~ts~ʃ~h		XIII	s
	VIII	s~ʃ~h		XV	h~ø
	IX	s~h		XVI	h
	X	s		XVIII	ʃ~tsj~hj
	XI	s~ts		XX	ʃ
	XII	s~h~ø		XXII	h
	XIII	s~ʃ~h			
	XIV	s~h	stuck	IV	d
	XV	h~s~d~ø		VI	t
	XVI	h		XI	t
	XVII	s~h~ø		XIII	t
	XVIII	h		XVII	d~t
	XIX	h			
	XX	h~ø	broke	II	b~p
	XXI	s~h		V	b
	XXII	s~h~ø		VI	b
	XXIII	s~h~ø		VIII	b
	XXIV	s~h~ø		IX	b
				X	b
				XII	b~bw
				XIII	b~bw
soft	IV	s~ʃ~tʃ		XIV	b
	VII	s~t~ts~h		XVI	b
	VIII	hj~sj		XVII	b
	XXI	hj		XVIII	b

Monosyllabic Forms: Variation across Phone Spaces

The greatest amount of variation in the initial position of monosyllabic words across phone spaces involved alternations between the

bilabial and alveolar spaces with very little variation between those and the glottal phone spaces. Most words whose initial consonant productions crossed over from bilabial to alveolar did so in only one or two sessions. Examples of words whose initial consonants varied between /b/ and /d/ in a limited number of sessions included "lady," "bird," "block," "boy," "cow," and "candy." Velar stops, although infrequently produced, occasionally alternated with bilabial and alveolar stops. One word ("this") was noted in which Allison's initial consonant productions varied between the alveolar and glottal phone spaces. Presented in Table 15 is a list of representative words, the sessions in which they were produced, and the phone classes to which they were assigned in each session.

Table 15. Allison: Monosyllabic, Syllable Initial: Most Variation across Phone Spaces

Word	Session	Phone Class	Word	Session	Phone Class
candy	VI	d	this	IX	d
	XI	b~d~t~k		X	d
	XII	t		XIII	d
				XIV	d~h
				XV	d
				XVII	d
				XVIII	d
cow	XXI	k		XIX	d
	XXII	d		XXI	d~h
	XXIV	b~d		XXIII	d

As mentioned above, the least amount of variation in initial consonant production of monosyllabic words across phone spaces involved alternations between the glottal and the other two phone spaces. The word "this" (See Table 15) is one of only a few examples of words which varied in initial consonant production outside of the glottal phone space.

First Syllable of Bisyllabic Forms: Variation within Phone Spaces

The same phone spaces were applicable for bisyllabic words as for monosyllabic words in Allison's data, except that the fricatives /s,ʃ/ rarely interacted with the glottal /h/. Also, minimal variation within or across phone spaces was observed in bisyllabic words. In the initial position of the first syllable of bisyllabic word forms, approximately equal variation occurred within the bilabial and alveolar phone spaces. There was occasional alternation between /b/ and /p/ as in the words "baby" and "puppy." Alternation between /d/ and /t/ in the alveolar phone space was also minimal but occurred in a few sessions in the words "thank you" and "kitty cat." The nasal members of the bilabial and alveolar phone spaces (/m/ and /n/) did not alternate at all with other members of their phone spaces.

First Syllable of Bisyllabic Forms: Variation across Phone Spaces

The least amount of variation in initial consonant production of the first syllable of bisyllabic words across phone spaces was between the alveolar and glottal classes. However, there was only one example of a word form whose initial consonant production varied across phone spaces in bisyllabic words. That word was "kitty." Its initial consonant generally varied between /d/ and /t/ as noted above, but in one session was produced with initial /h/. There was no variation between the bilabial phone space and the others.

Second Syllable of Bisyllabic Forms: Variation within Phone Spaces

As with the initial consonants of the first syllable of bisyllabic words, there was little variation within or across phone spaces in Allison's initial consonant productions of the second syllable of bisyllabic

words. Again, approximately equal variation occurred within the bilabial and alveolar phone spaces. The initial consonant of the second syllable of the words "baby" and "purple" varied between /b/ and /p/, while the productions of "Daddy" and "kitty" varied between /d/ and /t/. Allison's productions of "Daddy" also alternated with a segment outside of the alveolar class, the glide /j/, during two sessions.

The least amount of variation within phone spaces for the initial consonant of the second syllable of bisyllabic words was within the glottal class, which was very stable. Allison's productions of the word "doctor" varied between /h/ and /ʔ/ in one session. This was the only instance of variation within the glottal phone class.

Second Syllable of Bisyllabic Forms: Variation across Phone Spaces

It was not possible to determine the greatest amount of variation across phone spaces for the initial consonant of the second syllable of bisyllabic words as each phone space was involved in one, and only one, alternation outside its own space. Allison's productions of the word "Daddy," as mentioned above, alternated between /d/, /t/, and /j/; and her productions of the word "bunny" varied between /b/ (bilabial) and /h/ (glottal) in one session. Likewise, the least amount of variation between phone spaces was not determined as it was equal across all three phone spaces.

Overall Patterning of Phone Spaces

Allison's glottal phone space was quite active in monosyllabic forms but not in bisyllabic forms. In monosyllabic forms, the members of the glottal phone space participated in the greatest amount of variation among themselves and in the least amount of interaction with members

of other phone spaces. Hence, in monosyllabic forms, the glottal phone space was treated as a cluster of sounds separate from other phones. The least amount of variation within phone spaces in monosyllabic forms involved members of the alveolar phone space. However, these phones alternated considerably across phone spaces with bilabial phones.

The limited amount of variation either within or across phone spaces observed in bisyllabic forms seemed to be related to Allison's strong preference (i.e., selection strategy) for CV syllable shapes. Relatively few bisyllabic forms were produced, thus accounting for the minimal variation found as compared to monosyllabic forms. Allison's selection strategies will be discussed in Chapter IV.

Levels of Variability

Using Schwartz and Folger's (1977) procedures to determine the amount of variation, variability ratios were computed for each session by dividing the total number of different productions in the sessions by the total number of words attempted. A ratio of 1.0 indicated no variability while ratios above 1.0 indicated variability in production. Presented in Table 16 are the variability ratios obtained for each child session-by-session.

The mean variability for all sessions of a particular subject was calculated in five different ways in order to control for sample size and potential extremes of variability session-to-session. First, the variability ratios from all sessions were added together and divided by the total number of sessions. The second mean was obtained by eliminating from the computation the two (or three) sessions with the highest and lowest variability ratios. To compute the third mean, the two or

three sessions with the least and most number of words attempted were eliminated. The fourth mean was calculated by eliminating only those two sessions in which the lowest variability ratios were obtained. The fifth mean was calculated by eliminating the two sessions in which the least number of words were attempted. The mean number of words attempted by each subject in all sessions was also computed. All means obtained are presented in Table 17.

Table 16. Variability Ratios for Each Subject Session-by-Session

Jenny	Jason	Allison
I. 40/31 = 1.29	I. 31/23 = 1.35	I. 34/18 = 1.89
II. 97/52 = 1.86	II. 41/25 = 1.64	II. 11/10 = 1.10
III. 73/46 = 1.59	III. 46/23 = 2.00	III. 19/9 = 2.11
IV. 93/60 = 1.55	IV. 44/28 = 1.57	IV. 72/38 = 1.89
V. 103/71 = 1.45	V. 64/37 = 1.73	V. 48/28 = 1.71
VI. 97/66 = 1.47	VI. 69/38 = 1.82	VI. 37/28 = 1.32
VII. 105/83 = 1.26	VII. 48/34 = 1.41	VII. 55/31 = 1.77
VIII. 152/104= 1.46	VIII. 78/51 = 1.53	VIII. 41/29 = 1.41
IX. 102/66 = 1.54	IX. 116/63 = 1.84	IX. 34/25 = 1.36
X. 142/97 = 1.46	X. 73/53 = 1.38	X. 30/25 = 1.20
XI. 114/80 = 1.42	XI. 81/68 = 1.19	XI. 38/24 = 1.58
XII. 129/85 = 1.52	XII. 72/60 = 1.20	XII. 37/26 = 1.42
XIII. 164/113= 1.45	XIII. 83/48 = 1.73	XIII. 78/47 = 1.66
XIV. 89/58 = 1.53	XIV. 94/61 = 1.54	XIV. 15/13 = 1.15
XV. 84/69 = 1.22	XV. 88/63 = 1.40	XV. 71/49 = 1.45
XVI. 96/68 = 1.41	XVI. 84/64 = 1.31	XVI. 52/44 = 1.18
XVII. 94/67 = 1.40	XVII. 61/42 = 1.45	XVII. 113/75 = 1.51
	XVIII. 83/48 = 1.73	XVIII. 88/64 = 1.37
	XIX. 95/61 = 1.56	XIX. 73/45 = 1.62
	XX. 108/67 = 1.61	XX. 26/17 = 1.53
	XXI. 139/88 = 1.58	XXI. 64/46 = 1.39
	XXII. 86/59 = 1.46	XXII. 38/27 = 1.40
		XXIII. 47/31 = 1.52
		XXIV. 69/40 = 1.72

In order to facilitate comparison of the data with Schwartz and Folger's (1977) results, mean length of utterance (MLU) for each subject was estimated in two different ways. Tyack and Gottsleben's (1974)

method of calculating MLU was employed and modified for use with children at the one-word stage of development. Starter phrases such as Allison's "see" (e.g., "see bird," "see dress," etc.) were included only once in each session in which they occurred. First, MLU was calculated from the two sessions in which the most words were attempted and from the two sessions in which the least number of words were attempted. The estimated MLU was the mean of these four MLUs. The second estimated MLU was computed by calculating MLU from the two sessions with the highest variability ratios and from the two sessions with the lowest variability ratios. The mean of these four MLUs was then computed. The estimated MLUs obtained for each subject are presented in Table 18.

Table 17. Variability Means, Mean Number of Different Words Produced, and Total Number of Words Produced for all Subjects

	Variability Means		
	Jenny	Jason	Allison
1. All sessions	1.46	1.54	1.51
2. High and low var. omitted	1.46	1.53	1.48
3. High and low # words omitted	1.47	1.54	1.51
4. Low var. omitted	1.49	1.57	1.55
5. Low # words omitted	1.47	1.52	1.50
Mean # different words--all sessions	71.6	50.1	32.8
Total # words--all sessions	423	382	236

Table 18. Estimated MLU for all Subjects

	Mean Length of Utterance		
	Jenny	Jason	Allison
1. Most, least words/session	1.00	1.01	1.11
2. Most, least variability	1.01	1.004	1.07

In Schwartz and Folger's (1977) analysis of variability, spontaneous speech samples of at least 100 utterances in length were collected from 20 children in a small number of sessions over a period of six weeks. They found a significant difference between the variability ratios obtained for children at Stage VI, with a marked decrease in variability as sensorimotor learning progresses. In order to claim that Stage VI of sensorimotor development has been attained, the child must have acquired (1) representational ability, (2) the ability to perform mental combinations, and (3) the internalization of action schemas, thus permitting representation of these schemas (Schwartz and Folger, 1977). Furthermore, Schwartz and Folger claimed that the attainment of Stage VI occurs simultaneously with the onset of two-word utterances and the acquisition of the fiftieth word.

All subjects in this study may be considered to have reached Stage VI of sensorimotor intelligence as they each had acquired over 50 words and had demonstrated representational ability, the ability to perform mental combinations, and internalized action schemas. Based on each subject's calculated MLU, none of them had begun to use predominantly two-word utterances; but their cognitive development was consistent with that expected at Stage VI.

It was interesting, therefore, to note the high level of variation in sound production of the subjects of this study. Schwartz and Folger (1977) found a mean variability ratio of 1.34 for children who had acquired Stage VI of sensorimotor intelligence and a mean of 1.74 for children at Stage V. The variability means of the subjects of this study, which clustered around 1.5, were approximately midway between the means found by Schwartz and Folger, demonstrating that marked variability

in sound production was still present in children who had attained Stage VI of sensorimotor development and who were well beyond the acquisition of the first 50 words.

The discrepancy between variability ratios obtained in this study and those obtained in Schwartz and Folger's (1977) study may be attributable to differences in sampling. Schwartz and Folger's data may not have been as sensitive to small changes in variability as the data of this study were, due to a smaller sample size, longer intervening time periods between sessions, and a shorter time span of data collection.

Based on the levels of variability obtained in this study, especially when considering the relatively high mean number of words per session (See Table 17) and the large overall number of words per child (See Appendices B, D, and F), speculation of the emergence of underlying representations is of questionable status. As Piaget (1952) suggested, a Stage VI child is able to combine and compare various images. Yet, Piaget noted that these images (representations) at this stage link only successive perceptions without an overall representation dominating.[3] As Schwartz and Folger (1977) concluded, it would be difficult to credit the young child with either a system of sound contrasts or a set of processes (i.e., mental operations) which may apply systematically. This will be discussed in more detail in the final chapter. Even though the subjects in this study were functioning at Stage VI and were also far beyond the acquisition of the first 50 words, systems of sound contrasts and sets of processes which apply systematically were not present.

Recap of Results

The nature and amount of variability in the session-by-session analysis of each subject's data have been presented. The analysis of

productive phone spaces yielded specific patterns of variation both within and across phone spaces for each subject. Variability ratios were computed to reflect the amount of variation session-by-session.

Overall, considerable amounts of variation were found both within and across phone spaces for each subject. Patterns of variation across the three syllable positions analyzed (i.e., monosyllabic forms, syllable initial; first syllable of bisyllabic forms, syllable initial; and second syllable of bisyllabic forms, syllable initial) were suggestive to a certain extent of individual strategies of sound acquisition which may be tied to syllable structure preferences.

Variability ratios obtained were high (approximately 1.5 for all subjects) when compared to the prediction made by Schwartz and Folger (1977) that the amount of variability would decrease in the sound productions of children who had achieved Stage VI of sensorimotor development. These high levels of variability were especially interesting when the high mean number of words and large overall number of words for each child were considered. Based on these results, it would not be appropriate to credit the young child with either a system of sound contrasts or a set of processes that apply systematically.

The following chapter deals more specifically with the sound and lexical development of each child. Strategies for dealing with sounds and syllable shapes are suggested based on each child's performance. The substantial variability found in all subjects was indicative of sound changes in progress, but great individual differences in the manner in which each child dealt with the problem-solving task of obtaining productive use of English sounds were evident.

CHAPTER IV

DISCUSSION AND CONCLUSIONS

Beginning very early in life, the child is motivated to express his needs and to control and manipulate his environment. Since emergent language is available as a flexible means of achieving such goals, "why the child learns seems quite clear, but how he learns and what he learns are not. The latter are two of the great imponderables of current cognitive psychology" (Derwing and Baker, 1978, p. 86). The acquisition of a sound system as it relates to the lexical items a child learns early on is a significant component of this emergent language. Of theoretical, and, more importantly, of practical concern here is how the child initially deals with the sound system of the language to which he is exposed.

In the study of the acquisition of a sound system, Farwell (1976) pointed out that the focus has shifted away from studies of similarities of development (i.e., universals of acquisition) to analyses of individual differences and variation. Ingram (1974a) also noted a growing interest among developmental psycholinguists in the significance of observations that children whose phonetic inventories are similar may produce quite different renditions of particular lexical items. Based on individual differences, it may be expected that a given child employs unique strategies when confronted with the task of acquiring the sound system of a language. As defined by Farwell (1976, p. 97), strategies, in a very general sense, are "ways in which a child takes an active

organizational role in determing the structure of his language." An example of a strategy which influences sound production is one of avoidance or selectivity in the production of particular sounds (Ferguson and Farwell, 1975; Vihman, 1976; and Shibamoto and Olmsted, 1978). As discussed by Ferguson and Farwell (1975), selectivity as a strategy involves careful selection by the child of words which contain certain sounds and avoidance of words containing sounds that are beyond the capacity of his emerging system. For example, a child who has not acquired a contrast between /b/ and /p/ and produces only /b/ sounds may choose only /b/ words to say and may avoid words beginning with /p/ in the adult model. A strategy which is tied to syllable structure is reduplication whereby a word is comprised of two identical or partially identical syllables (Schwartz, Leonard, Wilcox and Folger, 1980). Reduplication may represent a child's compensation for his inability to produce bisyllabic forms in a fashion which approximates the adult model. Although the child perceives more than one syllable, he is able to replicate only one. Therefore, the second syllable is produced similarly to the first, resulting in reduplication.

Strategies provide a means by which a child may concentrate on a particular class of sounds (or on a particular syllable shape) and may use these sounds (or syllable shapes) in situations where they might be easier to produce. An either-or relationship in the selection of a strategy should not be assumed such that a child uses either one or another strategy. Rather, he may use a combination of strategies, and he may not employ one particular strategy consistently. Consequently, variation in a given child's production of sounds may be partially attributed to these factors.

While discussing the acquisition of a sound system from a cognitive perspective, Vihman (1976) claimed that strategies reflect the child's inner organization of what he currently perceives to be the sound system of the language he is in the process of acquiring. Consonant with the position taken by Ferguson and Farwell (1975) and Ingram (1976b), Vihman (1976) proposed that the child initially constructs his own system which must eventually come to match the adult system. She viewed acquisition as a "see-saw-like" progression between the cognitive tools of assimilation and accommodation which are available early on to the child. Following Piagetian tradition, she defined assimilation as "the reduction of complex stimuli to the dimensions of an existing mental schema" and accommodation as "the expansion of an existing schema to encompass more complex stimuli" (Vihman, 1976, p. 233). More simply stated, assimilation is the child's departure from the adult system, and accommodation is the child's departure from his own system. The child may either assimilate or accommodate adult target words which do not conform to his existing inventory of phonotactic constraints, thus maintaining a relative level of internal stability as he gradually adapts to the adult sound system.

Schwartz and Folger (1977) also advocated a cognitively oriented approach to the study of a child's emergent sound system. They claimed that the ability to internalize representations and to perform mental combinations results in a reduced number of noncontrastive sounds, which can be demonstrated by an analysis of a child's phone classes in various syllable positions. The presence of a phone class such as /b~p/ indicates that the child has not yet acquired a productive contrast between /b/ and /p/. When the contrast is acquired, /b/ and /p/ become

independent phone classes, with the effect that specific lexical items are consistently and appropriately produced with either /b/ or /p/.

Critical to the acquisition process then is an adaptation process wherein the child vacilates between assimilation, or the formation of inner matches, and accommodation, or the formation of outer matches, as a means of achieving the ultimate goal: equivalence or overlapping matches (in reference to the adult sound system). A model depicting such a process is presented in Figure 2. The primary assumption here is that as the child's ability to depart from his own system increases and as he moves toward the attainment of equivalence with the standard language, variation in production subsides and approaches 1.0. The child's phone classes become increasingly more restrictive and stable as this ability emerges, with the result that individual lexical items are more consistently produced (i.e., match the adult models).

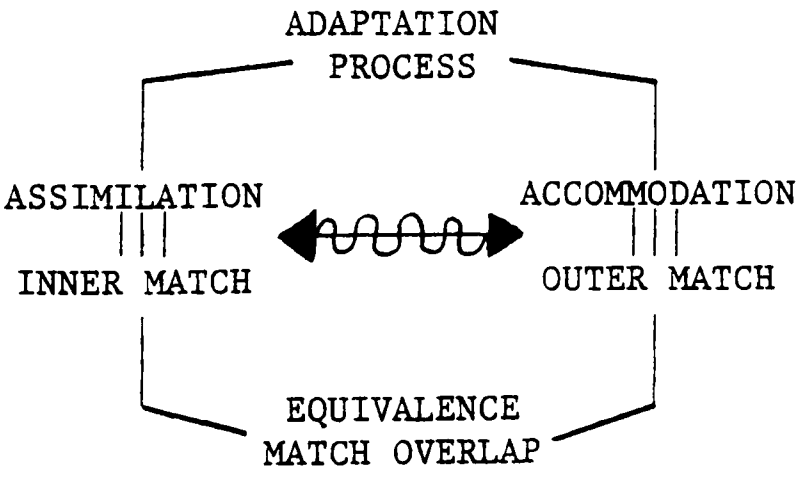

Figure 2. Adaptation Process

During much of the period of the "see-saw-like" progression, the acquisition of sounds is essentially lexically centered and, thus, tied to individual lexical forms. Later, generalizations develop as the child's phone classes begin to stabilize and variation subsides. It follows that during periods when variation levels are somewhat high,

lexically-based analyses represent efficient approaches to the study of early sound development and what eventuates in the formation of a rule-like (i.e., adult) phonological system.

Phonological processes, as discussed by Ingram (1976b), are to a significant extent representative of adult phonology. Consequently, when incorporated in studies of child phonology, processes essentially describe the child's departure from the adult model. For example, a child-like production of /dʌn/ for the word "sun" may be considered to be an example of the phonological process of stopping. According to Farwell (1976), a central assumption to the claim that a continuant consonant has been transformed to a stop consonant is that the child has the adult form as his underlying representation. However, as noted earlier, Ingram (1976b) recommended that the practice of proposing underlying forms for a child be discouraged in order to avoid making assumptions that are too much based on adult phonology.

Phonological processes or rules, as they are generally discussed in the literature, imply language-specific phonological constraints. Clumeck (1979) proposed incorporation of a phonetic explanation of the sound patterns produced by a child in acquiring a sound system in terms of aerodynamic (language-independent) factors which are universally present in the human speech mechanism rather than by language-specific phonological processes or rules. Shouten and Pols (1979) also discussed a distinction between unlearned processes and learned (phonological) processes. While both types of processes represent forms of allophonic programming, the former is language-independent and the latter is language-specific.

Stampe (1969), in espousing a theory of natural phonology,

attempted in part to view the acquisition process from the child's viewpoint by discussing natural processes as opposed to adult or learned phonological processes. His theory was based on the assumption that "the phonological system of a language is largely the residue of an innate system of phonological processes, revised in certain ways by linguistic experience" (Stampe, 1969, p. 442). In the "language-innocent state," the child's innate system consists of a full set of processes which are unlimited and unordered. As acquisition progresses, the child learns to produce phonetic oppositions, each of which involves a revision of the innate system through suppression, limitation, and ordering of processes. Ultimately, according to Stampe, the child's goal is to acquire a system which is compatible with the adult standard but which retains all aspects of the innate system which the mastery of pronunciation has left intact.

In sympathy with Shibamoto and Olmsted (1978), interpretations based on adult phonology are to be avoided in the discussion which follows. Instead, processes are discussed in terms of their being primitive or unlearned (Stampe, 1969). They reflect the child's current level of cognitive organization (Vihman, 1976). As the child develops an equivalence relationship with the standard language, the interaction of assimilation and accommodation provides a useful means of describing how the child begins to approach the task of problem-solving phonetic space that he must reduce to manageable proportions over a short period of time. What in the end emerges as the equivalent of phonological processes may be considered to be an extension or an outgrowth of a child's individual strategies of sound acquisition.

The three strategies discussed here reflect the language-independent processes of reduplication, phonetic assimilation and homonymy. When used as a strategy, reduplication represents an attempt to constrain the syllable structure of words. Reduplication occurs when a word is produced as a sequence of at least two syllables that share identical consonants and/or vowels. Syllable structure constraints of this type enable the child to maintain a level of cognitive stability as he moves toward equivalence so that his system is not overloaded with complex linguistic stimuli at any given time. Phonetic assimilation, whereby "a sound becomes similar to (or is influenced by) another sound in the word" (Ingram, 1976c, p. 34) represents an approach to controlling the production of other sounds. Homonymy, as a strategy wherein surface contrasts between numerous pairs or sets of words are overlooked, represents a means of controlling both the sounds and syllable structures of words. While the use of alternate pronunciations for one or more members of a homonym set is generally available for the purpose of achieving surface contrast, a child whose productions reflect a high level of homonymy does not engage in unique departures from his system to achieve these contrasts. While variations in the productions of homonymous forms may occur, these alternate pronunciations may be members of other homonym sets. For example, in Session XV, the following homonym sets were produced by Allison:

Produced Form	Words
/da/	clock, dark, duck
/doʊ/	dog, duck, nose
/dɔ/	dark, dog, duck, table

While the words "dark," "dog," and "duck" all had alternate pronunciations, their produced forms were homonymous in each case. Consequently,

the child's alternate pronunciations were not effective in achieving surface contrast.

The following is an analysis of the relative similarities and differences in the phone tree tracings within and across the three subjects observed in this study. A comparison of the three phone trees for each child (i.e., initial consonants of monosyllabic forms and initial consonants of both syllables of bisyllabic forms) reflected the child's individual strategies of sound acquisition.

Phone Tree Tracings

As pointed out earlier in Chapter II, vertical lines connected phone classes of different sessions which were related in one of three ways as described below. Solid lines indicated a direct match or lexical overlap between phone classes; they connected phone classes of different sessions which contained the same word. Dotted lines, indicating a secondary match between phone classes, connected phone classes which did not contain the same word but which were connected to a class from a previous session which did. Alternating dot-and-dash lines connected phone classes which were phonetically identical and stable although they did not contain the same word and were not connected to a class which did; hence, there was no direct match between lexical items, but the sound segments were identical.

Similarities between Subjects

The tracings for each child studied revealed similar patterns. Within the productive phone spaces, more solid and dotted lines were found as compared to sounds outside the child's productive phone spaces, suggesting greater strength of relationship between phone classes of

different sessions within the productive phone spaces. However, weaker relationships were noted between the less preferred segments within each productive phone space (e.g., the voiceless bilabial and alveolar stops /p/ and /t/). Also, sound segments requiring more difficult or refined articulatory movements regardless of whether or not they occurred within a productive phone space entered into weaker relationships with other phone classes across sessions. These phone classes may correspond to a child's attempts to accommodate additional features of the adult model into his productions.

A greater number of single-member phone classes were found in those sound segments which required more advanced articulation as well as in those which were outside of a given child's productive phone spaces. For example, the velar stop consonant /k/ was outside of Allison's productive phone spaces. During the period of data collection, she produced an initial /k/ in monosyllabic forms in only four sessions. In each of the four sessions, her /k/ phone class contained only one lexical item.

Variation across phone spaces generally involved lexical items which were unstable in terms of consistent articulation patterns. These variations were indicative of the child's attempts to either assimilate or accommodate problematic segments. It was also noted that a greater number of single member phone classes varied across phone spaces, indicating sound changes specific to individual lexical items. For example, Jason's productions of the initial consonant of the word "Trigger" reflected three single member phone classes in three different sessions as follows: /g/ in Session XIII, /hw/ in Session XVII and /d~dʒ/ in Session XXII. This variation across productive phone spaces indicated

instability in the production of the initial consonant as well as Jason's attempts to produce an appropriate segment.

Differences between Subjects

Based on the phone tree analyses, individual differences in sound acquisition strategies and syllable structure preferences between subjects were observed. All of Jenny's phone trees (i.e., initial consonants of monosyllabic forms and initial consonants of both syllables of bisyllabic forms) closely resembled each other, reflecting her reduplication strategy to be discussed in the following section. These similarities across syllable positions were largely due to Jenny's relatively limited inventory of sounds and her production of identical consonants in the initial position of both syllables of bisyllabic forms. More specifically, Jenny's bilabial and alveolar phone spaces were especially similar across syllable positions. The majority of her lexical items were produced with initial consonants within these productive phone spaces in both monosyllabic and bisyllabic forms. Reduplication then caused the initial consonants of the second syllables of bisyllabic forms to reflect those of the initial syllables.

To a lesser extent, Jason's phone trees reflected the use of reduplication. However, the outstanding characteristic of his phone trees was the greater inventory of sounds that he used productively (i.e., bilabial, alveolar, alveolar and palatal fricative/affricates, velar, and glottal). Had his final consonants been analyzed, close similarities between initial and final consonants within syllables (especially within monosyllabic forms) would have been evident based on his high level of phonetic assimilation (e.g., "truck" /gʌk/, "talk" /kak/).

A comparison of Allison's three phone trees revealed considerably more productivity in sound production in monosyllabic forms than in bisyllabic forms. In monosyllabic forms, Allison's bilabial, alveolar, and glottal productive phone spaces were very active in terms of frequency of production and variation. Limited interactions of fricative consonants (e.g., /s,ʃ/) and the glide /j/ with members of her productive phone spaces was also noted. By contrast, considerably less variation within or across productive phone spaces was noted in bisyllabic forms. Also, the glottal phone space was much less productive in either syllable of bisyllabic forms. The above observations reflected Allison's strong preference for CV syllable shapes.

In the following section, predominant strategies of sound acquisition for each of the three subjects will be proposed. In order to highlight the individual differences, the strategies and linguistic performances of the three children will be compared. A summary of the findings of this study as related to the theoretical issues presented will then be provided.

Strategies

Jenny

Jenny, the most verbal of the three subjects, was willing to attempt practically any word she heard. Consequently, very little lexical selectivity was apparent in her productions, especially when considering that she did not try to avoid words which contained difficult sounds or syllable shapes. However, numerous constraints on the sounds or syllable shapes she produced were evident. Assimilation seemed to be much more active in determining her produced forms than

accommodation during the period of data collection; she transformed most of the phonetic forms in her linguistic environment so as to reflect a preferred set of sounds and syllable shapes. This is not to say that she was less than adventuresome in terms of sound acquisition; she occasionally attempted to produce or accommodate sounds and syllable shapes that were not in her productive repertoire. For example, the initial consonant of Jenny's name was produced as /d/, /n/, or /j/ in the initial sessions. Beginning in Session VIII, Jenny began to accommodate the /dʒ/ sound, and she alternated between /d/ and /dʒ/ as the initial consonant of her name during the remaining sessions. She was very interested in communication and would frequently modify her productions (sometimes several times) when not understood. These successive modifications generally approximated the adult pronunciation of the words more closely than her initial productions.

Reduplication was by far the most predominant strategy used by Jenny in her productions of polysyllabic forms. To elaborate on the definition of reduplication provided earlier, a distinction between full and partial reduplication (Schwartz, Leonard, Wilcox, and Folger, 1980) may be made. Full reduplications are characterized by concurrent consonant and vowel harmony (e.g., "bottle" /baba/ from Jenny I). By contrast, partial reduplications are characterized by either consonant or vowel harmony (e.g., "pillow" /bʊbɔ/ from Jenny VI, "flower" /bapa/ from Jenny VIII). Ingram (1976c) also included certain forms ending with /i/ (e.g., "hi" /haidi/) as partial reduplications.

In isolating reduplicated forms in Jenny's data, productions which reflected accurate reproductions of adult reduplicated forms such as "bye bye" /baIbaI/ were not included. Also, in order to obtain a

conservative estimate of Jenny's use of reduplication as a strategy, forms ending in /i/ which did not demonstrate either consonant or vowel harmony were not included. The remaining forms which exhibited full or partial reduplication were isolated and subsequently analyzed.

In their study of reduplication, Schwartz, et al. (1980) classified a child as a reduplicator (i.e., to employ reduplication as a primary strategy) if 20% of his total sampled lexicon consisted of fully or partially reduplicated forms. Jenny's percentage of reduplications was computed differently from those of the subjects in the Schwartz, et al. (1980) study for the following reason. While her productions of bisyllabic words reflected a high percentage of reduplicated forms, Jenny employed reduplication as a strategy for monosyllabic word forms only rarely.[4] Therefore, in computing the frequency with which Jenny used reduplication as a strategy, monosyllabic words were not included unless they were produced in bisyllabic form (e.g., "green" /ninə/ in Session III). This was done as it was felt that the inclusion of other monosyllabic forms would provide a distorted representation of the extensive amount of reduplication in which Jenny engaged. Since percentages of frequency of occurrence of reduplicated forms were tabulated differently in this study as compared to the study by Schwartz, et al. (1980), the results in terms of frequency for the two studies cannot be directly compared.

When tabulating the level of reduplication, the number of bisyllabic words produced in each session were counted with care being taken to exclude forms which when produced in reduplicated form were accurate replications of an adult word. The number of bisyllabic forms Jenny produced was divided into the total number of reduplicated forms produced

in each session to determine a percentage of reduplication. For all sessions, an average of 54% of the bisyllabic forms produced by Jenny were reduplications. It is important to note here that there was an apparent decrease over time in Jenny's use of reduplication as a strategy. In the earliest sessions, her bisyllabic productions revealed approximately 62% reduplications while in later sessions, her average dropped to around 45%. However, the decrease in her production of reduplicated forms was only an apparent decrease. The decrease seemed to be affected by an increase in the production of bisyllabic words beginning with vowel sounds (e.g., "Opal" /oʊpu/ from Session IX and "elephant" /ɛdə/ in Session XII) which did not conform to the definition of reduplication for the purposes of this study.

Schwartz, et al. (1980) proposed that the adoption of a strategy of reduplication may serve two purposes for the very young child. Primarily, it may be used to constrain multisyllabic productions. Ingram (1974b) suggested that reduplication may result from the child's inability to appropriately produce the second syllable of a word. In other words, the child perceives two (or more) syllables, but his internal schema is limited and can replicate only one of them. Since the production of subsequent syllables is beyond the child's current range, he employs the cognitive process of assimilation whereby those syllables are produced identically or similarly to the first syllable of the word. Jenny's use of reduplication to constrain multisyllabic productions was quite apparent throughout all sessions as evidenced by her frequent attempts to produce polysyllabic words up to four syllables in length in the adult model (e.g., "alligator" /dɛdaI/ in Session II).

Next, and to a lesser extent, reduplication may "serve in conspiracies to constrain final consonant production" (Schwartz, et al., 1980, p. 75). Thus, simplification of the syllabic structure of multisyllabic forms may be accomplished through reduplication which, in turn, may affect final consonants in the productions of a reduplicator. The absence of final consonants can be adequately explained in terms of the child's current syllable structure biases. Presented in Appendices B and C, respectively, are lists of lexical items produced in each session and examples of reduplicated forms.

Jason

As mentioned in Chapter III, Jason was in general more productive across sound classes than the other two subjects. He frequently experimented with sound production by producing particular words over and over again, seemingly because he enjoyed the sound (or feel) of them. Cognitively, Jason demonstrated the "see-saw-like" progression between assimilation and accommodation as discussed by Vihman (1976). While sound and syllable constraints were generally apparent, there was a certain "boldness" in many of his productions in that he was willing to expand his mental schema to incorporate more complex stimuli. In other words, both assimilation and accommodation seemed to be operative in Jason's sound productions.

The task of isolating a predominant strategy for Jason was more difficult than for the other subjects because a number of processes seemed to be active in his repertoire of productions. However, phonetic assimilation and reduplication (frequently operating in conjunction with each other) were the most common and will be discussed as a conjoint

strategy of sound acquisition for Jason. As mentioned earlier in this chapter, phonetic assimilation is a primitive process by which the production of a sound is affected by another sound in the word. Ingram's (1976c) discussion of assimilation focused on a distinction between progressive and regressive assimilation. Assimiliation was considered to be progressive if the affected segment followed the one that influenced it as in Jason's production /teIt/ for "tape" in Session IV. By contrast, assimilation was considered to be regressive if the affected segment proceded the one that influenced it (e.g., "talk"/kak/ in Session IV).

Two observations made by Compton and Streeter (1977) are relevant to Jason's data. The first was their finding that regressive assimilation occurred more frequently than progressive assimilation in monosyllabic forms. While both types of assimilation occurred in Jason's speech, the majority represented instances of regressive assimilation. Secondly, Compton and Streeter (1977) observed that in regressive assimilation, the final velar consonants /k,g,ŋ/ exerted the greatest influence over preceding consonants in words. Jason's lexicon contained several words containing velar stops in the final or medial position. Consistent with Compton and Streeter's finding, his productions of these words were usually affected by regressive assimilation such that the velar stop was also produced in the initial position of the word. Examples included the following words: "truck," "tickle," "talk," "jacket," "stuck," and "drink."

Reduplicated forms did not occur with nearly as much frequency as assimilations, but certain forms often represented both a reduplication and an assimilation. In other words, a strict separation between the

two processes was not always possible as it sometimes could not be determined whether one or the other or both were responsible for his productions.

As in Jenny's speech, Jason's reduplicated forms served as a means of dealing with the production of multisyllabic words. To a much lesser extent, it might be claimed that reduplications served to constrain final consonant production. However, many of Jason's fully and partially reduplicated forms contained final consonants; hence, they were of the $C_1V_1C_1V_1C_2$ or $C_1V_1C_1V_2C_2$ syllable shapes. Examples from his data included "outside" /saIsaIt/ in Session XII and "Sesame Street" /dIdit/ in Session XIV.

In her report on strategies in the early production of fricatives, Farwell (1976) discussed an approach which capitalizes on "favorite" sounds. This approach dealt with the selection of lexical items which contain sounds which are of particular interest to the child at a given point in time. Jason was the only subject in this study who showed any interest in fricative sounds. As mentioned by Farwell (1976), fricatives are a relatively difficult class of sounds which usually do not occur in the earliest stages of language production. Jason's early interest in fricative productions may be indicative of an attempt to accommodate more features of adult sound productions to his system. A number of lexical items which he chose to produce contained fricative and affricate sounds and were usually produced with sounds within that same range. Examples of these lexical items included the words "sing," "swing," "juice," "sugar," "shoes," "cereal," "Susan," and "Alicia."

Selectivity in terms of lexical items attempted was probably greatly affected by the notion of favorite sounds. Syllable structure

constraints affected the production of consonant clusters and words over two syllables in length in some of Jason's productions. Constraints on sound production seemed to be relatively relaxed due to the large inventory of sounds which Jason used productively. Presented in Appendices D and E, respectively, are lists of lexical items produced in each session and examples of phonetic assimilation and reduplication from each session.

Allison

Allison was by far the most cautious and selective communicator in this study. She demonstrated a strong preference for CV syllable shapes as well as for particular classes of sounds (i.e., bilabial, alveolar, and glottal). She rarely attempted either spontaneously or imitatively words which violated these constraints. In Vihman's (1976) terms, Allison's selection strategy may have been one by which she eliminated as "noise" stimuli which she perceived to be beyond her range. During the course of this project, the cognitive process of assimilation seemed to be much more active than accommodation as she generally transformed the phonetic forms in her linguistic environment to match the inner organization of her sound system. Allison's frequent bouts with otitis media may be partially responsible for her limited system of sounds and syllable shapes and for the slow development of her expressive language skills. Her receptive skills, on the other hand, may be considered to be average or above average based on her responsiveness (although frequently nonverbal) and on the demonstration of appropriate cognitive skills for her level of development.

The most outstanding feature of Allison's speech samples collected

during this study was a high level of homonymous forms. This might be expected based on the limited sets of sounds and syllable shapes found in Allison's productive repertoire. Homonyms were defined by Locke (1979, p. 258) as "words whose surface forms are identical" such as "wait" and "weight" /weIt/ in adult speech. Although pressure to avoid homonyms is assumed to operate cognitively and linguistically, the child initially is unable to avoid homonyms because his lack of phonological sophistication and articulatory skills prohibit him from speaking distinctively all the words he knows (Locke, 1979). According to Priestly (1977), the underlying forms for each member of a homonym set are different. The disparity between the child's underlying form and his spoken form is considered by Priestly to be caused by articulatory factors. This is in line with Locke's (1979) position.

Ingram (1975) observed that a child does not have as many homonyms as would be expected given the current status of his sound system. Most children, according to Ingram, constantly compare their productions and attempt to make changes in those which do not maintain a surface contrast. In a one-month study of five children at the age of 1;6, Ingram found a very small number of homonym pairs in relation to the size of each child's sample. An average percentage of homonyms for his subjects was .0015 (.15%).

Allison's data do not lend themselves to the discussion of homonym pairs as she frequently produced the same form for more than two words. Allison's homonym sets averaged 2.6 words per set. At the upper extreme, /bu/ was Allison's produced form for nine different words ("balloon," "caboose," "book," "bear," "bird," "bunny," "boot," "spoon," and "Weeble") in Session XVII. To compute a rough percentage of

homonymy, the total number of words participating in homonymy were compared against the total number of productions in each session. Allison's percentages of homonymy in individual sessions ranged from zero to 54 percent with an average of 27.4 percent. The sessions with the lowest percentages of homonymy tended to be those with the fewest overall productions. In other words, the more verbal Allison was during a given session, the more homonym sets she produced. However, Allison's percentages of homonymy should not be directly compared to those of Ingram's subjects for the reasons discussed below.

Locke (1979) observed that what adults perceive to be homonyms may not be in a true physical sense. Surface contrasts between potential homonym pairs may be maintained by factors such as vowel duration (or stress), aspiration, vowel nasalization, and lip rounding. Also, since the perception of consonants is basically categorical, the discrimination of sounds belonging to the same phonemic category is more difficult than the discrimination of sounds belonging to different phonemic categories. Therefore, a child's progress toward a new phonemic result may go unnoticed by adults until it crosses perceptual boundaries in the standard language. Consequently, many of the homonyms which Allison produced probably were not truly identical. In fact, her use of vowel length and aspiration to separate homonym pairs was noted by the examiner and by her mother. Since broad transcription was used in this study, fine distinctions of this sort were not recorded. Also, Allison undoubtedly produced some distinctions which were not perceptible to adults.

With the exception of contrasts which are not perceptible to adults, Ingram (1975) took the above factors into consideration before

calculating percentages of homonymy for his subjects. Although Allison's percentages are not directly comparable to those of Ingram's subjects, her level of homonymy was still considered to be higher than normal.

Ingram (1975) also discussed a distinction between "resolved" and "unresolved" homonym pairs. A resolved pair referred to a pair in which the child had alternate pronunciations for one or both words of the pair such that surface contrast was achieved in other productions within the same session. Allison's data reflected both resolved and unresolved homonym sets. However, her alternate pronunciations were not always effective in achieving a surface contrast as they frequently were members of other homonym sets in the same session. For example, in Session I, /hi/ was Allison's produced form for the words "see," "sleep," and "hat." In the same session, /ha/ was the produced for "hold" and "hat." Although there was variation in production of the word "hat," it was produced in the same manner as other words in both instances. Thus, its produced form was potentially confusable with that of other words even though Allison changed her production of the word. Expanding the above example, the words "hat" and "hi" were produced as /haI/ in Session VI. Hence, a month later, Allison's production of "hat" continued to be unstable as it was produced the same as another (different) word.

The use of alternate pronunciations is one strategy that may be used by the child to avoid the loss of surface contrast according to Ingram (1975). This strategy was frequently ineffective in Allison's case as discussed above. Ingram discussed a second strategy for preserving surface contrast, that being the use of unique processes and

contrasts (i.e., ones that are not used for non-homonymous pairs). In other words, the child may produce a form that is not consistent with a form that would be expected given his current system solely for the purpose of achieving surface contrast. To determine the presence of such forms in a given child's repertoire would involve an extensive analysis of his data. Such analysis was beyond the scope of this study; therefore, the presence or absence of these kinds of forms in Allison's data was not determined.

A point made by Locke (1979) was that the young child is usually well known to those he communicates with. In Allison's case, this was especially true as she was very cautious with unfamiliar people and required a considerable amount of exposure to them before she would attempt to communicate. Therefore, communication was greatly facilitated by familiarity; and the need to produce phonetic distinctions in her words was not as great as it might have been for other children. This type of linguistic environment seemed to provide a certain degree of freedom for Allison in that she could experiment with sound variations at will without a significant loss of communicative efficiency. She did not usually spontaneously modify her productions when not understood by an adult. Rather, she was more prone to produce the same form again, sometimes adding nonlinguistic cues, and then to wait for the adult to "figure out" what she was saying. In other words, the burden of communication was placed upon her communicative partner for the most part.

A child who attempts to eliminate homonymy deviates more from the adult system as he continually compares his productions and searches for ways to reduce homonymy. These creative attempts by the child to achieve

surface contrast contribute to a unique set of processes. On the other hand, a child who continues to produce a substantial number of homonyms and makes only minimal attempts to achieve surface contrast may progress more in line with the adult system. This approach is somewhat unimaginative by comparison and may result in a lengthier process of acquisition. Hence, a strategy which allows the persistence of homonymy is not economical in terms of the acquisition of a sound system and may serve as a disadvantage for the child.

Ingram (1975) concluded that a child's attempts to avoid homonyms indicate that he is aware of discrepancies between his perceived and produced forms. In terms of the adaptation model presented earlier in this chapter, the child demonstrates signs of both assimilation and accommodation. Assimilation may be evidenced by the production of a surface contrast that conforms to the child's existing internal schema, and accommodation may be represented by the child's attempts to assure that distinctions between homonymous forms are made.

By contrast, a child who does not effectively reduce his level of homonymy may not be aware of discrepancies between perceived and produced forms. As a result, he resorts to no means of reducing the confusion outside of his system. Cognitively, very little interaction between assimilation and accommodation is apparent, and assimilation seems to be strongly favored. The production of phonetic forms consistent with the child's current system which do not reflect an attempt to achieve surface contrast between homonym sets are representative of cognitive assimilation. Hence, the see-saw-like interaction between assimilation and accommodation may not be as evident in the sound acquisition of a child who does not effectively reduce homonymy.

Allison's history of otitis media may have some relevance in regard to her use of homonyms. As mentioned in Chapter II, Allison became almost nonverbal during her bouts with otitis media and seemed to lose some of her previously acquired language skills after each infection. Although her hearing acuity ranged only from normal to low normal, the infections apparently caused some problems for her in terms of language acquisition. It may be that Allison is merely functioning at a lower linguistic level because of the effects of otitis media and will gradually begin to reduce the level of homonymy in her productions.

Allison's overall strategy might be characterized as one of great selectivity or avoidance in addition to a persistence in the use of homonyms. Selectivity, as mentioned previously, was evident from the standpoint of sounds, syllable shapes, and lexical items that Allison chose to attempt. She consistently avoided lexical items which did not conform to or could not be easily converted to her system. An exception to this observation could be "difficult" words which were of particular interest to her such as her sister's name, Stephanie. Her production of this word, however, was generally of the CV syllable shape with initial /t/ and variable vowels; thus, it was transformed to the constraints of her system. Presented in Appendices F and G, respectively, are lists of lexical items produced in each session and examples of homonymous forms from each session.

Summary and Conclusions

Individual Differences

The pervasive nature of individual differences was highlighted by the results of this study. The three subjects represented markedly

different approaches to acquiring sounds and lexical items. According to Ferguson and Farwell (1975), some of these differences may be accounted for in terms of different input, different environmental conditions, and different strategies. Each child in this study demonstrated individual strategies, preferences, and an idiosyncratic lexicon. Phone tree tracings for each of the three subjects revealed significant individual differences in terms of sound acquisition and syllable structure preferences.

The factors mentioned above reflected each child's unique organizational capacities (Ingram, 1974b). Cognitively, individual differences were apparent in the interaction between assimilation and accommodation in each child's progression toward equivalence with the adult language. Jason demonstrated the see-saw-like progression between assimilation and accommodation (Vihman, 1976) to a greater extent than did the other two subjects. Jenny, and especially Allison, demonstrated a greater reliance on assimilation during the course of this project. It was demonstrated that attention to these individual differences revealed considerably more information about an individual child's sound acquisition than did a focus on universals of acquisition as proposed by Jakobson (1968). Jakobson's theory of phonological development seems useful for general purposes such as providing a clinician with a knowledge of basic skills which might be expected at various stages of development. However, it certainly is not sufficient for a thorough analysis of the sound acquisition of individual children.

Variation

While the children in this study were well past the period of

acquisition of the first fifty words and the attainment of Stage VI of sensorimotor intelligence, considerable variability continued to be present in their production of sounds. This variation was noted within and across the productive phone spaces of each child and was contrary to the prediction made by Schwartz and Folger (1977) that variability would decrease once representational abilities were apparent. Vihman's (1976) discussion of the cognitive tools of assimilation and accommodation could also be interpreted to predict a decrease in variability as the child moves closer to acquiring the use of sounds compatible with that of the standard language. In other words, the child's accommodation of his existing mental schema to encompass more complex stimuli implies a concomitant decrease in variability as the child's sound productions progress in the direction of equivalence (or overlapping matches) with the adult system.

On the other hand, a high degree of variability might be expected when the child initially begins to accommodate his system to that of the adult's due to uncertainty or progressive approximations to the standard use of sounds in mature speech. As the child gets closer to accepted pronunciations, variability in production would be expected to decrease. Based on the "see-saw-like" relationship between assimilation and accommodation noted by Vihman (1976), the assumption is not that the child first assimilates, then accommodates. However, the frequency of accommodation would be expected to increase in relation to a decrease in assimilation as the child progresses toward the adult system.

In this study, considerably more assimilation was observed than accommodation which is consistent with the notion of high variability. Conversely, the subjects' levels of cognitive and lexical development

were not consistent with the high levels of variability found according to the literature. Thus, cognitive development and number of lexical items acquired may not be appropriate indices of changes in variability.

Processes and Strategies

An attempt was made to discuss processes in terms of the child's current level of cognitive functioning (i.e., his tendencies to assimilate and accommodate). The focus here was on natural or unlearned processes as opposed to "phonological" processes which imply sound acquisition based on characteristics of the adult system.

According to Farwell (1976), the assumption of the existence of phonological rules such as stopping (replacement of fricative or affricate sounds with stops) results in a reduction of the surface inventory of sounds while it might be more reasonable to assume that strategies would be aimed at increasing that surface inventory. Especially in Jason's case, it seemed that his strategies were aimed at increasing the surface inventory of sounds as he was productive across several classes of sounds and seemed to enjoy experimenting with sounds.

Strategies, as discussed here, imply that the child takes an active organizational role in structuring his own sound system. Processes, then, are an outgrowth of the child's strategies. The child's strategies and resultant processes determine his progress through the adaptation process, as he continually moves toward equivalence (match) with the adult sound system. A "see-saw-like" progression between the cognitive tools of assimilation and accommodation (Vihman, 1976) enables the child to deal with the complex linguistic stimuli to which he is continually exposed and to gradually accept new structures without overtaxing his system at any given time.

Strategies have been discussed in relation to selectivity and avoidance (Ferguson and Farwell, 1975; Farwell, 1976; Vihman, 1976; Priestly, 1977; and Shibamoto and Olmsted, 1978). Avoidance, according to Farwell (1976) is characterized by a child's failure to produce certain sounds and by his refusal to learn adult words containing the problem sounds. Jenny and Allison both seemed to use types of avoidance. Jenny's use of it was in terms of sounds and syllable shapes she produced. She did not seem to avoid lexical items containing sounds outside of her system as she simply transformed the sounds and structures of those words to sounds and structures in her system. Allison's use of avoidance was more widespread than Jenny's as she avoided sounds and syllable shapes outside of her productive repertoire as well as lexical items containing those sounds. All three children showed a preference for words containing voiced bilabial and alveolar stops in the initial position of words as would be expected according to Jakobson's (1968) universal order of acquisition.

Ferguson and Farwell (1975) noted great lexical selectivity based on the absence of particular sound contrasts in a child's speech. They stated that variable forms and partial contrasts often correspond to a sound change in progress. For example, when a /b~p/ contrast is absent (e.g., only /b/ sounds are produced), they found that a child would be highly discriminatory in the lexical items he would choose to say in that he would choose only /b/ words to say. This selectivity was observed to some extent in the children in this study as all of them produced more /b/ and /d/ words than /p/ and /t/. Vihman (1976) discussed the selection (or avoidance) strategy in terms of the child's inner organization of the sound system (i.e., assimilation and

accommodation). She viewed this strategy as a filtering process whereby the child eliminates "stimuli which would overtax his capacities for identifying, processing, storing, and producing new structures" (Vihman, 1976, p. 233).

Lexical Parameter in Sound Change

Wang (1969) proposed that sound change takes place on three parameters: phonetic, lexical, and social. On the phonetic parameter, a sound change occurs abruptly followed by a period of variation and approaches completion when other forms change abruptly without going through a period of variation. On the lexical parameter, a sound change begins in a subset of relevant words and gradually spreads through the lexicon to other relevant forms. Socially, a sound change starts with a certain group of people or in a particular speech style and spreads to other people and other speech styles. Ferguson and Farwell (1975) argued that the lexical and phonetic parameters of sound change are highly interrelated. Their model of phonological development emphasized the primacy of lexical items in early phonological development. They suggested that "lexical items of particular phonetic shapes are acquired together with notions of appropriateness of use in particular social frames" (Ferguson and Farwell, 1975, p. 437). Shibamoto and Olmsted (1978) supported a weaker version of Ferguson and Farwell's hypothesis of lexical primacy in phonological development. They agreed that lexical selectivity operates on the initial phone of a word to determine whether or not the child will attempt the word. After that, they proposed that phonological, rather than lexical, processes shape the remainder of the word.

As this study was concerned with initial consonants only, Shibamoto and Olmsted's (1978) hypothesis cannot be addressed. However, lexical selectivity as discussed by Ferguson and Farwell (1975) seemed to be quite relevant. Jason and Allison were quite selective in the words they chose to produce. Jason seemed to concentrate on words containing fricatives and velar stops and added a substantial number of words containing these sounds to his lexicon. Allison was even more selective in that she rarely attemped words which contained sounds or syllable shapes outside of her system. On the other hand, Jenny did not seem to be selective in terms of the lexical items she chose to produce, but she transformed most words so that they conformed to the constraints of her system.

The lexically-based analyses of each child's productive phone classes revealed information regarding variation in production, strategies of acquisition and their resultant processes, and individual differences present among children acquiring the sound system of the same language.

Based on the "see-saw-like" progression between cognitive assimilation and accommodation (Vihman, 1976) and the high levels of variation in a child's sound productions at a level of development considerably beyond the acquisition of the first 50 words, sound acquisition at this level appeared to be strongly tied to individual lexical items. Hence, lexically-based analyses of sound acquisition as the child progresses toward his ultimate goal--equivalence with the standard language--proved to be effective and informative.

NOTES

1. A designation for age such as 1;6 indicated one year, six months. When a third number was included (e.g., 1;6;14), it represented the number of days.
2. The /s/ phoneme was included in Allison's glottal class because her production, while it acoustically resembled an /s/, had glottal characteristics.
3. Ingram (1976b) discussed an organizational level, which is an intermediate level between perception and production. At this level, the child makes hypotheses based on what he perceives (i.e., his perceptual representations). His underlying forms consist of his perceptual representations and the application of his organizational principles that are applied to his perceptual representations. However, Ingram basically supported the position that caution should be exercised in proposing underlying forms for a child because it is tempting to make assumptions based on adult phonology.
4. Monosyllabic words in Jenny's productions generally were not affected by syllable structure constraints with the exception of cluster reduction and deletion of final consonants, which may be more reasonably attributed to constraints on internal organization or articulation at this point than to "phonological" processing (Ingram, 1976b). The main constraints on Jenny's production of monosyllabic words were in terms of the sounds produced as she favored nasals, bilabial stops, and alveolar stops; and she generally produced most words with these consonants.

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APPENDICES

A. Subject Consent Form

B. Jenny: Word Lists Session-by-Session

C. Jenny: Reduplications Session-by-Session

D. Jason: Word Lists Session-by-Session

E. Jason: Phonetic Assimilations and Reduplications Session-by-Session

F. Allison: Word Lists Session-by-Session

G. Allison: Homonymous Forms Session-by-Session

Appendix A. Subject Consent Form.

I hereby give my consent for my child's participation in the project entitled: Lexicalization and Sound Development. I understand that the person responsible for this project is Dr. Michael D. Smith (Texas Tech University, Division of Speech Pathology and Audiology, 742-3908).

He or his authorized representative, Susan Trim, has (1) explained the project procedures to be followed; (2) described the benefits to be expected; and (3) explained that the results of this project may be published and therefore read by a large number of people. I also understand that my child will not be identified by name in any published or unpublished results, but that a description of his/her performance involved in this project will be included.

Dr. Smith and his representative have agreed to answer any inquiries I may have concerning the procedures and have informed me that I may contact the Texas Tech University Institutional Review Board for the Protection of Human Subjects by writing them in care of the Office of Research Services, Texas Tech University, Lubbock, Texas 79409, or by calling 742-3884.

No risks are involved in this project. However, we are required to make the insurance statement below.

If this research project causes any physical injury to my child, treatment is not necessarily available at Texas Tech University or the Student Health Center, or any program of insurance applicable to the institution and its personnel. Financial compensation for any such injury must be obtained from Dr. J. Knox Jones, Jr., Vice President for Research and Graduate Studies, telephone 742-2152, Room 118 Administration Building, Texas Tech University, Lubbock, Texas 79409.

I understand that my child may not derive therapeutic treatment from participation in this study. I understand that my child may discontinue this study at any time I choose.

Signature of Parent:_____ Date:_____

Signature of Project Director or his Authorized Representative:

_____ Date:_____

Signature of Witness to Oral Presentation:

_____ Date:_____

Appendix B. Jenny: Word Lists Session-by-Session.

Total Number of Words Omitting all Replications = 423

Session I
Date: 11/13/79
Age: 1;6;0

back
ball
bell
bird
blanket
block
book
bottle
broken
bye
dog
feet
floor
hand
hat
heater
hi
Jenny
Mama
mine
music
no
open
planet
pot pie
pretty
Snoopy
Susan
tape recorder
umbrella
up

Session II
Date: 11/27/79
Age: 1;6;14

alligator
Amanda
baby
ball
balloon
bear
blanket
block
book
bottle
bus
bye (bye)
clothes
cold
color
do
dress
duck
ear
hammer
hat
heart
heater
heavy
here
horsie
ink
Jenny
joy
juice
man
mine
Missy
Mommy
night night
no
Opal
open
pencil
please
rock
running
sit
Snoopy
thank you
tiger
tree top
truck
tuba
two
up
zipper

Session III
Date: 12/4/79
Age: 1;6;21

baby
back
ball
book
broken
butterfly
(un)button
bye
clock
Daddy
do
dog
door
Ellie
ghost
go
gone
green
heater
hi
home
hot
in
Jenny
lady
man
Matt
me
more
no
off
on
out
owl
picture
please
push
Snoopy
Susan
Terri
that
ticking
two
umbrella
up
water

Session IV
Date: 12/18/79
Age: 1;7;5

airplane
angel
arm
baby
ball
big
heart
heater
hello
horsie
hot
in
no
Nonny
off
out
outside
pee pie

Session IV, continued

book
clothes
clown
cold
Daddy
day
dirty
dog
door
dressed
fit
fly
girl
hat
Jenny
Jo
key
lady
later
lock
man
mine
Missy
Mommy
move
move it
name
Nanny
please
rabbit
roll it
(a)round
Santa Claus
seat
shoe
sit
snow
Susan
try
turn it
up
work

Session V
Date: 1/2/80
Age: 1;7;20

baby
back
block
board
book
boy
bracelet
broom
bucket
busy
bye bye
cheese
clock
close
coat
cookie
doll
down
duck
ear
Ellie
embarrassed
fish
fix
go
hair
hand
hello
help
horse
house
in
Jenny
Jesus
key
kid
kitty
legs
Las
mine
mobile
Mommy
Nanny
necklace
no
off
on
open
orange
out
paper
Paw Paw
pen
play
puppy
ride
shoe
silly
sit
slide
Snoopy
Susan
town
turn
two
up
water
way
Weeble
Woodstock
write

Session VI
Date: 1/9/80
Age: 1;7;27

Amanda
Amy
baby
ball
bed
block
book
break
broom
bye bye
Casey
clown
cold
cook
cry
doctor
down
duck
eye
get it
hair
hand
heart
heater
him
hit
hop
hot
Humpty
in
Jason
Jenny
Jo
man
mine
Missy
move
nice
Nonny
nose
on
one
open
Paw Paw
pillow
play
please
purse
radio
rock
room
shoe
sit
slide
snap
Snoopy
sock
talk
truck
two
up
way
Weeble
Woodstock
zipper

Session VII
Date: 1/21/80
Age: 1;8;8

a
almost
Ann
baby
ball
Barney
bath
bear
bell
bib
big
blanket
blue
build it
bye bye
clothes
cookie
count
Daddy
dog
don't
duck
feet
find him
fit
fun
glasses
go
gone
Grandad
green
hammer
hard
harp
heater
help
hi
hide
hop
horsie
hot
in
Jenny
key
little
lock
Matt
men
Mommy
Nanny
night night
no
off
on
one
open
pat
Paw Paw
pillow
puppy
purse
quiet
rabbit
ring
robe
sheet
shoe
Sid
sit
sleep
slide
Snoopy
tea
this
Tim
toe
top
try it
two
up
water
wood
Woodstock

Session VIII
Date: 1/23/80
Age: 1;8;10

airplane
all
Amy
Ann
apple
baby
ball
balloon
Barney
be back
board
Bob
bottle
bye
Carol
carrot
cheese
close
coke
cold
couch
cough
Daddy
do
door
eye
fall
feed her
fence
fish
fit
flower
fly
food
get it
ghost
good
Grandma
grape
green
Grover
hard
head
hi
hole
home
hot
in
Jen
Jenny
Jo
juice
Las
little bit
Mike
milk
Mom
Mommy
moon
more
mouth
Nanny
night night
Nonny
on
open
orange
out
Paw Paw
pen
phone
piano
pillow
please
show
sick
Sid
silly
sit
sleep
slide
smack
sound
spell
steak
Susan
talk
tape
TV
through
together
top
train
Trent
trick
truck
turn
two
up
water
Weeble
write
yes
you

Session IX
Date: 1/28/80
Age: 1;8;15

all
Amy
animal
arm
bib
blanket
Bob
book
bottle
cap
carrot
Casey
cereal
clothes
coke
cold
day
dog
Donald (Donny)
dress
duck
Dumbo
ear
eat
fall
fish
girl
Grandad
happy
head
heater
hide
horsie
hot
hurt
Jenny
Jo
juice
ketchup
Mickey
Mom
move
Nanny
nap
night night
no
Nonny
number
on
one
Opal
pee pie
pillow
Pluto
rock
shoe
Sid
sitting
slide
sock
Susan
these
two
up
water
Weeble

Session X
Date: 2/4/80
Age: 1;8;22

again
airplane
Amy
Ann
Arney
at
balloon
Barney
bear
bed
boat
Bob
book
bother
bottle
bright
broom
busy
bye (bye)
Carol
carrot
close
couch
crash
Daddy
diaper
Donald
duck
eight
elephant
Ernie
eye
fence
Goober
good
Grandad
Grover
happy
hi
hiding
hippopotamus
hurt
in
itch
Jean
Jenny
Jo
key
kite
kitty
Las
Lata
light
Mickey
Mom
Mommy
monster
more
Nanny
no
oh dear
on
one
Opal
open
out
Pat
Paw Paw
pen
Pinocchio
put
puzzle
rabbit
reach it
read
rub
see me
scratch
Sid
slide
Snoopy
Susan
talk
telephone
telephone pole
them
three
train
truck
turtle
two
up
walk
Weeble
worm
write

Session XI
Date: 2/6/80
Age: 1;8;24

airplane
arm
ball
Barney
basket
bird
book
boot
bye (bye)
cake
call
car
Casey
cheese
clock
clothes
cry
Daddy
Donald
don't
duck
eight
elbow
fall
fence
go
good
great
happy
hi
home
horsie
Humpty
in
Jason
Jenny
Jo
key
leaves
lock
milk
mine
Mommy
mouse
move
Nanny
night night
no
Nonny
number
off
oh boy
on
one
Opal
open
orange
paper
Paw Paw
pee pie
potty
puppy
rock
shoe
Sid
slide
Snoopy
snow
sock
Susan
tough
tree
tricky
try
turn
two
up
walk
Weeble
Woodstock

Session XII
Date: 2/11/80
Age: 1;8;29

alligator
Amy
apple
ball
balloon
Bert
(Big) Bird
blow
bottle
bruise
butterfly
bye (bye)
chair
clock
cold
Cookie Monster
couch
count
Daddy
dirty
Donald
elephant
Ernie
eye
feet
fence
fly
good
Goofy
grass
Grover
Hairy
happy
head
hi
hiding
hold
home
hot
hurt
in
jean
Jenny
lady
leg
like
Linda
lost
man
mine
Mommy
monster
motorcycle
Nanny
neck
night night
on
open
Oscar
out
pants
paper
pee pie
piggy
Pinocchio
please
Pluto
read
rock
scratch
shoulder
show
sit
Snoopy
street
Sue
Susan
Terri
this
truck
umbrella
up
wall
Wednesday
Weeble
wood

Session XIII
Date: 2/13/80
Age: 1;9;0

airplane
all
Amy
animal
another one
apple
ball
balloon
Bambi
Barney
bell
Big Bird
bird
boat
book
bottle
buckle
bug
bus
butterfly
bye (bye)
car
carrot
caught
cheek
clock
clothes
cloud
clown
count
coyote
cry
Daddy
dirty
doll
Donald
down
eat(ing)
elephant
end
eye
fall
fish
frog
fun
get it
good
Grover
hammer
happy
head
heart
hi
hide
horsie
hot
Humpty
hurt
in
Jenny
kid
kiss
kitty
lady
Leta
light
look
me
mess
Mickey
mobile
moving
no
Nonny
on
out
owl
pat
pee pie
pig
pillow
pull
purse
reach it
read
red
rest
rock
rocket
Santa Claus
scratchy
shoulder
Sid
silly
sit
sleep
sleepy
slide
Snoopy
stop
sun
Susan
talk
this
three
toothpaste
turkey
two
umbrella
up
Willie
windmill
write

Session XIV
Date: 2/18/80
Age: 1;9;5

Amen
another one
back
ball
blanket
blow
Bob
bottle
bye (bye)
Casey
Charlotte
chin
cook
Daddy
dance
did it
down it
drink
fly
good
happy
help
in
in there
Jenny
knot
ladder
light
man
milk
mine
minute
Mommy
more
mouth
my
nap
neat
on
open
Pinocchio
pull
rabbit
radio
ride
shirt
shoe
slide
small
soup
Susan
thank you
thirsty
tie
truck
two
up
Wendy
Willie

Session XV
Date: 2/21/80
Age: 1;9;8

again
airplane
Amy
ball
balloon
Barney
blanket
book
boss
bottle
busy
bye (bye)
Casey
cheek
clip
count
Daddy
Donald
duck
Dumbo
dust
end
golf
Goofy
got
Grandad
hall
hand
help
hide
hold
hot
in
jean
Jenny
Jo
kitty
Lady
like
Linda
look
man
Mickey
Mom
Mommy
more
move
Nonny
night
night night
no
Nonny
Opal
out
Paw Paw
puppy
(al)right
see me
Sid
sleepy
slide
snow
(some)body
Susan
talk
up
water
way

Session XVI
Date: 2/25/80
Age: 1;9;12

airplane
all
apple
back
Barney
birdie
bite
boat
bright
bus
butterfly
bye bye
car
clip
close
coyote
cup
day
Donald
duck
eye
fire truck
frog
get
gone gone
got
Grandad
Grover
hand
happy
home
horsie
hot
Jenny
Jo
key
kite
kitty
lady
light
man
Mickey
Mommy
move
Nanny
no
Nonny
on
Opal
out
Paw Paw
please
Pinocchio
puppy
Raisin Bran
rock
shoe
Sid
silly
slide
sun
Susan
train
tuba
up
water
windmill

Session XVII
Date: 2/27/80
Age: 1;9;14

Amy
another one
back
balloon
Bambi
Barney
belt
big bus
birdie
bite
bye bye
call
Casey
cracker
Daddy
duck
eight
fall
fence
Gary
goat
Grandad
happy
hat
heavy
hi
him
home
horsie
Humpty
hurt
in
Jenny
key
kitty
look
look
man
nine
Mommy
moon
neck
night night
Nonny
o'clock
off
on
once
Opal
open
owl
Pat
Pinocchio
Pluto
read
rocket
rooster
Santa Claus
shoe
sing
Snoopy
talk
thank thank
two
up
wall
yellow

Appendix C. Jenny: Reduplications Session-by-Session.

Session	Date	Produced Forms	Word
I.	11/13/79	/baba/	bottle
		/bʌbə/	broken
		/mʌmə/	music
		/mimi/	Snoopy
		/bʊbə/	umbrella
		/nɛnə/	planet
		/bIbi/	pretty
		/dIdu/	Susan
II.	11/27/79	/mɛmi/. /mImI/, /mIni/	Snoopy
		/dɛdɛ/	tuba
		/jIji/, /nini/	Jenny
		/nɛni/	thank you
		/dɛdeI/	alligator
		/mɛmɛ/, /mɛmə/	Amanda
		/mIni/	Missy
		/mɛmɛ/. /mɛmə/, /mama/	hammer
		/dIdI/. /dudI/, /dudu/	zipper
		/baba/	bottle
III.	12/4/79	/jɛjɛ/, /jɛjə/, /jɛjɛ/, /lɛjɛ/	Terri
		/ninə/	green
		/mimi/, /mImi/	Snoopy
		/bʌbə/, /bʊbɛ/	umbrella
		/jɛjə/, /leIlɛ/, /leIli/	lady
		/tIti/	tickling
		/bʊbə/, /bʌbə/	broken
		/baba/	water
		/joʊju/	Susan
IV.	12/18/79	/bɛbɛ/, /bɛbɛ/	rabbit
		/mumI/	move it
		/dʌdə/, /dʊdə/	dirty
		/wʊwə/, /wʌwə/	roll it
		/mImI/, /mimi/	Missy
		/nana/	turn it
		/glɛglɛ/, /leIli/	lady
		/lʊlə/	Susan
		/nInI/, /nIni/	Jenny
V.	1/2/80	/tItI/, /tIti/	cookie
		/mImi/, /mimi/	Snoopy
		/bibə/, /wIwə/, /bʊbʊ/, /bubu/, /bubə/	Weeble
		/nini/, /nInI/	Jenny
		/bɛbɛ/	bracelet
		/nɛnɛ/	necklace
		/bʊbɔ/, /bɛbɛ/	embarrassed
		/dʊdə/	Susan
		/bʊbə/	bells
		/babə/	water
		/didI/	kitty
VI.	1/9/80	/bʊbə/, /bubʊ/	Weeble
		/daIdɔ/. /deIdə/, /dadə/	Woodstock
		/leIleI/, /laleI/	Casey
		/bʊbɔ/	pillow
		/bibi/, /mimi/	Snoopy
		/ninI/	Jenny
		/dIdi/	get it
		/mɛmi/, /mimi/	Missy
		/bʌbə/	radio
		/bʊbɛ/	zipper
		/nɛnɛ/, /nɛnə/	Amanda
		/dɛdeI/	Jason
VII.	1/21/80	/wawa/	water
		/nini/	Jenny
		/dɛndɛn/	Grandad
		/glɛglɛ/	glasses
		/bibi/, /baIbi/	Snoopy
		/bɛbɛ/	rabbit

Session	Date	Produced Forms	Word
VII.	1/21/80, continued	/bʌbə/	pillow
		/dɔdu/, /dʌdi/	cookie
		/dudə/	little
		/mʌmɔ/	hammer
		/bʊbə/	build it
VIII.	1/23/80	/wɔwə/, /baba/	bottle
		/didi/	silly
		/biblɪ/	little bit
		/bibə/, /bIbʊ/, /wʊwə/, /bʊbə/	Weeble
		/nIni/, /nini/	Jenny
		/dʊdə/	together
		/babɔ/	pillow
		/bapa/	flower
		/dɛdɛ/	Carol
		/dlowdlow/, /dlɔdlɔ/, /dlowlow/	Grover
		/dIdi/	get it
		/data/	carrot
		/dliti/	tv
		/bʌbʌ/	be back
		/dʊdə/, /dIdə/	feed her
		/dudu/	Susan
IX.	1/28/80	/bʊlə/, /lulu/, /dulu/, /lulow/, /bʊlu/	Susan
		/mʌnə/	numbers
		/jeIkeI/, /deIdleI/	Casey
		/bʌdə/	pillow
		/dini/	Jenny
		/didI/	sitting
		/bawa/	water
		/babeI/	blanket
		/wiwi/	Weeble
		/dɔdə/	carrot
		/taItow/	Pluto
X.	2/4/80	/dowdow/	Carol
		/dida/	Leta
		/bʌbi/, /bʊbi/, /bubI/, /bibi/, /bɛbi/, /bIbi/, /beIbi/	Snoopy
		/dʌdə/	turtle
		/glimi/	see me
		/bwʌbə/, /dʊdə/	Weeble
		/dlowdlow/, /dlowdow/, /dowdow/, /dlɔdow/	Grover
		/dɛnɛɛ/	Grandad
		/bowbow/	telephone pole
		/dɛdə/	carrot
		/nowʔnowʔ/, /nowʔnowʔ/	Pinocchio
		/dʊdə/	Susan
		/bʌbʌ/	rabbit
		/bʌdə/	puzzle
XI.	2/6/80	/budu/, /bubʊ/, /bʊbu/, /bwʊbə/, /bubə/	Weeble
		/dʌdə/, /dudə/, /dʊdə/	Susan
		/dleIdeI/	Jason
		/mʌmɔ/	number
		/deIdeI/, /dleIdleI/	Casey
		/ʌpbʌp/, /bʌʔbʌʔ/	Humpty Dumpty
		/bɛdɛ/	basket
		/dini/	Jenny
XII.	2/11/80	/bʊbə/, /wʌwə/	Weeble
		/dlaIdaI/, dɛɛbɛ/	butterfly
		/dɛdɛ/	Goofy
		/nina/	Linda
		/owtnowt/	Pinocchio
		/bibi/	Snoopy
		/bʊbad/, /bIbad/, /babad/, /babʌd/, /babʊd/	Big Bird
		/dowdlow/, /dlowdlow/	Grover
		/bʊdʊt/	Cookie Monster
		/mamat/	Monster
		/dowdʊ/	shoulder

Session	Date	Produced Forms	Word
XII.	2/11/80, continued	/dʌdə/	dirty
		/wɛnsɛ/	Wednesday
		/bebi/	paper
XIII.	2/13/80	/beIbeI/	toothpaste
		/bibi/	sleepy
		/doʊdoʊ/	shoulder
		/nanə/	another one
		/diti/	turkey
		/dida/	Leta
		/wʊmə/, /wɛmɛ/, /wɛmə/, /wɪmə/	windmill
		/moʊnoʊ/	mobile
		/gloʊgloʊ/, /dloʊdloʊ/	Grover
		/dleIdlə/, /dlidlə/	Santa Claus
		/bIbi/, /bibi/	Snoopy
		/didi/	silly
		/dʊdʊ/	Susan
		/bʌdə/	buckle
		/bʊlʊ/	pillow
		/babad/, /bʌbəʊd/, /bʊbud/	Big Bird
		/dIdi/, /didi/	get it
		/dlaIdlaI/	butterfly
		/bidi/	reach it
		/dədi/	dirty
		/bʌdə/	buckle
XIV.	2/18/80	/deIdeI/, /deIdleI/, /dlɛdeI/, /dleIdlɛ/, /dleIdleI/	Casey
		/dʊdu/	Susan
		/dʌdoʊ/	thirsty
		/deIdeIt/	did it
		/deIdeIt/	thank you
		/bʊbʊ/	rabbit
XV.	2/21/80	/dudu/, /dʊdu/, /dadoʊ/, /dudi/	Susan
		/ninoʊ/	Linda
		/dleIdi/	Casey
		/bIbi/	busy
		/dʌndʌn/	Grandad
		/bimi/	see me
		/dadoʊ/	bottle
		/deIdi/	lady
		/dludu/	Goofy
		/bIbi/	sleepy
		/wawa/	water
XVI.	2/25/80	/dandat/, /dʌndʌn/	Grandad
		/wawa/	water
		/bweIbweI/	Raisin Bran
		/dudu/	Susan
		/mImIl/, /mimɛʊ/, /mImIəl/, /mimləl/	windmill
		/bʌbə/, bubu/	tuba
		/kiti/	kitty
		/tloʊtloʊ/	Grover
		/noʊnoʊk/	Pinocchio
XVII.	2/27/80	/dʌkdʌŋk/, /dʌŋkdʌŋk/	thank thank
		/jidʒi/, /tIti/	kitty
		/wʊwʊ/	rooster
		/tʊta/, /ttɛtal/, /tlital/	Santa Claus
		/dʌndʌn/	Grandad
		/titeI/	Casey
		/jɛjoʊ/	yellow
		/noʊnoʊt/, /nuknoʊt/, /nuʔnoʊ/	Pinocchio

Appendix D. Jason: Word Lists Session-by-Session.

Total Number of Words Omitting all Replications = 382

Session I
Date: 11/16/79
Age: 1;8;1

bee (blanket)	go	read
break	hi	ride
broke	hot	shoe
bye bye	mine	talk
cookie	Mom	this
do	more	work
dog	night night	zip
door	no	

Session II
Date: 11/19/79
Age: 1;8;4

apple	bye bye	penny
ball	do	stereo
bird	frog	stop
block	go	stopped
book	hi	talk
break	hot	teeth
broke	light	that
broken	no	this
big		

Session III
Date: 11/29/79
Age: 1;8;14

baby	bubble	no
bike	Celia	off
birds	Daddy	on
bite	dark	Sesame Street
blow	door(s)	Susan
book	hi	talk
box	hot	trash
burn	light	

Session IV
Date: 12/6/79
Age: 1;8;21

bee (blanket)	coke	night night
bite	dark	on
bouncer	doors	pull
break	eat	push
broke	go	(car)seat
bubble	hot	Sesame Street
burn	light	talk
bye bye	men (man)	tape
cake	mine (me)	work
clock		

Session V
Date: 12/13/79
Age: 1;8;28

Amen	dark	no
baby	door(s)	on
ball	eat	Paw Paw
blow	eyes	please
book	go	quiet
boot	gone	rain
break	horse	shoes
burn	hot	sing
bye bye	key(s)	stuck
cake	light	swing
cold	Mark	touch
corn	night night	went
cup		

Session VI
Date: 12/20/79
Age: 1;9;5

baby	(pop)corn	mail
bag	cup	night night
box	dark	no
break	do	nose
breakfast	door(s)	Santa Claus
burn	drink	seat
bye bye	eyes	sing
cane	go	string
cards	got	stuck
Casey	hi	top
colors	hot	turn
cook	Jenny	work
cookie(s)	juice	

Session VII
Date: 12/26/79
Age: 1;9;11

baby	house	run
block	key	short
burn	light	sing
butterfly	mess	string
car	Mommy	stuck
cycle	night night	Susan
dog	one	talk
door	paint	that
drink	Paw Paw	tie
hard	radio	two
help	read	work
hi		

Session VIII
Date: 1/3/80
Age: 1;9;19

Alicia	hair	nuts
baby	here	paper
bite	hers	rain
bracelet	hot	round
bubble	it's	shave
bye bye	juice	shock
chair	key	sing
cold	lemon	spoon
cookie	light	stop
cycle	mat	sugar
Daddy	mess	Susan
dark	mine	swing
dirty	Mommy	talk
door	mouse (Mickey)	taste
eyes	night	tea
gone (gone)	night night	those
Goofy	nose	work

Session IX
Date: 1/9/80
Age: 1;9;25

back
banana
beater(s)
big
blow
break
breakfast
broke
burger
burn
bye bye
cake
clean
clock
close
coffee
coke
cold
cook
cover up
don't
door
down
drop
face
glove
go
gone (gone)
good
help
hot
jello
juice
light(s)
mess
microwave
milk
Mommy
night night
no
on
pancake
purse
push
quiet
rag
rain
ready
shock
shoes
shoot
(in)side
sing
stuck
this
through
top
touch
water
wet
whipped cream
work

Session X
Date: 1/14/80
Age: 1;9;30

apple
baby
boat
break
bubble(s)
button(s)
bye bye
close
cold
door(s)
down
duck (Donald)
go
gone
help
here
hold
hook
horse
key
leggos
light
man
mess
Mommy
monkey
night night
off
on
one
Pluto
pocket
purse
push
put up
rain
record
(a)round
seat
seed
shake
sing
sleep
spill
stuck
Susan
talk
tea
together
tractor
two
wash
water

Session XI
Date: 1/16/80
Age: 1;10;1

baby
back
bee (blanket)
belt
bike
blow
book
break
broke
bye bye
close
coffee
cold
coke
Daddy
daughter
dirty
doggie
door
ears
feet
felt
gone gone
horn
hot
jacket
keys
knock
mat
mess
milk
mine
mirror
no
nose
nuts
off
on
one
pants
root beer
run
second
shock
sing
snail
sound
spill
star
stop
Susan
swing
tea
thank you
this
thumb
toes
tractor
warm
water

Session XI, continued

eat
eyes
fan
pen
pretty
record
wood
you
zip

Session XII
Date: 1/21/80
Age: 1;10;6

Alicia
balloon
bird
book
bye bye
chair
clock
close
cold
cookies
(bi)cycle
deal
door
down
drink
drop
duck
eyes
four
gone
hands
happy
horse
hot
jack
last
light
Mark
medicine
milk
Mommy
more
napkins
no
on
open
outside
place
press
pull
push
records
(a)round
shirt
sing
somersault
spill
stick
stop
Susan
swing
talk
tape
tickle
tomorrow
turkey
vacuum
wash
water
write

Session XIII
Date: 1/23/80
Age: 1;10;8

baby
book
breakfast
broom
bye bye
car
Cee Cee
cereal
chair
clock
cookie(s)
Daddy
dark
door
down
drink
eye(s)
friend
gone
horsie
key
kitty cat
light
mine
more
move
nose
on
out
picture
radio
ring
shoes
sock
spill
stuck
swing
tape
Trigger
water
wet
work
wrench

Session XIV
Date: 1/28/80
Age: 1;10;13

airplane
baby
balloon
bear
big
bird
boat
book
Captain Kangaroo
car
chair
clock
close
count
cycle
Daddy
hat
home
horn
horsie
hot
Mama
moon
nap
night light
night night
off
on
pants
picture
pig
potty
plug
(a)round
Sesame Street
shadow
shock
shoes
sing
sit
sleep
sound
stars
stuck
Susan
touch it
two
up here
Valerie
water

Session XIV, continued

do do	puppies	what got
do it	push	work
down	ride	wrap
drive		
hand		

Session XV
Date: 1/30/80
Age: 1;10;15

back	hand	rain
birthday	hat	rock
block	hot	round
bracelet	kiss	seat
burger	light	shock
burn	milk	shut
bye bye	Mommy	sing
chair	more	skis
Chris	mouse	snack
close	name	stairs
coffee	nap	steam
cold	no	stop
Daddy	nose	stuck
dark	on	talk
door	pen	tea
down	people	this
ear	pluck it	tight
eyes	poke	tummy
face	potty	two
fire	pretty	wet
go	push	won't

Session XVI
Date: 2/6/80
Age: 1;10;22

Alicia	here	pig
blanket	horse	pull
bow	hot	purse
break	hurt	push
build	juice	rock
bye bye	machine	round
chair	Mark	seat
close	mat	sing
cookies	mess	shirt
couch	milk	shoes
do it	mirror	spill
door	Mommy	spin
down	nag	stairs
drink	night night	Susan
elephant	no	suspendars
eyes	nose	swing
face	open	there
fan	out	toast
game	paint	water
go	pants	wheel
heart	pennies	you
help		

Session XVII
Date: 2/11/80
Age: 1;10;27

angel	clock	phone
balloon	close	piano
billfold	door	plate
bird	down	radio
block	eye	round
book	flower	shake
boot	horsie	shoes
bowl	juice	shut

Session XVII, continued

break	Mommy	spill
break it	off	stuck
broke	on	Susan
burn	open	this
candle	pants	Trigger
car	paper	water

Session XVIII
Date: 2/13/80
Age: 1;10;29

bean	hat	radio
belt	hot	ride
box	I	Shaggy
break	jacket	shoes
burn	lady	soft
chest	light	stop
chicken	mouth	Susan
close	nose	talk
cold	off	tickle
do do	open	toe
door	pants	toys
eat	people	tractor
farm	pretty	train
flower	pull	water
get it	punch	wheel
hand	push	zipper

Session XIX
Date: 2/18/80
Age: 1;11;3

apart	dirt	orange
apples	door	out
bag	finger	paper
balloon	grape(s)	pen
bath	hair	picture
belt	hat	pretty
billfold	house	rock
bite	hurt	round
bright	juice	shoes
broke	keys	sing
brush	kiss it	spilled
button	lady	Susan
chair	light	tea
cheese	lock	tie
chest	medicine	toys
clean	neat	vacuum
close	noon	wet
coat	not	wheels
coffee	numbers	zip it
cold	open	zipper
dark		

Session XX
Date: 2/20/80
Age: 1;11;5

Alicia	hole	radio
apple	horsie	rock
ball	hot	round
battery	Jenny	Shaggy
bed	keys	shoes
belt	knock	sing
break	lemon	socks
broom	light	soft
bug	lock	spill
carpet	milk	Susan
Celia	mirror	sweep
chair	mouth	talk
clock	no	tie

Session XX, continued

close
cold
do
do do
door
fall
finger
flower
get it
hair
nose
nut
off
open
orange
out
pear
phone
pretty
throw it
toe
toothbrush
turn
water
wet
wheel(s)
zip
zipper

Session XXI
Date: 2/25/80
Age: 1;11;10

baby
ball
bite
book
break
breakfast
button
bye (bye)
chicken
close
cold
cool
diaper
do do
door
doughnut
down
ear
eyes
face
fall
finger
fit
glasses
go
green
hand
here
hole
horsie
hot
hurt
is
key(s)
kiss
knees
knob
lever
light
lock
lock it
milk
mine
mirror
Mommy
money
mouth
my
nice
night
night night
nose
on
open
paint
pen
picture
poke
potty
pull
push
rocks
roll
round
Shaggy
shake
shirt
shock
shoes
sing
socks
step
straight
Susan
the
tickle
toe
trash
truck
tv
two
Valerie
walk
wet
write
zip
zip it
zipper

Session XXII
Date: 2/27/80
Age: 1;11;12

airplane
Alicia
allgone
apple
back
back in
back yard
balloons
belt
bite
boy
burger
bye bye
cereal
Christmas tree
close
clothes
cold
comb
curtain
door
gone
grows
hair
hand
hat
here
in
juice
keys
light
milk
nice
noise
nose
open
Pinocchio
push
round
shake
shoes
shut
sing
spilled
stairs
straight
Susan
table
tea
tie
tree
Trigger
two
Valerie
want it
watch
water
wet

Appendix E. Jason: Phonetic Assimilations and Reduplications Session-by-Session.

P.A. = Phonetic Assimilation
Red. = Reduplication

Session	Date	Produced Forms	Word	Process
I.	11/16/79	/hak/	talk	P.A.
II.	11/19/79	/dit/	teeth	P.A.
		/dit/	this	P.A.
		/hɔk/, /hak/	talk	P.A.
		/haba/	apple	Red.
		/bɹoʊ/	broken	Red.
		/midi/	penny	Red.
		/nIni/, /mIni/	penny	P.A. &/or Red.
III.	11/29/79	/hak/, /ha?/	talk	P.A.
		/hak/, /ha?/	hot	P.A.
		/dat/, /dats/	dark	P.A.
		/dIdit/, /dɛdit/	Sesame Street	Red.
		/sazə/	Susan	P.A. &/or Red.
		/zIzə/	Celia	P.A. &/or Red.
IV.	12/6/79	/hɔk/, /hak/, /kak/	talk	P.A.
		/bwop/	pull	P.A.
		/dat/	dark	P.A.
		/teIt/	tape	P.A.
		/bəboont/	bouncer	Red.
		/dIdit/	Sesame Street	Red.
V.	12/13/79	/kʌk/	cup	P.A.
		/?ɔ?/, /hɔ?/, /?a?/	hot	P.A.
		/gʌk/, /kʌk/	stuck	P.A.
		/tit/	eat	P.A.
		/dat/	dark	P.A.
		/tʌts/	touch	P.A.
VI.	12/20/79	/sin/, /tsin/	sing	P.A.
		/gɔk/	work	P.A.
		/gʌk/	stuck	P.A.
		/gɛgk/	drink	P.A.
		/kʌk/	cup	P.A.
		/trin/	string	P.A.
		/dus/	juice	P.A.
VII.	12/26/79	/kɔk/	talk	P.A.
		/gʌk/	stuck	P.A.
		/gɛgk/	drink	P.A.
		/srin/, /tswin/, /tsin/, /sin/	sing	P.A.
VIII.	1/3/80	/dat/	stop	P.A.
		/swin/	swing	P.A.
		/sin/	sing	P.A.
		/doos/	those	P.A.
		/kak/, /kɔk/, /ɔt/, /ɔpt/	talk	P.A.
		/tum/	spoon	P.A.
		/sels/	taste	P.A.
		/pepɛ/	paper	Red.
		/ʃuʃə/, /suʃə/, /ʃuʒə/, /susə/, /ʃʌʃʊ/, /ʃʌʒʊs/	Susan	P.A. &/or Red.
		/ʃɪʃɪə/	Alicia	P.A. &/or Red.
		/ʃuʒʊ/	sugar	P.A. &/or Red.

Session	Date	Produced Forms	Word	Process
IX.	1/9/80	/ɒʌp/, /pap/	top	P.A.
		/dus/	juice	P.A.
		/kaʔ/, /haʔ/	hot	P.A.
		/haʔ/	cup	P.A.
		/ʃuʃ/	shoes	P.A.
		/gʌk/	stuck	P.A.
		/gʌk/	cover up	P.A.
		/gʊk/	good	P.A.
		/dʌcs/	couch	P.A.
		/gagoʊ/	go	Red.
		/dɛdoʊ/, /didoʊ/, /dɔdoʊ/	jello	Red.
		/ɒʌpi/	coffee	P.A. &/or Red.
		/kʊkin/, /kakin/	whipped cream	P.A. &/or Red.
		/kaikaik/	pancake	P.A. &/or Red.
X.	1/14/80	/gʌk/	stuck	P.A.
		/sin/	sing	P.A.
		/das/	wash	P.A.
		/gʌkɔs/, /gʊkɔs/	together	P.A.
		/pɪkʌk/	put up	P.A.
		/hɔk/, /kɔk/	talk	P.A.
		/kʊkɔ/	record	P.A. &/or Red.
		/sʊsu/, /sʌsɔ/, /sɪsɔ/	Susan	P.A. &/or Red.
XI.	1/16/80	/wʊn/	run	P.A.
		/swin/	swing	P.A.
		/sin/	sing	P.A.
		/susin/	sing	Red.
		/bəboʊ/	blow	Red.
		/dʒʌdʒu/	Susan	Red.
		/bʊbʊk/	back	Red.
		/bIbIr/	root beer	P.A. &/or Red.
		/ʒʊkʊt/	jacket	P.A. &/or Red.
XII.	1/21/80	/ʔʌk/	jack	P.A.
		/gʊk/, /gaIk/, /gʌk/	duck	P.A.
		/sin/	sing	P.A.
		/swin/	swing	P.A.
		/kɔk/	talk	P.A.
		/dʌti/	turkey	P.A.
		/saIsaIt/	outside	Red.
		/ʒaʒa/	Alicia	P.A. &/or Red.
		/sʊsi/	Susan	P.A. &/or Red.
		/sʊsIn/	medicine	P.A. &/or Red.
		/gIgoʊ/	tickle	P.A. &/or Red.
XIII.	1/23/80	/gʌk/	stuck	P.A.
		/gʊkʊ/	Trigger	P.A.
		/geIk/	drink	P.A.
		/ʃuʃ/	shoes	P.A.
		/mʊʊn/	on	P.A.
		/tIts/	wrench	P.A.
		/kʊkɛ/	kitty cat	Red.
		/sIsoʊ/	cereal	Red.

Session	Date	Produced Forms	Word	Process
XIV.	1/28/80	/[illegible]/	round	P.A.
		/[illegible]/, /[illegible]/	stuck	P.A.
		/bapeIn/	airplane	P.A.
		/papeIn/	airplane	P.A. &/or Red.
		/hahat/	hat	Red.
		/tvcic/, /dIdit/	Sesame Street	Red.
		/daIdaIt/	night light	Red.
		/vavi/	Valerie	P.A. &/or Red.
		/[illegible]/, /sIsət/, /[illegible]/	Susan	P.A. &/or Red.
		/[illegible]/, /[illegible]/	shadow	P.A. &/or Red.
XV.	1/30/80	/[illegible]/, /[illegible]/	talk	P.A.
		/ha?/	hot	P.A.
		/[illegible]/	stuck	P.A.
		/sin/	sing	P.A.
		/sIs/	this	P.A.
XVI.	2/6/80	/sin/	sing	P.A.
		/dus/	juice	P.A.
		/[illegible]/	Alicia	P.A.
		/[illegible]/	drink	P.A.
		/[illegible]/	shoes	P.A.
		/[illegible]/	machine	P.A. &/or Red.
		/sIsən/	Susan	P.A. &/or Red.
XVII.	2/11/80	/dus/	juice	P.A.
		/[illegible]/	phone	P.A.
		/[illegible]/	burn	P.A.
		/[illegible]/	stuck	P.A.
		/[illegible]/	Susan	P.A. &/or Red.
XVIII.	2/13/80	/[illegible]/	shoes	P.A.
		/douz/	close	P.A.
		/[illegible]/	talk	P.A.
		/deIdi/	lady	P.A. &/or Red.
		/[illegible]/	tickle	P.A.
		/[illegible]/	jacket	P.A.
		/[illegible]/, /gIkIt/, /[illegible]/, /[illegible]/	jacket	P.A. &/or Red.
		/[illegible]/	Shaggy	P.A. &/or Red
		/[illegible]/, /dIdIt/	get it	P.A. &/or Red.
XIX.	2/18/80	/[illegible]/	clean	P.A.
		/touz/	close	P.A.
		/taIt/	light	P.A.
		/[illegible]/	shoes	P.A.
		/[illegible]/, /[illegible]/	billfold	Red.
		/[illegible]/	medicine	P.A. &/or Red.
XX.	2/20/80	/[illegible]/	shoes	P.A.
		/sats/	socks	P.A.
		/didi/	pretty	Red.
		/[illegible]/, /[illegible]/	Susan	P.A. &/or Red.
		/[illegible]/	Alicia	P.A. &/or Red.
		/vavi/	battery	P.A. &/or Red.

Session	Date	Produced Forms	Word	Process
XXI.	2/25/80	/ʃɪʃ/, /ʃuʃ/, /ʃuʒ/	shoes	P.A.
		/kʌg/, /gʌk/	truck	P.A.
		/gIku/	tickle	P.A.
		/kIku/	tickle	P.A. & /or Red.
		/[illegible]zIz/	glasses	P.A.
		/[illegible]zIz/	glasses	P.A. & /or Red
		/sIzIn/	Susan	Red.
		/wɔwi/, /wɔɹwi/	Valerie	P.A. & /or Red.
XXII.	2/27/80	/ʃuʃ/, /ʃuʒ/	juice	P.A.
		/krIɪrIɪ/	Christmas tree	P.A.
		/ʃuʒ/	shoes	P.A.
		/bʊbeIn/	airplane	P.A. & /or Red.
		/ʒIʒə/, /dIdə/	Alicia	P.A. & /or Red.
		/ʃuʃən/	Susan	P.A. & /or Red.
		/wɔwi/	Valerie	P.A. & /or Red.

Appendix F. Allison: Word Lists Session-by-Session.

Total Number of Words Omitting all Replications = 236

Session I
Date: 11/10/79
Age: 1;8;5

baby	dolly	move
balloon	garage	off
block	hat	see
bottle	hold	shirt
bye bye	lid	sleep
Daddy	Mommy	that

Session II
Date: 11/17/79
Age: 1;8;12

bell	Daddy	no
book	kitty	puppy
broke	Mommy	Stephanie
chalk		

Session III
Date: 11/18/79
Age: 1;8;13

baby	down	my
cold	eye	off
Daddy	Mommy	sit

Session IV
Date: 12/1/79
Age: 1;8;26

baby	hair	puppy
bird	hand	rough
block	hurt	see
book	jean	shoe
both	Jill	sock
bunny	lipstick	soft
clock	me (my)	stick
clown	mirror	stuck
Daddy	Mommy	tight
dress	mouth	tongue
ear	nose	twisted
eye	off	up
feet	out	

Session V
Date: 12/7/79
Age: 1;9;2

all gone	duck	my (me)
baby	ear	open
balloon	eat	raisin
blue	garage	red
broke	gone	ride
button	here	ring
Daddy	hi	see
do	Mommy	take off
door	mouse	tree
down		

Session VI
Date: 12/16/79
Age: 1;9;11

baby	fix	more
beans	hair	no
block	hat	off
blue	hi	open

Session VI, continued

broke	hold	pull
candy	horsie	see
do	hot	shoes
duck	me	snow
eat	Mommy	stuck
eye		

Session VII
Date: 12/22/79
Age: 1;9;17

apple	go	off
baby	hat	okay
bird	hold	open
blue	juice	puppy
book	kitty	rough
bye	Mommy	seat
Daddy	more	see
dark	move	soft
do	my (me)	up
dog	no	yellow
door		

Session VIII
Date: 12/26/79
Age: 1;9;21

baby	go	out
ball	hat	push
bed	Mommy	red
broke	monkey	see
button	my	shoe
bye	no	(up)side(down)
dark	noise	sock
do	nose	soft
door	off	talk
eye	open	

Session IX
Date: 12/31/79
Age: 1;9;26

baby	do	off
ball	duck	out
blue	go	see
broke	here	Stephanie
bulb	hurt	there
bunny	Mama	this
bye	my	up
chair	no	write
Daddy		

Session X
Date: 1/5/80
Age: 1;10;0

baby	go	more
boot	Goofy	Mouse
broke	hat	nose
button	head	open
Daddy	here	see
dark	horsie	stop
do	Mamaw	this
duck	Mommy	write
fingernail		

Session XI
Date: 1/13/80
Age: 1;10;8

baby	here	rock
ball	he	see
bye	hurt	Stephanie
candy	Mamaw	stuck
Daddy	Mommy	Susan
dark	more	thank you
dog	my (me)	watch
hello	no	who

Session XII
Date: 1/14/80
Age: 1;10;9

apple	here	orange
ball	hurt	put
bear	it	right
broke	kitty	ring
butterfly	Mommy	see
button	monkey	shoe
candy	more	sock
doctor	off	Stephanie
fall	open	

Session XIII
Date: 1/19/80
Age: 1;10;14

baby	hair	nose
bead	hot	on
bell	he	open
break	head	out
broke	here	phone
bye	hi	see
close	hurt	shoe
clown	katchup	Snoopy
cup	lucky	standing
do	man	stuck
doctor	Mommy	teeth
dog	mouse	thank you
donkey	move	this
duck	my	toys
eye	night night	Woodstock
flower	no	you

Session XIV
Date: 1/21/80
Age: 1;10;16

baby	hurt	please
broke	Mommy	see
bye	no	thank you
clock	open	this
door		

Session XV
Date: 1/26/80
Age: 1;10;21

arm	dress	move
baby	duck	no
ball	ear	nose
bear	eye	off
bed	flower	on
bib	hand	open
bird	hat	phone
blocks	here	push
boot	horsie	see

Session XV, continued

box	juice	shoe
brush	man	spoon
bunny	Minnie	stop
bye	Mommy	sweater
chair	more	table
clock	mouse	Teddy
dark	mouth	this
dog		

Session XVI
Date: 1/28/80
Age: 1;10;23

airplane	doctor	mouth
apple	dog	my
bad	door	orange
ball	duck	pants
balloon	eye	phone
bear	fire	pig
bed	flower	puppy
belt	girl	ride
big	go	see
bird	heavy	shoe
broke	here	snow
bunny	kitty cat	spoon
car	light	talk
clock	Mommy	towel
clown	mouse	

Session XVII
Date: 2/2/80
Age: 1;10;28

baby	dog	Mommy
ball	Donald Duck	night night
balloon	down	noise
bear	dress	nose
bed	drum	open
bib	duck	panties
big	ear	plane
bird	elephant	right
blocks	eye	see
blow	fall	spoon
boat	flower	stand
book	girl	star
boot	go	stuck
boy	hat	Susan
broke	he	sweater
bunny	here	teeth
button	hi	thank you
caboose	horsie	this
chin	hurt	train
clock	juice	truck
clown	kitty	two
comb	lady	up
cow	lion	wagon
cup	man	Weeble
Daddy	Mattel	wheel

Session XVIII
Date: 2/4/80
Age: 1;10;30

baby	fish	open
ball	fit	pants
balloon	flower	pig
bead	girl	potty
bear	go	present
bird	Granny	right
bow	hair	Santa Claus

Session XVIII, continued

boy	hand	Scottie
broke	hat	see
brush	here	Shane
Bugs Bunny	hole	shoe
button	hurt	sleep
Chad	Jo	soap
clock	Kevin	sock
clown	kitty	stay
coat	knee	Stephanie
Cody	Matthew	teeth
Daddy	Michael	this
Dana	mouth	Tim
dog	my	tree
ear	nose	wheel
eye		

Session XIX
Date: 2/8/80
Age: 1;11;3

baby	comb	no
ball	dog	nose
bead	Donald Duck	open
bear	door	orange
big	elephant	pat
bird	eye	pig
block	go	pillow
boot	hair	right
box	here	see
boy	horsie	Snoopy
brush	kitty cat	star
car	Mattel	teeth
close	Mommy	this
clown	mouse	tree
coat	my (me)	Woodstock

Session XX
Date: 2/11/80
Age: 1;11;6

Bugs Bunny	here	right
dog	hurt	school
Donald Duck	kitty cat	see
felt	Mickey Mouse	shoe
go	moon	torn
hand	my	

Session XXI
Date: 2/16/80
Age: 1;11;11

baby	Daddy	my
baby bed	do	no
beads	Donald Duck	off
bear	drum	on
bed	eat	open
block	fish	Paul
blue	fit	raisin
boots	go	see
bottle	hair	small
boy	hand	soft
broke	here	take
bunny	house	tee-tee
button	juice	this
clock	kitty cat	too
clown	Mommy	wagon
cow		

Session XXII
Date: 2/18/80
Age: 1;11;13

bear	cow	Mommy
black	Daddy	mouth
bow	dog	nose
boy	door	off
buckle	fence	pig
button	go	plate
chicken	here	ride
close	hole	right
coat	horsie	see

Session XXIII
Date: 2/20/80
Age: 1;11;18

airplane	here	see
baby	Mickey Mouse	shoe
bird	Mommy	teeth
boy	mouth	thank you
dog	my	this
Donald Duck	no	train
eye	nose	washer
fit	on	wheel
go	orange	Woodstock
hair	right	yellow
hat		

Session XXIV
Date: 2/25/80
Age: 1;11;20

baby	hair	purple
bear	hand	ride
bike	here	right
bird	horsie	see
blue	knee	shoe
boot	Mommy	sock
(Bugs) Bunny	(Mickey) Mouse	teeth
cow	mouth	that
cry	my (me)	toe
Daddy	nose	too
Donald Duck	one	torn
eye	orange	tree
girl	pig	yellow
green		

Appendix G. Allison: Homonymous Forms Session-by-Session.

* Indicates words which had alternate pronunciations during a given session

Session	Date	Produced Form	Words
I.	11/10/79	/bou/	bell, balloon, bottle, block
		/hi/	see, sleep*, hat*
		/ha/	hold*, hat*
II.	11/17/79	—	—
III.	11/18/79	/dou/	cold*, down
IV.	12/1/79	/ʃɔ/	sock*, soft*
		/pi/	feet*, puppy*
		/ɔ/	off*, up
		/aI/	my*, mirror
		/hI/	ear*, hair
		/da/	clock, stuck
V.	12/7/79	/I/	ear, ring*
		/hi/	here, see*
		/dou/	down*, door
		/i/	eat, ring*, see*
		/weI/	red*, raisin
VI.	12/16/79	/nou/	no, snow
		/ou/	off, open
		/haI/	hat, hi
VII.	12/22/79	/dɔ/	door*, dark, dog
		/dou/	door*, go
		/bu/	book, bird
		/tsi/	see, seat
		/ʌ/	off*, up
VIII.	12/26/79	/bɔ/	button, ball
		/dɔ/	door, dark, talk
		/nou/	nose, no
		/ou/	out*, open*
		/ɔ/	out*, open*, off
IX.	12/31/79	/hu/	hurt*, here
		/bɔ/	ball*, bulb*
		/bou/	ball*, bulb*, broke
		/beI/	Stephanie, bunny*
X.	1/5/80	/hi/	here*, horsie*
		/heI/	head*, hat*
		/bou/	button, broke
		/mou/	mouse, more
XI.	1/13/80	/wa/	rock, watch
XII.	1/14/80	/bɔ/	button, ball, broke*
		/hi/	see*, here*
		/teI/	Stephanie, candy

Session	Date	Produced Form	Words
XIII.	1/19/80	/hi/	see*, here*, he
		/hu/	hat*, hurt, hair*, here*
		/haI/	hat*, head, hi*
		/hI/	see*, here*
		/dou̯/	dog, close, duck*, phone, nose*
		/du/	duck*, do
		/nou̯/	nose*, no
		/mou̯/	mouse, nose*
		/meI/	man*, my*
		/baI/	my*, bye*
		/bou̯/	broke*, bell, flower*
		/tʌ/	stuck*, cup
		/tou̯/	stuck*, toys, clown
		/ou̯/	nose*, out*, open*, on
XIV.	1/21/80	/hi/	see*, this*
XV.	1/26/80	/hi/	see*, here*
		/haI/	hand*, hat*
		/hu/	shoe*, sweater, chair
		/nou̯/	nose*, no
		/mou̯/	mouth, mouse*, more
		/da/	dark*, duck*, clock
		/dou̯/	dog*, nose*, duck*
		/dɔ/	dark*, dog*, duck*, table
		/di/	this, see*
		/beI/	bye*, bed*, bunny*
		/baI/	bye*, bunny*, brush, bed*
		/bu/	bear, boot
		/ba/	push*, blocks
		/bɔ/	push*, ball, box
XVI.	1/28/80	/hi/	here, see
		/haI/	heavy*, light
		/dou̯/	go, clown, duck*, door, car, dog* girl, towel*
		/dɔ/	dog*, talk
		/mou̯/	mouth, mouse
		/bu/	bird, spoon, bear*
		/bou̯/	belt, bear*, broke
		/baI/	bunny, bed*
		/wou̯/	flower, phone, fire
XVII.	2/2/80	/hi/	see*, here*, he
		/hI/	here*, hurt*
		/hu/	here*, hat*, juice, bird*, hurt*
		/haI/	hi, hat*
		/tɔ/	truck*, stuck*
		/taI/	train*, star*
		/dou̯/	duck*, cow, go*, girl, clown*
		/dɔ/	duck*, dog, go*, truck*, clock, cup, clown*
		/daI/	lady*, train*, lion, dress
		/baI/	boy, lady*, plane*, bunny*, bed*
		/bu/	balloon, caboose, book, bear, bird* bunny*, boot, spoon, Weeble*
		/bou̯/	boat, drum, bed*, blow
		/bɔ/	blocks, ball, button
		/wou̯/	wheel*, flower, Weeble*
		/weI/	wagon, feel

Session	Date	Produced Form	Words
XVIII.	2/4/80	/dow/	go, Jo, girl, clown*
		/dɔ/	dog, clown*
		/deI/	stay, Dana
		/hu/	here, hair, hurt
		/bow/	bird, brush*, bow, broke, button*
		/bu/	bear, pig*, balloon
		/baI/	boy*, pants, baby*
		/beI/	boy*, baby*
		/bɔ/	ball, hole, boy*, button*
		/bi/	bead, present*
		/tɔ/	clock, coat
		/ti/	teeth, tree, Tim
		/teI/	Scottie*, Stephanie*, Chad*, Kevin
		/taI/	Scottie*, Chad*, Stephanie*
		/mow/	mouth, Michael
XIX.	2/8/80	/dow/	coat, door*, dog*, clown, close, block*, car*
		/hi/	see, here*
		/hu/	here*, hair*, Mattel
		/now/	no, nose
		/ti/	teeth, tree
		/tɔ/	comb, star*
		/bu/	pillow, bear, bird*, boot, big*, boy
		/bɔ/	ball, block*
		/beI/	pig, my*
		/bI/	big*, put
		/ɔ/	elephant, open*, orange
XX.	2/11/80	—	—
XXI.	2/16/80	/bu/	bear, boots, blue
		/bɔ/	button, bed, bottle, broke*, Paul
		/dɔ/	clown*, drum*, brush
		/dow/	clown*, drum*, go
		/hi/	see*, fix
		/hu/	hair*, too
		/hI/	here, see*, this*
		/ɔ/	off, on*, small, open
XXII.	2/18/80	/bow/	buckle, button, pig*, bow
		/dɔ/	hole, boy*
		/dow/	cow, door, go, dog, coat, close
XXIII.	2/20/80	/wa/	right*, washer*, yellow*
		/hu/	hair, here*
		/hʊ/	here*, shoe
		/hi/	here*, see*
XXIV.	2/25/80	/dow/	toe, cow*
		/heI/	here*, hair
		/hI/	here*, see*
		/mow/	mouse, mouth*
		/bʊ/	bird, bear
		/baI/	bike, bunny*
		/waI/	right*, ride
		/aI/	eye, right*