

The Sounds of Infants
“Their Phonemicization and Symbolization”

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INTRODUCTION

Besides understanding the mechanism of speech development of infants, there are three important meanings in the study of phonemicization and symbolization of infants' sounds.

1) The observation of Kellogg⁽¹⁰⁾ and of Hayes⁽⁷⁾ shows a quantitative difference between the behavior of a human being and that of a chimpanzee, even if the human being and the chimpanzee are brought up experimentally in the same human environment. However, this difference does not appear until the human being acquires words. Yerkes gave the name “Chimpanzee Age” to the about-one-year-old period, when motor and manipulation behavior is very active but few meaningful sounds are heard.

So the study of this process throws light on the developmental process from a chimpanzee to a human being—that is, on the process of humanization.

2) The early meaningless sounds do not develop into general signs or symbols, but into words of each phoneme-system of the different races or nations. So the study of this process not only throws light on the humanization process, but also on the development from biological human beings to social and cultured ones.

3) Analogically we can learn about the phylogeny of speech development in this study. Of course this does not mean we contemplate the mechanical transference of speech development in ontogeny to that in phylogeny. However, if we analyze the various internal and external factors essential in acquiring words, clarify the relations among these factors and rearrange them historically, we may, some day, be able to solve the problem of phylogeny in speech development.

METHODOLOGICAL PROBLEMS IN THE STUDY OF SPEECH
DEVELOPMENT OF INFANTS

In spite of its importance for the psychology of development and of language, there have been few studies in this field because it has two methodological problems.

1) Problem of observation under controlled conditions

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Infants' utterances are greatly influenced by environments and sometimes they are not uttered or produced under unfamiliar conditions, so it is almost impossible or nonsense to state that we observe or record them under common external conditions or that we perform experiments under such and such controlled conditions. Their utterances must be studied longitudinally under natural conditions, especially under conditions in which infants feel comfortable and free from disturbance. Many of the past studies have been performed by this important method. However, although it can produce some fundamental data about speech development, it cannot give satisfactory information about the factors which influence speech development. It is, therefore, necessary to throw light on these by performing observations and experiments under—in so far as possible—controlled conditions but without disturbing the infant's natural environment; or else, by comparing the speech development of children suffering from speech disorders with that of normal infants.

2) The foremost methodological difficulty lies in hearing correctly the meaningless sounds and using correct phonetic signs to record them accurately. As infants' utterances are ones of a period when the phoneme-systems are not established, they cannot be described by the language of a race or a nation. And as their utterances are not yet differentiated, they cannot be described even by phonetic signs. In fact, the phonemicization process is precisely that process by which they become describable by the international phonetic signs or some language of races or nations. A new sounds analyzing instrument, which can record infants' sounds correctly and represent them precisely, is necessary for the study of the development of speech sounds, although describing them with the phonetic signs may suffice for the study of the function of language.

THE METHOD USED BY THE WRITER

In order to get over these methodological difficulties, the following methods were adopted.

1) In order to get fundamental data of speech development during infancy, longitudinal observations of some normal infants were performed.

2) In order to get objective data concerning the development of infants' sounds, the sounds of infants who were studied were recorded by tape-recorder and the collected sounds were analyzed by Sona-Graph.

3) To clarify the factors determining the symbolization process, the writer performed the following analytic studies:

i) Longitudinal studies on the speech development of infants with speech disorders as compared with that of normal infants

ii) Clarification of the relation between infants' utterings and their situations
Infants' sounds were recorded in several situations—i.e., playing alone, playing alone near the mother, playing with the mother.

iii) Clarification of how infants learn a sound as a symbol for an object

One infant was trained to use a certain sound "bu bu" (in Japanese baby talk this means "a pig") to symbolize a certain object (a toy pig).

4) Investigation of the background data of speech development and clarification of certain questions connected with it. The following studies were performed:

- i) A developmental test and observation of the infants' behavior
- ii) A questionnaire to the mother as to the verbal behavior of her infants
- iii) A study of the speech sounds of severely mentally deficient children

PROBLEMS CONNECTED WITH THE PHONEMICIZATION AND THE SYMBOLIZATION PROCESS

Relying on the literature of the subject and on the results of his own studies, the writer would hope to throw light on the mechanism of the phonemicization and the symbolization process and on the factors determining them during infancy.

The First Cry

To seek for the beginning of speech development is not simple. Infants utter their first cry at birth. Once, certain philosophers and psychologists interpreted this first cry as emotional and intellectual expression, but now it is regarded as a purely physiological function concerned with the establishment of normal respiration and oxygenation of the blood, and not as anything concerning speech development in itself.

Crying

Crying is physiological utterance which infants utter in uncomfortable situations. Bühler, Ch.⁽⁴⁾ recognized the relation between variety of utterances and situations in which they are uttered, but the literature often points out the difficulty of inferring a child's physiological condition from its uttered sounds. However, without minimizing this difficulty, we can observe the infant's crying soon beginning to function as a signal sign and causing the mother to care for the infant in various ways—mothering it, suckling or diapering it, etc. Thus, crying is thought to develop from physiological utterance into one communicating the infant's wants. So this utterance can be regarded as the beginning of communication. Crying and this developmental process can often be found even on the level of animals. For example, Kawabe points out that utterances of infants of the Japanese monkey are specialized by fear, anger, calling, and threat. The main language activity of the animal is at this level.

But the human being learns to use language symbolically. He captures reality and deals with it by means of abstract symbols. The formation of this power of symbolization cannot be understood by considering merely the above-mentioned development from crying. It may even be true that the formation of the function of symbolization is, in its initial stages, unrelated to the satisfaction of the human infant's needs. Even from the viewpoint of the formation of communication

function, in the case of human being, the development from crying produces only a matrix of communication and it cannot convey meanings of complex communication of human being. Therefore, to clarify the mechanism of speech development, we need to investigate the manner in which this symbolic function arises.

Non-crying Utterance

Non-crying utterance begins at about the end of the first month. These utterances are made in a state of comfort and relaxation after feeding or pleasant awakening. This non-crying utterance develops into babbling, and the study of this kind of utterance is thought to be a key for solving the puzzle of the verbalization process in human beings.

Some researcher (Jespersen,⁽⁹⁾ Bühler,⁽⁵⁾ Lewis⁽¹¹⁾ et al.) have concluded that this utterance is the basis of speech development, but they have not indicated their reasons for coming to this conclusion.

The writer finds the following seven reasons to be of significance.

1) Crying develops in the direction of a communication of the infants' needs to their mothers. As in infancy the development of the need system is almost on the level of subhuman animals, the functional development of crying can be considered to be on the biological level. But the non-crying utterance occurs as a result of many kinds of communication (including mothers' sounds, rearing behavior, and mothering) on the part of the mother; that is, this utterance is brought about by stimuli given by the mother as a cultural and historical being. So, even if non-crying utterance is instinctive at first, its development is greatly influenced by cultural and specifically human learning factors—all the more so in that these utterances consist of phonetic materials having great flexibility.

2) The non-crying utterance and babbling of human babies is of great quantity and variety as compared with that of subhuman animals.

Kellogg says, on the sound of chimpanzee baby "There were no random" noises to compare with the baby's prattle or to the apparently spontaneous chatter of many birds. On the whole, it may be said that she never vocalized without some definite provocation, that is, without a clearly discernible external stimulus or cause."

In the light of the facts mentioned above, non-crying utterance seems to be peculiarly human.

3) Crying stops when the infants are satisfied with their needs and uncomfortableness vanishes when the desired object is attained. The more the mother's cares suffice the fewer the cryings. For example, Aldrich and others^(1, 2) show that infants in institutions cry more frequently than those in normal homes and that even in institutions cryings become fewer if more sufficient cares are given. On the other hand, non-crying utterance appears in comfortable situations when the infants' desired objects are attained. As infants become well-adapted to their environments and their mothers endeavour to make them comfortable by adequate

care, chances for these non-crying utterances increase rapidly. Irwin et al.^(3,8) show that infants utter few non-crying utterances in institutions where there are many unpleasant incidents. This is related to the fact that such institutionalized infants acquire words later. Therefore we see that the quantity of non-crying utterance is very significant with regard to the acquisition of speech.

4) Crying has a definite connection with infants' needs and acts as a signal, but non-crying utterance is meaningless and has no value as a signal. The latter is comparatively mobile and situation-free, and it has flexibility which is important if it is to develop into symbolic sign.

5) In relation to 3) and 4), utterance in a comfortable condition is very active as compared with that in an uncomfortable one, both in Irwin and others' data and in the present writer's study^(19, 21). Moreover, most of the new sounds appear in comfortable situations and both variety and quantity of sounds (including both vowels and consonants) are much greater in comfortable situations than in uncomfortable ones; that is, even from the point of view of phonetic materials for later speech development, utterances in the former are much richer than in the latter.

6) In a congenitally deaf infant⁽²⁰⁾ and in a child suffering from a central language disorder⁽²²⁾ crying is not retarded as compared with that in a normal infant, but non-crying utterance and babbling resulted from the development of them are much retarded or regressive. In many feeble-minded children there is very little babbling in infancy.* From these data we can infer the importance of non-crying utterance (and especially babbling) for normal speech development.

7) Most cryings are uttered in frustrated or anxious situations. In comparison with crying, non-crying utterance arises in comfortable situations which make emotion stable, thus raising intellectual activities to the stable level and increasing the learning effects upon the utterance activities.

Babbling

There has yet been no definition discriminating clearly between babbling and non-crying utterance.

Bühler, K.⁽⁶⁾ considers all non-crying utterances babblings, but most investigators vaguely give babbling a double meaning of sounds uttered in a comfortable situation and of sounds uttered for their own sake as plays. On the other hand, in common usage babbling means repetition of sounds which occur frequently after the age of five or six months. Therefore there are many confusions in its definition. But, however babbling is defined, one should make, both phonetically and functionally, a clear distinction between undifferentiated sounds in 0;1-0;3 and those repetitious sounds after 0;5 which have much variety and are phoneticized pretty clearly.

* Among the patients at Biwakogakuen Hospital, it was found 'by their mothers' reports' that many of severely mentally deficient children (by congenital disease or by disease in the early infancy) uttered very little babbling, or very restricted sounds in infancy.

The writer distinguishes babbling from non-crying utterance phonetically and functionally. We define "Babbling is meaningless utterance in a comfortable condition. It results from the development of undifferentiated non-crying utterance and takes the form of repetition or of succession of unit utterances which show almost the same duration of utterance as adult utterance." So, we named the period (0;5-0;9) when these sounds are very often uttered "babbling period." Though the definition presented above is mainly concerned with phonetic development, still phonetic change involves a change of the functional meaning.

The characteristics and functions of babbling

1) Babbling as well as non-crying utterance, is uttered in comfortable situations and is often uttered as play.

2) Babbling as well as non-crying utterance, has its own phonetic development.

3) The development of babbling is influenced by learning factors. The writer's study of a deaf infant and Irwin's study of institutionalized infants show that this is more true of babbling than it is of non-crying utterance.

4) The importance of the factor of maturation in babbling development is made sufficiently clear by the fact that phonetic development takes its own special direction. For example, in the babbling of the deaf developmental change, though slight, is still discernible while both the sounds of Japanese infants and those of American infants develop on well until the end of babbling period.

5) Babbling offers phonetic materials out of which meaningful sounds develop. About this most investigators agree. It is made clear by the fact that training sound (bu bu) was uttered babblingly by the infant even when he acquires the word by training which reinforces a certain sound (bu bu) to a certain subject (a toy pig) repeatedly. Of course, babbling itself does not consist of words but is gradually defined and refined into words (for example, the babbling sound "ma ma ma ma" → meaningful sound "mamma").

6) If phonetic development is thought of from the point of view of physiological utterance and articulation, non-crying utterance may be on the physiological level and babbling may be on the articulation level.

7) Babbling has a function of phonetic play. It has been said that babbling is playing with sounds. That this is true is made clear by the fact that infants in this period often seem to be delighted with the various sounds they can make by forcibly twisting their tongues. This sound play has just the same function as playing patty cake. Substituting sounds for performances is very important to infants in forming the symbolic function, even if the substitution is done only in play. Also, making such utterances in a comfortable situation as a means of play with the mother affords a chance for their development into imitative sounds.

8) Babbling is generally uttered repetitively. Repetitious utterances in which articulation positions are the same or almost the same are active and explosive

sounds, nasal ones, and affricate ones predominate in those utterances. But utterances whose articulation positions are the same are not differentiated among and easily change, for example, from [m] into [b] and from [b] into [p].

9) Repetitive utterances are easily produced, as can be seen from the tendency of a child's utterance to become repetitious during a regressive phase.

10) The babbling period should be considered one of the stages of speech development. When infants in this period find themselves in an uncomfortable situation or when their activity level drops, they often utter cryings (Fig. 33) or non-crying utterances (Fig. 4, 22, 62) as one of the symptoms of regression. Also, that a child suffering from a central language disorder or an autistic child utters babbling-like sounds means that he is maintaining a certain stable stage of speech development by virtue of the regression of the speech function.

11) Babbling is not produced as autistic circular reaction, but develops in close relation to the mother's affectionate care and to her utterances. Neglecting the communicative function in the symbolization process here does not mean neglecting social factors.

12) One kind of babbling is a social babbling uttered in consciousness of adults but not communicating any need.

13) Another kind of babbling is autistic babbling, which is uttered as play when the infant is playing alone and is active from about 0;7 till about 0;9. There is a little phonetic difference between social and autistic babbling. Differentiation of social babbling and autistic babbling must be made from a consideration of differentiation of the outer environment and of the subject though on the behavioral level,** and further more the interaction of these differentiating functions promote differentiations in adaptive growth.

Imitative Sounds

The period when imitative sounds appear has not been unanimously determined by investigators. For example, Piaget makes it 0;3; Bühler, 0;6; Gesell, 0;10; Bayley, 0;11. These differences are not due to those of their subjects, but due to the difficulty of deciding how to think of "imitation". It is not easy to determine what behavior is imitative. A mother's sounds and her infant's imitative sounds, no matter how similar they may be to the ear, will, when analyzed by Sonagraph, not be the same (Fig. 68, 69. Fig. 84, 85. Fig. 88, 89). All "imitation"

* The results on the study of speech development of a deaf infant showed that :

- 1) The quantity and types of babblings of the deaf were very scanty.
- 2) The deaf exhibited developmental changes in his babblings but they occurred much later than in the case of the normal infants.
- 3) Babblings which were uttered stably by normal infants, quickly were relinquished by the deaf infant.
- 4) The deaf had a tendency to continue for a considerably long time very immature utterance.

** Many of emotionally dependent infants when playing alone do not utter babbling as is usual with independent ones but cry or call to their mothers.

being more or less imperfect, we need to understand it as a matter of degree. To set up a definition of imitative sounds and then by it determine the period in which imitative sounds appear will not get us very far. It will be more useful to attempt to make clear the process by which imitative sounds are formed and the factors which influence their formation.

If we then take such a position, imitative sounds will have the following constitutive aspects:

- 1) Increase of the degree of resemblance between utterances in adults and those in infants
- 2) Increase of frequency of resembling utterances
- 3) Increase of variety of resembling utterances
- 4) Increase of temporal contiguity
- 5) Change from imitation employing the existing repertory of sounds to that employing new sounds
- 6) Change from unconscious to conscious imitation
- 7) Transition from association with situation to independence of them

Although Piaget, J.⁽²⁹⁾ makes "imitation" the "accomodation process"—that is, not the process in which the environment is transformed, but that in which the behavior of the subject is changed to conform to the environment—this writer thinks subjective activities should be emphasized in considering imitation. Although imitation does not transform the outer environment, the infant chooses objects to accomodate itself to. It imitates interesting objects or ones that are easy to imitate. Now, as imitation is pretty difficult since it involves change in the infant's behavior, the mother usually tries to facilitate the infant's imitative behavior. For example, if a mother says "ba ba..." followed by an infant's babbling "ba ba...", its "ba ba..." becomes an imitative sound of the mother. If in that case it gets any reward (smiling, patting on the head), the sounds will be established very easily as imitative sounds. From the viewpoint of the formation of set, once imitation form is acquired, even if subjective activity does not intervene, imitative behavior seems to take place easily. When the mother imitates her infant's utterances by using infant-like sounds unconsciously, the writer considers this to be the effect of the mother's identification with her child. Though such identification behavior of the mother is not absolutely necessary, it is evident that it helps the infant, not only from the viewpoint of the formation of imitative set, but also because the mother in imitating her infant's sounds unconsciously expresses her mother's love for her infant. Therefore such identification is very important as an aid to the infant in acquiring words and in forming its personality.

Now, there are three kinds of imitative sounds in infancy. They are as follows:

- 1) Simple phonetic imitation (for example, when the mother says "ba ba...", the infant repeats an imitative "ba ba...")

2) Imitation of sounds which are uttered by the mother in association with special situations (for example, when the mother says "mamma" in connection with the feeding situation and the infant repeats a similar "mamma" while being fed)

3) The utterances which are learned in connection with certain situations and uttered independently of them (for example, when an infant utters "mamma" independently of eating)

In the first case phonetic imitation gives practice in uttering adult's sounds and is useful in reinforcing the infant's emotional attachment to its mother while uttering sounds as play. In the second case imitation is effective in forming an association between sounds and objects, and in making sounds into common social units i.e., words. In the third case utterance reinforces sounds' independence of objects and helps them become arbitrary signs, which is very important in the acquisition of meaningful sounds.

The general tendencies on phonemicization of infants' sounds.

The first non-crying utterances of infants are represented by the very simple pitch pattern shown in the Sona-Graph pattern of Fig. 1 and noise pattern shown in, Fig. 2 and the interval of sounds are pretty rhythmical. The sound repertory increases as months go by. The change of utterance time (Fig. 5, 6), of resonance position (Fig. 7), of intensity (Fig. 8), of pitch (Fig. 9) and of frequency area (Fig. 5~9) appear. Also, rhythmical relation among utterances is lost and a pitch in one utterance changes suddenly, and the pitch pattern and the noise pattern are jumbled (Fig. 10, 11). It is impossible to represent many of these sonagram patterns by the Japanese phoneme system or by international phonetic symbols (especially Fig. 12, 13, 14). But the appearance of the noise pattern means that the infants have begun to use consonants-like sounds (before this stage they used only vowel-like sounds). At the same time it means that in the first period of utterances there exists no regular relation between vowels and consonants. Thus, fundamentally, speech development of the first period in infants shows an increase in the quantity and variety of sounds. But we can already infer the presence of a tendency for the infants to approximate adults' utterance in the fourth month. This tendency can be inferred from the fact that the short utterance with the duration close to adults' appears individually (Fig. 15) or interposes in long utterances (Fig. 16) and that another kind of utterance with long duration differentiates into the one with different vowel pattern (Fig. 17, 18) or into the one with a gross rhythmic form (Fig. 19, 20). And from the fourth month to the fifth month, several kinds of consonant-like pattern (Fig. 23~28), combination of long utterance and short one (Fig. 34~38, Fig. 48~52) the sound including pitch pattern and noise pattern (Fig. 39~42), and the sound including vowel-like pattern and consonant-like pattern (Fig. 43~46) appear. This period (0;4~0;5) is a transitional stage from non-crying utterance to babbling, and the utterances in this period are phonetically

or structurally a babbling, but are not functionally a babbling, because an infant does not utter the sounds as play. After this period, infants enter the repetitive babbling period when unit utterances which have almost the same uttering time as adult's utterances (0.1~0.3 sec., especially 0.2 sec.) continue, and utterances resembling adults' appear* (Fig. 30, 32, 47). When listened to with the ear, many utterances in this period are heard as the repetition of almost the same sound, and most utterances are composed of more than two sounds (eight sounds or nine when long) (Fig. 53~62). And the infants' sounds cover a wide range of both vowels and consonants. However, there are no fricative sounds. This period especially from 0;7 to 0;9 is one of the peaks in the enlargement process of sounds. After that, the infants' sounds tend to become defined through a reduction of frequency area, a regularizing of the relation between vowels and consonants, and a shortening of successive sounds (long succession of sounds such as eight or nine disappears, and combination of two sounds appears) (Fig. 72~76) by imitation of mother's sounds and the practice of the infant himself.

Thus, utterances of infants develop toward the adult's phoneme-system and toward meaningful words. As above, the speech development of infants is characterized by an enlargement process in the first three months, by a defining as well as an enlargement process in the next six months, and by a defining and refining process in the last three months. As an explanation of speech development by change of position of articulation of sound is already mentioned in the previous paper⁽¹⁹⁾ we will only give an outline here.

The vowel patterns of sonagram develop from middle vowels in the direction both of back vowels such as the [u]-like and front vowels such as the [i]-like. On the other hand, the consonants (the physiological consonants dependent mainly upon maturational factors in infancy) develop from back guttural sounds to front labial dental sounds [g:]→[b], [p], [m]→[n], [t], and then to back guttural consonants (articulation level) [k], [g]. As the theory of the direction of articulation is pretty rough, it leaves plenty of room for future study.

Meaningful sounds

It is very difficult to determine when infants use their first words. Many of the mothers' reports on the first words of their infants represent merely how meaningfully the mothers hear their infants' sounds (Fig. 63~67). Putting the past studies together, it seems to be true that the first one or two words appear at about the end of the infant's first year** (Fig. 80, 82, 83, etc.).

Precedence of imitation or precedence of comprehension?

In the process by which meaningless utterances develop into meaningful ones, instances both of precedence of imitation and of the precedence of comprehension seem to be found. When an infant's sounds though forming recognizably good

* In the early babbling period, it is often found that infants' sounds are not clear though they utter the sounds repetitively (Fig. 29, 31).

** The writer recorded that infants utter the first meaningful sounds at about 0;10 year.

imitations of adult words, are presumed by the investigator to be meaningless to the infant, the investigator interprets this as demonstrating the precedence of imitation. Again, if the infant's sounds, though not forming recognizable adult words, seem to the investigator to have a symbolic function for the child, this is said to demonstrate the precedence of comprehension. Perhaps the apparent differences observed here are related to the different methods a mother may use in teaching her infant to acquire sounds.

The use of words and their comprehension

Much literature shows that infants comprehend words before using them. Though comprehending words appears earlier than using words, the speech function of infants does not develop from comprehending words to using them straight away, but both comprehension and usage have independent formations in speech development. The relation between the comprehension of words and their usage, if made clear, would be a key to the understanding of human speech development because, as we will discuss in what follows, their relation corresponds to the relation between symbol and signal. But until now all studies have been vague on this point. We have discussed the difference in the use of sign between animals and human beings. After many discussions we find the apparent difference consists in this: that animals use mainly signals while human beings use symbols. But, assuming this, there are two standpoints from which we can view the relation between signal and symbol. One viewpoint is that the signal gives rise to the symbol through a process of complication and that this process is a continuous one. The other viewpoint is that signal and symbol are intrinsically different and that the one cannot give rise to the other through any continuous process.

According to writer's standpoint, the symbolic function is uniquely human and is essential for human language. In fact, human language can be thought of as a tissue of socialized symbols.

1) What differences exist in the formation processes of symbol and signal? In the first place, the origin of the signal is shown in the behavior of the infant when he responds meaningfully to outer stimuli on the performance level in infancy. Even if the stimuli by which the sign behavior is brought out become complicated or take the form of a sign of a sign, the responses are carried out by the infants' existing schema or their transformed patterns and the infants' behavioral character remains on the performance level. The development of signal behavior shows a continuous increase in the possibility of adaptation. Its formation can be explained by conditioning from the viewpoint of the usefulness of signs in satisfying the infant's needs, and from that of the way in which signs promote the infant's adaptiveness to his environment. So comprehension of meaningful sounds is a stage in the development of signal behavior.

In the second place, we consider the origin of the symbolic function to be the behavior representing the performance or the object by a sound which is act

free from need, of representing a performance or an object by a sound. Such free acts are characteristic of the babbling period. Thus, symbolization is the substitution of the infant's subjective response and its system in contrast to the substitution of the stimulus system in the case of a signal. And yet in the babbling period, sound cannot be considered to be either more adaptive or more useful than performance. Why then does the infant symbolize by means of sound? If we question the adaptiveness and usefulness of sound as compared for an infant of the babbling age, with performance, then there can exist no other explanation than to speak of the "economy of energy" or "adaptiveness to the future." So the origin of symbolic behavior can be said to be representing performance by sounds.

It will be necessary that the meaning of play by performance or play by sound in this period be considered from the point of view of symbolization. The origin of symbolization is found in that play which uses sounds and performances in the babbling period. The relation between sounds substituted and performances or objects substituted for is almost arbitrary. What connects sounds with performances is play. In the babbling period, in order that sound-play is possible, the sound has to be substituted for the performance at the point of substitution of play function and this phenomenon appears before the particular sound is substituted for the particular performance. When sounds are substituted for the performance, both performances and sounds are pleasant for infants, that is to say, both have the same functional meaning as play. And as the babbling is a rhythmic utterance near the performance level, the substitution is comparatively easy, and both, being at first undifferentiated because of their simple intersubstitution differentiate into the "signifié" and the "signifiant" in the process of intersubstitution of performances for sounds and of sounds for performance as play, that is, the sound becomes to have representative function for performance. Of course, it is necessary that in this process a mother gives her infant rewards (both emotional ones and food). It is also necessary that the formation of the symbolic function takes place in the atmosphere of a stable and intimate mother-infant relationship, no matter what rewards or punishments may be given for acquiring words.

What takes place when a sound is substituted for an object? Objects in this period are not those which exist objectively for infants, but those which are grasped by sensory-motor schema. Grasping or getting objects is pleasant for infants and the satisfaction or the pleasure of getting the objects is connected with that of uttering the sound. In playing a sound is substituted for a performance as is a sound substituted for its object. The object is thought to increase in objectivity by substituting a sound. There is no difference between the formation mechanisms involved in the substitution of sounds for objects and those involved in the substitution of sounds for performances. It is important for the sounds which have acquired the symbolic function of designating an object or a performance to be used as playthings between the mother and the infant (social babbling and imita-

Table 1

12 mo. Test items	Factor loading		
	I	II	III
Cube : grasps two in one hand	.84		
Stands : grasps pellet (one hand held)	.74	.61	
Mirror : tries to take image doll in mirror	.75		
Pellet : inserts in bottle	.70		
Stands : momentarily alone	.68	.51	
Comprehends : a few objects by name	.63	.48	
Walks : needs only one hand held		.57	.58
Form bord : inserts round block			.71
Rod : strikes two rods each other			.70

Table 2

13 mo. Test items	Factor loading		
	I	II	III
Performance box : inserts red rod in middle hole (dem.)	.98		
Drawing : imitates stroke	.89		
Pellets : inserts in bottle (non dem.)	.57		.44
Vocabulary : utter three or four words	.50		
Massed cubes : builds tower of two	.48		.53
Form bord : inserts round block	.47	.69	
Rod : strikes two rods each other	.37		.39
Ball : releases with slight cast toward Ex.	.39		.37
Stairs : creeps up (two hands held)	.39	.85	
Walks : two or three steps		.95	
Walks : five or six steps		.87	
Stairs : creeps up		.62	
Comprehends : mother's verbal order		.47	
Cup-cube : six in and out cup		.35	.71
Two cups : searches toy in cup			.38

Table 3

inter-stage-factor intra-stage-factor mo.	A			B			C		
	I	II	III	I	II	III	I	II	III
10			.39	.62	.68	.63	.44	.50	
11					.73	.45	.57	.44	
12	.35	.32		.60	.56	.56		.49	.46
13	.74				.49			.39	0.80
14	.97		.73		.59			.48	

tive sound). The infant's sounds develop into social language through being endowed with both the character of labels and, at same time, independence of the labeled in this imitative and social activity.

As noted above, in order to comprehend how sounds and objects or performances can be differentiated into the "signifié" and the "signifiant" and how symbols become language, we cannot emphasize too much that substitution processes are subjective activity and are developed in play and that enjoyable sound stimuli and care by the mother are needed.

2) The factor analytic study concerning infants' behavior development by Maruyama and the writer shows that infants of the twelfth and the thirteenth month have the factor structure shown in Table 1, 2. In this Table 2, certain test items (uttering three or four words and understanding the mother's verbal orders) belong to different factors. And the factor involving the former test items has large factor loading in some intelligence items. The factor involving the latter test items has large factor loading in some motor items. In the factor structure of the twelfth month a test item (understanding the names of familiar objects) belongs to the motor factor. Based on the result of the factor analysis, the factor test is made from the test items of the large factor loading based on three factors in each month. Based on these test scores three factors were gotten by multiple factor analysis, and they were named respectively developmental-correlation factors A B C.

In this result, the second factor in the thirteenth month (including the item of understanding mother's orders which have large relation to the three factors of the twelfth month) seems to develop into the second factor of the fourteenth month. The latter is shown as a motor factor, but it has no relation to the first and the third factor of the fourteenth month.

On the other hand the first factor in the thirteenth month (including the item of uttering three or four words) is almost unrelated to any of three factors in the twelfth month, and has a close relation with the factor (alertness) and the third one (adaptiveness) in the fourteenth month.

As mentioned above the symbolic use of sounds and the comprehension of meaningful sounds belong not only to different factors, but also the factors to which each belongs are different in the developmental correlation and direction.

3) From the clinical data, it can be seen many of the feeble-minded infants cannot use meaningful sounds, though they can comprehend meaningful sounds. Speech disorder in institutional infants also takes the form of difficulty in uttering meaningful sounds. These results support the writer in emphasizing the qualitative difference between comprehension and use.

The relation between the sound representing and the object represented.

1) When a performance or an object is represented by things other than sounds, the question arises as to whether it is a symbol or not. Though Piaget

shows by careful observation that symbolic function is formed by the differentiation between the "signifié" and the "signifiant" in the development of circular reaction, he does not question the materials of the "signifiant". Of course, the fact that a performance and an object differentiate into the "signifié" and the "signifiant" is important for the formation of the symbolic function. But the fact that the "signifiant" consists of babbling sounds which are meaningless and flexible can be said to have significant relation to the formation of the original symbolic function in human being and the babbling period which is of no direct use in infancy is unavoidable for speech development.

2) What sounds and objects are connected would depend both upon the training by the mother and upon her infant's interests. She naturally tends to reinforce those connections between sounds which are easy for her infant to utter and objects which refer to interesting him. By means of the mother's reinforcement, a connection between sounds and things grows up in the infant's mind and this process forms one of the infant's play activities. By learning in play, an infant will happily utter reinforced sounds for things or even non-reinforced sounds for things. Of course, since the mother gives emotional rewards to correct connections, they will be reinforced and have meaning. But the symbolizing sounds do not always agree with the sounds reinforced by the mother. This is because an infant has its own peculiar concepts or schema concerning sounds and things. Sounds and things that a mother teaches often change by being adapted in his schema or conception. For example, according to Okamoto, an infant named a spitz dog toy "njan njan"* though he was taught "wan wan." He used extensively "njan njan" not only to refer to toy dogs, but also to refer to all other dogs and to anything tufty and puffy. And yet he used a different sound for the dog of the house next door.

3) In discussing the formation of the symbolic function the writer emphasized that the sound did not function as a device for the satisfaction of a need. But both the sounds representing needs and the communicative sounds (for example, "mamma",** "chodai"***) take the form of meaningful sounds with which the performance is not perfectly represented. They were often uttered together with the performances. But if the representation is perfect, they were thought to be symbolic sounds different from crying. This is because these sounds are not directed toward needed objects but are meant for obtaining satisfaction and they are also often used in play. But in infancy, if only these communicative sounds and ones representing needs are learned by training, these sounds are apt to become signs fixed to objects and to lack the flexibility of symbolic signs. As one factor in the retardation of speech development in institutional infants, it may be thought

* (njan njan) means "cat" in Japanese baby-talk.

** (mamma) means "food" in Japanese baby-talk.

*** (chodai) means "please give me" in Japanese.

that only useful sounds are learned because the lack of symbolic play between a nurse and an infant.

4) Symbolic formation was defined as the representing of an object with a sound. Representing an object with a sound is to distinguish the object from others, but in order to represent the object, it must already have been grasped definitely as one of the objects in a sensory-motor concept.

Okamoto's observation in the last paragraph will be interpreted as an example. The infant had formed two separate sensory-motor schemata, that is, "something tufty" and "a dog." As a sound happened to be connected with a spitz which mixed the two schemata, it may be said that the object became differentiated into the two existing schemata and that the sound generalized in the two corresponding directions. This representation by sounds systematized and made clear the concept of objects which were posited by the infant's sensory-motor schemata. But, as in this case, an infant's conceptualization often contradicts both adult concepts and his own experience. So an infant's concept is defined and made stable as a socialized concept by the social control of the mother's training and by the give-and-take between the infant himself and his environment.

In the socialization process, an infant's concept which is rejected as mistaken is always of value in his speech development. Though it is suppressed socially, it enriches the infant's conceptual resources and will perhaps aid in the formation of later socially viable concepts.

5) The infant's concept of human meaningful sounds is very vague and this concept goes through the processes of generalization and specialization and develops into the adult's concept. But in the developmental process some general types are seen. Okamoto's study shows that a sound is generalized to apply to a class of objects or that a sound is specialized to apply to a single object. One study by the writer showed that two different sounds were sometimes used to apply to one object. For example, an infant (15 months old) named a ball which was made of sewed cloth both "bon bon" and "dan dan". This fact shows that a one to one relation between sounds and objects is not yet formed at this age and that the arbitrariness of the relation of sound to object is one of the characteristics of the symbolization process. Another study by the writer showed that one sound is sometimes used for conceptually unrelated objects. When an infant already called a pig made of sewed cloth "bu bu," he was then trained to name a toy train "bu bu". Thus, he named two objects "bu bu". This shows that the connection in meaning between a sound and an object was not yet perfectly formed. This lack of connection was accompanied by confusion in the infant's behavior. While uttering "bu bu," the infant pushed the pig as if it were a toy train. This confusion was soon dispelled by naming the train "ba ba" and the two utterances became stable words.

Though these processes are regarded as incorrect for adults, for infants it is useful in enriching and making more flexible the powers of conceptualization.

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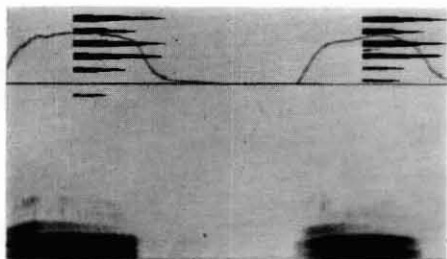


Fig. 1. First non-crying utterance (0:1 yr)

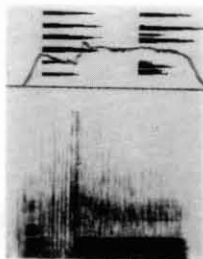


Fig. 2. First non-crying utterance (including the noise pattern) (0:1)

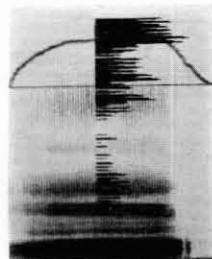


Fig. 3. Sound which an adult uttered to imitate the infant's sound of Fig. 1



Fig. 4. Sound similar to that of Fig. 1 (0:3)

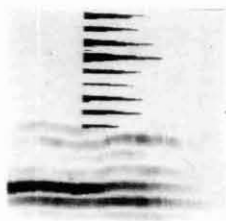


Fig. 5. Long utterance (0:2)



Fig. 6. Short utterance (0:2)



Fig. 7. (a)-like sound (0:3)

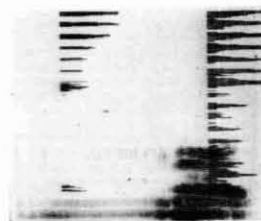


Fig. 8. Sound showing change of intensity in one utterance (0:3)

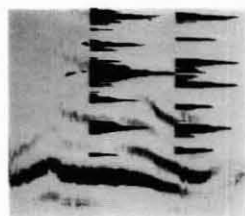


Fig. 9. Sound showing remarkable change of pitch in a utterance (0:3)

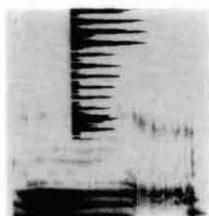


Fig. 10. Sound in which pitch and noise pattern are not regulated (0:2)

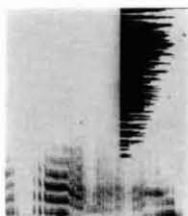


Fig. 11. Sound which change from pitch pattern to noise pattern (0:3)

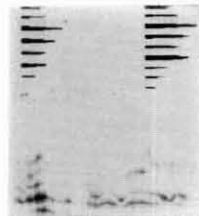


Fig. 12. Very complicated sound pattern (0:2)



Fig. 13. Very complicated sound pattern (0:3)



Fig. 14. Very complicated sound pattern (0:3)

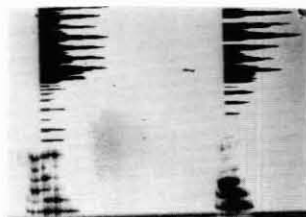


Fig. 15. Short utterance (uttering individually) (0:4)

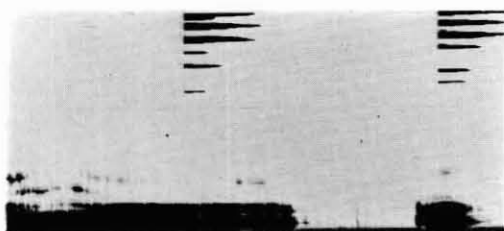


Fig. 16. Short utterance (can be seen in long utterance) (0:4)

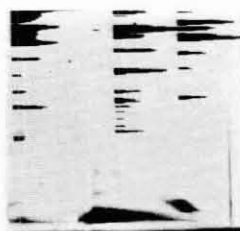


Fig. 17. Sound showing the change of resonance in a utterance (0:4)



Fig. 18. Sound showing the change of resonance in a utterance (0:4)

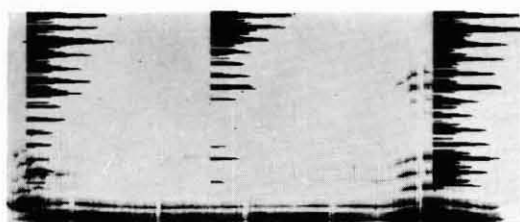


Fig. 19. Sound showing the regular and successive change of resonance pattern (0:4)

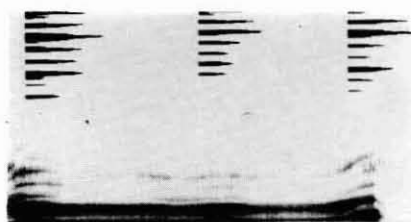


Fig. 20. Sound showing the regular and successive change of resonance pattern (0:4)

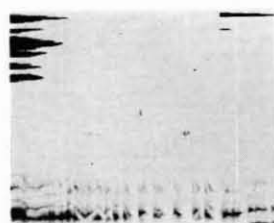


Fig. 21. Throatly sounds (0:4)



Fig. 22. Sound similar to that of Fig. 2 (0:4)

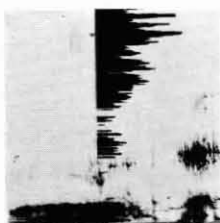


Fig. 23. Sound including (h) or (c)-like pattern (0:4)

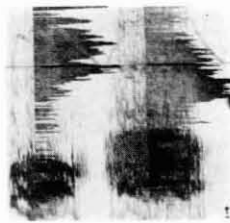


Fig. 24. Sound including (h) or (c)-like pattern (0:4)

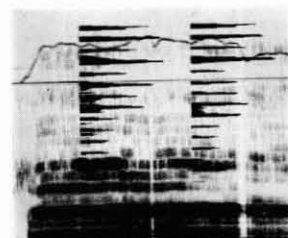


Fig. 25. Sound including (ε)-like pattern (0:4)

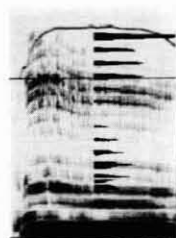


Fig. 26. Sound including (w)-like pattern (0:4)

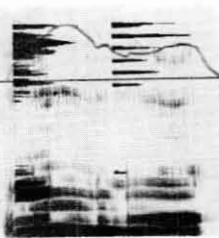


Fig. 27. Sound including nasal pattern (0:4)

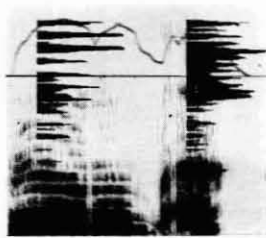


Fig. 28. Sound including labial pattern (0:4)

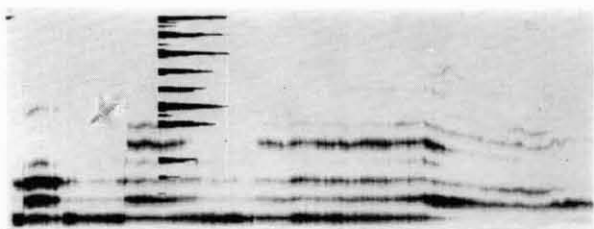


Fig. 29. Irregular repetitive sound including nasal pattern (0:5)

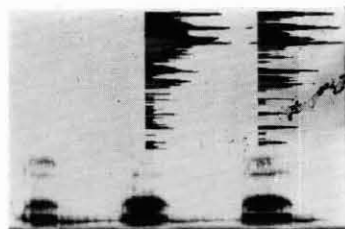


Fig. 30. Repetitive sound including labial pattern (0:5)

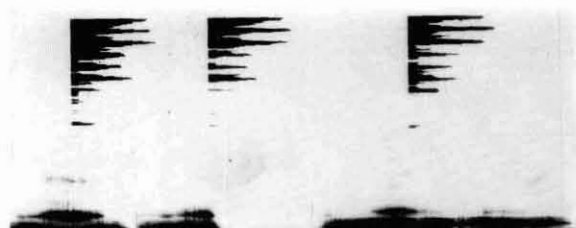


Fig. 31. Irregular repetitive sound (0:5)

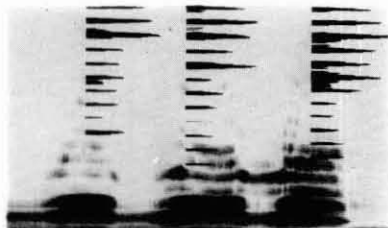


Fig. 32. Repetitive sound (0:6)

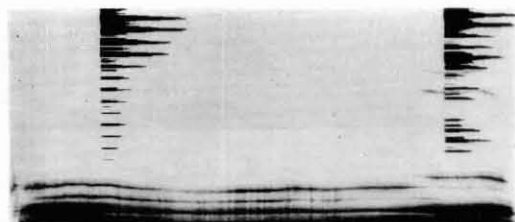


Fig. 33. Sound in discomfort (0:6)

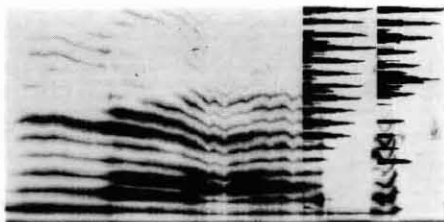


Fig. 34. From long utterance to short utterance (0:5)

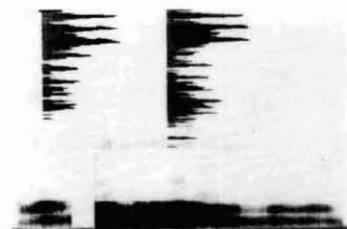


Fig. 35. From long utterance to short utterance (0:5)

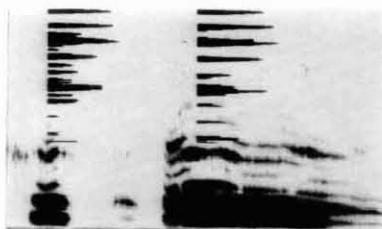


Fig. 36. From short utterance to long utterance (0:5)



Fig. 37. From long utterance to short utterance (0:5)

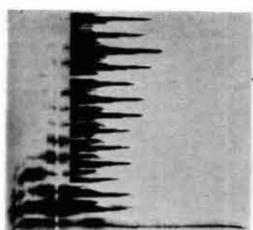


Fig. 38. Sound including short utterance and long one (0:5)

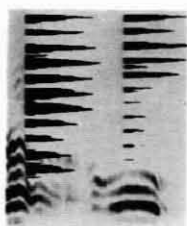


Fig. 39. Sound including pitch pattern and noise pattern (0:5)

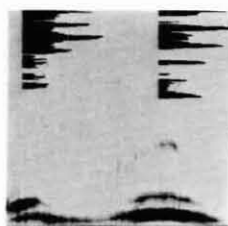


Fig. 40. Sound including pitch pattern and noise pattern (0:5)



Fig. 41. Sound including pitch pattern and noise pattern (0:6)

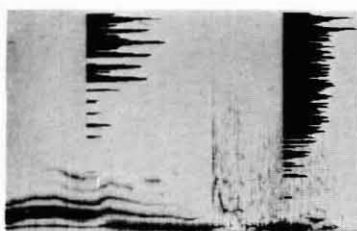


Fig. 42. Sound including pitch pattern and noise pattern (0:5)

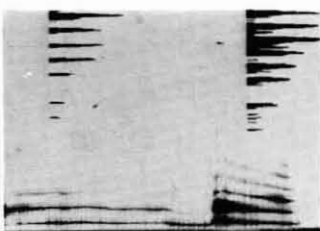


Fig. 43. Sound including vowel-like and consonant-like pattern (0:5)

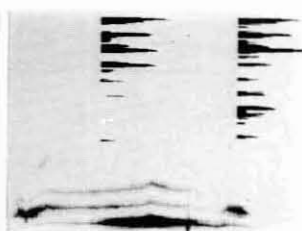


Fig. 44. Sound including vowel-like and consonant-like pattern (0:5)

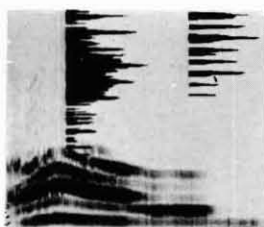


Fig. 45. Sound including vowel-like and consonant-like pattern (0:5)

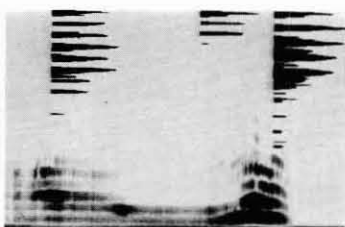


Fig. 46. Sound including vowel-like and consonant-like pattern (0:6)



Fig. 47. Repetitive sound (affricate) (0:6)

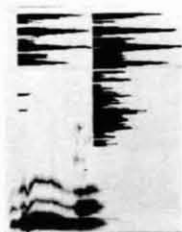


Fig. 48. Sound including consonant pattern (nasal) (0:5)



Fig. 49. Sound including consonant pattern (labial explosive) (0:5)

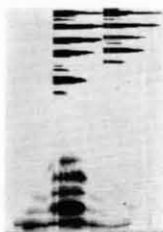


Fig. 50. Sound including consonant pattern (labial) (0:5)



Fig. 51. Sound including consonant pattern (alveolar) (0:5)



Fig. 52. Sound including consonant pattern (affricate) (0:6)

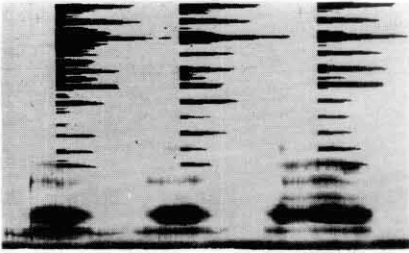


Fig. 53. Repetitive sound including [b] (0:7)

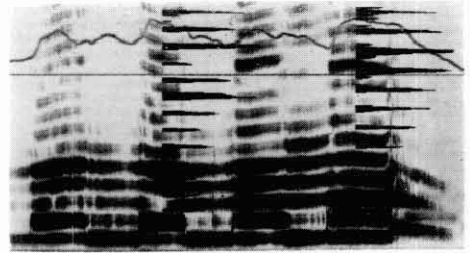


Fig. 54. Repetitive sound including [m] (0:7)

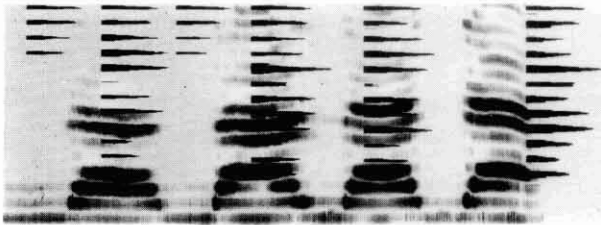


Fig. 55. Repetitive sound including [n] (0:7)

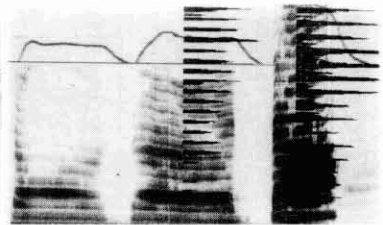


Fig. 56. Repetitive sound including [tʃ] (0:7)

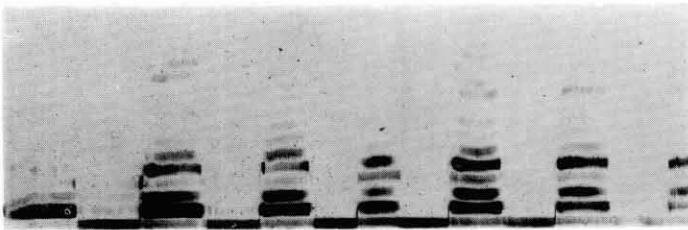


Fig. 57. Repetitive sound (long succession) (0:8)

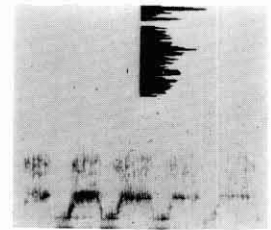


Fig. 58. Repetitive sound including (flapped) (0:8)

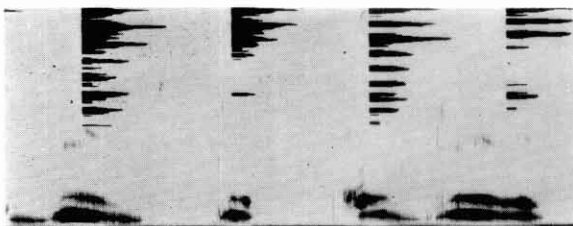


Fig. 59. Irregular repetitive sound (including [tʃ] and [dʒ]) (0:8)

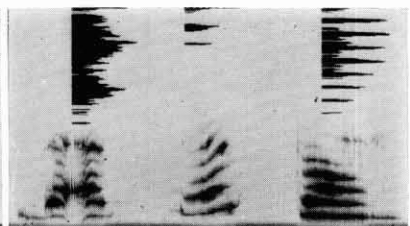


Fig. 60. Repetitive sound (including [tʃ] and [t]) (0:8)

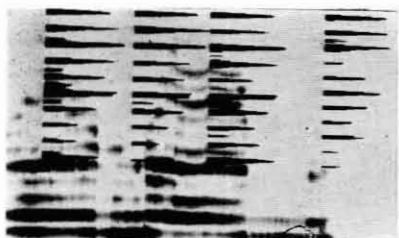


Fig. 61. Repetitive sound (0:8)

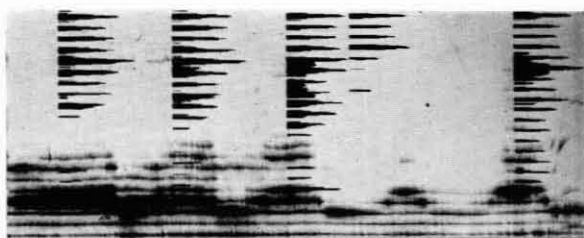


Fig. 62. Irregular repetitive sound (0:9)

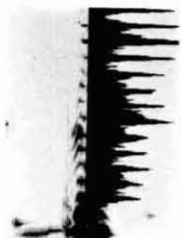


Fig. 63. Sound which is reported as a meaningful sound [mamma] by a mother (0:9)

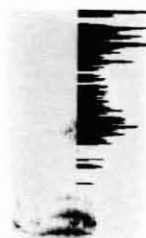


Fig. 64. Sound which is reported as a meaningful sound [mamma] by a mother (0:8)

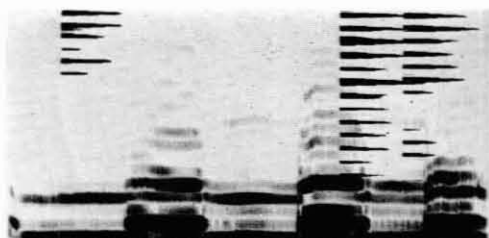


Fig. 65. Sound which is reported as a meaningful sound [mamma] by a mother (0:8)



Fig. 66. Sound which is reported as a meaningful sound [mamma] by a mother (0:8)

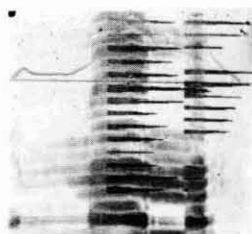


Fig. 67. Sound which is reported as a meaningful sound [mamma] by a mother (0:8)

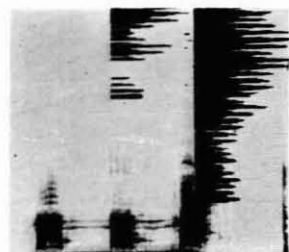


Fig. 68. (mamma) uttered by adult (0:8)

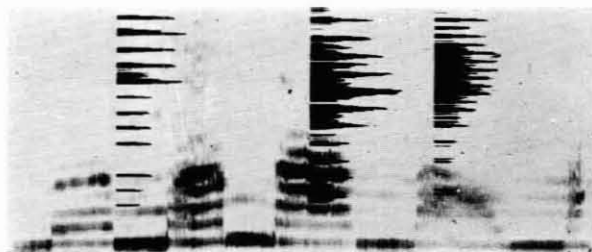


Fig. 69. Response to 68 (0:9)

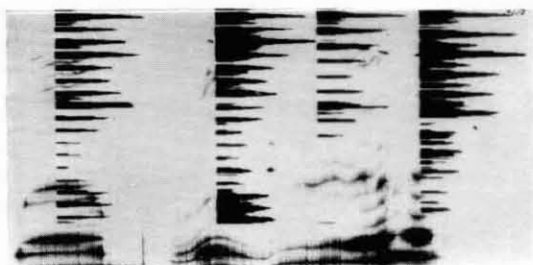


Fig. 70. Irregular repetitive sound (0:9)

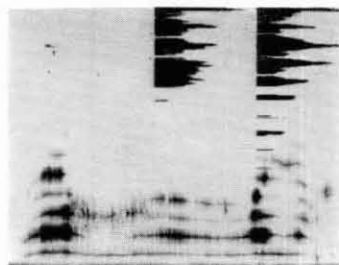


Fig. 71. Irregular repetitive sound (0:9)

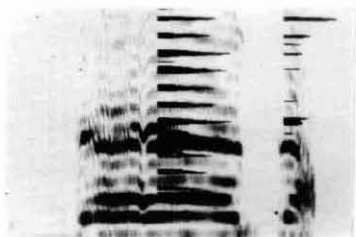


Fig. 72. Transitional sound from babbling to meaningful sound (0:8)

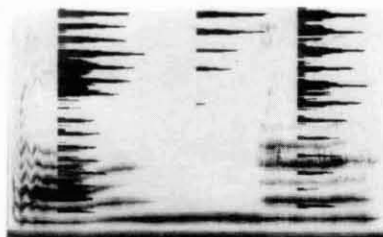


Fig. 73. Transitional sound from babbling to meaningful sound (0:9)

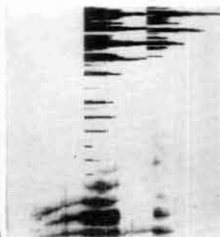


Fig. 74. Transitional sound from babbling to meaningful sound (0:9)

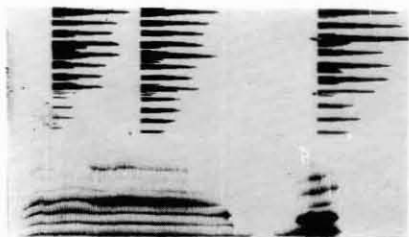


Fig. 75. Transitional sound from babbling to meaningful sound (0:9)

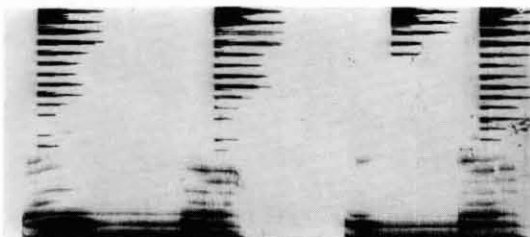


Fig. 76. Transitional sound from babbling to meaningful sound (0:9)

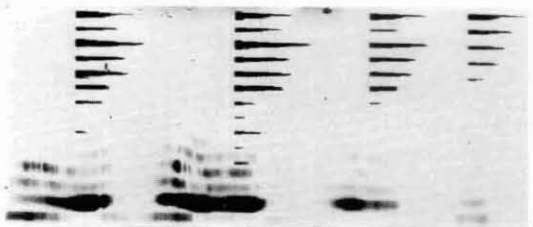


Fig. 77. Repetitive sound (0:10)

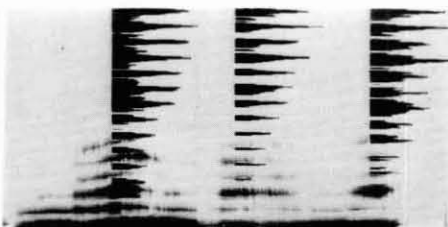


Fig. 78. Repetitive sound (0:11)

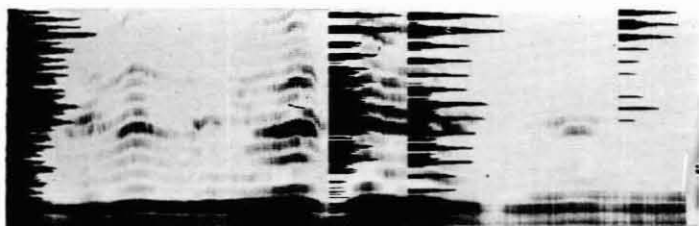


Fig. 79. Irregular repetitive sound (0:10)

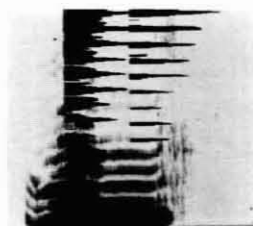


Fig. 80. Meaningful sound [njan njan] (0:10)

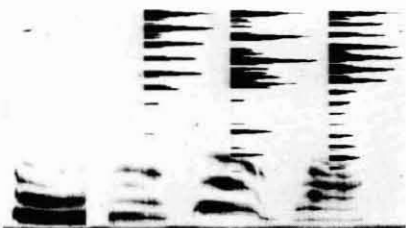


Fig. 81. Repetitive sound (0:11)



Fig. 82. Meaningful sound [nenne] (0:11)*

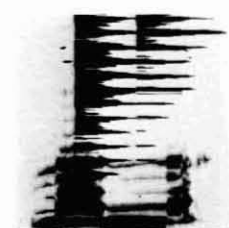


Fig. 83. Meaningful sound [mamma] (0:10)



Fig. 84. Father's sound [bu: bu:]

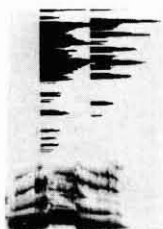


Fig. 85. Response to 84 (0:10)

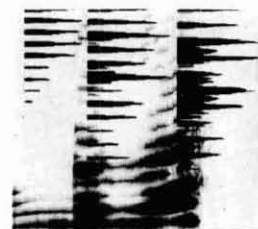


Fig. 86. Meaningful sound [wawwaw] (0:11)**



Fig. 87. Meaningful sound [waw waw] (1:0)

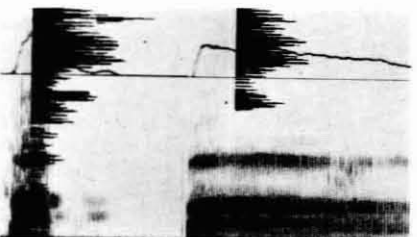


Fig. 88. Father's sound [ba: ba:]

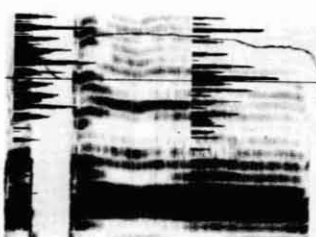


Fig. 89. Response to 88 (0:11)

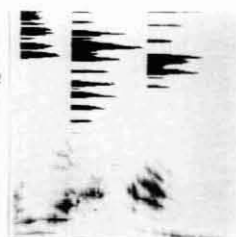


Fig. 90. Meaningful sound [ocha] (1:0)***

* (nenne) means "go to sleep" in Japanese baby-talk.

** These are the variation of [wan wan]. It means "bow bow" in Japanese.

*** (otja) means "tea" in Japanese.

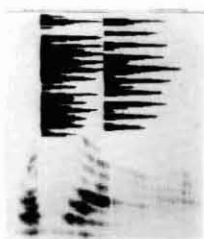


Fig. 91. Meaningful sound [botɕi] (1:0)****

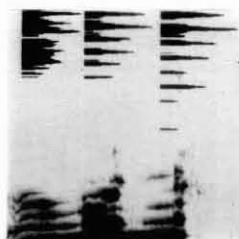


Fig. 92. Meaningful sound [ɲjan ɲjan] (1:0)

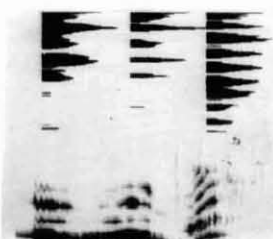


Fig. 93. Transitional sound from babbling to meaningful sound (0:11)

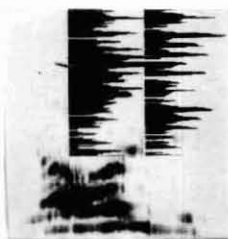


Fig. 94. Transitional sound from babbling to meaningful sound (0:11)

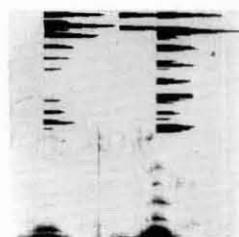


Fig. 95. Transitional sound from babbling to meaningful sound (0:11)

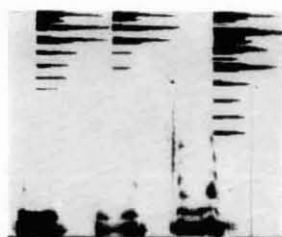


Fig. 96. The sound pattern including [k] (0:10)



Fig. 97. Directive word***** [kore] (0:11)



Fig. 98. Meaningful sound [kokko]***** (0:11)



Fig. 99. Meaningful sound [kokko] (0:11)

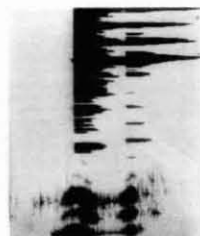


Fig. 100. Meaningful sound (1:0)

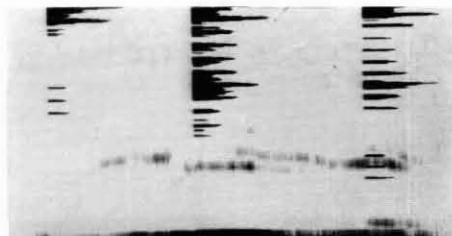


Fig. 101. sound pattern [I] (0:11)

**** [botɕi] is one of variation [bo:ɕi]. It means "cap" or "hat" in Japanese.

***** [kore] means "this" in Japanese.

***** [kokko] means "hen" or "cock" in Japanese baby-talk.