

A Comparative Study of the Speech Developments of Japanese and American English in Childhood (1) — A Comparison of the Developments of Voices at the Prelinguistic Period — *1

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I. INTRODUCTION

To make clear the developmental process of speech in childhood is one of the most important problems in the various studies of symbolic behavior, including the study of language, and also in the studies of human development. The study of speech development, however, has not progressed much, because of the lack of the objective description of voices. The latest advance in electronics has overcome this methodological difficulty. We can use a tape recorder in recording voices and can use a sound-spectrograph in analyzing and describing them.

Using a Sona-Graph, J. Murai made clear the developmental process of the prelinguistic utterance of Japanese infants (3). N. Okamoto made clear the process in which prelinguistic voices got stabilized as words in the case of a Japanese infant (6).

Comparing the speech developments of Japanese and American, we are going to make clear the following processes and the influences of environmental factors, especially the language system of parents, upon these processes :

- 1) How does the development of an articulation mechanism in childhood proceed ?
- 2) How do the prelinguistic voices, uttered by an infant, become systematized to be a specific phoneme system ?
- 3) How does the verbalization of these voices proceed through the process of the phoneme-systematization ?
- 4) What kind of fundamental relations exist between the phoneme-systematization, verbalization process and other developmental processes, especially the development of personality ?

In this article, as the first step of this research, we deal with infants from birth to about one year, the beginning of the phoneme-systematization and verbalization.

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II. PROCEDURES

We selected three female and three male Japanese and two female, two male Americans*², shown in Table 1. We recorded the voices of each of them in its favorite playing room by a tape recorder and described the situations in which it uttered sounds and behaved. Each recording took about half an hour. We analyzed these voices by the Sona-Graph, H.S., wide band, and recorded their overall envelopes by the Amplitude Display Unit, shown in Fig. 1-10. The tape recorder used was TEAC (TD 102, AR 11). Its overall recording and reproducing characteristic was from 40 cps to 15000 cps ± 3 db, speed 7 1/2 inch/second.

To supplement these recordings daily records were kept covering the following points:

- 1) Observations of S's voices and situations which S uttered them.
- 2) Observations of S's responses to external voice stimuli.

Table 1. Subjects and Recording Condition*³

Nationality	Subjects (Sex)	Beginning of Recording	Beginning of Recording by Tape Recorder	One Recording per	Sonagrams of their Voices, shown in
Japanese	E.T. (F)	5 days (0; 0,5)	28 days (0; 0,28)	1 Wk.	Fig. 1
	Y.S. (F)	2 Mos. (0; 2)	2 Mos. (0; 2)	2 Wks.	Fig. 4
	Ya.N. (F)	1 Mo. (0; 1)	1 Mo. (0; 1)	2 Wks.	Fig. 5
	H.K. (M)	1 Mo. (0; 1)	1 Mo. (0; 1)	2 Wks.	Fig. 7
	T.T. (M)	7 Mos. (0; 7)	7 Mos. (0; 7)	1 Mo.	Fig. 10
	Yu.N. (M)	1 Mo. (0; 1)	10 Mos. (0; 10)	2 Wks.	Fig. 9
Americans	G.M. (F)	3 Mos. (0; 3)	3 Mos. (0; 3)	2 Wks.	Fig. 2 & 8
	F.P. (F)	6 Mos. (0; 6)	6 Mos. (0; 6)	2 Wks.	Fig. 11
	E.D. (M)	7 Mos. (0; 7)	7 Mos. (0; 7)	2 Wks.	Fig. 6
	C.W. (M)	6 Mos. (0; 6)	6 Mos. (0; 6)	2 Wks.	Fig. 3

*³ We could not record regularly, because of S's or observer's sickness etc..

III. RESULTS AND DISCUSSIONS

In order to make clear the process of speech development we should find out what relations exist between successive stages in this process by a longitudinal study. We have recorded 10 Ss' voices longitudinally. We describe and discuss these 10 Ss' data. But to save space we select two Ss, E.T., a Japanese, and C.W., an American, and exhibit their sonagrams mainly and show their case histories in Table 3, 4.

We divide the prelinguistic period, i.e. from birth to about one year, into several stages mainly from the viewpoint of the development of an articulation

*² Every family of these Americans had a Japanese maid. Therefore these Ss' speeches were influenced by the maid's Japanese. We could not find any Americans without a Japanese maid. The parents of each family, however, talked to their infant in English.

mechanism.

1st Stage. From birth to about one month, the beginning of non-crying utterance. At this stage, the voices produced by Ss were crying. They cried when they were in a state of discomfort. When they cried their mother came to them and took away the causes of their discomfort. When their needs were satisfied they stopped crying.

Expression, evocation and representation are called the three functions of speech. Crying seems to be the expression of Ss' discomfort and the evocation to their mother. Therefore crying seems to be the origin of speech. As Murai (4) and J. Itani (2) stated, however, we don't think crying, voice directly related with needs, is the main origin of speech. The Japanese monkey has its own voice system. It has the function of expression and evocation, but not of representation. The path of evolution from the monkey's voice system to the human symbol system is not continuous (2).

At the first stage, two of our Ss, E.T. and H.K., produced some strange sounds. When they were not sleeping soundly, they moved their bodies and stretched their arms and legs in addition to producing these tense sounds. These sounds seem to be produced by a pipe, constructed from larynx to nose or mouth. They were produced without the vibration of the vocal cords, Fig. 1.1, or with it, Fig. 1.2. Two Ss continued to produce these sounds until about two months.

2nd Stage. The Beginning of the Phonation of the Non-crying Utterance. About one month.

We define pronunciation to be the utterance which consists of phonation, producing sounds mainly by the vocal cords, and articulation, the modification of these produced sounds.

At the second stage the Ss began to produce non-crying calm voices mainly with the vibration of the vocal cords. These voices were principally [ə]-like voices*⁴, Fig. 1.3, 2.1*⁵, with the most relaxed articulation organs. By chance, when the cavity between the back of the tongue and the soft palate was not open [ʃ]- or [x]-like voices*⁶ were produced, Fig. 1.4-7, 2.2-4. The Ss phonated voices rather actively. But their articulation was ruled by chance. The rhythm of their phonation was not exactly the same as that of their respiration. One period of the former was about 0.6-0.8 sec. and that of the latter was about 0.4-0.6 sec. Their phonation, however, was not independent from their respiration completely. These voices were phonated at the expiration period of their ordinary respiration.

*⁴ We cannot describe these voices by the phonetic symbols. We try to show what kind of voices they are, in this report. Refer to their sonagrams.

*⁵ As shown in Table 1, we have no data of Americans before three months, because of the difficulty of finding an American subject. We show the corresponding voices after three months.

*⁶ When the duration of the friction was short by chance, [ʃ]- or [x]-like voices turned into [g]- or [k]-like voices.

The Ss phonated these voices when they were comfortable, i.e. after enough sleep, food, being close to the mother, etc.. At first, they tended to begin to phonate these calm voices when they were with the mother, then, to phonate them even when they were alone in bed and to repeat phonation as if they were practicing this operation. For example, at the beginning of one month Ya.N. began to respond to her mother in a calm voice when she was being fed by the mother. Later she responded when she was with her mother even when she was not being fed. And at the end of one month she uttered calm voices when she was alone in bed more frequently than when she was with her mother.

As Murai stated (4), we think this calm voice is the main origin of speech. Why do human beings begin to pronounce speech at this stage? H. Wallon pointed out: When some function begins to work, its organ should be mature beforehand. The pattern of organs' maturation is specific to species. An infant, at first, begins to try to operate the newly matured organ. But its operation is not stable. Next, it operates the organ repeatedly without any relations with its needs. After that, it tries to operate the organ to satisfy its needs in various situations (11). We think, by the second stage, for human beings, the central and the peripheral organs concerning phonation have matured. And at this stage, they begin to operate these organs.

J. Piaget discriminated organic and functional needs (8). We use this classification in a somewhat different way. We classify two kinds of needs, functional needs, the end of which is only to operate the organ, and organic needs, in a wide sense. To satisfy the organic needs, the organ's operation is used as a means. Then we classify two kinds of voices, the voice related to the organic needs, i.e. mainly the crying, and the voice related to the functional needs, i.e. the non-crying voice.

The beginning and the development of the phonation are regulated by the maturation of the phonation organs and are accelerated by the mother's talking. The mother talks to her baby, e.g. when she is feeding it, etc., even if it does not reply in voice. When the baby begins to utter some sounds the mother tends to talk to it more. This talking stimulates the baby to phonate more. At first, vocal response, of course, is not differentiated from other responses to mother's actions. After this stage, vocal response differentiates gradually from other responses. A vocal response shown in Fig. 1.7 is one of the examples.

As shown in Table 2, E.T. cried differently in different situations. We think, by this stage the infant's needs and personality in general has already developed and differentiated to some extent. The differences in crying cause differences in the mother's reactions. The differentiation of the mother's reactions accelerates the differentiation of its personality. At this stage, of course, infant's means-end-relations are not differentiated. Also the development of its non-crying utterance has no direct relation to the development of its personality.

3rd Stage. The Development of the Articulation. About two to five months.

At about two months the Ss began to utter sounds independently from their respiration. The duration of one phonation became much longer than that of one normal expiration. They began to modify these voices actively. For example, E.T. began to change the pitch during one utterance, Fig. 1.8.

About two, three or four months: Middle-vowel-like voices, [ə]-like voices, appeared less often and front-vowel-like voices, e.g. [a]-, [æ]-, [ɛ]-, [e]-, [i]-like ones, Fig. 1.9-12, became dominant and back-vowel-like voices, e.g. [ü]-like one*⁷, Fig. 1.13, 2.3, appeared. Diphthong-like-voices consisting of these voices also appeared, Fig. 1.10-14, 2.3. Round-vowel-like voices, e.g. [u]-like ones, were articulated rather by chance, not constantly. The number of glottal-fricative-like voices' appearance, e.g. [ʁ]-, [x]-like ones', decreased very much. E.T. articulated [x]-like voice actively, not by chance, Fig. 1.20, at 0;3. [j]-, [ç]-like voices, articulated at the front part of the articulation organs, appeared, Fig. 1.10-11. When expiration came from the nose cavity by chance, [ŋ]-like voices were produced, Fig. 1.16. By five months, C.W., an American, had developed these articulations, Fig. 3.1-4. Voices articulated by the lips, [pʰ]-like one, and by the tip of the tongue, [tʃ]-like one, Fig. 1.17-19, were rather exceptional.

About four or five months: Tense voices appeared. Not only the voices articulated by the front part of the articulation organs, e.g. [i]-like one, but also those by the back, e.g. [o]-, [ɯ]-like ones appeared, Fig. 1.21-23, 3.1, 5,7. The voices articulated by the lips, e.g. [m]-, [β]- or [Φ]-like ones appeared, Fig. 1.22-24, 3.6, 8. Almost by chance, the Ss articulated them plosively or fricatively and expired through nose or mouth. The voices articulated by the tip of the tongue, e.g. [d]-like ones etc., began to appear, Fig. 1.25, 3.9. The Ss articulated voiced or voiceless ones almost by chance. Syllable-like voices, some combinations of these voices, appeared as a unit of articulation.

When they cried they used these articulation mechanisms, Fig. 1.29, 3.14. When they were in a state of discomfort they uttered nasalized-vowel-like voices and [ʁ]-like ones, a retarded pattern of articulation, Fig. 1.30, 3.15.

In the cases of Japanese, Murai found that vowel-like voices developed from the middle to the front on one side and from the middle to the back on the other side, and they developed from the relaxed to the tense (3). We obtained the same results both from Japanese and Americans.

The Ss were fond of operating both the phonation organs and the articulation organs or each of them in various ways. Their articulations varied in various ways, Fig. 1.28, 3.13. They voiced sounds in a high pitch, Fig. 1.26, 3.10, and even by inspiration, Fig. 1.27, 3.11. They repeated opening and closing their mouth or putting their tongue in and out without uttering. They were also fond of hearing their parents' voices, imitating their articulation.

*7 [ü] is one of the middle vowels. [ü]-like voice, described here, was the voice which varied from [ə]-like voice backwards a little but not so clearly as [w].

At the middle of two months E.T. began to play alone and at the same time she began to pronounce alone. Some Ss who played alone from the second stage pronounced alone from the second stage. Some Ss pronounced more actively when they were with their parents than when they were alone and some pronounced more actively when they were alone than when they were with their parents.

We think, through the third stage the maturation of the central and the peripheral organs concerning phonation proceed and the central and the peripheral organs concerning articulation mature. An infant operates these organs frequently. From two or three months an infant's response to its environment becomes active. An infant's various organs has matured and it operates these organs actively. Operating the phonation and the articulation organs is one of these phenomena. It is one of the circular reactions (1).

This operation was not so differentiated at this stage. For example, at two months E.T. stopped pronouncing when she was interested in looking at new objects surrounding her. As she got used to looking at these objects, she pronounced actively again in this situation. At five months when she began to be interested in playing with toys, the same tendency was observed.

Sometimes the Ss imitated their parents in action, shown in Table 3, 4, but not in utterance. They responded only by their own articulation mechanism, e.g. Fig. 1.12, 14.

Through the third stage, the differentiation of Ss' needs, their personality proceeded. And, as shown in Table 3, 4, their cognition of daily schedules developed. What they began to cognize was closely connected with their organic needs. We think, the developmental organization process of the infant's cognition, based on the differentiation of its personality, is accelerated by the satisfaction or the dissatisfaction of its organic needs. The infant's cognition of external voice stimuli is no exception.

4th Stage. Repetitive Babbling. About six to eight months. At about six months the Ss began to repeat some similar articulations rhythmically. These repeated voices were not exactly the same.

At first, at about six months, various consonant-like voices articulated by the lips were dominant, e.g. [m]-, [b]-, [p]-, [w]-, [Φ]-, [v]-like ones, Fig. 1.31-36, 3.16-24, 6.1, and then at about seven months, the Ss articulated voices by the front part of the tongue actively, e.g. [d]-, [t]-, [dʒ]-, [tj]-, [ɲ]-like ones, Fig. 1.41-45, 3.27-32. The repetitions of the articulations by the back of the tongue, e.g. [k]-like ones, Fig. 3.33, were observed in a few cases.

Some repetitive babblings in a whisper or in a high pitch were observed, Fig. 1.33, 3.20, 1.44, 3.33. Syllable-like voices, articulated not in repetition, also appeared, Fig. 1.48-50, 3.35-41. Voiced or voiceless, aspirated or non-aspirated, expiration through nose or mouth, some variations of a certain articulation, e.g.

[tɕə]- or [tæ]- or [tjæ]-, [tʲ]- or [tʰ]-, [wa]- or [βa]- or [va]-, [ʔ]- or [k]-like ones, etc., seemed to be articulated by chance. These utterances, repetitive babblings or syllable-like voices, consisted of vowel-like voices or of consonant-like voices or of their combinations. The Ss varied their articulations not only in adult's normal ways but also in peculiar ways. For example, E.T. articulated [l]-like voices with the tip of the tongue and the upper lip, Fig. 1.46. [k]-like voices were various kinds of mixtures of [k]- and [x]-like ones, e.g. Fig. 3.33, 41.

When they cried they used these articulation mechanisms accompanying nasalized-vowel-like voices, Fig. 1.47, 3.34.

By the end of the fourth stage, almost the same articulations as those of parents' phoneme system were articulated. But round vowel, [u], back vowels, [ɔ], [ɑ], semi-vowel, [w], lateral, [l], fricatives, [s], [z], [ʃ], [ʒ], [ç], [ʝ], [f], [v], [θ], [ð], and flap, [ɾ], were the exceptions.

At the beginning of the fourth stage articulations by the lips, at the middle by the front part of the tongue, at the end by the back of the tongue were relatively dominant both in Japanese and Americans. Murai found the same developmental direction of consonant-like articulation in the cases of Japanese (3). At this stage we did not find meaningful differences between the articulations of Japanese and those of Americans.

We think, at the fourth stage mainly at six and seven months, the maturation of the articulation organs, especially the jaw and the tongue, proceeds very much. An infant operates these organs repeatedly as if it were practicing these articulations and satisfying its functional needs. The development of these articulations is also accelerated by auditory stimuli. The characteristic feature of non-crying utterance as a circular reaction is most dominant at this fourth stage. As a matter of fact, not only parents' voices but also other sounds, e.g. a dog's barking, Fig. 10.2, caused these repetitive babblings.

Through the fourth stage, imitation in action, e.g. waving a hand or making a smile-like face etc., developed and became active. Even at the end of this stage, however, some imitations in utterance were observed only in a few cases. When the Ss were talked to by parents they smiled or uttered some voices but did not imitate parents' voices. Sometimes when they were looking at their parents' expressions they imitated their parents' voices. In these cases their voices were different from their parents' but almost the same in intonation, Fig. 1. 51-52, 3.42-43, 7.3-4. As shown in Fig. 1.53-56, E.T. seemed to try to imitate her mother's voice as correctly as possible.

By the end of the fourth stage, most Ss began to be afraid of strangers and began to stop their action when they heard their mother's "no".

We think, through the fourth stage, the differentiation of infant's needs, the development of its personality and the organization of its cognition proceed further. And on this basis, the organization of its cognition of the external voice

stimuli proceeds. It begins to learn that a certain external voice stimulus refers to its certain behavior or to a certain object in a certain situation. "No" inhibits the satisfaction of an infant's organic needs. This is one of the first words that it understands. Even at this stage, the development of an infant's articulation mechanism has as yet no direct relation to the differentiation of its personality and to the organization of its cognition.

5th Stage. The Decrease in the Repetitive Babbling and the Development of Prelinguistic Communication in Voice. About nine months to one year.

From about nine months the repetitive babbling, the rhythmical repetition of similar articulations, tended to decrease gradually. The Ss tended to change the rhythm in one utterance, e.g. E.T. articulated [i:ja:] like voice slowly and [æiaɪ] like voice rapidly, etc., Fig. 1.60, 3.47. The Ss tended to divide one long babbling into several pieces, i.e. word-like voices, consisting of several syllable-like voices, e.g. Fig. 1.59, 3.51, 6.2, etc.. Even after nine months some Ss articulated the repetitive babbling, e.g. [g]-, [ʃ]-like ones, Fig. 3.48-49, etc..

Articulations which appeared during the fifth stage: [ʃ]-like voices, Fig. 1.63, 3.51, [l]-like ones, Fig. 5.4, 6.2, by both Japanese and Americans. [ç]-, [ʁ]-, [bu]-like ones by Americans, Fig. 6.3, 3.50, 5.6, [t̥ü]-like one by Japanese, Fig. 1.62. We don't think there are meaningful articulation differences between Japanese and Americans at this stage. A Japanese articulated [zæ]-like voice, Fig. 5.3. [z] and [ç] are similar in articulation. When an infant articulates a [ç]-like voice with an effort it may turn into a [ʃ]-like one by chance. [ʁ] is similar to [di] in articulation (5). An American articulated [dʒw]-like voice, Fig. 3.41. It is similar to [t̥ü]-like one in articulation.

We think the maturation of an infant's articulation organs and its operating of these organs almost reach its peak by the end of the fourth stage. Therefore an infant's intentional operating of these organs begins to decrease after that. Of course, the detailed maturation of an infant's articulation organs proceeds further and its operating of these organs, satisfying its functional needs without satisfaction of its organic needs, continues through and after the fifth stage.

Articulations which did not appear by the end of the fifth stage: Back vowels, [ɔ], [ɑ], semivowel, [w], fricatives, [s], [z], [ʒ], [θ], [ð], [f], [ʃ]. If the Ss articulated some voices with an effort, protruding or rounding their lips might occur very easily. At this stage the Ss sometimes articulated with some unnecessary energy. Round-vowel-like voices, [u]-, [ʊ]-like ones, were articulated rather by chance, not constantly. The Ss did not articulate round-vowel-like voices, except [u]-, [ʊ]-like ones, e.g. [y]- or [ø]-like ones etc.. The Ss' articulations were not systematized yet. For example, F.P. articulated [v]-like voices with the tip of the tongue and the upper lip, Fig. 11.1.

The Ss tended to pronounce the word-like voices, even the repetitive babblings, changing the pitch and changing the stress. We heard them as if they

were in a conversation situation. For example, they pronounced these voices in rising intonation as if they were asking a question. Of course, these voices were meaningless ones.

As shown in Table 3, 4, the imitations in action were observed almost constantly. The imitation of the repetitive babbling was performed fairly well, Fig. 1.64-65. The imitation of a word was not performed well at first and was performed better later, e.g. Fig. 6.4-6. The Ss did not imitate a word's or sentence's voice articulation well but imitated its intonation fairly well. For example, C.W. did not imitate his mother's voice but imitated her intonation and her gestures, Table 4, Fig. 3.52.

As Piaget considered (9), if a schema has been differentiated well, an infant can imitate some behavior using this schema. We think, by the fifth stage, the schema of articulating repetitive babbling has been fairly differentiated as a circular reaction and the schema of articulating a word or a sentence, i.e. the conscious application of the schema of articulating repetitive babbling to new situations, has not been differentiated. By this stage, however, the schema of phonation has been differentiated. To produce intonation, i.e. to change pitch and stress, is one of the schemas of phonation.

Okamoto stated: The extensive use of voice in communication develops from about nine months (7). In our cases, from about nine months Ss' utterances, uttered while they were playing alone, tended to decrease and not only Ss' responses in voice but also their talks to others, mainly to their family members, even to a doll, Fig. 3.48, tended to increase both in Japanese and Americans. The Ss tended to use the non-crying utterance, instead of the crying, in order to express their organic needs and to evoke others. These voices were rather simple but not specific, e.g. Fig. 1.57-58, 3.44-46, etc.. These tendencies were observed typically in the case of E.T.. Her utterance of the repetitive babbling decreased very much, partly because she began to concentrate on trying to stand just at this stage.

At this stage, as shown in Table 3, 4, Ss' understanding of what their parents said also developed. The close relation between what they began to understand and their organic needs was observed clearly. E.T. had been very fond of being taken out for a walk every morning. She waved good-bye only in her mother's arms and at the entrance hall but not in any other situations. This situation had become the sign of going out for her. C.W. knew "Muffen" referred to his favorite dog. The development of Ss' cognition of external voice stimuli is based on the further differentiated organization of their cognition of general external stimuli.

In Okamoto's case, certain of the infant's utterances were already connected with certain objects at nine to ten months (6).

Piaget characterized the period of about three to seven months the stage of the secondary circular reactions. He stated that the character of the primary

circular reactions of infants consists in simple organic movements centered on themselves and not destined to maintain a result produced in the external environment. On the other hand, at the stage of the secondary circular reactions, the movements are centered on a result produced in the external environment and the means are beginning to be differentiated from the end, at least after the event. At about eight to nine months a certain number of solidary transformations appear concerning the mechanism of intelligence and the elaboration of objects. They are the first actually intelligent behavior patterns. Before this stage, the behavior patterns consist of circular reactions only. This stage is characterized: The co-ordination of the secondary schema and their application to new situations (8).

We think that at the fifth stage an infant's personality differentiates further; especially its intelligence develops. On this basis, it integrates the behavior patterns of using voices to express its organic needs and to evoke others, developed mainly by the crying, and the mechanism of the articulation and the phonation, developed by satisfying its functional needs. Also it integrates the latter mechanism and the organization of its cognition of the external voice stimuli referring to some behaviors or to some objects, developed by satisfying or dissatisfying its organic needs. On the other hand, the organization of its cognition is based on the development of its intelligence. That is to say, an infant begins to use the non-crying voices as a means of expression, evocation and representation. It reorganizes the articulation mechanism of the repetitive babbling at the level of a language. During and after this stage, an infant's voice develops as a system of symbols.

6th Stage. The Development of Phoneme-systematization and Verbalization. From about one year. From about one year, the Ss began to speak some words not only imitatively but also spontaneously, in Table 2. Even at this stage, Ss' articulation was not correct both in speaking spontaneously and imitatively, Fig. 1.66-67, 71-72, 4.2, 7.6-7, by Japanese, Fig. 3.54, 6.4-6, 8.4-8, 11.3-5, by Americans. It is considered that the reorganization of the articulation mechanism of the repetitive babbling at the level of a language begins at the fifth stage and proceeds through the sixth stage.

What are the characteristic features of the first words that the Ss began to speak?

1) Though they could not articulate these words correctly, they had already repeated similar articulations at about six to eight months, at the stage of the repetitive babbling, in Table 2. Some of them repeated similar voices at about nine to eleven months without reference to any specific objects, e.g. Fig. 5.5, 7.5, 3.56, etc..

2) They pronounced the intonation of these words fairly correctly and in a conversation-like way. For example, the falling intonation of [botçɔ] and [kokko], by Ya.N., of [har], by E.T., was the same as that of Japanese adult. C.W. and G.M. pronounced [dædæ] or [tettçə] in a rising intonation. It was the same as

Table 2. The List of The First Words

Nationality	Subjects (Sex)	Word	Corresponding Adult's Word	CA when Ss began to speak	Their Sonagrams are shown in	CA when Ss repeated similar Articulation
Japanese	E.T. (F)	/baibai/	good-bye	0 ; 11	Fig. 1.68	0 ; 6
		/wanwan/	dog	0 ; 11	Fig. 1.70	0 ; 6
		/mamma/	food	0 ; 11	Fig. 1.72	0 ; 6
		/hai/	here it is, or yes	0 ; 11	Fig. 1.73	0 ; 7
	Y.S. (F)	/poppo/	train	0 ; 11	Fig. 4.2	0 ; 7
	Ya.N. (F)	/bo:gi/	cap or hat	0 ; 11	Fig. 5.6	0 ; 10*8
		/kokko/	hen or cock	0 ; 11	Fig. 5.8	0 ; 9*9
H.K. (M)	/bu:nbu:n/	airplane	0 ; 11	Fig. 7.8	0 ; 7	
	/bunbun/	fly	0 ; 11	Fig. 7.9	0 ; 7	
Yu.N. (M)	/bu:/	car	1 ; 0	Fig. 9	0 ; 7	
T.T. (M)	/wanwan/	dog	1 ; 0	Fig. 10.4	0 ; 7	
	/bu:/	airplane	1 ; 0	Fig. 10.3	0 ; 7	
Americans	G.M. (F)	/tata/	thank you, or here it is	1 ; 0	Fig. 8.3	0 ; 8
		/baibai/	good-bye	1 ; 0	Fig. 8.8	0 ; 6
	F.P. (F)	/dada/	father	1 ; 0	Fig. 11.5	0 ; 8
	C.W. (M)	/bu:/	car	1 ; 1	Fig. 3.57	0 ; 7
		/hai/	yes, or here it is	1 ; 0	Fig. 3.58	0 ; 7
		/dada/	thank you, or here it is	1 ; 1	Fig. 3.60	0 ; 8
E.D. (M)	/wauwau/	dog	1 ; 1	Fig. 6.7	0 ; 7	

*8 [b]- and [tɕ]-like voices were articulated at 0;6 and 0;8, Fig. 5.1.

*9 [k]-like voice was articulated at 0;8.

that of English adults' "thank you" in a conversational situation.

We can classify two kinds of intonations: Intonation as the expression of emotion and intonation as the indicator of meaning. At this stage, the intonation pronounced by the Ss is the former. The latter develops after this stage and through the development of the phoneme-systematization.

3) The objects, referred by these words, had a deep relation with Ss' organic needs. A dog had been owned by T.T.'s and E.D.'s family and a dog had been seen in E.T.'s neighbor's garden. It had been their favorite pet. A hen had been in Ya.N.'s garden and had become the center of her interest. A car had been Yu.N.'s and C.W.'s favorite object and an airplane had been H.K.'s, T.T.'s. Y.S. had been fond of playing game in which she imitated a train. To say "bye-bye" waving a hand or to put a cap on a head had been the sign of going out which E.T., Ya.N., G.M. had been fond of. E.T., G.M., C.W. had been interested in handing over something to someone else and taking it back from it saying [hai] or [tettɕə] or [dædæ]. H.K. had been fond of looking for flies. Of course, they had been fond of their father and enjoyed food.

4) These words had been heard by the Ss very frequently. For example, "hai" is used when a Japanese hands over a thing to someone else.

Sex difference: There was no difference between boys and girls, except that the first words that boys spoke were /bu:/ (car), /bu:nb:n/ (airplane) etc., while girls had no such special words.

Racial difference: At the sixth stage some important differences between Japanese and Americans were observed. As shown in Table 2, words spoken by Japanese were different from those by Americans. However, /baibai/, /wanwan/ or /wauwau/, /bu:/, /hai/ were spoken by both Japanese and Americans. Both Japanese and Americans articulated [wauwau]-like voice for /wanwan/ or /wauwau/. /bu:/ and /hai/ were the results of Japanese influence. /baibai/ was the result of English influence.

We did not observe any meaningful differences between articulations of Japanese and Americans. Round vowels and consonants, articulated by the protruded lips, were not observed constantly. Americans articulated [ü]- or [u]-like voices instead of [u] or [u]. Their articulation looked like Japanese's. We think, it is not the influence of Japanese-speaking-environment. To pronounce English requires more differentiated articulation organs than to pronounce Japanese. As stated above, the intonations of these words were different in Japanese and Americans.

Americans tended to be slower than Japanese in the development of speech at this stage, because they had to learn two languages.

Therefore, we can say that the phoneme system of parents does not influence the development of an infant's speech until the end of the fourth stage, i.e. about eight months. It begins to have an influence from the fifth stage, i.e. from about nine months or later. And its influence is clear from the sixth stage on, i.e. from about one year on.

At the sixth stage, the Ss tended to utter increasingly word-like or sentence-like voices or even repetitive babblings, changing pitch and stress, while they were playing, even alone. Their utterances were almost meaningless. Their utterance might be a part of their play, or expression of their needs, or some talk, or some conversation. Some of our Ss showed this tendency typically. For example, E.T. showed this tendency clearly from eleven months on. But this tendency was observed from the fifth stage in the cases of some Ss. E.T. could stand alone for about thirty minutes at eleven months. We can say that when the maturation of some organs, other than the phonation and the articulation organs, reaches some level, an infant begins to concentrate on operating these organs and its utterance is stopped or decreased. After a while, as its operation develops to a certain level it begins to make utterances very much again.

While an infant is uttering these undifferentiated voices gradually its phoneme-systematization and verbalization proceeds through and after the sixth stage. We will describe this process on our next paper.

I would like to express my grateful acknowledgements to Mr. and Mrs. Daub, Mr. and Mrs. Kuraishi, Mr. and Mrs. Meyer, Mr. and Mrs. Prins, Mr. and Mrs. Shimizu, Mr. and Mrs. Toyohara, Mr. and Mrs. Tsushima, Mr. and Mrs. Wood and my wife for their kind cooperation. I appreciate Mr. Y. Takeuchi's cooperation in the use of electronic equipments.

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Table 3. Speech Development of E.T., a female Japanese.

M : mother F : father m : maid S : subject

Stage CA	Non-crying Utterance	Voice*	Response to External Voice Stimuli	Other Behavior
1st 0 ; 0,5	S produced strange sounds, moving her body or stretching her arms and legs.			S cried in a state of discomfort.
2nd 0 ; 1	S uttered calm voices, middle-vowel- and glottal-fricative-like ones, in a state of comfort, in M's arms or with M. S seldom uttered sounds alone. S still produced the strange sounds.	[ə] [ʃ], [x] [əkə]	S responded to M's calling her name.	S cried differently when she was hungry, when her diaper was dirty and when she wanted to be cared.
3rd 0 ; 1,25	Calm voices increased. S changed pitch. Front-vowel-like voices, Semivowel-like voice appeared. S talked to M spontaneously.	[ə:ʏə:] [æ], [ε] [e], [i] [j]	S responded to any person who talked to her while smiling, with smile and utterance.	When S was crying and M entered S's room S stopped crying and looked at M with smile.
0 ; 2	Appearance of fricative-like voice. Differentiation of middle-vowel-like voice. Glottal voices continued. They turned into plosive-like voices by chance.	[ç] [a], [ü] [ʃ], [x] [g], [k]		When S was crying in bed and was taken in M's arms S stopped crying. After a while S began to cry again. When M began to walk S stopped crying.
	S seldom produced the strange sounds. S uttered sounds lying on bed, did not utter them sitting in M's arms or on the floor supported by M.	[egaU] [kaε]	F talked to S with [u:] in rising intonation and S responded to it in rising intonation. Response in falling intonation to F's [Φu:] in rising intonation.	S looked around here and there attentively in a sitting situation.
0 ; 2,17	S began to utter sounds alone in bed, but less frequently than with M.			S began to play alone in bed. S grumbled in bed until m came to take her out for a walk and was delighted to looking at m every morning.
0 ; 3	S voiced glottal sound intentionally from time to time but not frequently.	[x]	S was glad to hear M's imitation of her [x].	Sometimes S repeated opening and closing her mouth or putting her tongue in and out without utterance.

* These voices are not the same as those described by phonetic symbols but only roughly similar to them. Refer to their sonagrams, in Fig. 1.

	<p>Nasal-like accompanied by vowel-like voice.</p> <p>Plosive-like voice, by lips or by tip of tongue, appeared, but exceptional.</p> <p>As S got used to be sitting her utterances increased but only slightly.</p> <p>When S found a new object or a person S did not utter a sound.</p>	<p>[ŋɛ]</p> <p>[p] [tɕ]</p> <p>[i] [o], [ɯ] [m], [p] [pʰ], [w], [β]</p> <p>[æ] etc.</p>	<p>When S heard M's voice outside of her room, S stopped crying.</p> <p>Almost every time when S heard her name called by M, S turned to M.</p>	<p>Sometimes S raised hands in imitation of F, staring at F.</p> <p>S was glad to see M's or F's peck-a-boo.</p> <p>While uncomfourt, S cried using these articulation mechanisms or grumbled with nasalized-vowel-like and glottal sounds, a retarded articulation pattern.</p>
<p>4 th 0 ; 6</p>	<p>Repetitive babblings</p> <p>by lips dominate,</p> <p>in whisper.</p>	<p>[wɛwɛwɛ] [ɕɛɛɛɛ] [m:bobowa] [mammammam] [wɛwɛwa] [wawwa:wæ:] [...pa] [ə:awɛ] [babababa]</p>	<p>S responded to M's [aɔ:wə] with almost same intonation.</p> <p>S imitated the same aged boy's babbling [babababa]. S did not imitate M's or F's babbling.</p>	<p>S cried when a strange person approached her.</p> <p>S imitated M's, F's, m's smiling.</p> <p>S moved her mouth, tongue, jaw in various ways without utterance.</p>
<p>0 ; 7</p>	<p>Repetitive babblings by lips,</p> <p>by front of tongue,</p>	<p>[p'p'p'p'] [ceemptu:] [aɑiddzɛ] [æʰædɛtɛ] [tɕatitjæt'] [t'at'at'a]</p>		<p>S imitated waving a hand of F, M, m and person on TV.</p> <p>S cried when she looked at strangers, except for children and women the same age as M.</p>

0 ; 8	<p>in high pitch. Articulation by back of tongue.</p> <p>S's repetitive babblings were more active when S was playing alone than when with another person.</p> <p>S articulated with tip of tongue and upper lip. Articulation by tip or front of tongue increased.</p>	<p>[papapapap]</p> <p>[...tæ]</p> <p>[kɔwə]</p> <p>[ʔai]</p> <p>[hɯndɛ]</p> <p>[paçæçæ]</p> <p>[Φapaʔa]</p> <p>[p'papæ]</p> <p>[liü]</p>	<p>Sometimes S imitated. For example, 1st response to M's [papapapa], 2nd response, 3rd response.</p> <p>S stopped when she heard M's "No!". When S heard m singing she began a song-like changing pitch, moving her body rhythmically.</p>	<p>S cried using these articulation mechanisms with nasalized-vowel-like sounds.</p> <p>S imitated clapping.</p>
5 th 0 ; 9	<p>Repetitive babblings decreased very much. Crying decreased and non-crying utterance increased to express S's organic needs and to evoke.</p> <p>Word-like voices, conversation-like intonations, e.g. rising intonation, as if S were asking a question, appeared.</p> <p>S looked at M and talked to her while playing alone with M nearby.</p>	<p>[æ], [ə], [e:] etc.</p> <p>[Φɯtatjɯ]</p> <p>[e:çe] etc.</p> <p>[əi], [e:] etc.</p>	<p>Calm voice response increased when F, M and m talked to her.</p>	<p>S concentrated on trying to stand holding something.</p> <p>S was unstable, seemed to be in a marginal period, e.g. S began to cry more easily than before etc..</p> <p>S wished to do everything herself, e.g. eating with a spoon etc..</p> <p>S imitated F, M, m, person on TV, raising a hand, dancing, etc., intentionally.</p>
0 ; 10	<p>Differentiation of articulation mechanism proceeded, fricative-like voice.</p>	<p>[tür]</p> <p>[ʃ]</p> <p>[pəbæbæbæbæ]</p> <p>[e:ɛ:e:ɛ:e:ɛ:e]</p>	<p>Imitation of M's [ʃ]. Every time S was on her stool for bladder training M said [ʃ].</p> <p>Imitation of M's [babababa].</p> <p>S sang replying M's asking "Sing!". S did not sing whenever asked. When S was comfortable and heard other person sang, S sang.</p> <p>S waved bye-bye when S heard M's "bye-bye" at the entrance hall on her way to go out for a walk in M's arms, but not in another situation.</p>	

			When S was hungry and heard M's "mamma (food)" S was delighted.	
			When S was sleepy and heard M's "nenne (sleep)" S lay down in bed, but not every time.	
6 th 0 ; 11	S said, waving good-bye in M's arm at the entrance hall. S was interested in giving an object to a familiar person and taking it back, saying Sometimes S said when sleepy, but not after lying down in bed. Sometimes S said in eating situation. Her utterances increased while playing. When S saw a familiar person coming, S was glad and said	[baba] [ʔai] [hai] [nenne] [mamma] [ɕwauwa] [wauwa] [æ], [hə] etc.	When S heard M's "bye-bye" in M's arms S waved bye-bye even when not at the entrance. Imitation of M's [bai-baibaibai]. Imitation of M's [mamma]. Imitation of M's [wanwan]. When M said her "Stand", S stood alone, looked at M and smiled.	S imitated M, F, m, using a vacuum cleaner, using a comb, drumming, piping, writing with a pencil, etc.. S could stand alone for about 30 minutes.

Table 4. Speech Development of G.W., a male American.
M : monther F : father S : subject s : elder sister

Stage CA	Non-crying Utterance	Voice*	Response to External Voice Stimuli	Other Behavior
3 rd 0 ; 5	S articulated most vowel-like, nasalized-vowel-like voices, except [ə], [u], [U], [ɔ], [ɑ], consonant-like voices, by front of tongue, by lips, by tip of tongue, by back of tongue, (rather by chance).	[i], [ɪ], [e], [ɛ], [æ], [a], [ə], [o], [ɯ], etc. [ɕ], [j], [m], [β], [d] [ʃ], [x], [ŋ], [g], [k]		In a state of discomfort, S cried using these articulation mechanisms or grumbled with nasalized-vowel-like voices and glottal voices, a retarded articulation pattern.

* Refer to their sonagrams, Fig. 3.

	S combined and varied articulations in various ways, even in high pitch, by inspiration, etc..			
4 th 0 ; 6	Repetitive babblings by lips dominate,	[aæe] [bəbjabjabja] [bʌΦʉpa] [p'p'] [bb...] [m:m:ma] [wæwæ:]		Sometimes S moved his mouth, jaw, tongue without utterance. S was afraid of strangers.
0 ; 7	by front of tongue, in whisper, Articulation by lips, by front of tongue, by back of tongue	[ææææ:] [aɪɛɪdzɛɪ] [ɲɛɲɛɲɛɲ] [b ba] [pΦə:] [çɛɪ] [tçə] [ka], [ʔə] [hæ:] [wæɛ]	Response to M's [ba], with the same rising intonation.	
0 ; 8	S uttered these babblings shaking his body rhythmically. S babbled slowly while shaking slowly, rapidly while shaking rapidly. S's babbling was not active when S was motionless, active when playing actively. It was more active when S was playing alone than with another person. Repetitive babbling by tip of tongue, by back of tongue. Articulation by back, by upper teeth and lower lip.	[ndɪtjæ] [tæt'tjæ] [tɪtæ] [kxækjʉkæ] [kx], [gæ] [v]		S cried using these articulation mechanisms with nasalized-vowel-like sounds.
5 th 0 ; 9	Utterance when S was alone decreased and utterance for evocation and expression of his organic needs increased. Changing pitch and stress, not rhythmically, increased, e.g. rising intonation as if S was asking, etc..	[æ], [ə], etc. [a:]	Vocal response to a familiar person who talked to him increased. Response to M's "Won't you talk?"	S was fond of watching another person playing peek-a-boo.

6 th 1 ; 1	<p>S said, when S was playing with his wooden car, i.e. pulling it. [bu:bu:]</p> <p>S gave an object to a familiar person and took it back repeatedly, saying in rising intonation. [dædæ]</p>	<p>When M told him "[oi[umilk] (good milk)", S was delighted.</p> <p>S went to bed when M talked to him "[nenne] (sleep)" in Japanese.</p> <p>S knew who daddy was, who mommy was.</p>	
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Fig. 1 Voice of E.T., female Japanese.

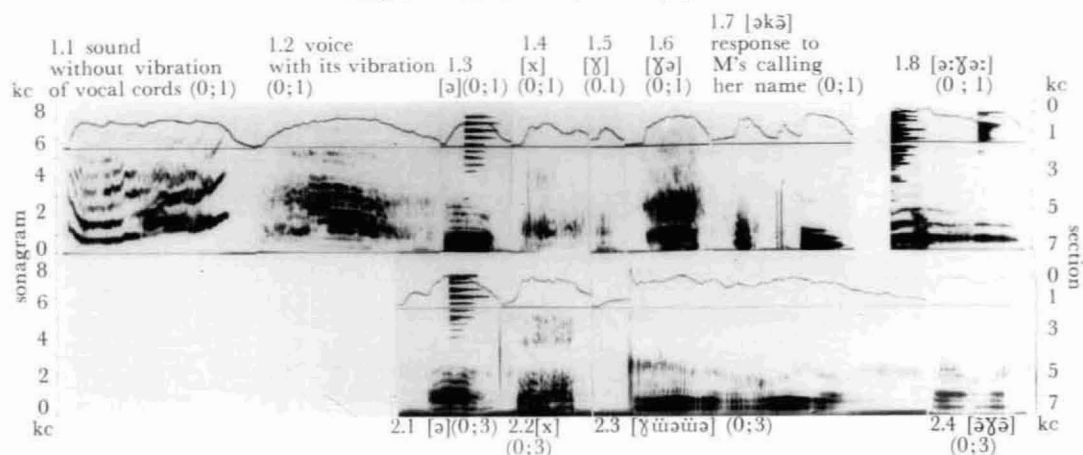


Fig. 2 Voice of G.M., female American.

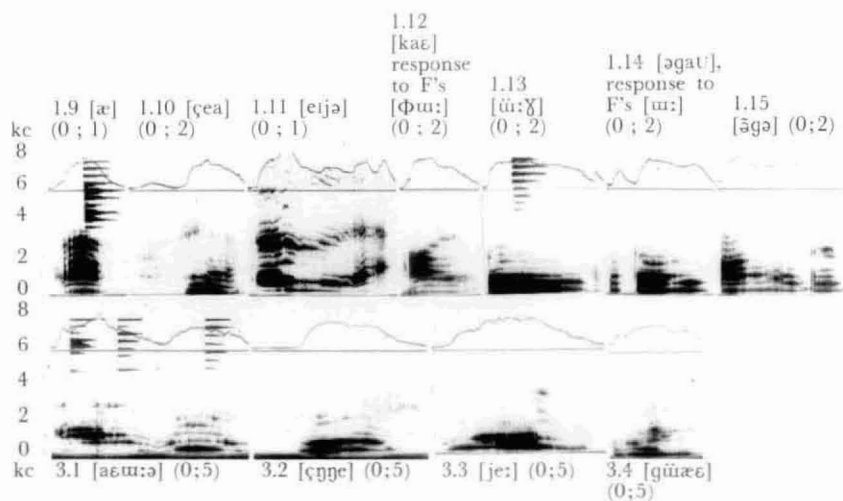
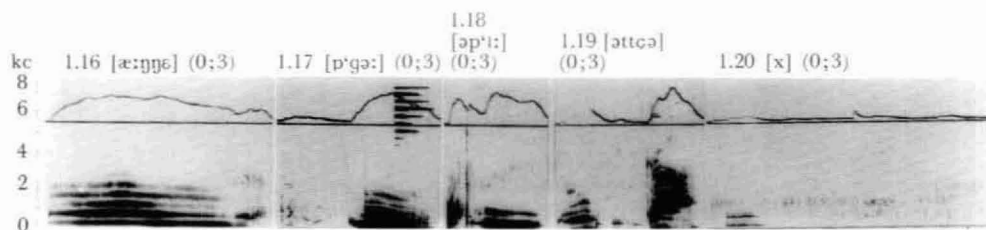
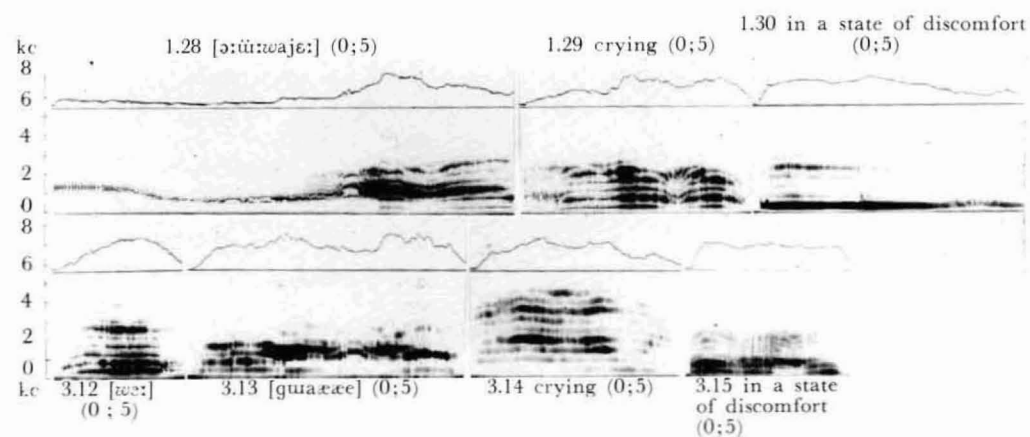
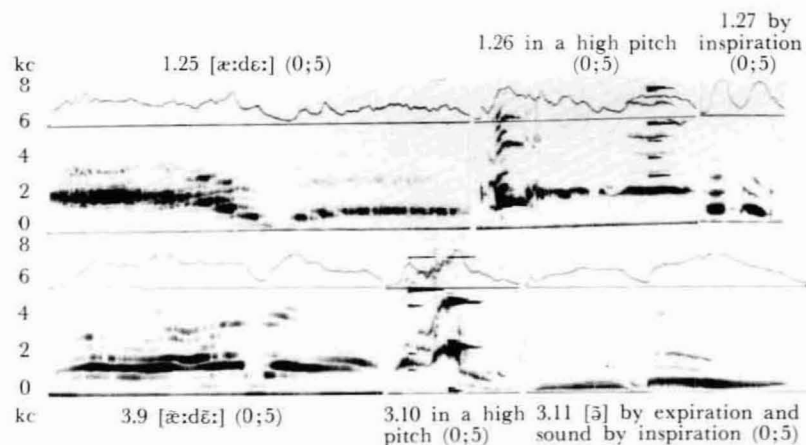
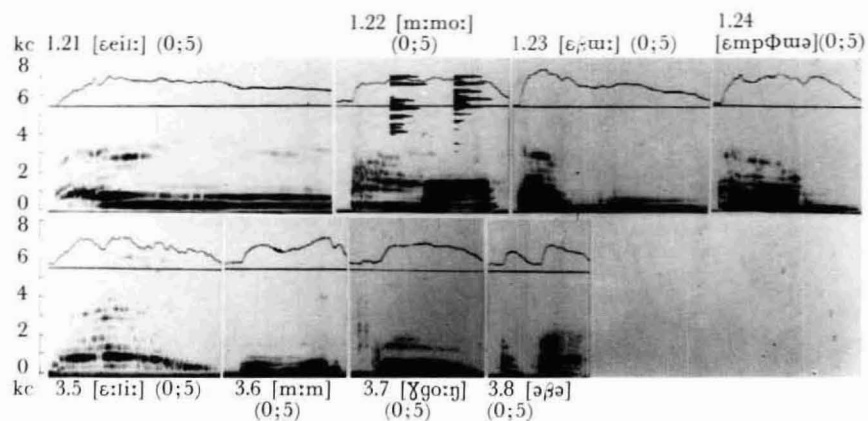


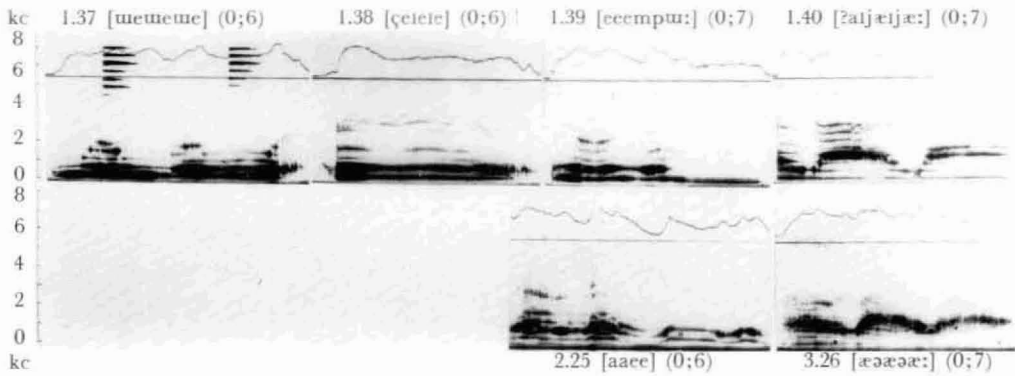
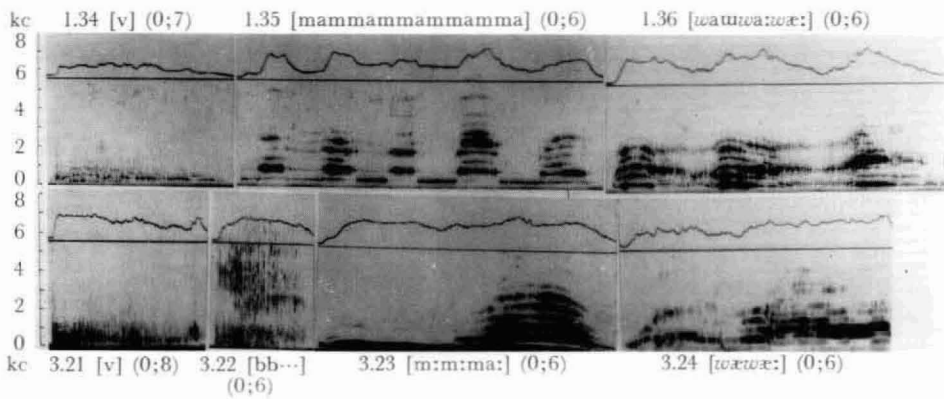
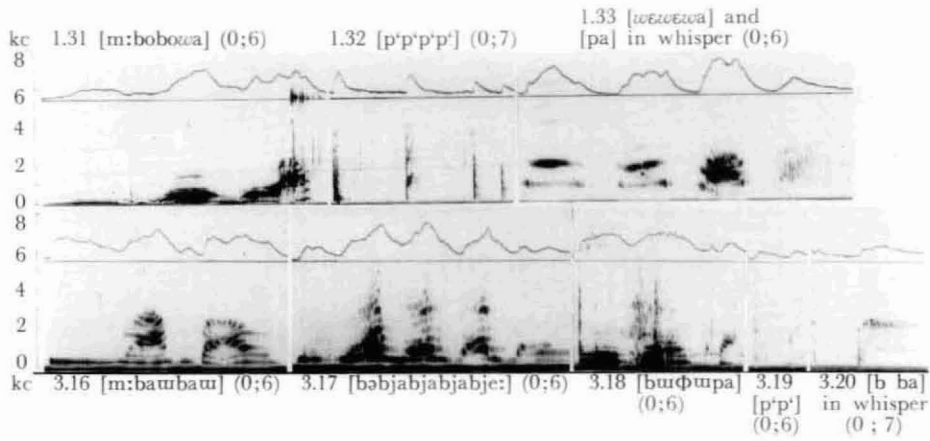
Fig. 3 Voice of C.W., male American.

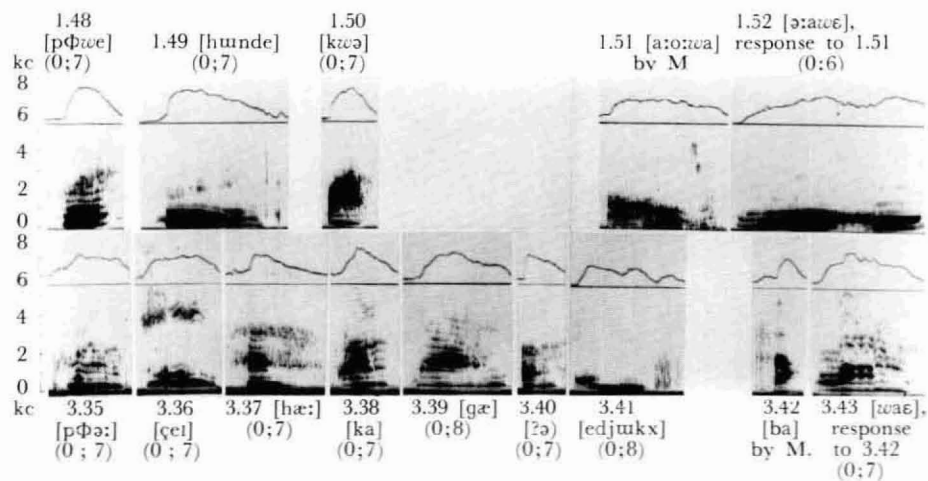
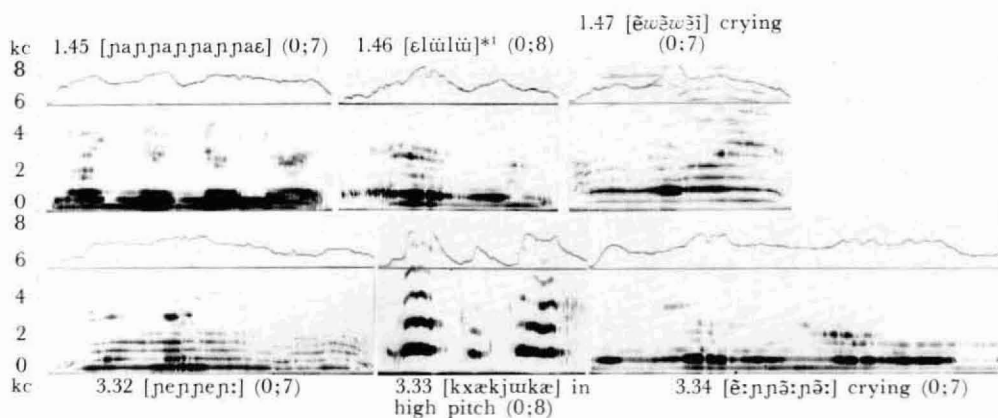
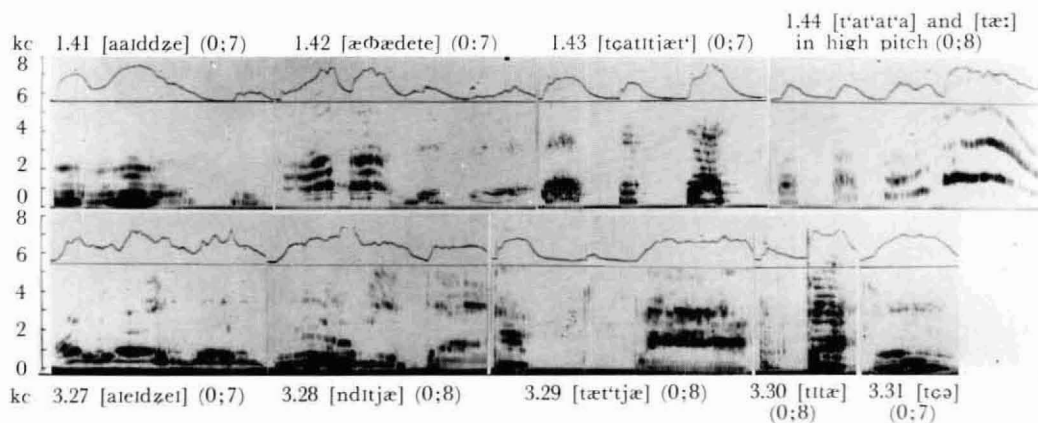


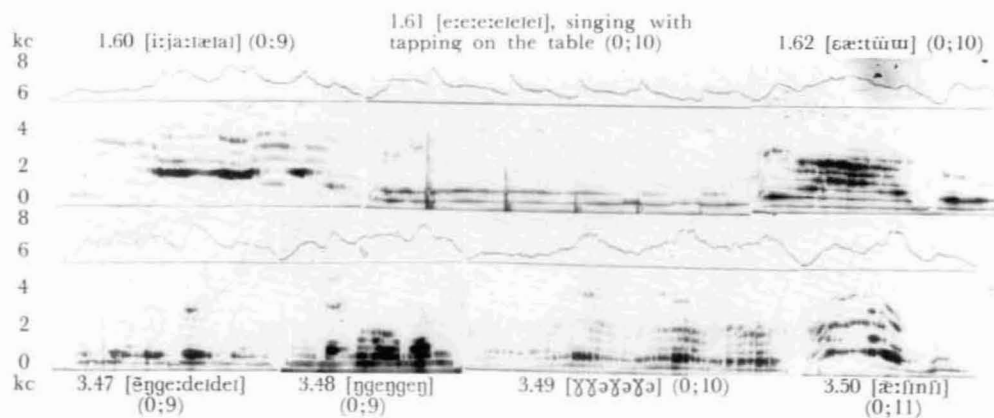
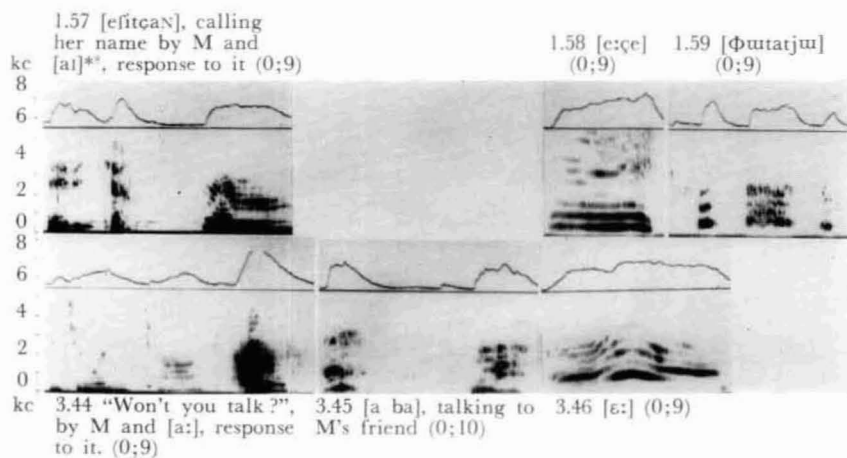
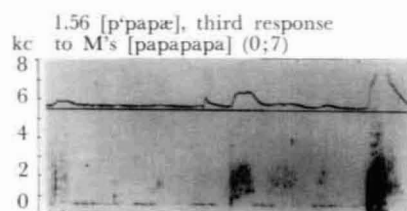
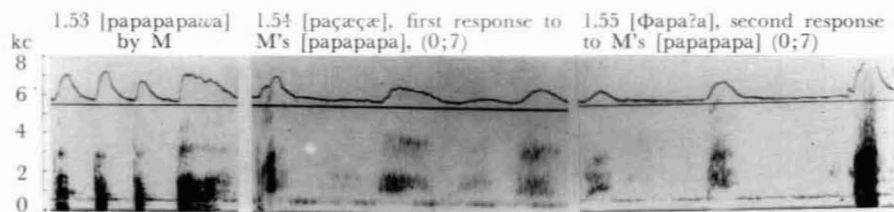
1. These voices, shown on sonagrams, are not the same as those described by the phonetic symbols, only roughly similar to them, e.g. [ə] means [ə]-like voice etc.
2. Figures inside the round brackets show S's chronological age when S pronounced the voice, e.g. 0;3 means zero year, first year, and three months.

F : father M : mother









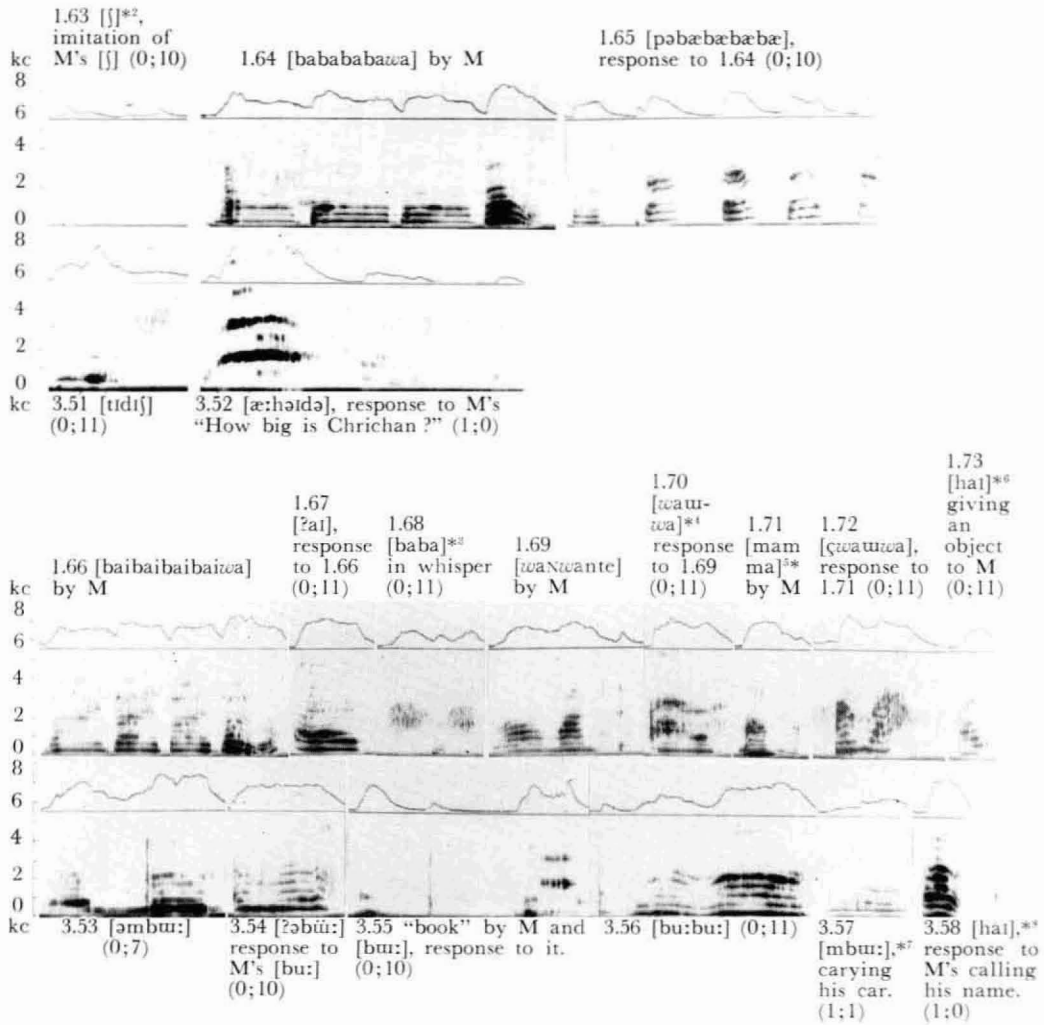


Fig. 4 Voice of Y.S., female Japanese.

Fig. 5 Voice of Ya.N., female Japanese.

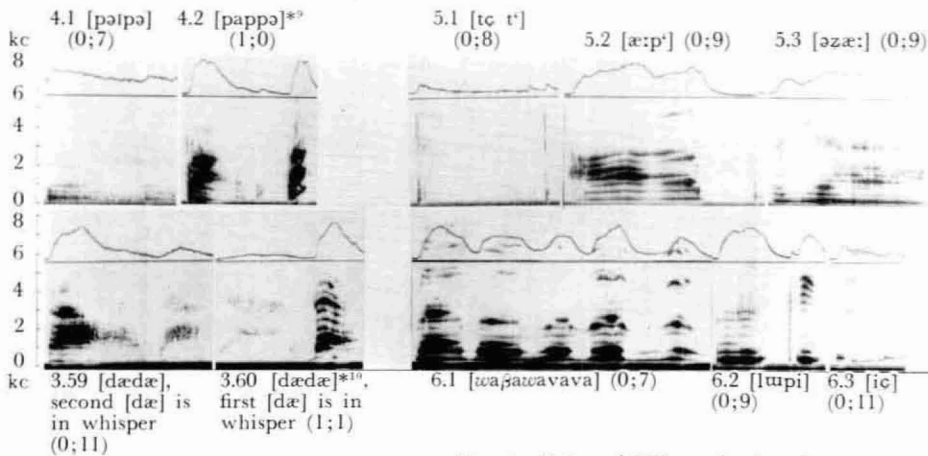


Fig. 6 Voice of E.D., male American.

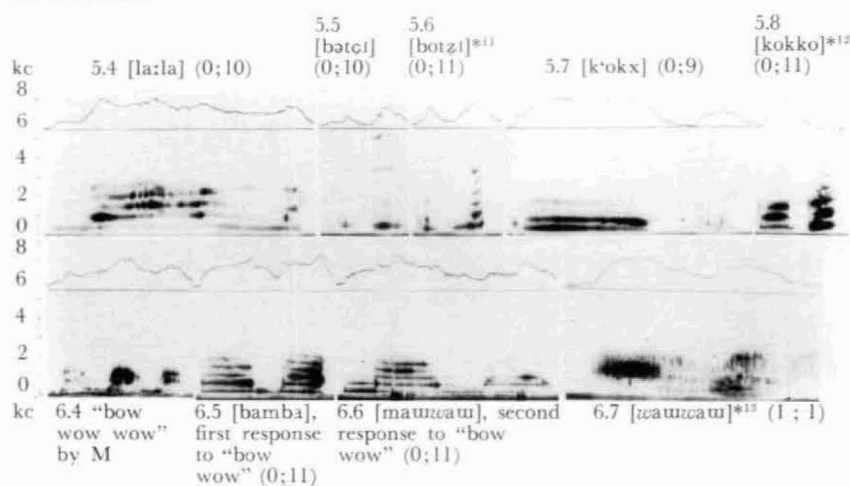


Fig. 7 Voice of H.K., male Japanese.

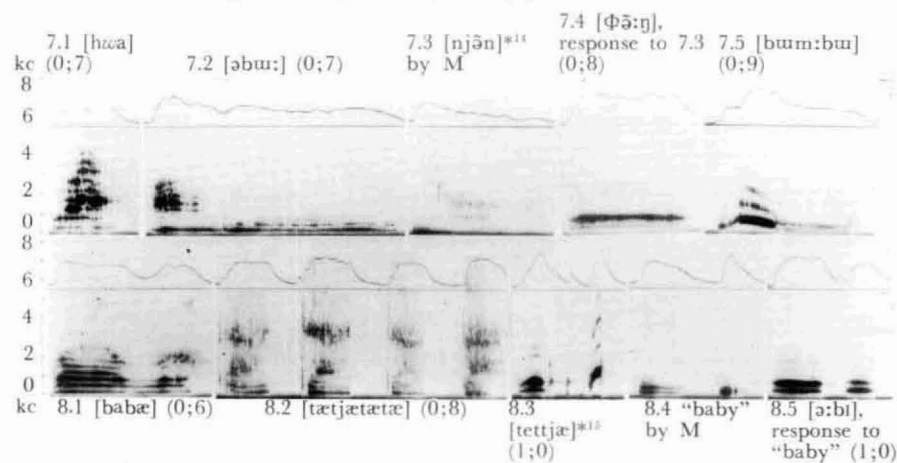


Fig. 8 Voice of G.M., female American.

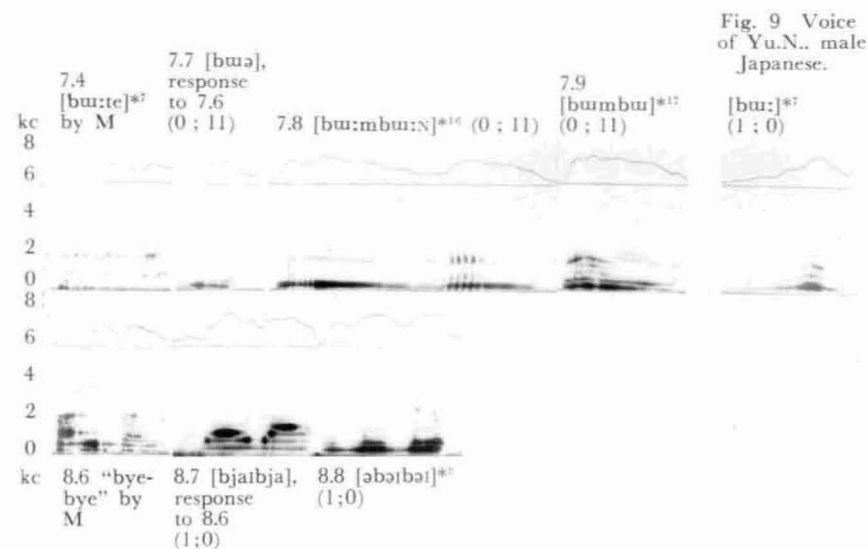


Fig. 9 Voice of Yu.N., male Japanese.

Fig. 10 Voice of T.T., male Japanese.

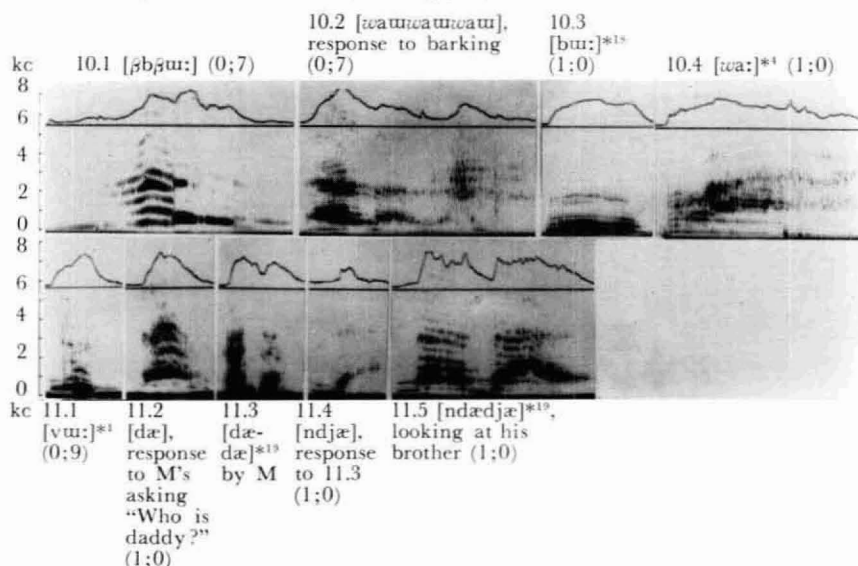


Fig. 11 Voice of F.P., female American.

- *1 Both [l], Fig. 1.46, and [v], Fig. 11.1, were articulated by the tip of the tongue and the upper lip.
- *2 When an infant is on a stool for bladder training, mother says [ʃ], in Japan.
- *3 These are the variations of [baibai]. It means "good-bye" both in Japanese and American baby-talk.
- *4 These are the variations of [wanwan]. It means "bow wow" in Japanese baby-talk.
- *5 [mamma] means "food" in Japanese baby-talk.
- *6 Japanese say [hai], when they hand over an object to another person.
- *7 [bu:] means "car" in Japanese baby-talk.
- *8 Japanese reply [hai], when their name is called.
- *9 [pappə] is one of the variations of [poppo]. It means "train" in Japanese baby-talk.
- *10 [dædæ] means "thank you" or "here it is".
- *11 [botɕi] is one of the variations of [bo:ci]. It means "cap" or "hat" in Japanese.
- *12 [kokko] means "hen" or "cock" in Japanese baby-talk.
- *13 [waɯwaɯ] means "bow wow".
- *14 [nɕi:n] means "cat" in Japanese baby-talk.
- *15 [tɕtɕæ] seems to mean "thank you" or "here it is".
- *16 [bu:mbu:n] means "airplane" in Japanese baby-talk.
- *17 [bumbu] means "fly".
- *18 [bu:] means "airplane".
- *19 [dædæ] means "daddy".