Discernible differences in the babbling of infants according to target language

Bénédicte De Boysson-Bardies, Laurent Sagart and Catherine Durand

Journal of Child Language / Volume 11 / Issue 01 / February 1984, pp 1 - 15
DOI: 10.1017/S0305000900005559, Published online: 26 September 2008

J. Child Lang. 11 (1984), 1–15. Printed in Great Britain

Discernible differences in the babbling of infants according to target language*

BÉNÉDICTE DE BOYSSON-BARDIES
Laboratoire du Psychologie, C.N.R.S.
LAURENT SAGART
Centre de Recherches Linguistiques Asie Orientale, C.N.R.S.
AND
CATHERINE DURAND

(*Received* 29 *October* 1982)

ABSTRACT

Samples of babbling productions of 6-, 8- and 10-month-old infants from different language backgrounds were presented to adult judges whose task was to identify the infants from their own linguistic community. The results show that certain language-specific metaphonological cues render this identification possible when the samples exhibit long and coherent intonation patterns. The segmental indications that are present in the fully syllabic productions of canonical babbling do not allow the judges to identify the infants correctly from their own linguistic community. These results seem to support the hypothesis of an early influence on babbling of the metaphonological characteristics of the target language.

INTRODUCTION

It is now generally recognized that infant babbling rests upon innately programmed articulatory mechanisms that also function in mature speech. This suggests that babbling is continuous with the speech phenomena proper to initial speech. Jakobson's thesis (1941) of a discontinuity between babbling and a child's first words has been recently reassessed in the context of research on universals of speech production. Thus Oller, Wieman, Doyle & Ross (1976) have shown that the same universal phonetic preferences described by Jakobson already exist in the babbling of 6- to 8-month-olds and have the same degree of generality. Their work establishes a link between babbling and first speech.

The idea that strong biological predispositions guide the course of speech maturation is further supported by studies of infants' phonetic repertoires

[*] The authors wish to thank M. Poizat and Y. Barbin for their valuable assistance. Address for correspondence: Laboratoire de Psychologie, C.N.R.S., 54 bld. Raspail, 75270 Paris cedex 06, France.

prior to their first words. Cross-cultural studies, in particular, seem to support the universalist position (Preston, Yeni-Komshian & Stark 1967, Nakazima 1962). Such studies suggest that important similarities relating to the phonetic repertoire exist in the babbling of children from different linguistic communities, and that features specific to the target language are not taken into account by infants before the first language.

There are, however, several reasons for questioning the conclusion that children of all language communities babble in a similar way. First, there are few cross-cultural studies. Secondly, those that exist in most cases are based only on counts of each sound within the repertory of babbling. Thirdly, the use of the IPA for transcribing the vocal productions of young children may induce an unwarranted uniformity in the data (Lynip 1951). Fourthly, one cannot rule out biases due to mother tongue and/or the training of transcribers (Stockman, Woods & Tishman 1981). In a majority of cases, transcriptions have been made by native speakers of English. Finally, the most important shortcoming of such studies is their self-imposed limitation to a sound inventory: natural languages also differ along more general parameters, such as pitch, timing, phonation types, voice quality, resonance pattern, rhythm and loudness – dimensions which mainly define the characteristics of the speech envelope and are referred to as the NON SEGMENTAL components of speech.

SEGMENTAL articulation specific to different languages is prepared by articulatory settings which might also be predicted from the nonsegmental characteristics of infant speech. The underlying determinant of the voice quality is articulatory setting, or the long-term muscular adjustments to which part of the vocal tract may be subjected. Settings of the larynx are responsible for different modes of vibration of the vocal cords and the corresponding phonation types. Particular settings of the pharynx, velum, tongue, lips and jaw all give rise to different voice qualities (Laver 1980). Contrasts specific to certain languages cannot be attained at the segmental level unless specific settings of voice quality exist. It is because a child has acquired a Vietnamese 'tense' voice that he or she will be able to articulate Vietnamese pre-glottalized occlusives with the proper accent. The child's mastery of the fundamental settings of the linguistic community to which he or she belongs is not only a matter of demonstrating affiliation to the community but also a prerequisite of fine articulatory control. Given that certain languages exhibit phonemic contrasts cued by voice quality (e.g. the contrasts of 'emphatic' vs. 'non-emphatic' consonants in Arabic, 'voiced' vs. 'voiceless' stop initials in the Wu dialect of Chinese, etc.), it seems plausible that the first language-specific settings to take place in the ontogenesis of speech acquisition relate to such dimensions. We use the term METAPHONOLOGICAL (Oller 1980) to refer to general parameters that play a role in the establishment of segmental and nonsegmental phonology.

At the onset of language acquisition, all normal humans are equipped with the same production apparatus and all must face the same physiological constraints. Infants especially face pronounced motor and neuromotor constraints. It is estimated that in 6-month-old infants motor control of the vocal tract is almost complete (Koopmans-van Beinum 1979). Complete oral closures, among others, can be performed. However, constraints deriving from the maturation of motor and neuromotor mechanisms are still at work; for example, motor control over the muscles is not sufficient to allow for fast and precise movements. One can assume that the progressive disappearance of some of these constraints follows an innately prescribed path during the development of speech. Such constraints may account for some of the similarities that are found in babbling.

Certain authors (MacNeilage 1980) have proposed that the constraints on early babbling are rigid enough to account for universal preferences in terms of articulatory and respiratory control. At the level of phonological development, articulatory mastery could be viewed as a progressive relaxing of universal constraints (Stampe 1973, Menn 1977). As most of the research on infant babbling has aimed at substantiating claims that babbling is interpretable in terms of universal tendencies, the early emergence of language-specific features of the target language in the infants' vocal productions has been largely ignored.

In our opinion (de Boysson-Bardies 1981, de Boysson-Bardies, Sagart & Bacri 1981), babbling should not be treated purely in terms of the maturation of pre-established articulatory programmes. We think that universal preferences are modulated as early as 6–8 months by a selection among characteristic features found in the target language. The main purpose of the present study is to determine, using a comparative approach, the extent to which constraints from the structure of the target language are influential in babbling and must be added to an interpretation in terms of physiological constraints and universal tendencies. We also aim to establish which speech parameters tend to be selected according to the characteristics of different target languages by using an instrumental and perceptual analysis of the samples used in our experiments.

Methodological problems

Statements about the sound system of natural languages can be made at both the segmental and the nonsegmental phonological levels. On the one hand, there are few valid homogeneous phonetic descriptions of the different parameters which specify the nonsegmental aspects of languages. On the other hand, the lack of uniformity in the description of the acoustical data and the lack of a precise knowledge of their perceptual value generally prevent a direct comparison between adult speech and babbling. Accordingly, it is extremely difficult to set up comparative scales with which to assess the degree

of conformity of the nonsegmental patterns found in babbling with the nonsegmental patterns of the target language. Given the impracticality of this approach, we chose an approach based on an adult's discrimination paradigm: it consisted basically in presenting adult judges with babbling samples taken from children belonging to the same as well as other linguistic communities and asking them whether the samples were compatible or not with the characteristics of their own language.

This approach has been used on only a few occasions in the past, but the results have been contradictory. In unpublished work, Tervoort found that Dutch adults were able to identify vocal productions from Dutch babies aged 7 months and older. Weir (1966) also reported that adults were able to discriminate between Chinese and American babies aged 5–7 months. However, Atkinson, MacWhinney & Stoel (1970), using Weir's original samples, could not replicate her results. Similarly, Olney & Scholnick (1976) reported that adults were not able to discriminate between samples from Chinese and American children aged 6, 12 and 18 months. However, the latter experiment rested on a very complex design: the samples included not only vocal sequences from American and Chinese children but also adult imitations of such children. The four types of stimuli were presented in one experimental block in pairs that might or might not be homogeneous in terms of linguistic origin. The judges' task was thus very difficult, since the differences between samples could be attributed to linguistic origin, to age or to the fact that the samples could be 'mock' babbling. In addition, Olney & Scholnick's methodology contained several obvious risks. First, the Chinese children used in the experiment belonged to the Chinese community of Boston and could have been exposed to English. Secondly, in order to obtain 15-second samples, Olney & Scholnick were obliged often to link up bits of sequences which, as they themselves pointed out, might have obliterated certain prosodic cues. Thirdly, the ages of 6, 12 and 18 months are not representative of the period of babbling proper, and imply a measure of overlap with the first language. Finally, listening conditions were not optimal, as the subjects were tested in a group setting with the sounds presented over loudspeakers.

In using the paradigm of adult discrimination of infant babbling, we paid particular attention to the following points. First, if one is looking for differences due to the environment, it is preferable to choose languages which differ along those dimensions which one can suppose to be particularly salient in the perception or the production of speech. Thus we chose to compare the productions of children whose target languages were strongly contrasted along the dimensions of laryngeal and supralaryngeal settings (Laver 1980) and that of prosody. Languages with contrastive stress or languages in which stress assignment is conditioned by phonemic properties of individual words provide quite different rhythmic patterns from those of languages like French with a demarcative, phrase-final accent. For these reasons we chose to begin

with a comparison of French and Arabic. At the metaphonological level, Arabic (Maghreb dialects) is mainly differentiated from French by the presence of a voice quality (faucalized or emphatic voice) unknown in French, by a rather posterior lingual setting as opposed to a front lingual setting in French (Catford 1977), and a stress system based on the weight of syllables (Hyman 1977). In addition, its phonetic repertoire differs mainly from the phonetic repertoire of French in its larger proportion of consonantal versus vocalic sounds. We also included Chinese (Cantonese) children whose target language differs from French, in that Chinese is a syllabic tonal language with a rather 'sharp', 'metallic' voice quality.

The second point relates to our choice of age groups: 6, 8 and 10 months. Patterns of vocal production undergo rapid mutations between 6–8 months and 10 months. Patterns present varied pitch at 6 or 8 months, but much less so at 10 months, especially when children produce sequences of isolated or reduplicated syllables. At that age, nonsegmental cues seem less prominent. Therefore, adults might make use of segmental cues in assessing the babies' productions. This constraint is likely to interfere strongly with a discrimination task.

The data were collected in the countries of origin. We thought that, given the high sensitivity of babies to speech (Aslin & Pisoni 1978, Eimas, Siqueland, Jusczyk & Vigorito 1971, Eimas 1975, Eilers & Minifie 1975, Jusczyk & Thompson 1978, Jusczyk 1981,Kuhl 1976), it would be better to minimize the possibility of external interaction with the language spoken in the family. Thus, in our study, French babies were recorded in Paris, Arabic babies in Tunis or in Algiers, and Chinese babies in Hong-Kong. Given the strong nationalist tendencies in North Africa, French linguistic influence is virtually non-existent. Young Algerian and Tunisian children are not exposed to French in their everyday life and never hear it on radio or television.

If we decided not to reveal the linguistic identity of the children to the participants in the first experiment, it was to avoid their making misleading hypotheses about what the characteristics of babbling should be in languages they were unfamiliar with. This factor was controlled in the second experiment.

Along with the discrimination experiments, perceptual and instrumental analyses were performed on the samples. The coherence of the samples with the corpus from which they were extracted was assessed by a comparison of pitch and intensity curves as well as spectrograms. General characteristics of babbling samples are presented in the Appendix.

EXPERIMENT I

METHOD

Subjects

Forty volunteers, all of them native speakers of French, participated in the experiments (there were 32 women and 8 men; among the women, 16 had children). They were tested individually, listening to the stimuli through earphones. The subjects were told that each pair of babbling samples included a sample from a French infant and a sample from an infant from a foreign country, but were not informed of the linguistic origin of these infants. They were required to judge which sample of a pair they thought came from a French infant.

The stimuli consisted of 32 15-second sequences of babbling from 8- and 10-month-old Arabic, Chinese and French infants. There were two Arabic, two Chinese and four French children. The same experimenters collected all the corpora for each language. The samples were recorded at the children's homes with the mother present. Once the children had begun to babble, the adults would withdraw somewhat, so as not to interrupt. Each recording session lasted at least 30 minutes. All screams, cries, laughter, noises, as well as vocalizations immediately following from an adult comment were deleted from the recordings. Fifteen-second samples were selected from productions described by Oller (1980) as 'marginal babbling', 'canonical babbling' including the subcategory of 'reduplicated babbling' and 'variegated babbling'. The main criterion for sample selection was sequence duration. In order to obtain samples with homogeneous intonation patterns, we selected sequences of at least 15 sec with pauses not exceeding 1,500 msec. In a few cases (5 samples) the above criterion could not be met and the samples were each composed of two shorter sequences separated by an interval of 1,500 msec. Thus most of these samples were characterized by long melodic patterns. Eight different 15-sec segments were selected from four 8-month-old French infants and eight 15-sec samples were selected from four 10-month-old French infants, each infant contributing two sequences. For Arabic and Cantonese children, four different 15-sec segments were selected from two different children in each community and for each age. Thus the productions of eight French infants were compared to the samples of eight non-French infants, four of them Arabic and four of them Cantonese.

Experimental design

Each subject heard 16 pairs of samples, 8 pairs from 8-month-olds and 8 pairs from 10-month-olds. The samples were presented in two separate blocks depending on the age of the infants. Within a block, order of presentation was randomized. Block order was counterbalanced across subjects. Each block included 8 pairs of samples. Each pair consisted of a sample from a French

baby and a sample from either an Arabic or a Chinese baby. The two different samples from each French child were paired once with an Arabic and once with a Cantonese sample. We used this procedure so that no difference between the results with Arabic and Cantonese could be attributed to differences between the French children.

Equipment

The recordings of babbling were made with a Sony 510/2 and a MD 441N Sennheiser microphone. Extraction of F_0 and intensity contours was made using the Ph. Martin algorithm. The pitch detector extracted F_0 values ranging from 10 to 1,000 Hz. Spectrograms were made on a Kay Elemetrics type B/65 Sonagraph.

TABLE 1. *Percentages of correct identification of the French sample in the French–Arabic and French–Cantonese comparison pairs* ($N = 40$) (*Experiment I*)

	Age of the child	
Comparison	8 months	10 months
French–Arabic	75·8	74·4
French–Cantonese	69·4	31·9

RESULTS

Table 1 shows the percentage of correct responses (that is, identification of the French sample) by age group (8 and 10 months) and by linguistic match (French–Arabic and French–Cantonese). An analysis of variance with two factors (age and linguistic match) was run on these results. The two main effects were each significant: linguistic match $F(1, 14) = 10{\cdot}38$, $P < 0{\cdot}01$ and age $F(1, 14) = 6{\cdot}76$, $P < 0{\cdot}05$. Interaction of the two variables was not significant: $F(1, 12) = 4{\cdot}38$.

The number of correct identifications was computed for each pair of samples. Percentages of correct identification in the French–Arabic pairs were: at 8 months, 90*, 65*, 70*, 90*; at 10 months 87·5*, 70*, 50, 90* (* = significance at $P < 0{\cdot}01$). In each of the four French–Arabic pairs at 8 months and in three out of the four French–Arabic pairs at 10 months, identification reached significance: $P < 0{\cdot}01$ (χ^2 test). Three out of four Cantonese pairs were significantly discriminated at 8 months where identification scores were: 72·2*, 47·5, 82·5*, 75*, but the Cantonese samples were systematically mistaken for French samples at 10 months with identification scores of 35, 35, 30*, and 30*.

Subject-by-subject analyses were conducted by calculating a score for each judge. Each subject's score was calculated by subtracting the number of that

subject's incorrect responses from the number of that subject's correct responses. The number of positive scores was tested against the number of null or negative scores with a binomial test. In the French–Arabic comparison pairs, only three out of 40 judges had a null or negative score ($z = 5, 53$, $P < 0{\cdot}001$). In the case of the French-Cantonese comparison pairs, the number of positive scores (23 vs 17) does not reach significance ($z = 0{\cdot}79$).

EXPERIMENT II

In this experiment, we tried to find out whether adults can reliably discern the linguistic origin of babbling samples from 6-month-old infants. We also tried to test the value of nonsegmental vs. segmental cues in the identification of babbling. For that, samples from 10-month-olds were extracted from only highly articulated productions of reduplicated babbling. Such productions are characteristic of the 9 to 10-month stage in babbling and are generally poor in intonation patterns. Thus, in this experiment, 10-month samples favoured segmental features, rather than the nonsegmental features which were favoured in the first experiment. Comparisons of babbling were here made for French and Arabic infants of 6–8 and 10 months. We did not make the comparisons with Chinese because it was not possible for us to collect new relevant data on Cantonese babbling; travel conditions to Hong Kong were impossible, and we wanted to use material collected by the same experimenters. Finally, we tried to ascertain whether the fact that the subjects were aware of the linguistic origin of the non-French children played any role in the identification of babbling.

METHOD

Subjects

Three groups of subjects – all native speakers of French – were tested. Group 1 consisted of 18 judges, who were not told the origin of the non-French samples. Group 2 consisted of 18 judges, who were told the non-French samples came from Arab infants. Group 3 consisted of 12 French phoneticians who were also told the origin of the non-French samples. The judges were tested individually and were asked to indicate which sample they thought was from a French child.

Stimulus material

As in the first experiment, each sample of babbling was 15 sec long.The samples from 6-month-olds and 8-month-olds were selected according to the same principles as in the first experiment. They consisted mainly of long vocalizations or sequences of vocalizations with pitch patterns spreading over the whole breath-group. The 10-month-old infants' samples were extracted from only highly articulated productions of reduplicated babbling. They

consisted of sequences of isolated or reduplicated syllables. These samples were generally poor in intonation patterns. In addition, we tried to select and to match samples of babbling carrying similar phonetic material in each French–Arabic pair. The Arabic data for this experiment were recorded mainly in Algiers.

Experimental design

There were six pairs of samples in each age group, which were presented in three separate age blocks. Order of presentation of the blocks as well as the order of the pairs within the blocks were systematically randomized.

TABLE 2. *Percentage of identification of French samples (Experiment II)*

Subjects	*N*	Age		
		6 months	8 months	10 months
Identity of non-French sample unknown	18	55·5	74**	53·3
Identity of non-French sample known	18	59·2	67·5**	49
Phoneticians	12	68*	72·2**	56·9

** $P < 0.01$. * $P < 0.05$.

RESULTS

Table 2 gives the percentage of correct identification of the French samples per age block and group of judges. Correct identification in the 6-month block only reaches significance for the phonetician group. Correct identification in the 8-month block reaches significance for each subject group. Correct identification in the 10-month block is not above chance for any group.

There is a great variability between pair-by-pair identification scores in the 6-month block: the percentages of correct identification of the French sample in each pair were: 35·4, 60·4, 68·7*, 33·3, 91·6*, 70·8*. However, pair-by-pair scores are much more coherent in the 8-month and 10-month blocks. In the 8-month block, the percentages of correct identification were: 83·3*, 77*, 72·9*, 68·7*, 85·4*, 39·5; in the 10-month block, the percentages of correct identification were: 52, 47·9, 58·3, 64·5, 60·4, 33·3.

Subject-by-subject analyses were conducted as in Experiment I. We tested the number of positive scores against the number of null and negative scores with a binomial test. Only in the 8-month block does the number of judges attaining a positive score differ from chance ($z = 3{\cdot}61$, $P < 0{\cdot}001$).

DISCUSSION

Our results show characteristics of the mother tongue in the productions of infants as young as 8 months. At 8 months, identification scores are clearly positive and stable across judges, which leads one to say that given simple experimental conditions, French judges are able either to recognize the babbling productions of children belonging to their linguistic community or to eliminate as alien to their linguistic community the productions of non-French children. The latter strategy implies weaker criteria for judgement. Knowledge of the fact that non-French samples were from Arabic infants was not of any help to the judges in Experiment II. When judges are trying to isolate what they suppose are features of Arabic, they tend to do less well than when trying to eliminate those samples which they recognize as maximally incompatible with their own language, or when trying to recognize features of their own language. On the other hand, the phoneticians' ability to deal with speech sounds allowed them to score higher than the other subjects, especially with the 6-month samples.

Probability of correct identification is closely related to certain dimensions of speech. In the first experiment, samples from 8- and 10-month-olds were characterized by long productions involving patterns of pitch and intensity. In the second experiment, the samples from 10-month-olds were extracted from highly articulated productions of reduplicated babbling that were poorer in prosodic cues. In comparing the results of the two experiments one may conclude that the judges relied mostly on non-segmental features which are more prominent in long intonated productions with a low rate of articulation. The nonsegmental cues most likely to be used are phonation type and organization of pitch and intensity contours (especially the weak–strong contrasts in the babbling from Arabic infants). Although perceptual and instrumental analysis show that pertinent features such as voice quality, different vocal ingress or rhythmical effects are present in well-articulated speech as in less articulated productions, the highly articulated productions seem to induce subjects to search for cues closely related to adult speech and even to word-like productions.

It is still unclear if the failure to recognize the productions of the French children at 10 months in Experiment II is due to the fact that specific segmental phonological cues are not available in reduplicated babbling. However, it has been shown that target-language phonological cues such as VOT in stops are not found in babbling. Comparative studies (Preston, Yeni-Komshian & Stark 1967, Eilers, Oller & Benito-Garcia, in press, Sagart 1979) show that the relevant contrasts are not yet established in 1-year-old children.

Thus, we believe the identification scores at 8 months reflect primarily the judges' skill at using cues relating to metaphonological characteristics. The

patterns found in the identification scores at 10 months in the second experiment could reflect a change of strategy and a greater emphasis on the search for segmental cues. This latter strategy proved inadequate, either due to the irrelevance of such cues for identifying the linguistic origin of productions of 10-month-olds or because of the difficulty in extracting language-specific aspects of the performance on segments in this experimental situation.

That the linguistic origin of samples of reduplicated babbling at 10 months was not identified is consistent with the findings of Olney & Scholnick (1976) with their group of 12-month-olds. However, if samples of variegated or late babbling carried more intonational information judges might be able to distinguish between them.

Although there is much in common between the babbling of children from different linguistic communities, our results demonstrated that there also exist discernible differences in the babbling of children from different language backgrounds. The only conceivable source of such differences comes from the target languages. Our results support the claim that the perceptually relevant dimensions relating to target language do not belong to the domain of segmental phonology but rather to that of metaphonology. It has long been noted (Lewis 1951, Weir 1962, Crystal 1979) that very young children imitate certain adults' intonations, but these imitations have been considered atypical performances and have not been integrated with models of speech acquisition. In our view, a child's ability to produce local patterns similar to patterns found in the target language reflects (*a*) an early general attuning of the vocal tract to conform with the laryngeal and supralaryngeal settings that are specific to the target language, and (*b*) the fact that certain rhythmic and intonational properties of the target language are beginning to be acquired. However, more analytic as well as experimental work will be necessary in order to clarify the early emergence of babbling of such patterns and to relate them to specific features of a target language.

APPENDIX

Perceptual and instrumental analysis

Some characteristics of the French, Arabic and Cantonese samples of babbling from the first or the second experiment as reflected in our instrumental and perceptual analysis are as follows.

French samples

Direction of air flow is always expiratory. Intensity is generally kept rather stable and low. F_0 contours are mainly flat in the medium-frequency range (the mean F_0 at the onset of each segment of utterances is 335 Hz for the 6- to 8-month samples and 370 Hz for the 10-month samples) with smooth pitch

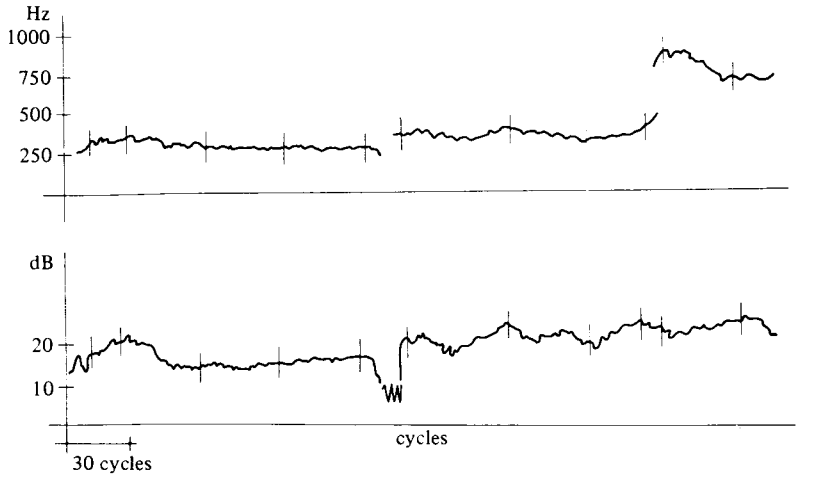

Fig. 1. F_0 (top curve) and intensity (bottom curve) contours of a segment of a babbling production by an 8-month-old French infant.

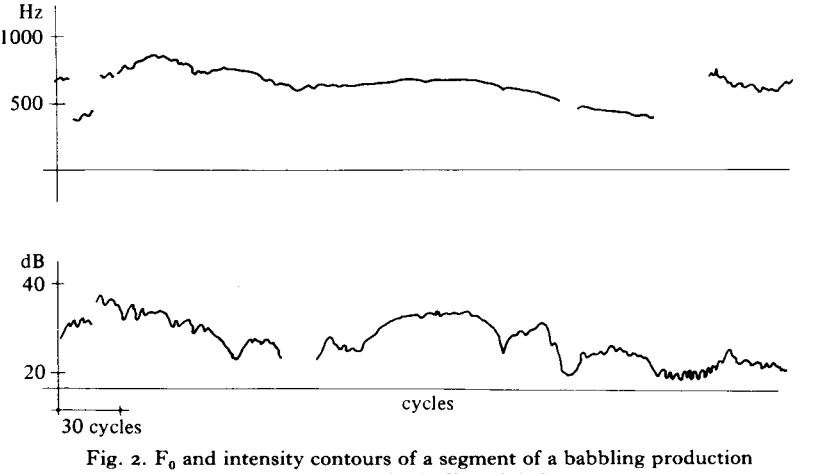

Fig. 2. F_0 and intensity contours of a segment of a babbling production by a 10-month-old French infant.

glides and flat or falling codas (Fig. 1). Some contours start high and then fall slowly, ending medium, with more short-term pitch variations (Fig. 2). Breath-groups are long: median length is 760 msec for 6-month-olds and 1,000 msec for 8-month-olds in our corpus. Terminal syllables are often much longer. Voice quality is neither very tense nor very lax. Sound repertoire shows a preference for voiced over unvoiced sounds.

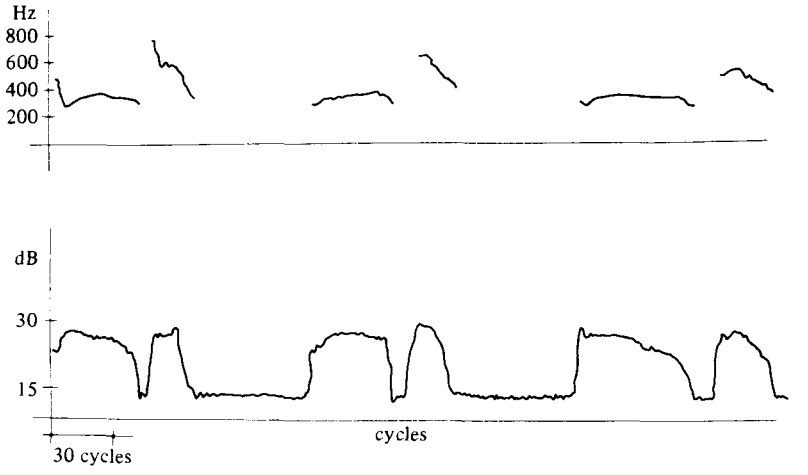

Fig. 3. F_0 and intensity contours of a segment of a babbling production by an 8-month-old Arab infant.

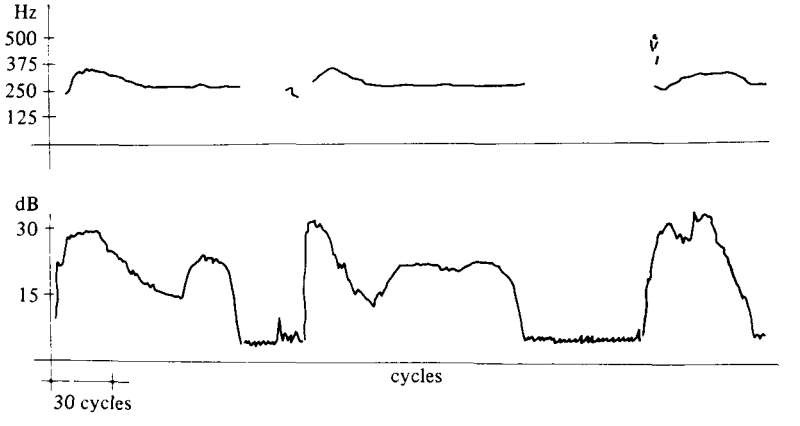

Fig. 4. F_0 and intensity contours of a segment of a babbling production by a 10-month-Arab infant.

Arabic samples

A phonatory pattern recurring with several Arabic children (Fig. 3) consists of alternated sequences of inspiratory and expiratory phonation in rapid succession, the upper articulators being kept in a neutral position. Apart from this pattern, phonation is expiratory. One observes sharp contrasts in pitch, intensity and/or duration between 'stressed' and 'unstressed' parts of the babbling chain, so that the productions form generally rhythmical weak–strong series. The mean F_0 is high at 6 and 8 months (the mean F_0 at onset

is 484 Hz). It remains relatively high at 10 months (the mean F_0 at onset is 406 Hz). Productions are mainly short (the mean is 370 msec for 6-month-olds and 450 msec for 8-month-olds in our corpus). Phonation shows a wide range of variation, from breathy to tense. There are syllables ending in a stop consonant. Vocalic ingress at the beginning of a vocalization is often abrupt.

Chinese samples

Phonation with the Cantonese children is always expiratory; intensity and F_0 are not subject to sharp changes. The main differences with French are, at eight months, the frequency of rising intonation contours and high pitch modulations.

REFERENCES

Aslin, R. N. & Pisoni, D. B. (1978). Some developmental processes in speech perception. Paper presented at NICHD Conference on Child Phonology – Perception, Production and Deviation, Bethesda.

Atkinson, K., MacWhinney, B. & Stoel, C. (1970). An experiment in the recognition of babbling. *PRCLD* **1**. 71–6.

Boysson-Bardies, B. de. (1981). The specificity of infant babbling in the light of the characteristics of the mother tongue. *Proc. 2nd. Int. Cong. Stud. Ch. Lang.* Lanham, MD: University Press of America.

Boysson-Bardies, B. de, Sagart, L. & Bacri, N. (1981). Phonetic analysis of late babbling: a case study of a French child. *JChLang* **8**. 511–24.

Catford, J. C. (1977). *Fundamental problems in phonetics*. Edinburgh: Edinburgh University Press.

Cruttenden, A. (1970). A phonetic study of late babbling. *BJDisComm* **5**. 110–18.

Crystal, D. (1979). Prosodic development. In P. Fletcher & M. Garman (eds), *Language acquisition*. Cambridge: C.U.P.

Eilers, R. & Minifie, F. (1975). Fricative discrimination in early infancy. *JSHR* **18**. 158–67.

Eimas, P. (1975). Speech perception in early infancy. In L. R. Cohen & P. Salapatek (eds), *Infant perception: from sensation to cognition*, Vol. 2. New York: Academic Press.

Eimas, P. D., Siqueland, E. R., Jusczyk, P. & Vigorito, J. (1971). Speech perception in infants. *Science* **171**. 303–6.

Hyman, L. (1977). On the nature of linguistic stress. In L. Hyman (ed.), *Southern California Occasional Papers in Linguistics* **4**. 37–82.

Jakobson, R. (1941). *Kindersprache, Aphasie und allgemeine Lautgesetze*. Uppsala: Almqvist & Wiksell.

Jusczyk, P. (1981). Infant speech perception: a critical appraisal. In P. Eimas & J. Miller (eds), *Perspectives on the study of speech*. Hillsdale, N.J.: Erlbaum.

Jusczyk, P. & Thompson, E. (1978). Perception of a phonetic contrast in multisyllabic utterances by two-month-old infants. *PerceptPsychophys* **23**. 105–9.

Koopmans-van Beinum, F. (1979). Early stages in infant speech development. *Proc. 5th Inst. Phon. Sci.* University of Amsterdam.

Kuhl, P. K. (1976). Speech perception in early infancy: perceptual constancies for vowel categories. *JASA* Suppl. 1, S90.

Laver, J. (1980). *The phonetic description of voice quality*. Cambridge: C.U.P.

Lewis, M. M. (1951). *Infant speech*. (2nd edn). London: Routledge & Kegan Paul.

Lynip, A. (1951). The use of magnetic devices in the collection and analysis of the preverbal utterances of an infant. *GenPsychMonogr* **44**. 221–62.

MacNeilage, P. F. (1980). The production of speech: development and dissolution of motoric and premotoric processes. *Proceedings of Attention and Performance*, Vol. 9, Cambridge.

Menn, L. (1978). Phonological units in beginning speech. In A. Bell & J. B. Hooper (eds), *Syllables and segments*. Amsterdam: North-Holland.

Nakazima, S. (1962). A comparative study of the speech development of Japanese and American English in childhood. *StudPhonol* **2**. 27–39.

Oller, D. K. (1980). The emergence of the sounds of speech in infancy. In G. Yeni-Komshian, C. Kavanagh & C. Ferguson (eds), *Child phonology: perception and production*. London: Academic Press.

Oller, D. K. & Eilers, R. (1982). Similarity of babbling in Spanish- and English-learning babies. *JChLang* **9**. 565–77.

Oller, D. K., Wieman, L. A., Doyle, W. J. & Ross, C. (1976). Infant babbling and speech. *JChLang* **3**. 1–11.

Olney, R. & Scholnick, E. (1976). Adult judgements of age and linguistic differences in infant vocalization. *JChLang* **3**. 145–56.

Preston, M., Yeni-Komshian, G. & Stark, R. (1967). Voicing in initial stop consonants produced by children in the prelinguistic period from different language communities. Johns Hopkins University School of Medicine, Annual Report of Neurocommunications Laboratory **2**. 305–23.

Sagart, L. (1979). *Babbling and early language in Cantonese*. Working Papers in Language and Language Teaching. University of Hong Kong Language Centre, **2**. 1–5.

Stampe, D. (1973). A dissertation on natural phonology. Unpublished doctoral dissertation, University of Chicago.

Stockman, I., Woods, D. & Tishman, A. (1981). Listener agreement on phonetic segments in early infant vocalisations. *JPsycholingRes* **10**. 593–619.

Weir, R. H. (1962). *Language in the crib*. The Hague: Mouton.

—— (1966). Some questions on the child's learning of phonology. In F. Smith & G. Miller (eds), *The genesis of language*. Cambridge, Mass.: M.I.T.