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Infant babbling and speech*

D. KIMBROUGH OLLER, LESLIE A. WIEMAN, WILLIAM J. DOYLE AND CAROL ROSS

University of Washington

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ABSTRACT

Previous scholars have claimed that the child's babbling (meaningless speech-like vocalizations) includes a random assortment of the speech sounds found in the languages of the world. Babbled sounds have been claimed to bear no relationship to the sounds of the child's later meaningful speech. The present research disputes the traditional position on babbling by showing that the phonetic content of babbled utterances exhibits many of the same preferences for certain kinds of phonetic elements and sequences that have been found in the production of meaningful speech by children in later stages of language development.

INTRODUCTION

In Jakobson's (1941) study of the human phonological capacity, it was concluded that basically the same phonetic preferences are expressed in meaningful child speech, aphasic speech and in phonological universals of the adult natural languages of the world. Given a nativistic view of phonology and phonological learning, this conclusion is not surprising, since all of these realms of phonology are presumably governed by the same underlying ability to produce, perceive and conceptually manipulate phonological strings. Jakobson did not, however, believe that childhood babbling was governed by the general constraints of the human phonological capacity. Subsequent researchers (Velten 1943, Mowrer 1952, Osgood 1953, Lenneberg 1962, Rees 1972) have often restated Jakobson's explicit claims to the effect that babbling merely reflected the entire range of possible human speech sounds. In Jakobson's view, babbling was essentially unrestricted and bore 'no relationship' to the child's later pronunciations of adult words. Jakobson's belief in a discontinuity between babbling and speech has channelled

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the interests of linguists and psycholinguists away from babbling. (Important exceptions include Menyuk 1968 and Cruttenden 1970.)

The present study employed data from children in English-speaking homes to show that Jakobson was in error about the nature of babbling. We have obtained evidence that babbled utterances are not 'random vocalizations' but are rather a systematic expression, manifesting many of the same basic phonetic preferences which have been shown in later childhood pronunciations of adult words and in certain phonological universals of adult languages. The parallels between our babbling data and previous data on meaningful child speech are so striking as to suggest that many aspects of the major processes of substitution and deletion in meaningful child speech could have been predicted on the basis of little more than a phonetic preference analysis of babbling data.

METHODS

Our evidence is derived from a number of recordings of childhood babbling which have been made in the Seattle area in recent years. We have recordings of half an hour to one hour in length, some on audio only and some on video and audio tape, of over 50 normal infants aged from 0;4 to 1;1. Because we did not intend to analyse inter-child differences in raw amount of babbling, we did not employ systematic methods to ensure that all the children would produce a substantial number of babbled utterances during the sampling period. As a result, even though our parent reports suggested that all the infants DID babble daily, only a few of the study tapes included enough relevant vocalizations to be useful in our analysis of frequency of occurrence of phonetic elements in babbled utterances. As the reader can imagine, some children went to sleep, some fussed, some cried and some remained largely silent – apparently fascinated with the novel laboratory surroundings and people. In addition, some of the tapes had more adequate audio and/or video quality than others. On the basis of clarity of the recorded signal and the number of babbled utterances produced during the recording period, we selected tapes of five children between the ages of 1;0 and 1;1 and five between 0;6 and 0;8. We employed as data all the auditorily adequate babbled utterances which occurred on each of these tapes.

At least two phonetically trained observers transcribed each babbled utterance independently and then all transcribers conferred. Repeated monitoring of the tapes did not always result in perceptual agreement; in fact, there were often substantial transcriptional disagreements. Therefore, we constructed composite transcriptions which took phonetic alternatives into account. The final analysis did not make use of phonetic features about which our transcriptions were not in agreement.

METHODOLOGICAL AND THEORETICAL FOUNDATION

This study was based upon an interest in the possibility that certain infant vocalizations are related to a developing speech capacity. In keeping with this interest, we studied only 'speech-like' utterances of infants. If we had considered (and transcribed) such irrelevant (or, at best, marginally relevant) vocalizations as cries, whimpers, coughs, grunts, laughs, breathing artifacts and swallows, we would have confused our data with no scientific advantage.

Within the category of what we have called speech-like utterances, we have chosen to focus our analysis only on those utterances which include reasonable acoustic and articulatory approximations of consonantal elements (syllabic margins as opposed to syllabic nuclei) which have been reported to occur in some existing natural language or in meaningful child speech. This decision is partly practical; more is presently known about relative frequency of occurrence of consonantal elements in meaningful adult and child speech than is known about frequencies with regard to vocalic elements. The limitation of our study to analyses of frequencies of occurrence of consonants should not be taken to mean that we have no interest in vowels. Certainly in the future there should be work in which frequencies of vocalic elements in babbling are also analysed; but the value of such work is presently constrained by a relative lack of comparable data from relevant other fields.

Definitions

In this study, a babbled utterance was defined as consisting of at least one syllable wherein a consonantal element (i.e. syllable margin) could be identified, and wherein the child was not crying, laughing, etc. Since a syllable margin requires a syllable nucleus, a babbled utterance had to possess at least one vowel as well as at least one consonant. Our definition of babbling also required that the infant vocalization be apparently 'meaningless', in the sense that it was not an apparent approximation of some adult word the child might have learned or imitated.

Interpretive problems

We have often been asked if the limitation of our babbling data to speech-like, consonant–vowel and vowel–consonant sequences does not result in question-begging; that is, if we only consider babbled elements which are perceptually most comparable to adult or childhood meaningful speech, we are bound to conclude that there is some 'continuity' between babbling and speech since we have defined out the possible discontinuous elements. The answer to this criticism is implied in the goals of our study. Our methodology WOULD result in question-begging if we were immediately interested in the infant's possible production of DIFFERENT elements from those produced in meaningful speech. In the present study, our goal was of another sort. We wished to employ our knowledge

of frequency of occurrence of certain elements in meaningful speech and in the languages of the world (e.g. in both cases, unaspirated plosives occur more frequently prevocalically than do aspirated plosives), and to determine if similar orderings in terms of frequencies of occurrence would be found in babbling. This is surely not question-begging, since it would be perfectly possible in the abstract for babbling infants to produce some sounds relatively more often than they are produced in meaningful speech (e.g. to produce more aspirated plosives than unaspirated ones).

Another criticism we have received repeatedly is that, since our transcriptional system is adult-based, it may be inapplicable to a study of infancy. First of all, we should respond that the transcriptional system is based upon both adult and child meaningful speech elements. Secondly, it should be said that we have attempted to add new symbols to our system as the acoustic and articulatory facts of babbling seemed to justify the additions. Yet it is still true that our analysis is primarily framed in terms of elements which have been a part of the International Phonetic Alphabet for decades. This focus, again, was dictated by our goal: to determine whether the relative frequencies of occurrence of basic consonantal elements are the same in babbling as they have been shown to be in meaningful speech. In cases where the infant elements we transcribed differed substantially from IPA elements and simply were not amenable to unambiguous categorization within the framework of our hypotheses (as, for example, with certain elements which could be interpreted as either weak nasal consonants, weak nasalized fricatives, lax nasalized glides, or lax nasalized stops), it was imperative that we set them aside for later detailed analysis in a study which is bound to show important discontinuities between babbling and meaningful speech. We look forward to presenting some results of such a study at a later date.

Another potential criticism of our work derives from the possibility that frequencies of occurrence of phonetic elements in babbling are not based upon all the same underlying factors as are involved in meaningful speech. For instance, frequencies of elements in meaningful speech are influenced by perceptual, productive and more central organizational factors (for discussion of aspects of these factors, see Ingram 1972, 1973), while babbling frequencies may be influenced only by productive factors or by some different combination of the various factors involved in meaningful speech. Such possible limitations of comparison between data from babbling and from meaningful speech should be kept in mind in the interpretation of our results.

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RESULTS[1]

Our data presentation is framed in terms of our knowledge of well-documented processes of substitution and deletion in meaningful child speech (Jakobson 1941, Oller 1973*a*, Edwards 1971). We made predictions concerning the frequency of occurrence of babbled elements on the basis of the meaningful speech processes. For instance, cluster reductions in meaningful speech (e.g. [tɔp] for *stop*) suggest the prediction of a greater frequency in babbling of singleton consonants than of consonant clusters. Final consonant deletions in meaningful speech ([dɔ] for *dog*) suggest the prediction of a higher frequency of initial than of final consonants in babbled utterances. And, in general, substitution of one class of phonetic elements for another in meaningful speech suggests a higher frequency in babbling of the substituted elements.

Clusters

The reduction of consonant clusters in meaningful child speech is widely reported for a number of languages (Ohnesorg 1948, Smith 1973, Salus & Salus 1973). The prediction that singleton consonants would outnumber clusters in babbling held up far beyond our original expectations. Over 90 per cent of all positions[2] where consonants occurred were filled by singleton consonants rather than consonant clusters (see Table 1). The data from all ten subjects showed this highly significant trend.

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[1] There are a few noteworthy differences between the data presented here and those presented in the Stanford Forum paper, which was the precursor to the present one. First of all, we have added two subjects in the present version. Secondly, the numbers reported here do not match precisely with those in the Stanford paper even with regard to the eight earlier subjects. These minor discrepancies result from updated interpretations of some of our data on the earlier eight subjects. For instance, we decided for the present version of the paper to count uvular trills and taps as liquids in the comparison of liquid and glide frequencies. This decision counteracted our previous categorization which had excluded trills and taps, since we originally believed that these elements were not normally replaced by glides in child speech. We still do not have straightforward evidence of the relationship between glides, taps and trills in child speech; because of our uncertainty, for the present version of the paper, we have adopted a more conservative counting method which maximizes the number of liquids in our sample and thus reduces the chance of verifying our hypothesis that glides will outnumber liquids.

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

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TABLE 1. *Singleton consonants and clusters*

Children at 1;0–1;1 Subject	Single C	CC	%	Total of babbled utterances in sample	Children at 0;6–0;8 Subject	Single C	CC	%	Total of babbled utterances in sample
Sandie	97	4	96	75	Ellie	40	4	91	18
Sally	121	6	97	67	Jared	35	7	83	27
Ginny	95	1	99	55	Ken	43	3	93	33
Seth	58	4	94	46	Dennis	76	1	99	61
Glenna	55	4	93	49	Eric	72	3	96	44
Average			96		Average			92	

TABLE 2. *Initial, final and medial consonants* (%)

	IC	FC	MC		IC	FC	MC
Sandie	35	18	47	Ellie	25	2	73
Sally	21	2	77	Jared	40	3	52
Ginny	55	24	21	Ken	37	0	63
Seth	48	24	28	Dennis	18	4	78
Glenna	65	7	27	Eric	23	13	64
Average	45	15	40	Average	29	5	66

Initial and final consonants

Final consonant deletion has been reported as a common process of meaningful child speech by many investigators (e.g. Albright & Albright 1956, Tracy 1893, 1909). Initial consonant deletion, on the other hand, is relatively rare. The prediction that initial consonants would outnumber finals in infant babbling was borne out in our data, again, in all ten children (see Table 2). The average ratio of initial to final consonants was over three to one.

Predictions based on substitutions in meaningful child speech

Deaspiration. Jakobson (1941) reported the tendency of children to avoid production of aspirated stops in early meaningful speech. Substitution of unaspirated for aspirated stops in word-initial pretonic position has also been reported by Oller & Warren (1973) and numerous others. The prediction that babbled utterances would show more unaspirated than aspirated stops held up in our data. In fact, only three ASPIRATED plosives appeared in the entire corpus of data which included 149 initial plosive consonants. All ten subjects showed the preference for the unaspirated (see Table 3).

Final devoicing. The devoicing of final consonants in meaningful child speech has been repeatedly observed for speakers of several languages (Leopold 1947, Stampe 1969). On the basis of the devoicing process, we correctly predicted that in

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TABLE 3. *Deaspiration (initial stop consonants)*

	Aspirated stops	Unaspirated stops		Aspirated stops	Unaspirated stops
Sandie	1	22	Ellie	0	4
Sally	0	21	Jared	0	1
Ginny	0	36	Ken	1	7
Seth	0	21	Dennis	0	8
Glenna	1	15	Eric	0	11
Totals	2	115		1	31

TABLE 4. *Final devoicing*

	+Voiced obstruents	−Voiced obstruents		+Voiced obstruents	−Voiced obstruents
Sandie	3	13	Ellie	0	1
Sally	0	2	Jared	0	1
Ginny	1	22	Ken	0	0
Seth	0	10	Dennis	1	1
Glenna	1	3	Eric	6	2
Totals	5	50		7	5

TABLE 5. *Stopping*

	Initial stops	Initial fricatives	Initial affricates		Initial stops	Initial fricatives	Initial affricates
Sandie	23	2	1	Ellie	4	0	0
Sally	21	0	0	Jared	1	2	0
Ginny	36	1	0	Ken	8	0	3
Seth	21	2	1	Dennis	8	1	0
Glenna	16	1	0	Eric	11	0	0
Totals	117	6	2		32	3	3

babbling final obstruents would be primarily unvoiced. Of 67 final obstruents in the data, only 12 were voiced. Because of the very small numbers of relevant observations among the 0;6–0;8 children, it is hard to judge the importance of the minor reversal of this trend. Only one child actually had more voiced than unvoiced final consonants (see Table 4).

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

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Spirantization. The widely reported preference for stops in initial position is not normally found in final position in meaningful child speech. In fact, there is persuasive evidence that in final position children often substitute fricatives and affricates for stops (Olmsted 1971, Ferguson 1973, Oller 1973*b*, Compton, personal communication). The babbling data supported the asymmetry in treatment of stops and spirants in initial and final positions. Final fricatives outnumbered stops by about three to one. Unfortunately, the very small number of final obstruents in the data from several of the subjects makes this observation apply with only limited reliability (see Table 6).

TABLE 6. *Spirantization*

	Final stops	Final fricatives	Final affricates		Final stops	Final fricatives	Final affricates
Sandie	6	7	0	Ellie	0	0	0
Sally	2	0	0	Jared	0	0	0
Ginny	3	18	0	Ken	0	0	0
Seth	2	8	0	Dennis	1	1	0
Glenna	0	4	0	Eric	1	6	0
Totals	13	37	0		2	7	0

TABLE 7. *Liquidation*

	Prevocalic glides	Prevocalic liquids		Prevocalic glides	Prevocalic liquids
Sandie	22	3	Ellie	1	0
Sally	14	2	Jared	3	3
Ginny	5	3	Ken	8	1
Seth	0	0	Dennis	14	0
Glenna	3	4	Eric	0	0
Totals	44	12		26	4

Liquidation. The substitution of glides ([w] and [j]) for prevocalic liquids ([l] and [r]) has been reported by many investigators (Jakobson 1941, Smith 1973, Ingram 1971, Edwards 1971). The prediction that glides would outnumber liquids in babbling was well verified in our data. There were 70 prevocalic glides and only 16 prevocalic liquids (see Table 7).

Fronting. Jakobson (1941) cites studies in numerous languages showing the preference in children's meaningful speech for apical over dorsal (i.e. alveolar and dental over palatal and velar-uvular) articulations of consonants. Substitution of apicals for dorsals is widely acknowledged. Our data on babbling among the 1;0–1;1 subjects strongly supported this preference. But the 0;6–0;8 group showed the preference to a much smaller extent (see Table 8).

This difference between younger and older children is reminiscent of Irwin's (1947) claim that infants produce back consonants during the first months of life and then later tend to produce more front consonants. Perhaps if we extended our study to three- to five-month-olds, we would discover a considerable discontinuity within the babbling of infants at various ages with regard to production of apical and dorsal elements.

TABLE 8. *Apical and dorsal consonants (obstruents and nasals)*

	Children at 1;0–1;1			Children at 0;6–0;8	
	Apical	Dorsal		Apical	Dorsal
Sandie	31	10	Ellie	8	13
Sally	57	25	Jared	7	11
Ginny	56	4	Ken	2	13
Seth	52	0	Dennis	30	1
Glenna	80	1	Eric	28	5
Totals	276	40		75	43

Other elements

For the purpose of completeness, it should be pointed out that, even though it was not our goal to do so, we found in the babbling data many examples (though not in high proportions) of phonetic elements which are not particularly common in meaningful child speech and for which the languages of the world have not shown preferences. Among these were syllabic nasals, bilabial trills (also reported in Hoyer & Hoyer 1924) and labio-lingual 'consonants'. Why these elements might appear frequently in child babbling but not in meaningful child speech is not at all clear to us at this time.

CONCLUSION

Contrary to the position taken by Jakobson and many of his followers, babbling does appear to be governed by general restrictions of the human phonological capacity. To a much greater extent than was expected, the predictions of our study were borne out in the data. In fact, after examining our data on babbling, it is possible to make predictions in the opposite direction, i.e. it is possible to predict quite accurately the nature of the most commonly reported substitutions and deletions which occur in meaningful child speech.[3]

[3] These predictions also depend upon the recognition of certain acoustic and/or articulatory similarities among alternating elements. Thus, the substitution of glides for liquids can be predicted given the greater frequency of glides and the acoustic and articulatory similarities of liquids and glides. At the same time, even though initial stops outnumber both liquids and glides, substitutions of stops for liquids or glides are not predicted due to significant articulatory and acoustic differences among these categories.

Of the earlier data which support the relationship between babbling and meaningful child speech, much is unfortunately anecdotal in nature, and the methodologies of the more precise studies limit the possibilities of performing calculations of frequencies such as those reported here. But Tracy (1893), Leopold (1947), Nakazima (1962), Murai (1963), Weir (1966), Gruber (1966), Menyuk (1968) and Cruttenden (1970) all provide evidence suggestive of just the sort of preferences we have verified here.

Perhaps the primary import of our claim that a continuity exists between babbling and meaningful child speech (and, by implication, between babbling and phonological universals) has to do with a model of the child's innate predisposition for phonological learning. Stampe (1969, 1972) and Drachman (1970) have contended that the child's phonological maturation includes a rather sudden change at the time meaningful speech begins. Stampe claims that it is then that the 'innate processes' of substitution and deletion are brought to bear. Oller & Warren (1973) have argued against the 'innate processes' hypothesis by contending that the form of processes need not be preprogrammed. Instead, they claim the child's phonological processes are 'generated' or 'formulated' by the child as a means of operationalizing certain natural phonetic preferences. The child's phonetic production preferences antedate his meaningful speech, as evidenced by the babbling data. It would therefore seem reasonable to assume that phonological processes are the OUTPUT of an innate phonological acquisition device which has access to, and to a large extent abides by, the child's production preferences.

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