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WORDS AND SOUNDS IN EARLY LANGUAGE ACQUISITION

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Development of initial-consonant production in relation to the acquisition of words is investigated. Longitudinal data of three children are analysed from about age 1;0 until the total recorded lexicon reaches 50 or more words. Using the word as the basis of analysis, PHONE CLASSES are set up for each child and are followed through time in PHONE TREES. As in historical sound change, both lexical and phonetic parameters are involved. Phonological idioms, saliency rules, universal order hypotheses, and acquisition strategies are discussed. Tentative suggestions are made toward a model of phonology.*

In acquiring full control over the language of his speech community, the child must learn to deal with an enormous array of lexical and phonological elements, as well as with the complex relations among these elements which constitute the grammar of a particular language, different from all other possible languages. In addition to the machinery of the language itself, he must learn when and how to use the language in accordance with his own needs and the norms of the community. And all this confronts the child not in neat, separate units, but in conglomerate batches which he must largely sort out for himself. Even if the speech input to which he is exposed is restricted in scope and simplified in structure, as the talk addressed to young children tends to be, the analytic problem is severe, and it must not be expected that the child's early attempts will match with any great precision the adult's language behavior and its underlying principles of organization.

Thus the linguist who wishes to identify analytic units in the child's speech encounters even greater pitfalls than he does in abstracting from the adult's speech those components at various levels which merit analytic autonomy. Looking for distinctive features, inflectional categories, syntactic rules, and all the dozens of other possible basic units in a child's linguistic system is a hazardous pastime; yet if we are to understand the processes of language development—indeed of language behavior in general—we must make the effort to do so, since it is manifestly impossible to deal with the child's language in one large undifferentiated mass.¹ In the present study, we examine the language development of the child in terms of two putative units: 'words' and 'word-initial consonants'. In the description and

* An earlier version of this paper appeared in *Papers and reports on child language development*, Stanford University, 6.1-60 (April 1973), including three appendices: these gave the primary data, a list of phone classes, and a word index. Corrected versions of these appendices, which are not published here for lack of space, are available from the authors.

¹ The difficulty and the challenge are neatly summarized by Chomsky (1964:35-6): 'It seems that the attempt to write a grammar for a child raises all of the unsolved problems of constructing a grammar for adult speech, multiplied by some rather large factor ... if anything far-reaching and real is to be discovered about the actual grammar of the child, then rather devious kinds of observations of his performance, his abilities, and his comprehension in many different kinds of circumstances will have to be obtained, so that a variety of evidence may be brought to bear on the attempt to determine what is in fact his underlying linguistic competence at each stage of development.'

analysis which follow, no assertion is made that these units are independent of all other possible units, or that recognition of these two units precludes recognizing certain other possible units (e.g. morphemes/formatives, syllables, sentences, prosodies, schemata, idioms, distinctive features, rules, agreement ...) What is assumed is twofold: (1) 'words' and 'word-initial consonants' are valid units of analysis from the earliest productions of meaningful speech by the child, and (2) it is instructive to study these two units in relation to each other.

1. DATA. The data used here are a small part of those collected in a longitudinal study of seven children, conducted as a part of research on the development of consonants in first-language learning.² The children, four girls and three boys of monolingual English background, were selected for the study when they were reported by their parents to use several words. Ages at the beginning of the study ranged from 0;11 to 1;2.

1.1. PROCEDURE. Each child was visited at home at approximately weekly intervals for seven to ten months, with occasional larger gaps because of illness and family vacations. Three observers participated in the project, two attending each session when possible. For about half the sessions, only one observer was present, but each child was seen consistently by the same observer.

During each half-hour visit, attempts were made by parents and observers to elicit as many of the child's words as possible, by the use of picture books and things familiar to him (food, toys etc.) The sessions were tape-recorded, and notes were made by the observer(s) of the probable adult equivalent of each utterance. Utterances were considered meaningful if there was sufficient consistency to allow recognition of the form, and if there was some consistency in reference or accompanying action—not necessarily exactly that expected from the meaning of the adult word. Similarly, it was not required that a specific adult English equivalent should be identified. Occasionally, it was found that a child would consistently use a form for which no probable adult equivalent could be imagined. In fact, however, such uninterpretable words occurred much less frequently than expected. They were included in the data, as well as forms which seemed to correspond to whole adult phrases rather than words, e.g. *I see you*.

Identification of words was aided by parents' recognition, although observers often obtained evidence of the use of a particular word before parents noticed it. We assume that our judgment of the identity of meaningful forms is valid. McCurry & Irwin 1953 demonstrated 91% inter-observer agreement in the determination of meaningful utterances and their referents in naturalistic settings, and our agreement in sessions attended by more than one observer was similarly high.

Child utterances were transcribed using the techniques established by the Phonetics Workshop of the Child Phonology Project, Fall 1971, and problems were

² The data collection and some of the analysis were carried out under the Stanford University Child Phonology Project, which is supported by National Science Foundation Grants GS 2320 and GS 30962. The data collection was planned by Carol Molony, and was carried out by her, Carol Farwell, and Carolyn Johnson. Transcriptions used in this study were done chiefly by Farwell but some also by Molony, and some of the questions were discussed in the Child Phonetics Workshop conducted by Clara N. Bush.

referred to that workshop. An expanded IPA symbol grid was used (Johnson & Bush 1972). Transcription is to a level comparable to that in Leopold 1939–49, with narrower transcription of initial consonants and less attention to vowels.

1.2. SUBJECTS. This paper reports the early stages of development of two girls, T and K, from the larger study. Utterances occurring from the beginning of the study to the week in which the 50th word type was recorded are included.³ In order to provide a reference point for our analysis, Hildegard Leopold (H) has been included as a third subject, since information about her development is widely known and generally available.

T was a first child and spent almost all her time with her two parents. Her mother kept a detailed list of words produced by T during each week, and conscientiously elicited new words for us at each session. T had just begun to walk when we started our study. She did not engage in much babbling, and she imitated only infrequently—usually words she had already produced herself. Pivot-type syntax, especially with the words *hi* and *where*, was evident from the first sessions; and two-word utterances became more common soon after the session with the 50th word.

K had an older brother and, possibly in self-defense, was physically aggressive and active. She spent time with both her parents and a housekeeper, and was often left alone with investigators during a taping session. Our tapes of K contain a lot of ‘babbling’ or at least unintelligible speech, and she showed willingness to imitate almost any word beginning with a sound at least close to one she could say. Even during the first sessions where our data are scanty, she would occasionally imitate or even spontaneously say three-word sentences; and our general impression was that she was more adventuresome and less concerned with details than T and H.

H, a first child, was deliberately raised as a bilingual: her father spoke to her only in German, her mother in English. She spent two months (age 1;0 and 1;1) in Germany where even her mother spoke only German to her, and for some time on her return she did not understand English. To make the Leopold data comparable, only the words which H still said at age 1;0 were included in the study; but those words are followed from their beginnings, back to 0;10. She imitated very rarely—always words which she understood. Until 1;5, the last month considered here, many of H’s words occurred only in whispered form, although some had full voice from the beginning, and a whisper/voice distinction sometimes separated homonyms. H learned to walk in the second half of 1;1, a month and a half after the beginning of the period studied here. On the whole, H was cautious: ‘It was characteristic of her that she generally avoided altogether any words the meaning and form of which she could not successfully cope with’ (Leopold, I.172).⁴

³ In the case of K, 72 words were included in order to get 50 words which occurred either spontaneously or more than once in an articulated form.

⁴ Leopold’s comments about H are of special value because they are made in comparison with his observations of her younger sister Karla, whose speech development he followed in less detail some years later. He also makes comparisons with previously published studies of child language development.

The children and the number of sessions reported here are shown in Table 1.

CHILD	AGE AT BEGINNING	NUMBER OF SESSIONS	TIME SPAN	TOTAL NO. OF WORDS
T	0;11	9	13 weeks	51
K	1;2	13	13 weeks	72
H	1;0	—	6 months	54

TABLE 1. Periods of elicitation for the three subjects T, K, and H.

Because no natural criteria present themselves for grouping weekly sessions together, each session has been analysed separately. For H, grouping is done month by month, since Leopold tells us only the month in which each form occurred. The main effect of the use of larger time divisions with H is that fluctuations from day to day are likely to be lost in the general trend of development. This tendency—coupled with the fact that Leopold often reports only a few phonetic variants of a word during a month, while one of our children might produce as many as eight variants of a word in one session—tends to make H's progress look much smoother than that of the other two children. Far from making the two sources of data incompatible, such a difference can be put to good use: H's development can help us recognize over-all trends within the variant forms in our data, while our data can make clear the degree of simplification in the H data.

1.3. IMITATIONS AND OTHER PROBLEMS. In a study of child phonology, as in any other phonological work, it is common to exclude certain problematic forms of data from analysis. For example, utterances in which a child 'imitates' or 'echoes' an immediately prior adult utterance are often separated from other, 'spontaneous' utterances. Researchers have sometimes found that such imitations may be more accurate phonetically than the same forms said spontaneously; and they have excluded imitations in order to maximize the number of utterances processed by the child's phonological system, rather than by a separate imitative ability.

There are several reasons why we have not excluded imitations from analysis in this study. For one thing, a very high percentage of what a one-year old says is imitated, so that there is very little purely spontaneous data. Furthermore, a study of the forms collected shows 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. Finally, even children this young can repeat or imitate things said by adults at some distance of time—five minutes or more—despite considerable intervening speech, so that no simple definition of imitation is feasible. Hence a separation of imitated utterances has not been carried out here, since it would lead to a great reduction of available data without any demonstrable gains of accuracy or homogeneity—although such a separation might be methodologically sound when dealing with older children, where data are not so limited. (For discussions of this whole question from different points of view, cf. Templin 1947, Olmsted 1971:94–5, and Edwards & Garnica 1973.)

Several kinds of data have been excluded, however. In order to make the three children comparable, forms which Leopold himself questions or which H 'seemed

to repeat once' have been excluded, as well as exclamations which probably would not have been collected from our children. Some of H's words have been included several months later than Leopold first lists them. Similarly, marginal forms such as *mmm*, *hm-m*, *tsk-tsk* etc., as well as onomatopoeic words in which imitative qualities obscure the segmental phonology, have been left out in all three children. However, H's *sch-sch* has been included because of its conventional referential meaning—although it is extremely marginal phonologically, the [ʃ] being syllabic and not occurring before a vowel, like other consonants.⁵

Finally, certain forms have been included even though they present problems for the analysis of word-initial consonants. A short listing of three cases in which this occurs may help explain some of the variation observed:

(a) Backgrounding: the word-initial consonant is deleted or drastically reduced when the child is 'working on' another part of the word (for full discussion of 'trade-off' phenomena in phonological development, see Edwards & Garnica).

One example from our data shows two forms of a word: (T IX) *milk* [b̃ʌʔ, ʌk̃].⁶

(b) Assimilation and syllable deletion: here a word-initial consonant is affected by a phonological rule. Such cases are familiar from the literature. Examples of each are: (K IX) *fish* [ʃɪʃ, kʰɪʃ], (K IV) *thank you* [m̃kjũ].⁷

(c) Prosodic phenomena: here the child treats the whole word, rather than its segments, as a phonological unit. Two examples are: (T III) *shoe* [gutʃɪ, gutʃɪdi], (T IX) *feet* [tʰfiʔ].⁸

1.4. PHONE CLASSES AND PHONE TREES. One way to proceed in analysing the initial consonants in the data would be to group together all recurrences of the same phonetic symbols used in transcription. Such a structureless listing is unilluminating for several reasons. First, it simply does not show which different symbols might be regarded as variants of one another, i.e. which sounds are in some structural sense related and which are not. How similar must two sounds be for the analyst to decide they belong together? Second, it does not allow the very likely possibility of overlap in the phonetic value of different structural units or features. The phone represented by a given phonetic symbol may be a production sometimes of one phonological unit, sometimes of another. Finally, this procedure offers no satisfactory way to relate the phones of one session with those of another session. If one speech sound has changed sufficiently between one session and the next to be reported with a different symbol, how does the analyst recognize this fact? Or if a

⁵ At a slightly later period, H had [ʃ] as a favorite syllable-final sound, where it represented any fricative of the adult model and was used very frequently.

⁶ For T and K, the roman numerals indicate session numbers.

⁷ In this case the pronunciation may be caused not by syllable deletion but by adult renditions with suppressed initial syllable: pronunciations like [ŋkju] and [mke] are fairly common among adults for *thank you* and *okay* respectively, although they were not observed from the adult in this study.

⁸ One example of prosodic treatment of a word was so radical that it was not included, but it is interesting in itself. In K IV, the new word *pen* received the following forms in this order in a one-half hour session: (1) [mã] (imitation), (2) [ʔ] (imitation), (3) [de⁴p], (4) [hin], (5) [m̃bō], (6) [pʰɪn], (7) [tʰŋtʰŋtʰŋ], (8) [baʰ], (9) [dʰau^N], (10) [buã]. K seems here to be trying to sort out the features of nasality, bilabial closure, alveolar closure, and voicelessness.

child has nine phones (i.e. different phonetic symbols) at one session, and twelve at the next, how is one to relate the two systems?

What is needed is a way to determine which phones belong together or correspond to one another, and the most obvious way is to use the word as the framework for phone identification and classification. This is hardly a new idea, since it is implicit in much of the phonological analysis of child language, but it seems never to be made explicit (thus Francescato 1968 criticizes Jakobson and others for not making explicit use of the word, although he himself does not offer analysis of this kind).

By using the word as the basis of comparison, it is possible to establish the notion of 'correspondence' or 'corresponding phones', similar to the notion of sound correspondence in comparative linguistics. For the purposes of our study, in which we are dealing only with initial consonants, we may define 'corresponding phones' essentially as any two consonants which begin different utterances of the same word, whether at a single session or different sessions. This definition must be modified to exclude instances of omission or assimilation which may put non-corresponding phones in initial position.

The procedures employed in our analysis were as follows. For each session, all the renditions of a given word were grouped together, and all variants of the initial consonants in those renditions were noted. Then all words beginning with the same phone or set of variant phones were put together. The set of initial-consonant variants of each of these groups of words constitutes a 'phone class', and is represented by the appropriate phonetic symbols in a box, or between vertical lines.⁹ Thus a phone class $[d \sim t^h]$ consists of the initial consonants of all of those words whose initial-consonant sound varied between $[d]$ and $[t^h]$. All the phone classes of one child at one session were represented by boxes in a horizontal row, arranged roughly in order of place of articulation. Thus a child might show three phone classes of initial consonants at a particular session:

$[p \sim b]$ $[m]$ $[t \sim d]$

After this, phone classes in different sessions were constructed according to the occurrences of the same word. With each session making up a horizontal level, solid vertical lines were drawn between successive phone classes if they contained the same word. If successive phone classes did not contain the same word but were related to phone classes which did, dotted lines were drawn connecting them. For example, in T's $[m]$ class:

m	(<i>mama</i>)
⋮	
m	(<i>milk</i>)
m	(<i>milk, mama</i>)

In addition, and especially in the case of K, dotted lines were used to connect

⁹ The box was adopted as a convenient symbol, different from the brackets and slant lines used in phonological transcriptions, and suggestive of the unity of the class; the same symbol was used with a somewhat similar value in Jakobson 1949. For typographic reasons, the box is replaced by vertical lines in the present text, although boxes are used in the figures.

phone classes which were each well-motivated and were phonetically close or identical, but shared no words in common (especially K's |b~p| in IX to XII).¹⁰

Diagrams of this kind which connect corresponding phone classes of successive stages constitute 'phone trees'. The phone trees constructed for T, K, and H appear as Figures 1, 2, and 3. In each figure, the number in parentheses to the right of each phone class indicates the number of words belonging to that class.

Sometimes the phone classes are not as simple as described above. Thus the phone class |b~β~bw~p^h~Φ~∅| in T VI contains the following words and initial-consonant variations: *baby* [b~β], *ball* [b], *blanket* [b], *book* [b~∅], *bounce* [b], *bye-bye* [b~p^h], *paper* [b~Φ]. One might reasonably make several phone classes out of these words, perhaps separating those in which [b] does not vary or varies only with ∅ from those in which variation is with a fricative or voiceless stop. For our purposes, they have been grouped together in opposition to the phone class [p^h] in which the following words occur: *pat*, *please*, *pretty*, *purse*—all beginning only with aspirated [p]. The claim of this grouping is that it is only accidental that some words in the |b| class were found with variation of one sort, and some with another; but that it is not accidental that the words in the |b| class are separate from those in the [p] class.

In fact, if we look at the corresponding classes in the next session, we find the following: *baby* [b~w~p], *ball* [b], *bang* [b], *blanket* [b], *book* [b], *bounce* [b], *box* [b], *bye-bye* [b~β]; but *paper* [p^h], *pat* [p^h], *purse* [p]. From the data listings, it can be seen that *baby* occurs 7 times with an initial [b], once with a [p^h], and once with a [w]. *Bye-bye* occurs three times with a [b] and once with a [β]. Hence it seems justifiable to group them with other [b] words, and again it seems that the important split is between the [b] words and the [p] words.

The notion 'phone class' here is similar to the notion 'phoneme' of American structuralism, in that it refers to a class of phonetically similar speech sounds believed to contrast with other such classes, as shown by lexical identifications. The determination of the phone classes of a particular child's speech is made by methods similar to linguists' procedures of elicitation and phonemic analysis, but largely without the benefit of minimal pairs and speakers' judgments. The purpose of the exercise (as ultimately for phonemic analysis as well?) is to locate valid behavioral units.

In general, an attempt was made to distinguish as few phone classes as possible, so that any error would be in the direction of under-differentiation. Consider the word *dog* in T I–VIII. It is included in phone classes with some variation even though the word *dog* itself is consistently produced with an initial *d*. By Session VIII, however, *dog* seems to belong to a phone class by itself, and perhaps it should have been separated all along.

Even with the policy of minimal differentiation, it may happen that phone classes are separated unjustly. Consider T's two classes |^ts~s~ʃ| and |ç~ʃ~d| in Session

¹⁰ There is a danger that phone classes containing the same words may not actually correspond because of an intervening re-analysis of a certain word at the input level by the child. There is evidence that such re-analysis does take place: see Smith's example of *some* and its compounds (1973:145–6). Probably, however, such re-analysis is relatively infrequent, and in any case not directly related to the development of the sound system.

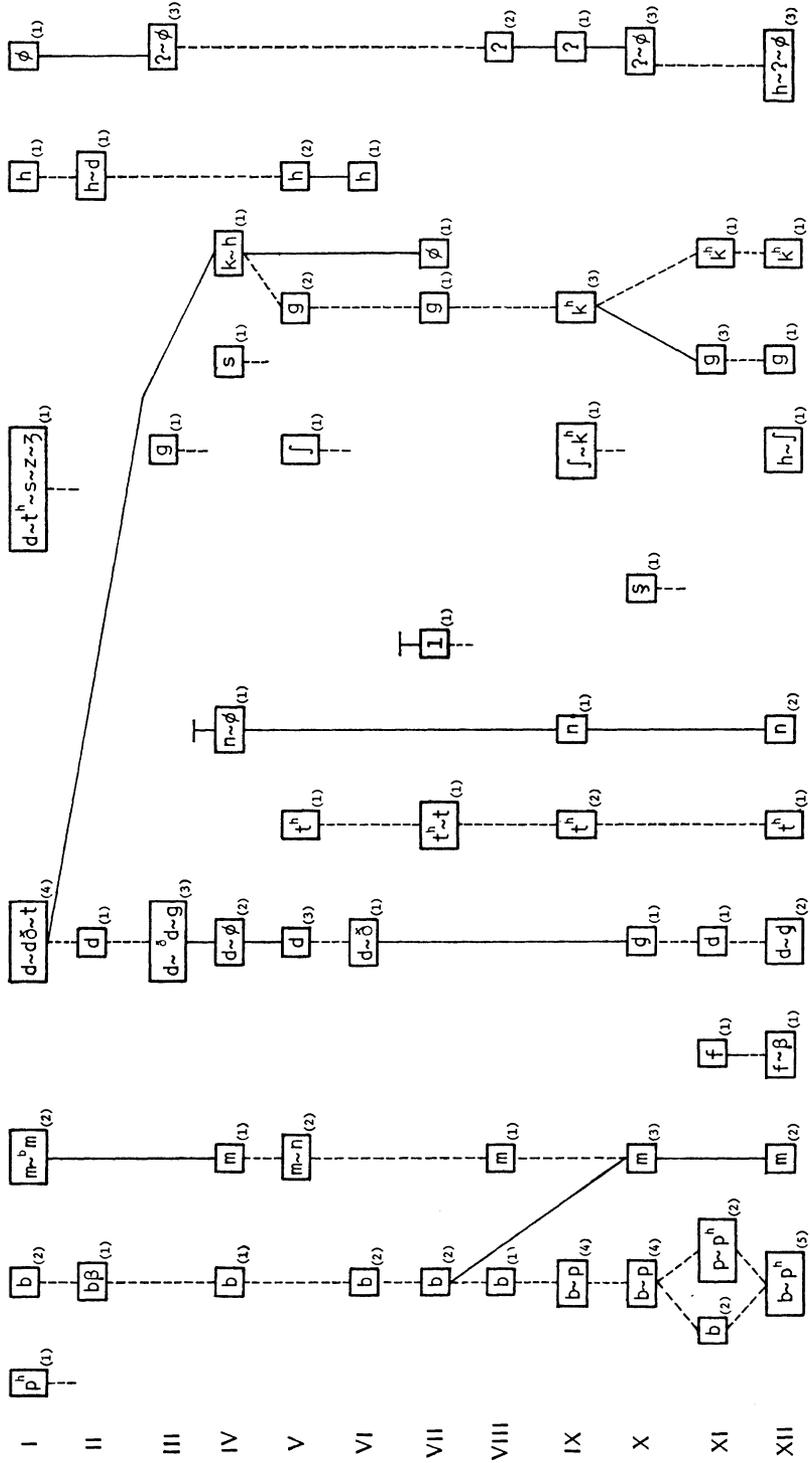


FIGURE 2. Phone trees of K.

V. Although the regular criteria require their separation during that one session, the fact that they are joined in the sessions before and after suggests that the criteria are misleading in this case. A similar example is the separation of $[d \sim t^h]$ and $[t^h]$ classes in Sessions VIII and IX. However, since mergings are easy to see in the phone trees, such cases have been left as originally analysed. The lack of such phenomena in the H data is explainable by the longer time periods contained in each stage.

2. ANALYSIS. Given the organization of the observed data into phone classes and phone trees, we should be able to compare them to our general expectations of the course of phonological development as it has been previously reported. When we do this, we find certain surprising tendencies in our data. One inconsistency is the existence of a high level of variation of word forms. The range of variability plus certain regular forms of variation together make it difficult to make statements about either phonological contrasts or unique underlying forms and systematic rules, so that traditional forms of phonological analysis are not strictly applicable.

Another surprise is that many words seem to have more accurate renditions at this early stage than would be expected. Furthermore, the child will sometimes reduce an earlier, more accurate form as his learning proceeds. A final and related surprise is the seeming great selectivity of the child in deciding which words he will try to produce.

All these aspects of our data point to one principle which puts them in the proper perspective. Phonological development in children, like sound change in language, takes place on several parameters, only one of which is the phonetic. Here it is useful to consider the lexical parameter.

2.1. THE LEXICAL PARAMETER IN SOUND CHANGE. In general linguistic theory, synchronic or diachronic, the goal is to find generalizations of maximum validity; as a consequence, little attention is paid to differences in the behavior of individual words. Only the field of linguistic geography, with its slogan of 'Every word has its own history', has represented the opposite tendency (Malkiel 1967). Similarly, in the studies of child language development, both phonological and grammatical, the effort to find generalizations has tended to exclude the study of individual words. Even the large literature on child vocabulary development is mostly concerned with estimating the extent of the total lexicon at successive stages rather than with tracing the history of individual words. One exception is Leopold's account of Hildegard's vocabulary development, which in many respects is one of the most informative (esp. I.149-79).

European linguistic geographers, working with some of the same languages in which the neogrammarians had shown regular sound correspondences, found that isoglosses marking the extent of each sound change varied from word to word; they thus showed the simple neogrammarian model of linguistic change to be inadequate in spite of impressive evidence in its favor. The dialectologists' view and the neogrammarian model, each in several forms, tended to remain side by side in linguistic theory without integration (cf. Bloomfield 1933, chaps. 19 and 20). Some recent models of linguistic change, such as that proposed by Wang 1969, attempt to account for both sets of facts. Wang suggests that sound change

takes place on three parameters. On the phonetic parameter, the phonetic manifestation of a sound change occurs abruptly at some point, goes through a period of variation in which some words are found in two forms, and finally approaches completion—whereupon other forms may change abruptly without going through a period of variation. On the lexical parameter, sound change starts in a subset of the relevant words—determined phonetically, socially, or by other factors—and spreads gradually through the lexicon to other relevant forms. On the social parameter, sound change starts with some group of people and spreads to others, or it begins in one speech style and spreads to other styles in the same individual. (For discussion of a sound change in a framework of this kind, cf. Ferguson 1971.)

Linguists have begun to acknowledge the phenomenon of variation which accompanies linguistic change, but the lexical parameter has remained largely ignored both by American structuralists and by present-day generativists, who assume it is the phonological system which changes—regarding words as products of the system, rather than as having a phonological existence of their own.¹¹

The parallels between sound change in language history and sound change in child phonology development have often been drawn, and Jakobson ([1941] 1968:18) quotes Grammont's cogent remarks of decades earlier: 'By collecting the linguistic peculiarities of a very large number of children, one could construct a kind of grammar of changes which have appeared and can appear somewhere in language.' As an example of a parallel we could draw attention to the phonologization by borrowing outlined by Jakobson 1949, using Russian /f/ in illustration. The adult model for the child's language is the analog of the source language in the Russian example, and the full acquisition of a phoneme by the child parallels the final addition of /f/ to the Russian inventory.

Here, however, we are suggesting a rather thorough-going application of Wang's model of linguistic change to some of the phenomena of child language acquisition (cf. also Hsieh 1972 and Moskowitz 1972, where aspects of Wang's model are applied to child phonology). Of Wang's three parameters, the social seems least relevant at this early age, since sound changes are taking place within an individual, and children under two have very little control of different speech registers (Gleason 1973 suggests that their main register split is speech vs. silence; cf. also Weeks 1971). The other two parameters, however, are fully relevant; and we would like to argue that one cannot profitably study either the phonetic or the lexical parameter of child language acquisition without taking account of the other.

2.2. CONTRASTS. From the earliest months of language development, some words assume a relatively stable phonetic form, while others vary considerably. Variable words are often those which have more advanced canonical forms or harder sounds, so that variation can be explained as a kind of struggle with the word. In other

¹¹ Two important recent exceptions should be mentioned: Chen 1972, for a fuller discussion of different approaches to sound change and an explication of Wang's model as applied to the lexical parameter; and Labov 1972, for a typology of sound change along social and lexical parameters. In the absence of any linguistically motivated ordering principle, we assume that phonological change affects earliest child language according to Labov's Model E, 'Random decomposition'.

cases, however, relatively difficult words have early stable forms. H's word *tick-tock*, which she first attempted at 0;11, assumes the form [t'i-t'a] from 1;0 on, and maintains that form steadily for months. Similarly, the word *Carolyn* becomes stable for H as [da-da]. Yet some relatively simple words show variation, such as H's *ball* (1;2-1;5) or her *mama*, which gave her two months of trouble before stabilizing. Compare also the relative stability of T's *rock-rock* (V-VIII) and *book* (VI-IX) with the relative instability of *baby* (II-IX), *daddy* (I-IX) and *milk* (VII-IX).

One important consequence of the existence of variable forms emerges if an attempt is made to determine phonological contrasts at these early stages. Consider the contrasts *m/b* and *m/n* in K's forms. From session I on, K has something which one might call an *m* class, including words which start with /m/ in the adult language, as well as occasional /n/ words (*Nona*, V; *night-night*, VIII). This fact, along with the [m~n] variation at V, might lead us to think that there is no *m/n* contrast. At the same time, there is a *b* class containing some forms which start with /m/ in the adult model (*moo*, VII; *mama*, XII). In all this time, there are no minimal pairs which would establish an *m/b* contrast in phonemic terms: there are simply some forms which start with [b] and some which start with [m]. From Session IV on, furthermore, there is an *n* class containing only one word (*no*), which never varies with [m]. (In XII, another word, *nose*, is added.) So again, although there may be no *m/n* 'contrast' in the usual sense, there are words which start with [m] or [m~n] and other words which start only with [n]. Cruttenden 1970, in discussing a very similar example, suggests: 'It may be that it is only possible at first to make statements about the existence of contrast between individual words.' It does seem from our data that it is often impossible to make well-motivated claims about phonological contrasts in the usual sense at these early stages, as some might wish to do.

Often, variable forms and partial contrasts seem to correspond to a sound change in progress, as we might expect from our model of phonetic change. One example is in H's *p* and *b* classes from 1;0 to 1;3. By looking at the phone tree, it can be seen that at 1;0 there are two well-motivated phone classes, |p| and |b|. At 1;1, one of the *p* words has begun to show variation; at 1;2, it is joined by one of the *b* words. Finally, at 1;3, the third stage of phonetic change is observed: the varying words join the |b| class along with a *p* word that has never shown variation, as predicted by Wang's model. Other |p| words tend to drop out, while new |b| words are learned. At this point, the sound change is complete, leaving one residual form. The sound change that has occurred can be described as the acquisition of a rule of voicing which states that initial consonants tend to be voiced (see Ingram 1973:59). For several months after 1;3, the |b| class will be the dominant labial-stop class, whereas the |p| class will contain a small number of residual or marginal forms. Note that a similar change takes place in H's |t| and |d| classes at 1;3 and 1;4, so that we may say that the voicing rule has spread to the alveolar stops.

This sound change is really quite a strange step from a Jakobsonian point of view. Rather than the learning of an opposition, this sound change results in a loss of an earlier lexical, if not phonemic, opposition. The *p* word which starts the change at 1;1 is *papa*, a word that begins with a *p* in the adult language. The data

shows that *papa* is first used 'correctly' with a *p*, then later becomes variable and finally joins the group of words beginning with *b*'s. In other words, *papa* has become less like the model language in the process. That this case is not an unusual one can be seen from an examination of what have been called 'progressive phonological idioms' (Moskowitz 1971, 1972).

2.3. PHONOLOGICAL IDIOMS. The clearest example of a progressive phonological idiom is *pretty*, H's 'first permanent word', occurring in almost perfect phonetic form at 0;10. At a time when other words are monosyllabic or have reduplicated consonants, *pretty* has two syllables beginning with different consonants, and often has a successful initial cluster. Only much later (1;9) does *pretty* become integrated into H's phonological system, taking the reduced form [piti], and even later (1;10) becoming [bidi].

The opposite kind of phonological idiom, the 'regressive idiom', is not so obvious at these early stages of acquisition. A regressive idiom is a word which maintains an earlier form even though a different form would be expected, given the child's phonological system. Regressive idioms are usually more reduced than forms in the current system; but in cases like the voicing change, forms which are 'better' in terms of the adult phonology may be regressive idioms if they maintain a contrast no longer in the system. Thus *pretty*, when it is not affected by the voicing change, remains progressive in terms of its total form, but becomes regressive in terms of its initial consonant.

Progressive idioms suggest that a child's perceptual and productive abilities are more advanced than the phonological system seemingly exemplified by most of his words; but the extent to which they are actually more advanced is open to question. Since progressive idioms are by definition marginal or extra-systemic, a linguist searching for generalizations might want to exclude them from his data. However, determining which forms are progressive, apart from the most obvious examples, implies a prior determination of a phonological system—already shown to be a difficult or questionable task at the earliest stages of development.

One might assume that any word which changes from an earlier more phonetically accurate form to a more reduced form has been a progressive idiom until the time that it is reduced (ignoring the problems of determining what word form is more phonetically accurate, since one sound in a word may change in one way, and another sound in another way). Given this definition, H's *papa* is a progressive idiom when it is pronounced with a *p*, but it joins the system when it is pronounced with a *b*. A generalizing approach would then simply ignore the earlier form [papa] in describing the development of the child's phonology.

It is hard to see the full consequences of this policy from our data, since the time section is so short; but another example may make the dangers clear. The word *hello*, which has just appeared in the form [ʔələ] at H 1;5, can be used. At the same time that *hello* appears, H begins to use *l*'s occasionally in other forms (e.g. *klingelingeling*), and at 1;7 she adds *alle* to her vocabulary with an *l*. *Hello* maintains the same form until 1;10, at which time it becomes [jojo] by a liquid reduction rule and reduplication, making its form more primitive. At about this same time, some other words participate in the liquid reduction rule, while some show variation, and still others have *l*'s. Data are given in Table 2.

	<i>hello</i>	<i>alle</i>	<i>bottle</i>	<i>lie</i>	<i>Loch</i>	<i>Loscher</i>
1;5	ʔələ					
1;6			ba:ɪ			
1;7		ʔalə	ba:ɪ			
1;8		ʔajə	baru			
1;9			balu			
1;10	jojo	ʔalə	baju		lok'/jok'	
1;11	jojo		balu	jar		loko/joke

TABLE 2. Development of the lateral /l/ in H's speech during the 2nd year.

From this account, one could claim that *hello* and *alle* are progressive idioms for several months, thus ignoring them and maintaining that *l* is acquired first as /j/, which later splits into /j/ and /l/. What actually seems to be happening, however, is that two sound changes are occurring simultaneously. One, the acquisition of *l*, or the combining of features for liquids, begins around 1;5 in the form [ʔələ]. Another, the liquid reduction rule (assuming it is a rule, and not a simple failure to distinguish between *l* and *j*—which is unlikely, given the earlier *l* forms), begins somewhat later. The two rules compete for the same forms, and various words come under them at different times. Since the existence of an *l* is a prerequisite for the liquid reduction rule, it is not surprising that forms with *l*'s sometimes precede the more reduced forms. To call the early *l* forms idioms, and to omit them from consideration in the phonology, gives a neat picture of successive phonological systems, but omits important aspects of phonological development.

Just as H's earlier forms with *l* are relevant to her phonological development, so are her early forms with *p* (such as *papa*). Similarly, even if T's and K's phonologies show great reductions of surface forms with the later acquisition of rules, one can maintain that their earlier and more phonetically accurate forms are part and parcel of the children's phonological development.

2.4. SALIENCY RULES AND AVOIDANCE RULES. There is another feature of the T and K data which would not be predicted by a Jakobsonian view of phonological development. A glance at the phone-class listings shows a strong tendency for each phone class to represent words containing that sound in the adult model. Thus T simply does not attempt an adult *p* word until VI, at which point she has four words beginning with [p^h]. Similarly, adult alveolars generally appear as alveolar; and not many adult velar words are attempted at all until velar consonants are being attempted (H is a slight exception to this rule, having several *k* words in her [t| class.) It also seems to be true that, after a rule such as initial-consonant voicing becomes active in the child's system—producing, e.g., a general class of oral labial consonants—the child next takes both adult *p* and *b* words into that class. Thus H acquires almost exclusively *b* words until 1;10 and 1;11, when a phonemic voicing contrast begins to develop in her system; however, the few *p* words that are acquired tend to have *b* forms (*paper, Paul, pick, pocketbook, push.*)

The great selectivity of the child in picking the words which he will attempt to say is not usually noted in the literature (but see now Ferguson et al. 1973, Ingram 1972). Authors have mentioned a general avoidance of difficult sounds, multi-syllabic words, or words with consonant clusters; but no one has made it clear that, at an early stage in which a contrast is absent (e.g. only *b* sounds, no *p* sounds

in a child's speech), the adult words chosen by the child will be highly discriminatory (e.g., he will choose only *b* words to say). The issue of phonologically determined selectivity in word acquisition and use, even by adults, is interesting in regard to the notions of phonological structure and phonological importance. There are probably different degrees of effort with which an adult acquires new vocabulary items of different phonetic shape; and adults may systematically—even consciously—avoid words difficult to pronounce. In the child's acquisition process, however, this whole issue seems centrally important and deserves systematic investigation.

Our data, then, seem to cast doubt on the Jakobsonian assumptions of (a) strict separation between phonetic and phonological development, and of (b) simultaneity in lexical and phonological parameters of the break between prelanguage and language. The Jakobsonian position is that, at the very time at which one finds the first true words, one finds a very reduced phonological system, and that successive splittings of those vowels and consonants eventually produce the adult phonological system. In terms of contrasts determined by phonemic analysis, this account may be true. But in terms of the phonetic shapes of words and the selective acquisition of words, we have seen that a child's early words are often much more phonetically accurate than one would expect, and that these 'progressive' forms reveal processes of sound development which remain hidden if a strict separation of phonetic and phonemic development is assumed.

3. DISCUSSION. The data and analysis provided in this paper have many implications for broader issues in linguistics, some of which have already been mentioned. In this section, such implications will be discussed under the headings of universal order of acquisition, individual differences, and phonological theory. The hypothesis of a universal order of acquisition in phonology, first advanced by Jakobson, has proved to be stimulating and fruitful, and any attempt at theoretical discussion of phonology acquisition must react to it. Individual differences in language behavior have traditionally been of little interest to linguists; but if their work is to have relevance for therapy and education, linguists must learn to use their analytic tools for description and explanation of such differences. Finally, it is our conviction that the study of child phonology is a major source of insight for the development of phonological theory in general. Under all three headings, as in several earlier paragraphs, our tendency is to phrase the discussion in terms of criticisms of Jakobson. But we want to make it clear that we feel his theory is still the most detailed, explicit, and suggestive one available (cf. Ferguson & Garnica 1973); for this reason, we use it as a starting point in exploring the implications of our own work.

3.1. UNIVERSAL ORDER OF ACQUISITION. One of Jakobson's major claims is that there is a uniform order of sound development which tends to occur in different children learning the same language, and—to the extent that phonological structures are similar—in children learning different languages. The order is held to be a result of fundamental implicational laws which are equally reflected in the distribution of phoneme types among the languages of the world—such that, e.g., a rare sound in the world's languages is acquired later by children learning a language

which has it. To what extent, then, do T, K, and H seem to follow the same path of development, and how does it accord with Jakobson's order?

Even though the phone trees show lexical contrasts rather than the phonemic contrasts that Jakobson spoke of, the development of the three children is quite similar, and follows many of Jakobson's predictions. Many of the differences that do exist can be explained by the fact that the first fifty words do not constitute a natural unit of phonological development. In particular, K seems to be further along in the beginning of the data studied than either T or H; while H, who takes much longer to develop 50 words, is doing more systematizing as she goes. All three children have labial and alveolar stops as their first sounds, with nasals and glides in these positions developing later, and fricatives even later. All three have labial nasals before others, although dental nasals may be more widespread in languages of the world; but this is acknowledged and explained by Jakobson. For all three children, velar consonants begin development much later than those of other areas.

The details of order, however, are not in exact agreement among the children. K has a labial nasal long before a labial glide: her first *w*, like her first *f*, occurs two sessions after the end of our data. T develops her $|m|$ class just before her $|w|$, although the $|w|$ forms appear more stable. H, on the other hand, develops a $|w|$ form first, although her $|m|$ class appears to be more productive at 1;5. It is simply not true, then, that all contrasts are absolutely ordered with respect to each other; but it is true in general that the ordering predicted by Jakobson seems to hold for the three cases. We note, however, that Jakobson has not given appropriate attention to the acquisition of semivowels and /h/, which are frequently acquired quite early (as in the cases of T, K, and H), and also often serve as early substitutes for fricatives and liquids.

At least one striking similarity is not predicted at all by Jakobson. All three children show a preference for voiced labial and alveolar stops, but voiceless velars. The children show this preference both in the forms they produce and in their choice of forms from the model language. Thus even H, who does not have a velar stop class before 1;5, borrows several velar-stop words from the parent language, all beginning with *k*. Although her $|d|$ class is the productive alveolar class, the *k* words are taken into the $|t|$ class and constitute its only members, aside from *tick-tock*. This tendency is mentioned explicitly by Leopold, confirmed by T and K, and is also supported by data recently reported by Olmsted (75). This point, which is probably related to the instability of voiced velars observed by Joseph Greenberg (personal communication) deserves further investigation.

3.2. INDIVIDUAL DIFFERENCES. Jakobson's concern with generalizations about order of acquisition leaves no room for considering the nature of individual differences in phonological development. Yet any careful comparison of different children learning the same language shows differences in the individuals' paths of development. Some of the differences are doubtless to be accounted for in terms of different input under different conditions, e.g. the accidents of use of different vocabulary items, different attitudes on the part of parents, etc. Some of the differences seem to rest on different strategies adopted by children in acquiring

adult phonology, whatever the ultimate source of such strategies may be (cf. Ferguson et al. 1973). Such individual strategies include preferences for certain sounds, sound classes, or features ('favorite sounds'); extensive use of reduplication; special markers for certain classes of words (e.g. final *-rs* as a sign of reduced polysyllables, cited in Menn 1971); preferences either for lexical expansion or phonological differentiation at the expense of the other; and persistent avoidance of particular 'problem sounds'.

Certainly, there are differences in the way T, K, and H are approaching the learning of phonology. T, for instance, unlike the other two, has sibilant fricatives and affricates as favorite sounds. Words beginning or ending with these sounds (e.g. *ice*, *eyes*, *shoes*, *keys*, *cheese*, and *juice*) are welcomed into her vocabulary and are used often, with varying forms, so that the phone class representing words which begin with these sounds is very complex. This group of words might well represent a schema, in the sense of Waterson 1971; but T does not seem to show the corresponding kind of clear production patterns of such words that Waterson finds. For T, one might say that the sounds in this class are, for a time, more important than the lexical contrast which she seems to be developing at the end of the period.

H, on the other hand, seems to gain control over certain classes and then to prefer to add new words to them. Classes which show this preference on H's phone tree are |b|, |m|, |d|, and |ʔ|. K similarly seems to prefer adding words to her |b~p|, |d|, and |ʔ~h~∅| classes, although the greatest additions to those classes occur soon after the end of this study and are therefore not shown. T, on the other hand, seems to prefer building up her velar-stop class more than the other two children do.

K seems to approach the voicing contrast in her labial consonants in a slightly different way from the other two, although this may simply be caused by the small samples collected during many sessions. She apparently follows an avoidance strategy: rather than establishing a separate |p| class before making |b| the dominant class, she seems to avoid *p* words from the very beginning. She also produces no *p* sound types until the time when *p* words are being taken into the |b| class.

One final difference of note is the fact that H whispers most of her words until 1;4, but consistently gives some words full voice. *Da* is the only voiced word at 1;0, and it continues to be voiced from then on. At certain points, Leopold hypothesizes that H actually uses the whisper/full-voice contrast to separate homophonous forms. Thus, during 1;4, fully voiced [dada] is *Carolyn*, while the same form whispered is *thank you*. Similarly, [baba] with full voice is *Papa*, while [baba] whispered is a reduplicated form of *ball*.

T and K both occasionally whisper words, giving the impression that they are not sure of those forms; and K (XII) learned whispering as a speech register associated with a book about a sleeping baby (on the use of whisper as a register by young children, cf. Weeks). But there is nothing in the other two children to compare with H's consistent use of whispering, and it is hard to assess the function of whispering in her speech development.

In sum, each of the three children is exhibiting a unique path of development, with individual strategies and preferences and an idiosyncratic lexicon.

3.3. PHONOLOGICAL THEORY. Linguists approaching the study of child phonology have naturally tended to use the theoretical constructs which have an important role in their general phonological theories. Thus European and American structuralists have tended to look for phonemes and distinctive features in child phonology, while generativists tend to look for unique lexical representations and phonological rules which operate on them. Our approach is to try to understand children's phonological development in itself so as to improve our phonological theory, even if this requires new theoretical constructs for the latter.

The data and analysis of this study suggest a model of phonological development and hence of phonology which is very different from those in vogue among linguists. The model would de-emphasize the separation of phonetic and phonemic development, but would maintain in some way the notion of 'contrast', i.e. the distinctive use of sound differences. It would emphasize individual variation in phonological development, but incorporate the notion of 'universal phonetic tendencies' which result from the physiology of the human vocal tract and central nervous system, as constrained by universal syntactic-semantic processes. It would emphasize the primacy of lexical items in phonological development, but provide for a complex array of phonological elements and relations—including the notion of 'phonological rule' in the sense of a synchronic sound change determined by classes of sounds, lexical items, or grammatical boundaries. In an oversimplified characterization, the model would assert that children learn words from others, construct their own phonologies, and gradually develop phonological awareness. The elaboration of such a model is a major undertaking going far beyond the limits of this study, but four key assumptions are worth stating here.

First, we assume that a phonic core of remembered lexical items and articulations which produce them is the foundation of an individual's phonology, and remains so throughout his entire linguistic lifetime. Lexical items of particular phonetic shapes are acquired together with notions of appropriateness of use in particular social frames; and changes in the phonic core are to be understood and accounted for in terms of (at least) lexical, phonetic, and social parameters. Thus we assume the primacy of lexical learning in phonological development, even though it may be heavily overlaid or even largely replaced by phonologically organized acquisition processes at later stages. Lexical primacy has many implications which cannot be developed here, such as the need for assuming a non-phonological, organized phonetic storage and the need to rethink our notion of 'THE phonology of a language'.

Second, we assume that the child constructs phonological abstractions or generalizations from his own phonic core and to some extent from new input; i.e., he gradually imposes increasing phonological organization on his stock of articulations and lexical representations. The kinds of organization may include allophonic relationships, processes of assimilation, constraints on the phonetic structure of morphemes, and all the complex regularities which linguists are able

to identify. We emphasize, however, that our approach requires the validation of phonological regularities by empirical investigation; i.e., a particular relationship or process can be imputed to a particular child only when there is direct or indirect behavioral evidence. For example, the fact that a child has two lexical items which differ in a single phonetic segment is not in itself sufficient justification for asserting that the child has the phonological contrast as such in his repertory. Evidence is required from the child's verbal play, his response to experimentally introduced nonsense material, or the like.

Third, we assume—although this feature of the model does not follow from the limited data of this study—that phonological development includes the gradual development of phonological awareness; i.e., the child's ability to deal explicitly with phonological elements and relations is seen as a kind of self-discovery of his phonological organization (cf. Ferguson & Slobin 1973:138 ff.; Kavanagh & Mattingly 1972:138–41, 321–2, 327–9).

Fourth, we assume that an adult's ability to pronounce his language at any point in his life constitutes a stage in his phonological development, and that this ability exhibits the same kind of structure (although obviously differing in detail) that is assumed in the child's phonological development. Thus any satisfactory analysis of an adult's pronunciation of his language requires the specification of relevant lexical classes and the identification of relevant social dimensions in addition to the description of phonetic elements and relations. Further, since children have different inputs and utilize different strategies, the gradual development of phonological organization and phonological awareness may proceed by different routes and at different paces; hence adult phonologies may differ from one another just as the lexical stocks of individuals may differ. The individual's 'phonological idioms' at any age are not mysterious aberrations, but are manifestations of the natural course of phonological development.

In order to gain a deeper understanding of phonological development and hence of phonology in general, some linguists at the present stage of the art might be well advised to turn away from the fascination of writing rules of maximum generality and conciseness for whole languages, and undertake instead highly detailed analysis of the idiosyncratic paths which particular children follow in learning to pronounce their languages.

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