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ABSTRACT

This panel discussion seeks to determine the role of babbling and of nonlinguistic behavior in language acquisition. A central question is whether there is a continuity between babbling and speech. The paper presents the views that: the infant's ability to assimilate and adapt to his environment antedates the maturation of his visual and auditory systems; generalization in infant cognitive behavior takes place before symbolization; babbling is systematic and reflects phonetic preferences found in later speech; from the physiological point of view babbling is an integral part of speech acquisition. The panel concludes that: a definition of terms is necessary; the variance between child and adult speech presents a special problem; neurological studies are relevant to language acquisition; there is a continuity between babbling and speech; and further research is needed. (AM)

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PANEL DISCUSSION:
FROM BABBLING TO SPEECH

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INTRODUCTION

John B. Delack

For some several decades at least, a great deal of attention has been devoted to defining the role of babbling in the child's acquisition of language (cf. Kaplan & Kaplan, 1971; Rees, 1972). Until recently, two major theoretical orientations have held the field, primarily in North America and northern Europe. These two approaches can, perhaps, be best categorized as the "Learning Theorist" position versus the "Maturationalist" (or "Linguistic") position. In general, the Learning Theorists -- such as B.F. Skinner (1957), O.H. Mowrer (1952, 1958), and C.E. Osgood (1953) -- argue for an essential continuity in the transition from babbling to speech and language, whereas proponents of the Maturational approach -- such as R. Jakobson (1968) and E.H. Lenneberg (1967) -- purport to have demonstrated an essential discontinuity between the so-called prelinguistic stage and the linguistic stage and have neglected the transition altogether. In support of their respective position, both sides have drawn rather selectively on the empirical evidence and have left a great deal unexplained and unaccounted for; much of the debate has also been at cross-purposes and not concerned with the same phenomena. Moreover, much, if not most, of the data utilized in this regard has derived from investigations on infants and young children whose vocal output was in some way commensurate with that of the adult linguistic community -- which is to say that these children had progressed to the point where their utterances had assumed form and content recognizable, or at least interpretable, by adult standards. The flaws in such approaches are obvious.

More recently, such studies have begun to be augmented by investigations into the cognitive and semantic development of the child, as well as its capacity for comprehension, in the attempt to find correlates with linguistic development. Here I am thinking of the work by L. Bloom (1970), E. Clark (1973), K. Nelson (1973), D.I. Slobin (1971), and H. Sinclair (1971, as well as her contribution to this Forum), among many others. Here too, however, the first year of life has been largely relegated to future research.

On the other hand, more and more efforts are being devoted to studying early infant behavior on all fronts, but particularly in the cognitive-perceptual domain. B. Friedlander (1970) has been delving into receptive language development in infancy; A.R. Moffitt (1971), P.D. Eimas et al. (1971) have been conducting research which purports

to demonstrate categorical, or linguistic, perception by very young infants (but cf. Trehub & Rabinovitch, 1972); O. Wasz-Höckert and his colleagues (1968) have been able to isolate and describe in acoustic terms several meaningful categories of cries in the first months of life: these cries are associated with, or expressive of, physiological states such as hunger, pain, and pleasure.

Most recently, P. Mounoud (1973) of the Université de Genève has found that Piagetian cognitive tasks which the infant is capable of performing via the visual modality only when much older are demonstrable early in the first year of life, if one examines carefully the manipulative activities of the infant. Along these lines, Condon & Sander (1974) seem to have shown that, "As early as the first day of life, the human neonate moves in precise and sustained segments of movement that are synchronous with the articulated structure of adult speech" (p. 39).

The notion that the infant is apparently capable of extraordinary, or at least unexpected, feats early on in its career, and the knowledge that these capacities can be observed in experimentally efficient ways, open the field of linguistic enquiry (with respect to language acquisition) to more than speculative theorizing, without a priori bias.

Some of the issues which come to mind are, for example: What are the salient features of infant vocal behavior? That is, how are we to accurately define the term babbling? Is it meaningful to debate the question of continuity versus discontinuity in linguistic development? If so, what would constitute a demonstration of one argument over the other? What are the behavioral, physiological and cognitive concomitants which might be brought to bear on the matter?

The first step towards answering such questions lies in defining our terms and criteria rationally and very explicitly. In this regard, I have asked a number of people who have been engaged in research on early infant behavior to sit on this panel, in order to share their thoughts and research findings with you. Some of the topics for discussion are: phonetics and phonology, syntax and semantics, and physiological aspects of speech and language development during the period of infancy, the first 104 weeks of life. Depending on the time available, we should be able to entertain questions from the floor, to add a little more variety and dimension to our presentation and to guard against "collective monologues."

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PROSODIC ANALYSIS OF INFANT VOCALIZATIONS AND THE ONTOGENESIS OF SOUND-MEANING CORRELATIONS

John B. Delack

With respect to my own research, let me say first of all that I defend the view that the most salient feature of linguistic behavior is the well-defined relation between sound and meaning (on any given definition of the word "meaning"). The cry-studies, to which I alluded earlier, and the work carried out by Wolff (1966), which appears to demonstrate that crying and non-crying vocalizations are functionally and morphologically related, indicate that such sound-meaning correspondences may begin as non-volitional responses to endogenous as well as exogenous stimuli. It would thus seem that this capability arises very early in an infant's existence and is to a large degree non-arbitrary. It is circumscribed only by its interactions with the internal and external worlds. The degree to which it may come under volitional control is a moot point.

I have been examining infant vocal behavior during the first year of life, by tracing longitudinally the emergence and development of certain non-segmental phenomena in non-crying vocalizations (cf. Crystal, 1973, for an extensive review of the subject). This project has involved spectrographic examination and statistical evaluation of acoustic parameters such as fundamental frequency (F_0) and its contours, duration and range -- with respect to the various contexts in which the spontaneous or reactive utterances have been produced. These contexts include those in which the infant vocalizes for itself, with no apparent external referent or interlocutor; those in which it is having apparent conversations with the mother, father, or other adult; and those in which it is clearly vocalizing to a given object, such as a favorite toy or blanket.

We have found that most of the infants in the study altered their intonation patterns qua variations of F_0 according to context, although very often they did so inconsistently. (These inconsistencies, however, may be due to artefacts of the analytical measures employed; more refined procedures are presently being implemented to clarify

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the situation.) Thus, for example, an infant alone would generally vocalize in shorter, less elaborated F_0-contours than when in the presence of a favored object or an adult, particularly the mother. Over the first year, moreover, the duration of utterances becomes progressively greater, starting with a mean fundamental frequency of 400 Hz at five weeks, and dropping ca. 50 Hz by the end of the year; within-utterance F_0-range likewise increases during the first year and comes under differential and apparently volitional control. Details of the methodology and analysis, as well as further theoretical considerations, may be found in Delack, 1973.

I might add that our data do not corroborate some of P. Lieberman's (1967: 45-46) findings, which purport to show that children in nid-infancy adjust their F_0 in an attempt to mimic their parents' F_0; nor have we found, as did Lieberman, that the subjects (at the equivalent age levels) used lower F_0 in such cases as opposed to solitary babbling.

It is not unreasonable to expect that infants might use intonation (= variation of F_0 and its contours, duration and range) as a vehicle of expression in terms of "semantic intent," given that this is one of the few ways in which they can interact with the world in early infancy. This propensity becomes one of the mainstays of linguistic behavior and appears to be one of the universal ways in which affect is signalled throughout adulthood. It is only around the beginning of the second year of life that the supralaryngeal speech mechanisms have sufficiently matured and become cortically integrated, that they can come into linguistic play inthe Jakobsonian sense (cf. Critchley, 1967; Lieberman et al. 1971, 1972; Kirchener, 1970; Wind, 1970). As we continue to analyze our data, we hope to be able to illuminate the character and development of control which is involved and to better understand the relationships between early vocal behavior and accomplished language use.

In any event, I believe that the preliminary findings of our study demonstrate a very real, albeit limited, ability on the part of the infant to assimilate and adapt to events in its environment in a differential manner, and that this ability antedates the maturation of the visual and auditory systems, as well as their integration in the development of communicative function.

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A STUDY OF 750 PORTLAND, OREGON CHILDREN DURING THE FIRST YEAR

Joe E. Pierce

This is a report of an on-going study at the University of Oregon Medical School. The research team is observing and recording the linguistic behavior of 750 children, matched as perfectly as possible against the US census reports for age of parents, only children, economic status of the family, education of the parents and a significant number of less important variables. The sample consists of 25 boys and 25 girls for each of a number of age levels, beginning at three months and running up through 96 months. The data secured from these subjects includes tapes of freely vocalized noises as well as elicited speech in response to specific instructions and questions. The data to be presented today covers the period from birth through the end of year one, i.e., the 3-month, 6-month, 9-month and 12-month samples. This is as far as the researchers have completed their analysis to date.

In securing the data from younger children, trained speech therapists encouraged the subjects to vocalize as much as possible and all vocalizations were recorded. The parents were also questioned as to what additional utterances the child commonly made, and attempts were made to elicit those words or noises that the parents reported. For the older children, a series of tests, designed to elicit various types of linguistic behavior were created. In general, we began a particular test at an age level at least three months below that at which the child should be able to complete the task and carried it on to a level at least three months above the point at which the children should have all been able to complete the task.

Once the materials had been collected, two listeners, working together, attempted to transcribe the noises made. In an attempt to get away from forcing children's language into the common mold of adult sounds, we transcribed the vowels by placing dots on a traditional vowel chart. Each dot represented approximately the vowel quality which the two listeners felt they had heard. Finally, a circle was drawn on each chart which circumscribed all of the dots for that child. Since the child does not have much that could be called structured contrasts, it was felt that this range might be meaningful in terms of understanding the development, learning or emergence of linguistic structures. By superimposing the ranges for each child on a single sheet, we derived charts I, II, III and IV for the 3, 6, 9

and 12 month samples respectively. It is easily seen from a comparison of these charts that the range of vocalic quality produced by 3-month old children is very small and restricted to the low front and mid central area of the vowel hart. The infants do not produce an infinite range of sounds as is often said to be the case. The range of vocalic quality begins in the low front area and gradually increases, spreading up and back, with each successive age group, until at 12 months, the children were producing virtually the entire range of adult English vowels. Perhaps half a dozen non-English vowel sounds were also produced, but basically the children were producing the sounds of the parents and others around them as they developed in a monolingual environment.

Moving now to the consonant-like sounds, we utilize symbols which do not stand for sounds in any language. Each symbol stands for an articulatory movement, e.g., the letter b does not stand for a phoneme, but for a closure of the lips, accompanied by voicing, and nothing else. An aspirated b' is transcribed with the apostrophe added. This in no way is related to the adult sounds of English, and both listeners have had extensive experience with at least half a dozen other languages, many of which are non-Indo-European with consonant systems vastly different from English. The entire range of consonant-like sounds recorded from the 3-month-old children was: ʔ, h, w, d, n, m, ŋ, g, b, x, ɣ, β and a bilabial trill. Only ʔ, h and w were produced by the entire sample of 50 children. One or two children produced each of the other sounds, so one would have to say that the inventory of consonant-like sounds produced by the average 3-month old child included ONLY ʔ, w and h. The typical consonant inventory for 6-month-old children still included ʔ, h and w, but with the addition of four other consonants selected from: g, b, m, l, v or β. The average 6-month-old child, then, had an inventory of 7 consonant-like sounds, but the exact arrangement was extremely ego-centric, except for ʔ, w and h. The average consonant inventory for a 9-month-old child was ʔ and h, but with the /w/ having dropped out of the speech of many children, and the addition of five consonants selected from: n, g, d, m, y, b, k, w, β, or ɣ. Finally, a typical consonant system for 12-month-old children would be: ʔ, h, m, b, y, w, d, and g with two additional consonants selected from the list: β, n, ŋ, t, k, l or v, and the average child produced at least two two-consonant clusters. Each child's pattern of clustering appears to be completely ego-centric. Note here again that while there are a smattering of sounds which the child could not have learned from his environment, the overwhelming majority are consonant-like sounds which are of types commonly used by the language they hear about them every day. For example, there are no glottalized consonants, no rounded front vowels, etc.

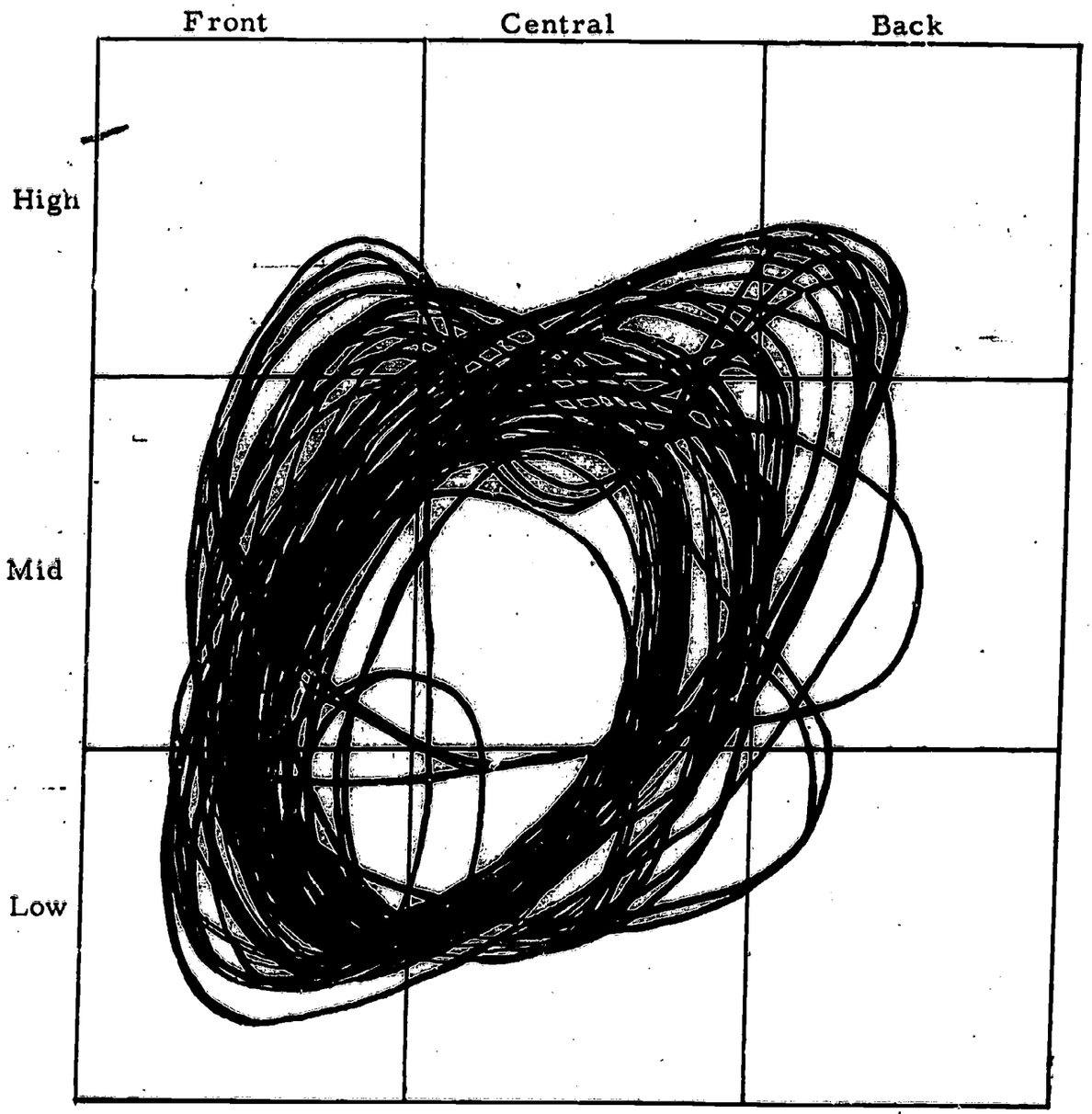

Chart I

In the chart above odd-shaped ovals surround the range of vowel qualities produced by each child. With all of these superimposed, it is clear that the white area slightly to the front and extending down from the center of the mid-central area is an area in which all of the children, or virtually all, produced vowel sounds. Further, no children produced any sounds in the extreme high-front, high-back or low-back regions. The sounds appear to be produced for the most part with the tongue more or less relaxed and a more or less greater opening of the mouth and the front-back position to be governed by accident.

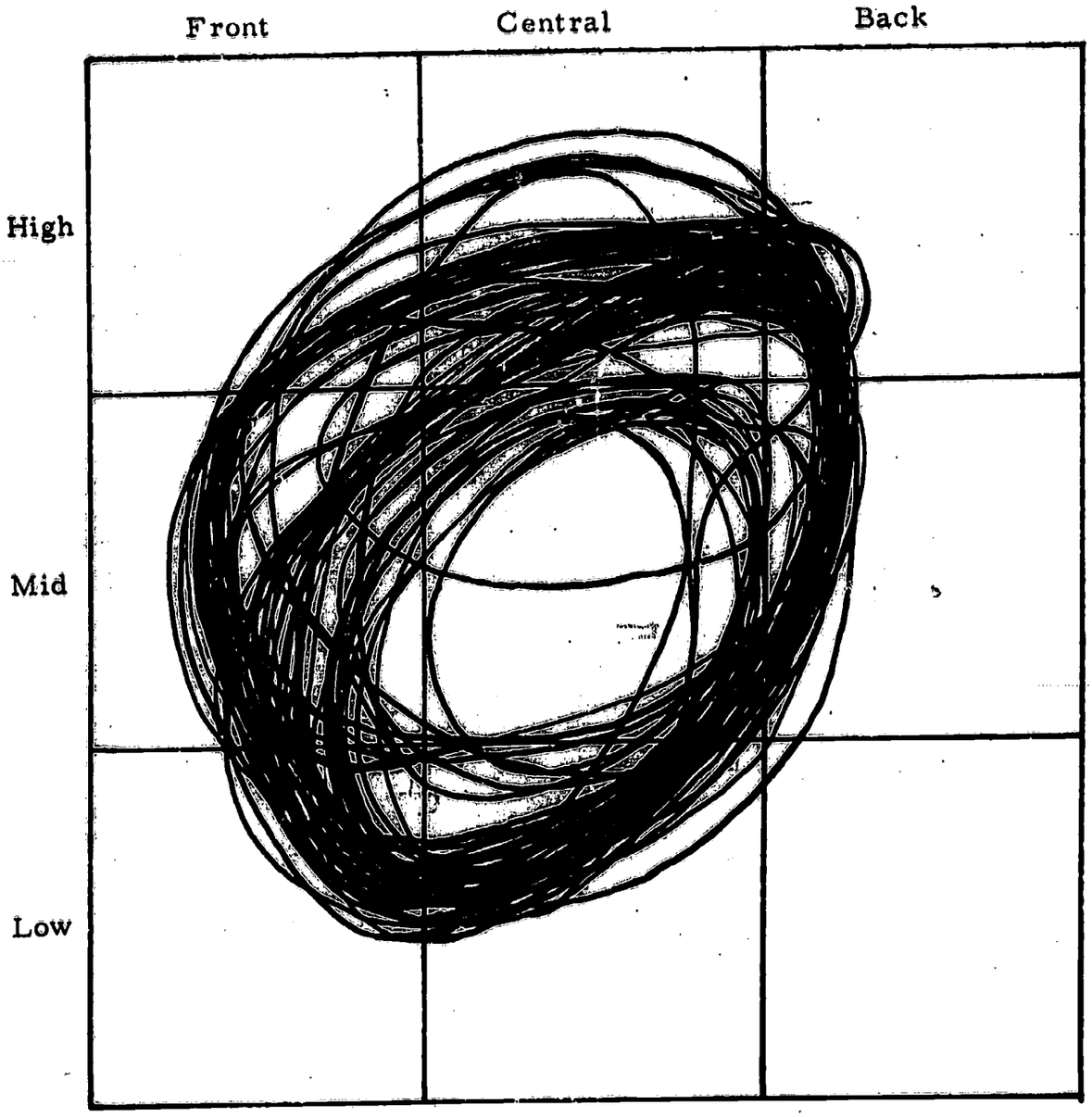

Chart II

Note that the range of vowel quality produced by the six-month age group is also enclosed in an irregular oval, but that this oval includes considerably more of the vowel range than did that for the three-month age group. However, statistically, the overwhelming predominance of sounds still occurred within the low-front, mid-front-open and mid-central areas of the chart.

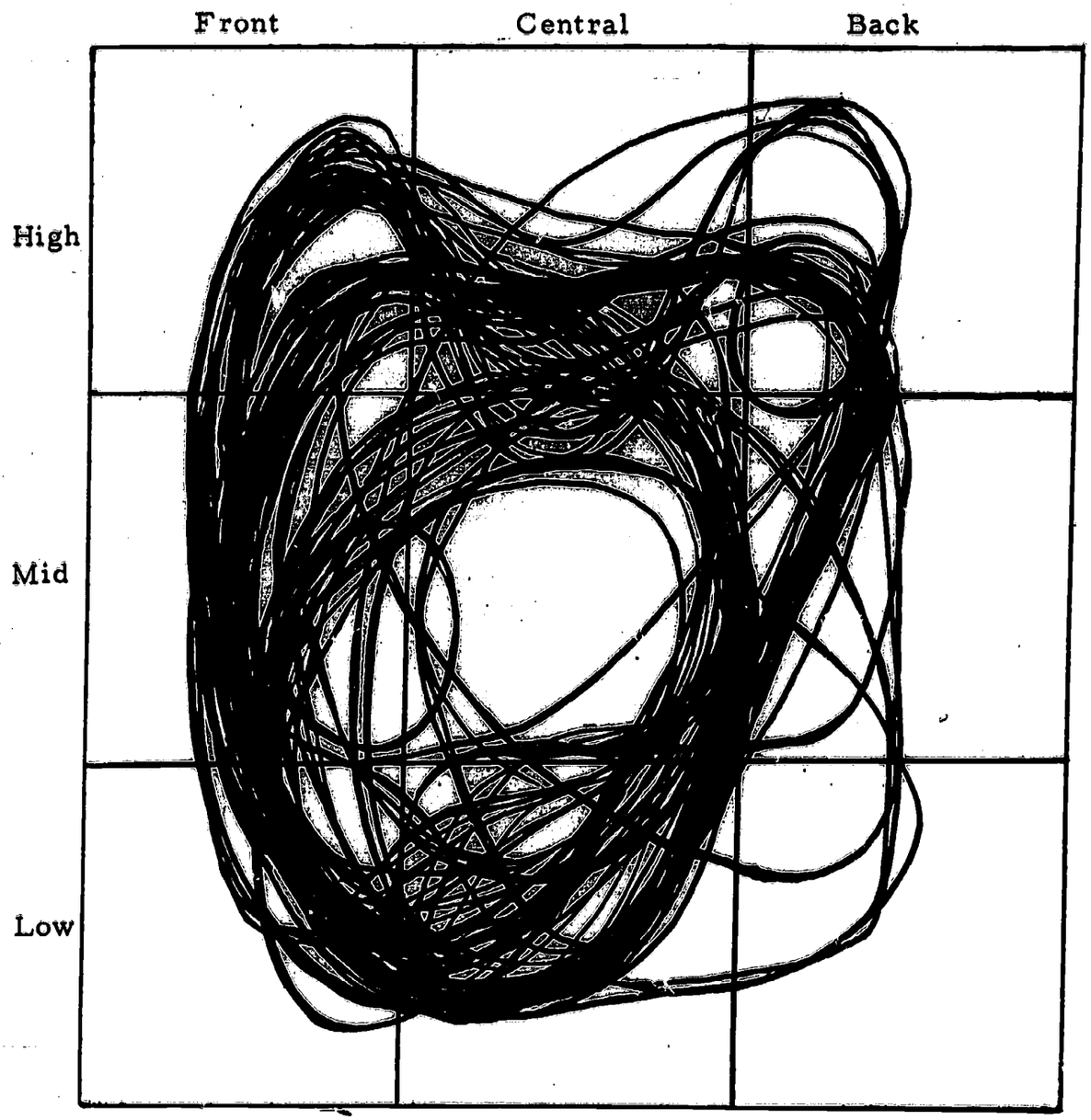

Chart III

In the chart above the ranges of vowel quality for the children in the nine-month old sample are plotted.

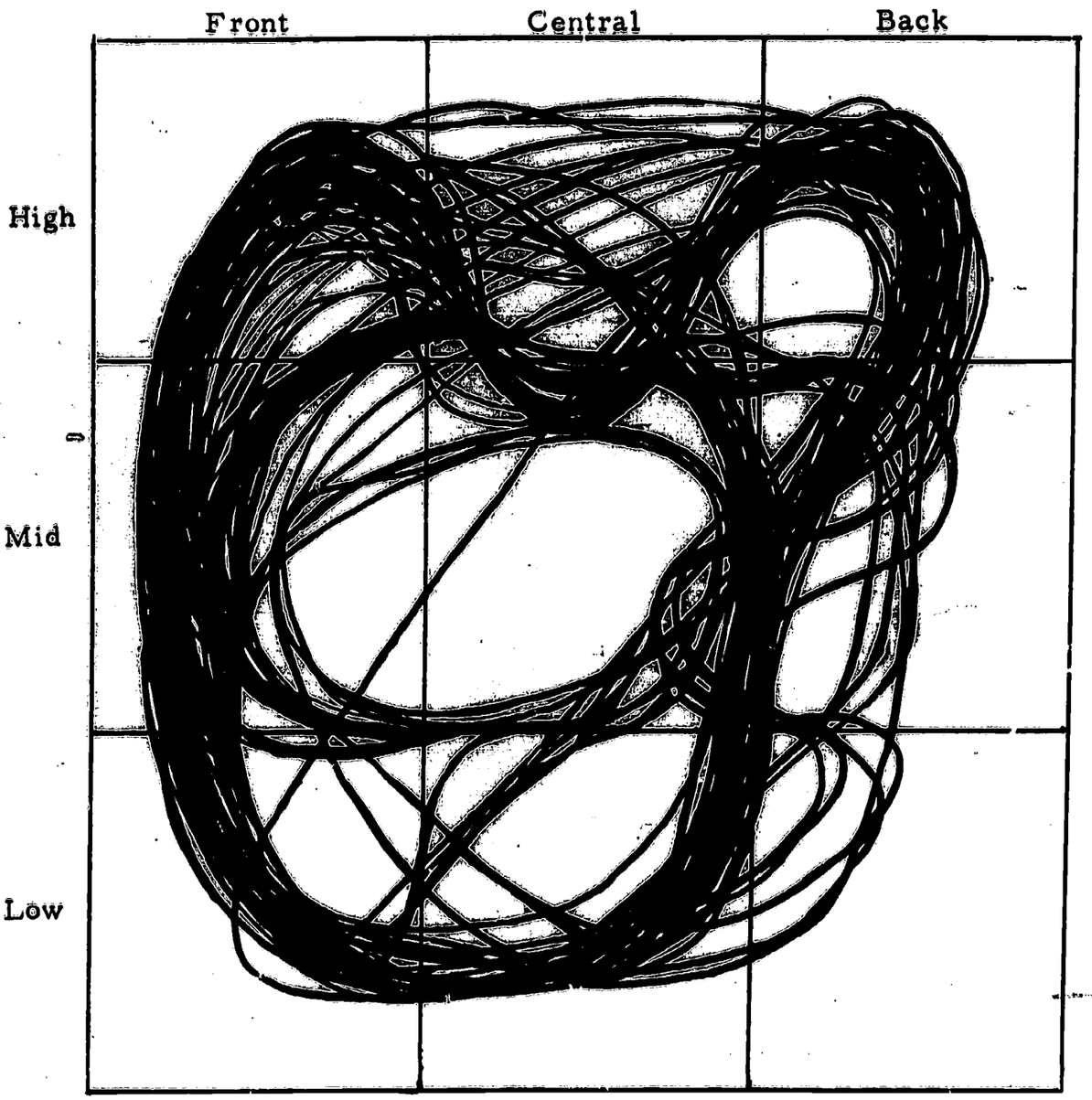

Chart IV

On the chart above are plotted the distributions within which the sounds for each child in the 12-month old sample occurred. Note particularly that all front, mid and low-central and high-back open are produced by nearly all of the children. The notable lack in production occurs in the high-central and mid and low-back areas on the chart.

To summarize briefly, it is clear from the evidence above that both the range of sound types and qualities increases gradually from a very small and restricted set of sounds at three months to a very large, but still incomplete inventory at 12 months of age. In terms of words, slightly less than half of the 12-month old children utilized at least one word, so we have the beginnings of symbolization at this age, but not for the average child. An interesting point here is that every child in the sample that knew only a single word, utilized the word daddy, i.e., dædi, dædɨ, dada, etc. The largest number of words used or understood, so far as we could determine, by any of our 12-month-old children was 3, and a form for mama appeared only as the third word learned. Further, our experience differs from that of Piaget in that our children appeared to over-generalize on the basis of function, e.g., kok (for coke) stood for anything drinkable, kaki (for cookie) stood for anything to eat, etc. This would indicate that the child learns to generalize in some way in terms of functioning of things about him before he learns to symbolize the objects. He classifies them on the basis of function and then applies a label to a functional class. Subsequent "learning" consists of refining these classes until, finally, his classification system is roughly parallel with that of the adult culture.

Further details of the study may be found in Pierce (1973).

REFERENCE

Pierce, Joe E. 1973. The phonological structure of infant language: Year one. Paper presented at the Deuxième Colloque International d'Audiophonologie, Besaçon, France, 7-11 November (to appear in the Proceedings).

THE BEGINNINGS OF SPEECH*

Ann M. Peters

1. Background

This is a report on research that some of us at the University of Hawaii are doing on very early stages of language acquisition. The age range that we are concentrating on is six months to approximately 24 months. The three projects involved are the following:

1) A completed study (written up as a Ph.D. dissertation under Michael L. Forman) by Ronald Scollon (Scollon, 1974) which followed a girl, Brenda, as she learned English between 12 and 24 months. Brenda has a Japanese mother (born in Japan) and an American-Chinese father (born in Hawaii) whose native language is English. The speech varieties to which Brenda was exposed during the time of the study were Hawaiian Standard English, Hawaiian Creole (pidgin), and some Japanese.

2) A study, in progress, by a graduate student, Anita Nordbrock, of a boy, Laya, in a bilingual home in which the mother (born in the Philippines) speaks Tagalog and English and the father speaks only English. The mother reports that she speaks Tagalog to the child during the day but that the parents speak English when the father is home. This study was started when Laya was eight months old. He is currently (April, 1974) 15 months old.

3) A study, in progress, by myself, of a boy, Minh, the son of a Vietnamese mother (born in Vietnam) and an English speaking father. The child's main language exposure is English; as with Brenda the mother primarily speaks English to the child. This study was started when Minh was seven months old. He is currently (April, 1974) almost 18 months old.

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* I would like to acknowledge the contributions to this paper made by Ron Scollon, Anita Nordbrock and Michael Forman. They encouraged me to present this report, which is a synthesis of all our research, and patiently discussed the details of presentation with me. My debt to Ron Scollon is particularly great since much of the orientation of this material grew out of our many discussions about our respective data.

2. Method

Our general methodological procedure has been the following (although we are constantly revising our approach as we encounter and solve new problems). One person has exclusive responsibility for collecting and transcribing data for one child. As far as possible, one hour of data is collected each week by going to the child's home at the same time of day on the same day each week and recording continuously for one hour whatever more or less naturally occurs. We call these "regular" sessions. One half hour of this regular recording is then transcribed. Lately we have started "charting" the second half hour of each session, i.e., noting for future reference the general sequence of events as well as any interesting utterances. In order to expand our knowledge of the child's range of speech situations we have decided that every seventh week we will try to obtain a wider range of recordings which we call "variable" recordings. We have done some experimentation with trying to record more of the general context by having an observer go along with a second tape recorder. The observer's job was to try to narrate unobtrusively into his recorder what the child was doing at all times -- much like a sports announcer -- leaving the main investigator free to interact with the child and leaving his tape free for the child's utterances. This approach seems promising, but we have not yet instituted it systematically.

In order to help solve problems that are constantly arising in data gathering, transcription, and analysis we have been meeting regularly to try and deal with some of these problems. We meet once a week, informally, to discuss problems directly related to data gathering and transcription. Our transcription problems, especially in the very "phonetic" period between seven months and one year, have been much aided by the paper by Bush et al. (1973), "On specifying a system for transcribing consonants in child language." Additionally, this semester we have been involved to varying degrees with a seminar which is exploring the implications of Stampe's theory of natural phonology (Stampe, 1969, 1972). At times one or another of us present some of our child language data for discussion in this seminar.

3. Rationale and Results

One may ask why we picked this age range to concentrate on. The answer in Scollon's case is that it was due to the availability of a child of that age, but that his findings have led us to believe that there is much more to discover in this age range than we had

originally thought. Also, Scollon had hoped to find the beginnings of speech, but after he started he realized he would have had to start earlier. I specifically wanted to study the transition from babbling to speech and started with a seven months old child. Even so there are clear examples of verbal imitation by the child in my earliest recordings. (Scollon now expects to be able to study the whole development from birth with his own child who was born in late March.)

Our interest in the transition from what has been called "babbling" to speech has been intensified by our growing awareness of the continuity of the whole developmental process. Scollon's work with Brenda has shown that, at least for this particular child, the transition from the one-word stage to the two-word stage was a gradual step-by-step process. The stages in this development (which are not discretely sequential) can be described as:

a) one word produced after multiple attempts;
b) one word produced after one attempt;
c) two related words in sequence (e.g. two terminal contours);
d) two related words in sequence with multiple attempts not needed;
e) two words in one construction;
f) sequences of related one- and two-word constructions;
g) multiple-word constructions.

The sequential constructions (c, d, f) Scollon has called "vertical constructions," while the close constructions (e, g) he has called "horizontal constructions."

My data from Mihn, moreover, has shown that vocalizations in what is called the "babbling stage" (7 - 12 months) can be classified into at least five categories according to their apparent function for the child:

a) communication sounds: fuss, cry, satisfaction;
b) vocal play: probably the category for which the name "babbling" is the most apt;
c) verbal imitation;
d) rudimentary dialogue with an adult: practice in turn-taking in speech, even though no recognizable surface message has been transmitted;
e) comment or naming: associating a verbal shape with an object or event.

I posited these categories for Minh when he was 12 1/2 months old, but I can find evidence for all of them in my earliest recordings at

7 1/2 months. All of these verbal functions still exist now that he is in the early speech stage (17 months).

We consider methodology to be very important in our studies. We feel that the developmental continuity between the one-word stage and the two-word stage would not have been so apparent if Scollon had not paid scrupulous attention to such data as repetitions by the child. We feel that all too often the data are filtered to include only those utterances immediately intelligible to the researcher. Scollon found that as he worked with the data his understanding became "stretched" so that he was able to account for more utterances than he had been able to do at first. This "stretching" resulted sometimes from learning additional facts about the child's world, sometimes from working back from a later to an earlier stage. The preservation of as much context as possible has obvious relevance here. Repetitions seem especially vulnerable to being thrown out, and yet they can give invaluable insight into a child's struggles with both phonological and syntactic processes. (We are trying to see if the natural phonology framework can account for Brenda's phonetic variation within sequences.)

This sort of scrupulous attention to phonetic detail has also revealed an interesting interaction between phonology, intonation, and syntax. Concentration on one area may affect another area. Thus, Brenda seemed to lose some of the control she had gained over intonation patterns just at the time she was adding final stops to her words. Again, a word said in isolation was phonetically nearer the adult target than when it was used in construction (whether vertical or horizontal construction). Finally, Scollon's study of Brenda has shown that discourse between child and adult played an important role in the development of syntactic constructions. For these reasons, attention to linguistic structures larger than a single utterance has become very important for us. We are anxious to see what results these investigational procedures will bring in our two current studies.

We are aware, however, from reading the literature on child language development that no two children develop language in exactly the same way. Certain aspects of this are already clear in our current projects. A feature of Minh's language acquisition which is particularly noticeable is his strategy which I call developing the tune before the lyrics. Around 14 months he starting saying "what's that?": Something like [ʌ sæ] but with a fairly wide segmental variation. The intonation pattern, however, was much more consistent: [¯ ⁄]. Also at around 14 months he started saying:

"Oh-oh!" [ʔo ʔo], whenever anything fell down. This, too, had a clear "tune": [¯_]. To this he would often append something like [da da da]: [ʔo ʔo dadada] [¯_ _ _]. As far as we can tell he was saying something like 'Oh-oh, it fell down.' He also sometimes appended [da da da] to his word for 'Mommy': [mani dadada] 'Mommy, I need help' or 'Mommy, something's wrong.' As early as 11 1/2 months he seemed to have acquired the phrase "Look at that!" although this phrase was more widely used at 14 months. This sort of phenomenon was not exhibited by Brenda during the period she was under study.

Laya, the youngest of the three children we are studying, is the least developed in terms of number of recognizable words. So far his verbal output has been less analyzed as well. Therefore I can only mention a few of our general impressions about his development; these will have to be somewhat intermediate between Brenda and Minh in amount of verbal play as opposed to amount of attempts at "words" (as far as we can be sure of such categorization ourselves.) He is beginning to say a few words, and on the whole they all seem to have Tagalog models. At least one, however, his word [ba] 'ball' has a possible model in both languages: Tagalog bola, English ball. The most potentially interesting aspect of Laya's development is probably his incipient bilingualism.

4. Problems

In carrying these projects forward we have encountered a number of difficulties, not the least of which is the question of what is the most helpful theoretical framework. Although we feel indebted to the pioneer work of Jakobson (1968) we feel that the framework of natural phonology as suggested by Stampe (1969, 1972) promises to resolve some of the issues that Jakobson's theory of contrasts has not been able to solve. And though we are dealing with younger children we are also very aware of Brown's (1973) team approach to research as well as Bloom's (1970) emphasis on the importance of context. The issue of context, however, is a thorny and difficult matter. For guidance we have found varying degrees of support from Labov, both for linguistic context with his studies of narrative syntax as well as for non-verbal context with his attention to matters of setting (especially Labov et al., 1968 and Labov, 1972). For matters of non-verbal context we, like Labov, have drawn from the framework called ethnography of communication (e.g. Gumperz & Hymes, 1972).

Each of the specific problems we have encountered seems to be affected by whatever theoretical framework we accept. I will mention three of these specific problems.

One difficulty arises when we try to determine just what the child is aiming at. Is it his own perception of an adult word?—Is it the adult surface form? Or even the adult underlying form? If we think he is aiming at the adult surface form, then what is this? The last instance he heard? An average of the last five instances he heard? (Whether slow, fast, kidding, angry, sloppy.) What if the mother and the father have different "averages" (as with all three of our children.) If a child is aiming at a constant target then why do we observe that her pronunciation of a specific word may improve right after an adult has pronounced the word -- and then revert to her current level of accuracy. If she is aiming at a variable target then why does she seem to have a fairly consistent level of accuracy at any given stage?

Another problem is the question of how many "systems" a child is working with at one time. It seems that imitation clearly differs from other types of production. Does imitative production occur at a phonetic level while spontaneous production occurs at a "systematic" phonological level? Perhaps two types of perception are being used by the child: phonetic perception in imitations, phonological perception in spontaneous words. Further, are Minh's "word" words part of a different system than his "tune" words? E.g. are [krkæ] 'kitty cat' and [gadyi] 'doggie' qualitatively different from [ob d do] 'open the door' (recorded at 14 months), "look at that" and "What's that?" What about the "words" that seem to straddle these two categories? E.g. [ʔo ʔo] and [mani] which occur alone and with [dadada] appended. Does my "intuition" tell me to categorize "words" and "tunes" separately because they really are different, or because we expect children to develop language in a nice neat Jakobsonian manner and don't know how to handle it when they don't? We suspect that perhaps the ethnography of speaking approach that would look at these events in terms of the communicative functions of the child's language might be more fruitful here.

A final problem that I would like to mention is that of words spontaneously invented by children that have no apparent models in the adult system. We don't know how to handle these. Most children seem to have invented at least one word, which we roughly gloss as 'comment.' How does this fit into the developing phonological system, especially if the system is described in terms of processes operating on adult targets (Stampe, 1972; Smith, 1973)?

5. Prospects

We hope to complete our current projects and start on several new ones if we can get funding. We think it will be important to

conduct several studies simultaneously, deeping data collection and transcription techniques as uniform as possible in order to explore a range of acquisition strategies, and, hopefully, to find some generalizations we can make. We hope to focus especially on child/adult discourse, on the range and implications of variation in early child speech, and on language acquisition in bilingual or bidialectal home situations.

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CHILD SPEECH, BABBLING AND PHONOLOGICAL UNIVERSALS*

D.K. Oller, Leslie A. Wieman, William J. Doyle, and Carol Ross

In Jakobson's (1941) monumental study of the human phonological capacity, he concluded that basically the same phonetic preferences are found in meaningful child speech, aphasic speech, and phonological universals of the languages of the world. Given a nativistic view of phonology and phonological learning this conclusion is not surprising since all of these realms of phonology are presumably governed by the same underlying ability to produce, perceive and conceptually manipulate phonological strings. Jakobson did not, however, believe that childhood babbling was governed by the same phonological constraints. Subsequent researchers (Velten, 1943; Mowrer, 1952; Osgood, 1953; Lenneberg, 1962; Rees, 1972) have often restated Jakobson's claim that babbling was essentially unrestricted and bore "no relationship" to the child's later pronunciations of adult words. Jakobson's belief in a discontinuity between babbling and speech has channeled the interests of linguists away from babbling. (Two important exceptions are Menyuk, 1968 and Cruttenden, 1970.)

The present paper will use data from children in English-speaking homes to show that Jakobson may have been in error about the relation of babbling to language. We shall argue that babbled utterances are not "random vocalizations" but rather are systematic forms of expression, manifesting the same basic phonetic preferences which are shown in later childhood pronunciations of adult words and in certain phonological universals of adult language. The parallels between our data on babbling and previous data on meaningful child speech suggest that the major processes of substitution and deletion in meaningful child speech could have been predicted from a phonetic preference analysis of babbling.

Method

Our data come from a number of recordings of children's babbling made at the University of Washington during the past two years. We have collected thirty-minute recordings, some on audio only and some

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on video and audio tape from over 50 normal infants aged four to thirteen months. Unfortunately, many of the infants did not babble during the recordings. Of those who did produce a sufficient number of babbled utterances, we selected five aged twelve to thirteen months and three aged six to eight months for detailed analysis.

Our discussion assumes the identifiability of babbling as distinct from other childhood vocalizations such as crying, laughing, coughing and so on. Babbling is defined for our purposes as a vocalization containing identifiable syllables. Babbled utterances which were unclear because of inadequate signal to noise ratio or because of the superimposition of features like crying or laughing were not considered in the analysis.

At least two trained observers transcribed each babbled utterance independently. Repeated monitoring of the tapes did not always result in agreement among transcribers, and in fact, there were often substantial differences in the transcriptions. In such cases, we constructed composite transcriptions which took phonetic alternatives into account. The final analysis only made use of phonetic features on which all transcriptions were in agreement.

Our analysis of the consonant-like sounds was based upon the existence of well-documented processes of substitution and deletion in meaningful child speech (Jakobson, 1941; Oller, 1973a; Edwards, 1971). Our predictions about the frequency of different babbled elements are derived from meaningful speech processes. For instance, the occurrence of cluster reductions in meaningful speech (e.g. [top] for 'stop') suggest that singleton consonants will be more frequent in babbling than consonant clusters. Final consonant deletions in meaningful speech ([do] for 'dog') suggest a higher frequency of initial than of final consonants in babbled utterances. And, in general, substitution of one class of phonetic elements for another in meaningful speech suggests a higher frequency in babbling of the substituted elements.

Results

(1) Clusters. The reduction of consonant clusters in meaningful child speech is widely reported for a number of languages (Ohnesorg, 1948; Smith, 1973; Salus & Salus, 1973). The prediction that singleton consonants outnumber clusters in babbling is strongly upheld. Over 90 percent of all positions[1] where consonants occur are filled

[1] Consonant positions are defined as the places where consonants could occur in an utterance. Therefore, in a utterance with a single vowel, consonants are possible in two positions. In an utterance with two vowels, there are three consonant position: initial, medial, final.

by singleton consonants rather than consonant clusters (see Table 1).

Table 1

Singleton Consonants and Clusters

	12 months				6-8 months		
Subject	Single	Cluster	Percentage	Subject	Single	Cluster	Percentage
Sandie	97	4	96%	Ellie	40	4	91%
Sally	121	6	97%	Jared	35	7	83%
Ginny	95	1	99%	Ken	43	3	93%
Seth	58	4	94%				89%
Glenna	55	4	93%				
			96%				

The data from all eight subjects show this highly significant trend.

(2) Initial and Final Consonants. Final consonant deletion has been reported as a common process of meaningful child speech by many investigators (e.g., Albright & Albright, 1956; Tracy, 1893, 1909). Initial consonant deletion, on the other hand, is relatively rare. The prediction that initial consonants will outnumber finals in infant babbling is borne out in our data, again, in all eight children (see Table 2). The ratio of initial to final consonants is two or more to one in each of our eight subjects.

Table 2

Initial, Final and Medial Consonants

Subject	Initial	Final	Medial	Subject	Initial	Final	Medial
Sandie	35%	18%	47%	Ellie	25%	2%	73%
Sally	21%	2%	77%	Jared	40%	3%	53%
Ginny	55%	24%	21%	Ken	37%	0%	63%
Seth	48%	24%	28%		34%	2%	64%
Glenna	65%	7%	27%				
	45%	15%	40%				

(3) Predictions Based on Substitutions in Meaningful Child Speech.

(a) de-aspiration: Jakobson (1941) reported the tendency of children to avoid production of aspirated stops in early meaningful speech. Substitution of unaspirated stops in word-initial pretonic position has also been reported by Oller and Warren (1973) and numerous others. The prediction that babbled utterances will show more unaspirated than aspirated stops holds up in our data. In fact, only three aspirated plosives appear in the entire corpus of data which includes more than 100 initial plosive consonants. All eight subjects show a preference for unaspirated stops.

(b) final devoicing: The devoicing of final consonants in meaningful child speech has been repeatedly observed for speakers of several languages (Leopold, 1947; Stampe, 1969). On the basis of the devoicing process, we predicted that in babbling, final obstruents tend to be unvoiced. Of 50 final obstruents in the data, only five are voiced. The preference for final unvoiced consonants is present in the data from all eight subjects.

(c) stops: The substitution of initial stops for fricatives and affricates in meaningful speech has been reported by Jakobson (1941) with regard to numerous languages. In our babbling data, we found that initial stops outnumbered fricatives by ten to one. Only one of the eight subjects shows more fricatives (3) than stops (2), but this case is suspect due to the small number of relevant observations, (total of 5).

(d) spirantization: The widely reported preference for stops in initial position is not normally found in final position in meaningful child speech. In fact, there is persuasive evidence that in final position children often substitute fricatives and affricates for stops (Olmsted, 1971; Ferguson, 1973; Oller, 1973b; Compton, p.c.). The babbling data supported the asymmetry in treatment of stops and spirants in initial and final positions. Final fricatives outnumbered stops by three to one. Unfortunately, the very small number of final consonants in the data from five of the eight subjects makes this observation apply with reliability to only three subjects, all of them in the older group.

(e) liquids: The substitution of glides ([w] and [j]) for prevocalic liquids ([l] and [r]) has been reported by many investigators (Jakobson, 1941; Smith, 1973; Ingram, 1971; Edwards, 1971). The prediction that glides would outnumber liquids in babbling is well-verified in our data. There are 52 prevocalic glides and only 7 prevocalic liquids. Furthermore, no subject has more prevocalic liquids than glides.

(f) fronting: Jakobson (1941) cites studies in numerous languages showing the preference in children's meaningful speech for apical over dorsal (i.e., alveolar and dental over palatal and velar-uvular) articulations of consonants. Substitution of apicals for dorsals is widely acknowledged. Our data on babbling among the twelve- to thirteen-month-old subjects strongly supports this preference. But the six- to eight-month-olds show the opposite preference.

Table 3

Apical and Dorsal Consonants: Raw Numbers

12-13 months			6-8 months		
Subject	Apical	Dorsal	Subject	Apical	Dorsal
Sandie	31	10	Ellie	8	13
Sally	57	25	Jared	7	11
Ginny	56	4	Ken	2	13
Seth	52	0			
Glenna	80	1			

This difference between younger and older children is reminiscent of Irwin's (1947) claim that infants produce back consonants during the first months of life and then later tend to produce more front consonants.

(4) Other

For the purposes of completeness, it should be pointed out that we found in the babbling data many (though not in high proportions) examples of phonetic elements which are not particularly common in meaningful child speech and for which the languages of the world have not shown preferences. Among these are syllabic nasals, bilabial trills (both voiced and unvoiced), and labio-lingual consonants. Why these elements might appear frequently in child babbling but not in meaningful child speech is not at all clear to us.

Conclusion

Contrary to the position taken by Jakobson and many of his followers, babbling does appear to be governed by general restrictions of the human phonological capacity. To a much greater extent than was expected, the predictions of our study were borne out in the data.

In fact, after examining our data on babbling, it is possible to make predictions in the opposite direction, i.e., it is possible to predict quite accurately the nature of the most commonly reported substitutions and deletions which occur in meaningful child speech.[2]

Of the earlier data which support the relationship between babbling and meaningful child speech, much is unfortunately anecdotal in nature and the methodologies of the more precise studies limit the possibilities of performing calculations of frequencies such as those reported here. But Tracy (1893), Leopold (1947), Nakazima (1962), Murai (1963), Weir (1966), Gruber (1966), Menyuk (1968), and Cruttenden (1971) all provide evidence suggestive of just the sort of preferences we have verified here.

Perhaps the primary import of our claim that a continuity exists between babbling and meaningful child speech (and, by implication, between babbling and phonological universals) has to do with a model of the child's innate predisposition for phonological learning. Stampe (1969, 1972) and Drachman (1970) have contended that the child's phonological maturation includes a rather sudden change at the time meaningful speech begins. Stampe claims that it is then that the "innate processes" of substitution and deletion are brought to bear.

Oller and Warren (1973) have argued against the "innate processes" hypothesis by contending that the form of processes need not be preprogrammed. Instead, they claim, the child's phonological processes are "generated" or "formulated" by the child as a means of operationalizing certain natural phonetic preferences. The child's phonetic production preferences antedate his meaningful speech, as evidenced by the babbling data. It would therefore seem reasonable to assume that phonological processes are the output of an innate phonological acquisition device which reflects the child's production preferences.

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[2] These predictions also depend upon the recognition of certain acoustic and/or articulatory similarities among alternating elements. Thus, the substitution of glides for liquids can be predicted given their acoustic and articulatory similarities. But even though initial stops outnumber liquids and glides, substitutions of stops for liquids or glides are not predicted due to significant articulatory and acoustic differences.

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ON BABBLING: SOME PHYSIOLOGICAL OBSERVATIONS

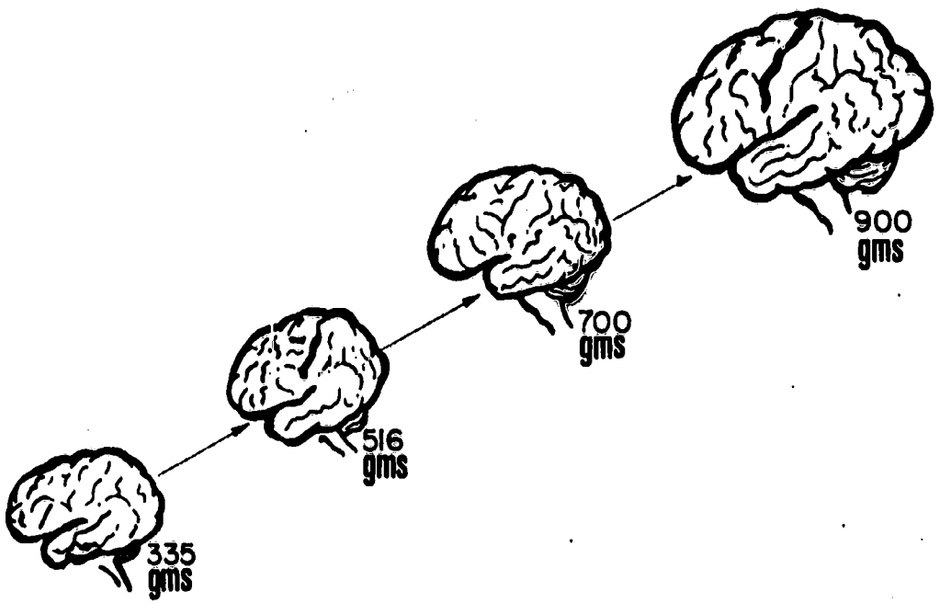
John H. Gilbert

Much of the research concerned with delineating progress from babbling to meaningful verbal utterance has concentrated on orthographic transcriptions of adults' perceptions of acoustical byplay of infants. The enormous problems associated with (1) response to perceptual tasks, (2) measurements of the acoustical signal and (3) the normalizing influence of adult listeners have led to a tendency to ignore available physiological data.

In his monograph, Lenneberg (1967) asks: "Do cooing and babbling represent practice stages for future verbal behavior?" (p. 140) and answers his own question: "We have every indication that this is not so." If Lenneberg's answer is true, it is a strange animal indeed that, given every physiological endowment, would begin to work to produce the complexities of its language system only after months of supposedly meaningless utterances! Babbling must surely be more than random noise.

Dichotic studies in the past ten hears (see Studdert-Kennedy & Shankweiler, 1970) have indicated that the left hemisphere is relatively more specialized for language than is the right hemisphere. Juhn Wada (p.c.) has shown that, in utero, the left hemisphere is larger and more convoluted than the right. Recent studies at the University of Western Ontario (Witelson & Pallie, 1973) conducted on newborns corroborate this left hemisphere specialization for language in the newborn.

The cochlea, so obviously necessary for transduction of the auditory signal to the auditory system, is virtually complete by three months in utero and therefore ready to transduce sound in all its complexity at birth. At the fetal age of two months, the brain constitutes approximately 25 percent of the total body weight, at birth it constitute only 10 percent of the body weight, and in adulthood only 2 percent of the body weight. It is therefore interesting to observe that the brain exhibits almost all of its growth potential by the age of six years, lacking the adolescent spurt that is so characteristic of the growth of other organs (Jabbour et al., 1973). During the first few years of life there is rapid proliferation of dendrites, axons and laterals; this differentiation is completed by the age of four or five years, although myelination and axonal maturation can continue throughout childhood and persist even into adulthood. The increase in brain weight is shown in Figure 1 (from Jabbour et al., 1973: 9). Relative



Myelination	Posterior Columns Spinothalamic tract Cranial nerves CN II - XII	Spinal tracts All Cranial nerves Thalamus	Spinal cord Brain stem Cerebrum	ALL AREAS
Occipital Frontal Circumference:	35 cms.	40 cms.	44 cms.	46 cms.
Age:	Newborn	4 mos.	8 mos.	12 mos.

Figure 1. Growth of the brain from birth to one year, (from Jabbour et al., 1973: 9).

increases in myelination are shown in Figure 2 (from Yakovlev and Lecours, 1967: 4-5). Unfortunately, there is no established time sequence for myelin deposition and differentiation; these processes continue throughout life as new skills and new knowledge are acquired. It is of interest to note that the acoustic radiation is not completely myelinated until age four years. Yakovlev and Lecours (1967: 64) postulate:

> The late postnatal myelination of the geniculo-temporal (acoustic) radiations in the human infant may correlate with the protracted maturation of the responses to the conditional stimuli-signals of physical agents, such as the sounds of spoken words, and -- eventually -- to the stimuli-symbols (representations or 'models') of the signals -- the language.

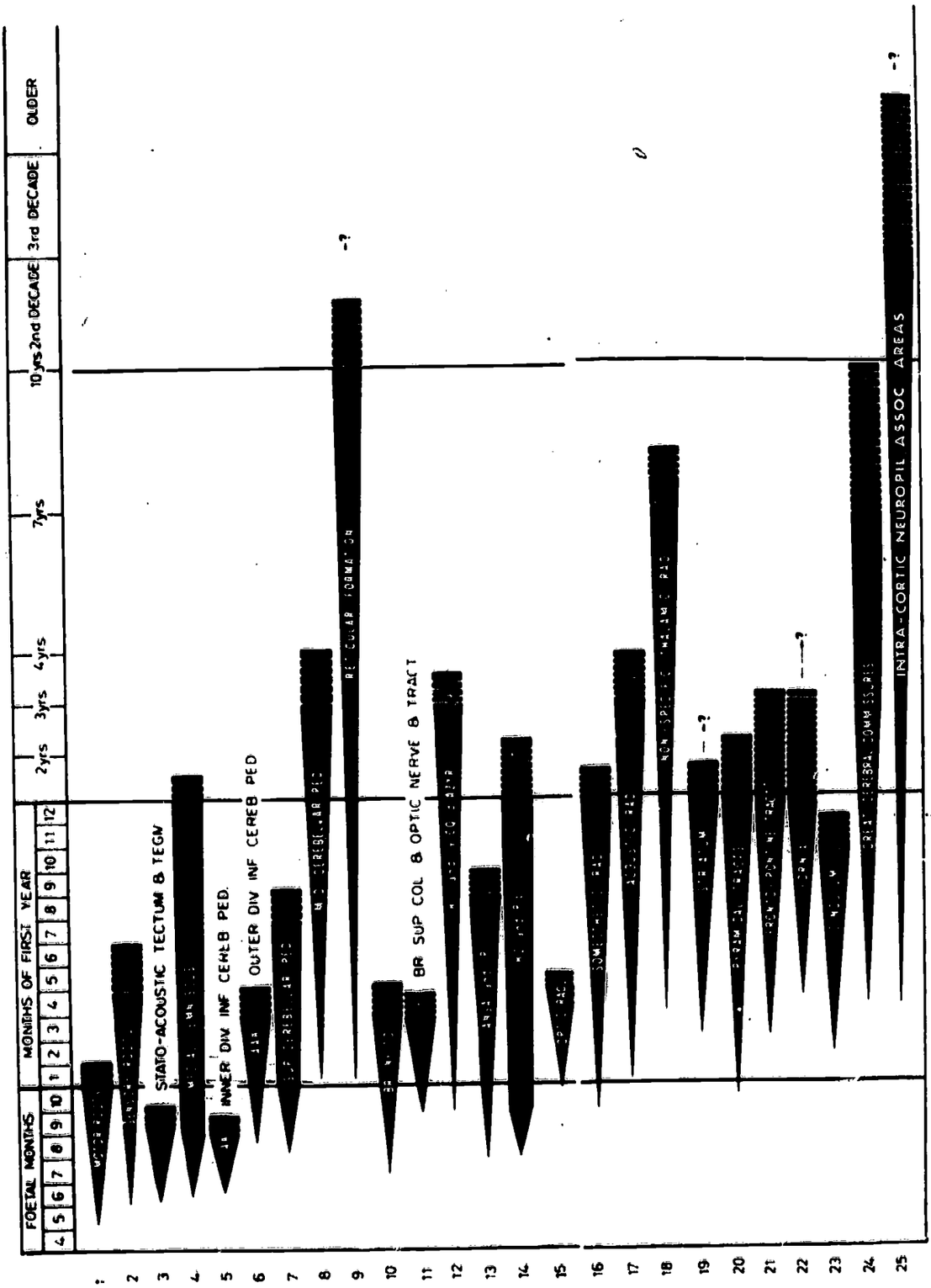


Figure 2. Cycles of myelination (from Yakovlev and Lecours, 1967: 4-5).

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Interesting examples of postnatal development of the human cerebral cortex around Broca's area, i.e. that area concerned with the ultimate production of speech sounds, are shown in Figures 3 and 4 (from Conel, 1939-1963, after Lenneberg, 1967: 160-161; ignore the stippled area). An inspection of these figures shows the dramatic increase of density of neuropil between one month and twenth-four months.

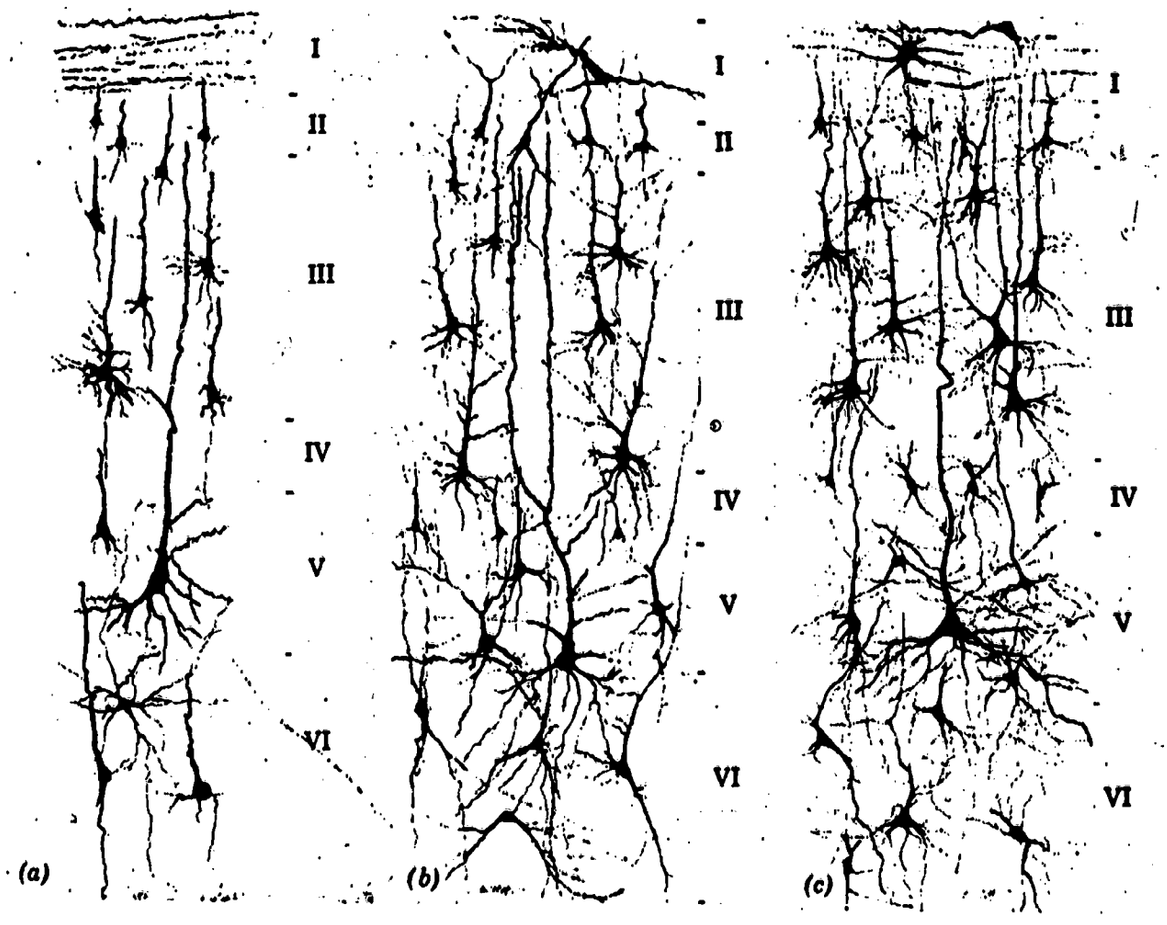

Figure 3. Postnatal development of human cerebral cortex around Broca's area; a) newborn, b) one month, c) three months (from Lenneberg, 1967: 160; after Conel, 1939-63).

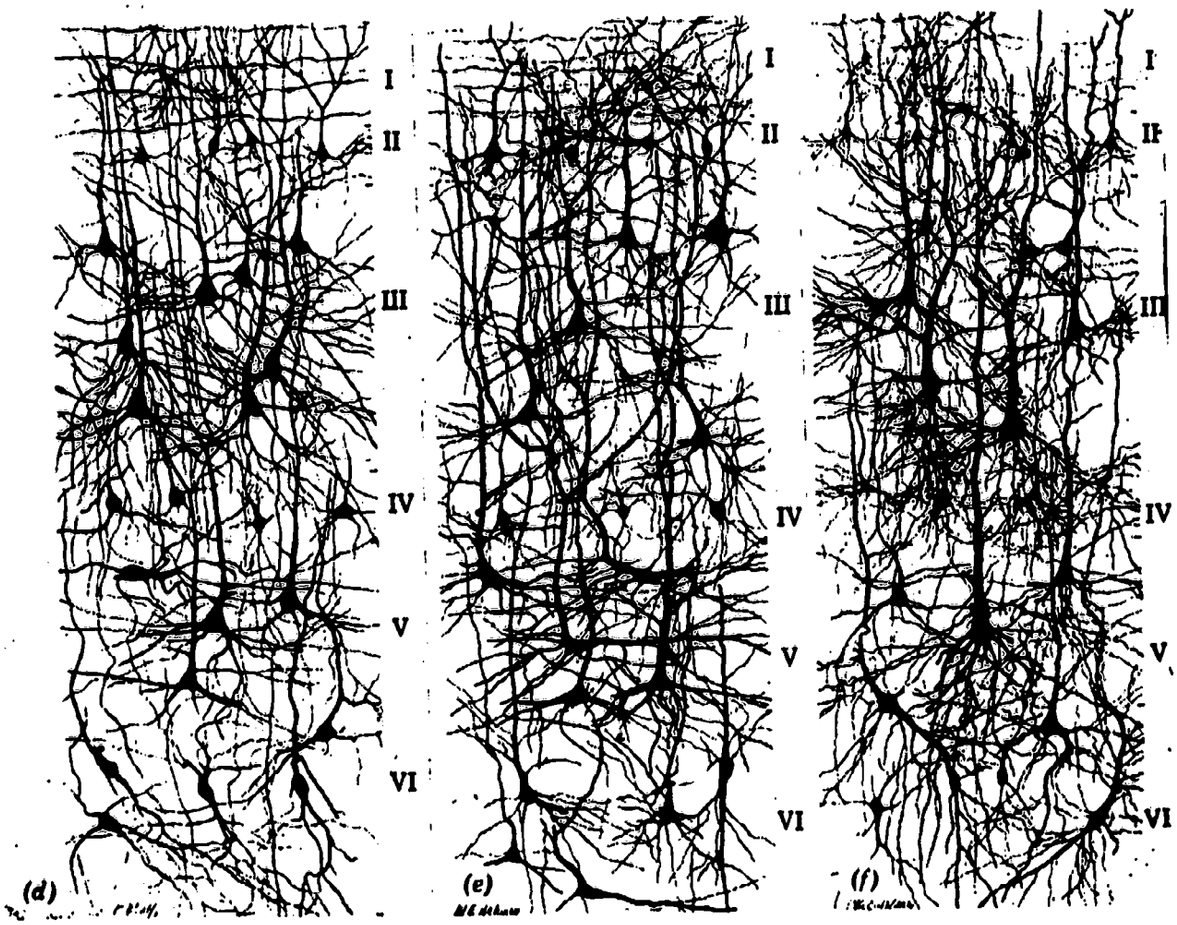

Figure 4. Postnatal development of human cerebral cortex around Broca's area; d) 6 months, e) 15 months, f) 24 months (from Lenneberg, 1967: 161, after Conel 1939-63).

Lenneberg (1967) has shown that as the cerebrum expands with advancing age, the nerve cells of the cortex become less crowded and the neurodensity increases (cf. Figure 5, based on data from Schadé and van Groenigen, after Lenneberg, 1967: 163; ignore the stippled area). In Figure 5, note particularly the shape of the curves during the period of infancy.

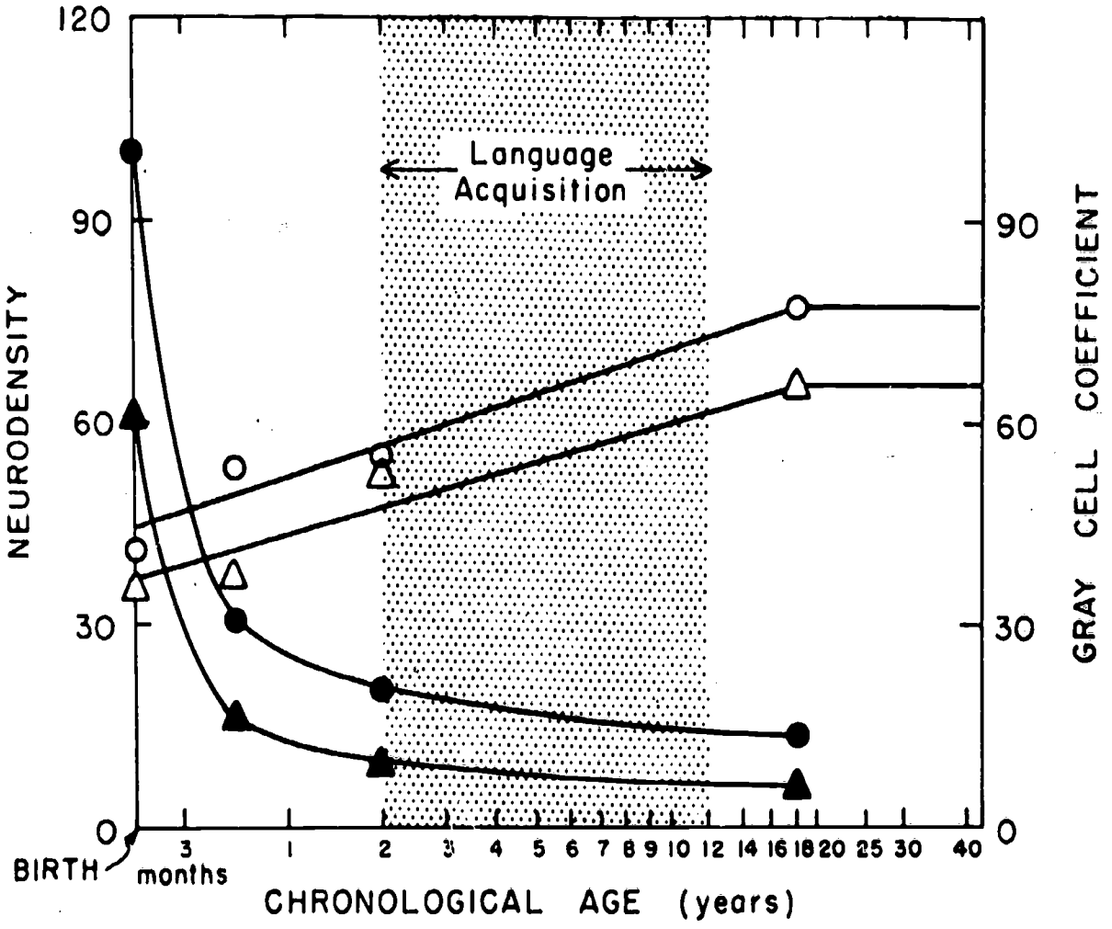

Figure 5. "As the cerebrum expands with advancing age, the nerve cells in the cortex become less crowded, and the neurodensity (number of cells time 10^3 cubic millimeter) decreases. The gray-cell coefficient was computed by dividing the volume of gray matter by the volume of nerve cells contained in it. The rising curves indicate that the distance between the cells increases with age and are increasingly filled with dendrites and neuropil, resulting in dense arborization." (Based on data by Schadé & van Groenigen; from Lenneberg, 1967:163.) Circles denote Layer III; triangles denote Layer V.

Although the infant vocal tract is changing length and diameter quite rapidly during the first year (Crelin, 1969), there is no reason to suppose that the acoustics of the system -- and all that this implies for phonetic production -- could not be explained by the acoustic theory of speech production (Chiba & Kajiyama, 1958; Fant, 1960).

It is equally likely that the constraints on vocal tract length and shape, when coupled with developmental constraints on the nervous system, would lead to a limited set of vocal tract configurations and articulatory targets productively possible by the infant. Since the sounds of speech themselves have relatively well-defined values in terms of frequency, intensity and duration when related to perception (Liberman et al., 1967), and since the ear appears to have a relatively well-defined characteristic response range for speech sounds, it would appear that both articulatory and acoustic portions of the physiological system work in concert to limit the number of perceptual and production possibilities during the babbling period. Recent papers by Belmore et al. (1973), DiSimoni (1974), and Stark and Rose (1974) give some rather interesting insights into developmental changes occurring in both perception and production of speech signals.

In summary, it is hypothesized that babbling is an integral part of ultimately learning to talk; that it is a continuous process (given a normally functioning physiological system); and that rather than operating with an open-ended set of articulatory and perceptual possibilities, the neonate and infant are, in fact, constrained by physiological changes, which themselves affect both production and perception. Obviously, validation of such hypotheses presents enormous experimental problems.

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SUMMARY OF PANEL DISCUSSION

John B. Delack

The individual participants' presentations and questions from the floor provoked several points for discussion, some of the more salient ones of which may be summarized as follows:

(1) It is now, more than ever, essential for the linguist studying language acquisition to define his/her theoretical and experimental terms and criteria explicitly. Terms such as "structure," "meaning," "meaningful utterance," "word," etc., must be fully elaborated by the individual so that misunderstandings will occur less frequently. Indeed, terms such as these have not heretofore been treated as worthy of overt definition, and misinterpretations have provoked vitriolic debate for no good reason. For example, if one investigator (implicitly) defines "structure" to mean an order imposed by the organism, whereas another investigator uses the same term to denote that which was observed in the corpus of data obtained from the organism (with no implication or claim that this was imposed by the organism), and if this difference in usage is not made explicit, progress in understanding the organism will most likely be impeded.

(2) In conjunction with the discussion on the physiological immaturity of the vocal tract and associated neural structures and mechanisms in young infants (cf. Gilbert's contribution), it was noted that there is a general non-comparability -- from either the articulatory or the acoustic standpoint -- of infant and adult vocalizations. Given that most transcriptional systems use impressionistic techniques based on adult perceptual capacities/proclivities, it would seem that such characterizations of infant speech would not adequately or appropriately capture the essence of the object under investigation. Due to the lack of infant-linguists, however, this impediment to experimental investigation will remain until such time as an adequate developmental (vocal tract) modelling procedure can be devised and implemented.

(3) Descriptions of phonological processes, such as utterance-final "devoicing" (cf. Oller's contribution), likewise derive from ostensible properties of fully-fledged linguistic systems. If examined in light of research which demonstrates that infants employ an overtly undifferentiated set of stop consonants at the age of one year (in terms of Voice Onset Time; cf. Preston et al., 1967; also reported in Delack, 1971) -- and one which may be differently interpreted according to the linguistic orientation of the observer -- it would seem that such

characterizations of infant speech can hardly be appropriately characterized by recourse to such processes. Again, more adequate descriptive and/or explanatory techniques must await further advances in the field, particularly as noted above in (2).

(4) While observations and manipulative experimentation of vocal behavior certainly have utility and relevance for an understanding of the infant's cognitive and linguistic functioning, one must not lose sight of the neurophysiological aspects which may more adequately characterize and explain the infant's abilities and inabilities. Without such an appreciation, the linguist's dependence on formal linguistic rules may only obscure the true nature of the phenomena in question.

(5) Without invoking the specter of the nature versus nurture controversy, it would seem to be the panel's consensus that there is a continuity of development between "prelinguistic" and "linguistic" behavior and that discontinuities can be regarded as purely local phenomena, or artefacts deriving from a given investigator's theoretical predilection and/or the results of bias in experimental methodology. However, further research into the cognitive and physiological concomitants of speech, hearing and language development should provide a more definitive resolution to the controversy.

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