Implosive and Prenasalized Consonant-like sounds in Babbling

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ABSTRACT

This paper reports an analysis of the production of implosive and prenasalized sounds by 6 children (3 Fulfulde and 3 Bambara) from the onset of babbling to the end of their first year. It shows that the production of implosive consonant-like sounds by the children is very early on language-specific i.e related to the presence of these consonants in the language the children are exposed to. Unlike the implosive consonant-like production, the prenasalized consonant-like sounds show no language-specific trend. Thus, in this cross-linguistic study on Fulfulde and Bambara children's babbled utterances, the implosive sounds are markers of early specialization in consonants' production by children exposed to these two languages.

Keywords: Bambara, Fulfulde, Early specialization, First Language Acquisition, Implosive, Prenasalized consonants.

1. INTRODUCTION

Literature on the study of babbling (child language production from 6/7 months to the end of the first year) contains not only accounts which report universal tendencies ([6],[13],[14]), but also studies which show that at that age children's productions are already tuned to the phonetic/phonological cues of the language spoken in the environment in which they are growing up ([2], [[3], [9]). Also, there is a third category of studies in which the coexistence of universal patterns and language-specific features are observed (e.g. [4],[17]).

The current study extends [5] which investigated the production of plosive and implosive consonant-like sounds by a Fulfulde child (M) from age 5 months to 10 months 29 days. Our study is concerned with investigating language-specific features and universal patterns in babbling by studying the babbled utterances of six children. While [5] is based on a single child's data and a single language, the current study is larger as it takes into account besides Fulfulde (M's mother tongue), Bambara, a language typologically different from Fulfulde. Also, unlike [5] which studies the production of basic and elaborate sounds (plosive and implosive sounds), we investigate the production of two elaborated sounds namely implosives and prenasalized stops. The concept of basic, elaborated and complex sounds is based on a scale proposed by [12].

This paper is structured in the following way: First, we will introduce the consonants' systems of Fulfulde (Niger-Congo, Atlantic) and Bambara (Niger-Congo, Mande) with a focus on the differences; second the methods used to collect and analyse the data will be explained, third the results will be presented and finally we will discuss our findings with regard to the literature on the issue.

2. FULFULDE AND BAMBARA CONSONANTS

Fulfulde and Bambara share most of the consonants in their phonological systems. In fact, the two languages have in common the following 23 consonants /p b t d c ɟ k g mb nd ɲɟ ŋg m n ɲ ŋ f s h l r j w/. Although the two languages share many consonantal features, there are sounds specific to Fulfulde while others are attested in Bambara only. The three implosives respectively bilabial, coronal and palatal /ɓ ɗ ƒ/ are attested in Fulfulde only[1]. The implosives are very frequent in Fulfulde lexicon as they are attested in 22 % of the words in the language. This percentage and the following data on Fulfulde lexicon are based on analysis of [7] which contains 6630 Fulfulde words. The unvoiced prenalized plosives /mp nt nc nk/ and the prenasalized fricatives /nf ns/ are attested in Bambara only. As regards the prenasalized consonants attested in both languages, two observations should be made: (1) their distribution within lexical units and (2) their frequency of occurrences in the lexica of the two languages are not the same. As regards the first aspect, in Bambara, prenasalized consonants are found exclusively at words' onsets whereas in Fulfulde they are found at words' onsets as well as in intervocalic positions. With regards to frequency of occurrences, in Fulfulde prenasals are very frequent in the adult lexicon where they are attested in nouns and verbs (at onset positions they are involved in initial consonants alternation chains). 18 % of the words in [7] contain prenasals. Prenasalized consonants in Bambara are found in a very small set of nouns naming some plants and small animals/insects ([15]). There is dialectal variation with regard to their frequency in Bambara. In the

variety spoken in Bamako ([8]) prenasals are less frequent than in dialects such Baninko ([18]). The lexicon used for this study is [1] which contains 8365 Bambara words and is based on data of Bambara spoken around Bamako. Prenasals are attested in 9% of the words in this lexicon.

3. METHODS

3.1. Participants

3 Fulfulde children (FC, MC[2] and AT) and 3 Bambara children (SS, SM and SK) were recorded every 15 days interacting with their mothers in their compounds during 7 months (from age 5/6 months to 12/13 months) with a Tascam RD100 and a Sony Handycam. The Fulfulde children are growing up in monolingual Fulfulde families (in Nokara, Central Mali) while the Bambara children were recorded in monolingual Bambara compounds (in Bamako, the capital of Mali).

3.2. Transcription and Analysis

The audio signal was sampled at 44100 KHz. Multilevel speech annotations and transcriptions were made using Praat (version 5.1.20) with the video footages. A detailed transcription of the infants' productions was done by means of the IPA symbols (the 2005 revised version). Fine phonetic details were transcribed using cues from the audio-signal wave form and sonagram (sound spectrum). Not all scientists working on child language acquisition agree on the validity of using IPA to code children's babbled utterances ([10], [5]).

Data was transcribed by the first author of this paper and transcription's accuracy checking was carried out with the help of two other linguists (the second author in this paper and Didier Demolin). The table 1 reports the percentage of agreement between the 3 transcribers. The total of agreement ranges from 69.57% (SK), the lowest percentage to 86.67% (FC) which is the highest percentage. These figures are high enough to guarantee that there is no bias from Fulfulde when the first transcriber (whose mother tongue is Fulfulde) did the first transcriptions.

Table 1: Reliability checking between 3 transcribers on 10 % of transcribed data for each child

	Child	Total number of hours transcribed	Agreement % between 3 transcribers
Fulfulde	AT	8	82.35
	MC	8	75
	FC	8	86.67
Bambara	SK	8	69.57
	SM	6	75
	SS	7	77.78

4. RESULTS

Table 2 displays the results of the production of implosive sounds by each child from age 5 months to 12 or 13 months (12+). The stages are divided as follows 5_8 : from age 5 months 0 day to 8 months 0 day; 8_10 : from age 8 months 1 day to 10 months 0 day ; 10_12 : from age 10 months 1 day to 12 months 0 day ; 12+ : above age 12 months. The percentages indicate the proportion of implosives produced at each age based on the total of all places of articulation found at that age. For example, AT produced 3.33 % of implosive sounds between 5 and 8 months.

The table indicates that implosive sounds are mainly found in the productions of Fulfulde children who are exposed to these sounds in their target language. However, despite the fact that implosives are not attested in Bambara, two Bambara children (SK and SM) produce implosive sounds while FC who is exposed to Fulfulde, a language in which implosives are phonological, has no implosive sounds in her babbled utterances. As regards the two Bambara children (SK and SM) who produce implosive sounds, a detailed analysis reveals that SK produced this sound only twice (once in two different recording sessions) while SM produced the implosive sound only once and during a single recording session. If we consider the places of articulation used, each of the two Fulfulde children (AT and MC) uses both labial and coronal places of articulation with the implosives while the Bambara children use only either labial or coronal. Thus, in terms of frequency and diversity of places of articulation associated with the implosive sounds, Fulfulde children produce more implosive consonant-like sounds and use more places of articulation than the Bambara children.

Table 2: The production of implosive consonant-like sounds by each child at a given age from 5 months to the end of the first year. NA=Not Available.

		Age in months			
		5_8	8_10	10_12	12+
Fulfulde	AT	3.33	0	0.88	2.17
	MC	0	1.33	12.31	NA
	FC	0	0	0	0
Bambara	SK	0	0.67	0	1.01
	SM	0	1.79	0	NA
	SS	0	0	0	0

Now as concerns the prenasalized sounds, Table 3 presents the percentages that each of the children produced at a given age. Overall, we observe that prenasalized consonant-like sounds are attested in the production of children from the two linguistic groups. Within the Bambara group, SK's percentages are outstanding: She has higher percentages compared to the two other Bambara children. Among the Fulfulde children, AT's percentages are also higher than that of the other two Fulfulde children.

Table 3: The production of prenasalized consonant-like sounds by each child at a given age from 5 months to the end of the first year. NA=Not Available.

		Age in months			
		5_8	8_10	10_12	12+
Fulfulde	AT	6.67	17.95	3.95	41.30
	MC	0	5.33	4.85	NA
	FC	2.78	2.49	0	9.09
Bambara	SK	6.82	4.04	26.73	27.27
	SM	0	1.79	3.57	NA
	SS	2.17	0	10.61	15.24

5. DISCUSSION

The findings in this paper support the early specialization hypothesis in babbling and yield the presence of individual variation within each linguistic group.

The presence of implosives almost exclusively in the production of Fulfulde children is interpreted as indicating an early influence of the target language on children's productions: the Fulfulde children who are exposed to implosives in the adult language (22% of Fulfulde words contain implosives) produce more implosive consonant-like sounds and with more places of articulation compared to the Bambara children who are not exposed to implosives. Children from this latter group produce very few implosives and each child uses a single place of articulation with this manner of articulation. This result confirms previous studies (for e.g., [[3], [[9], [[5]) which indicate that children's babbled utterances are influenced by the linguistic environment in which the children live.

As regards prenasalized consonant-like sounds, we notice that the two groups of children produce this type of sounds. If we limit ourselves to the data within the Bambara group, an early influence of dialects on children's productions could be proposed. Indeed, SK (Bambara child), exposed from birth to the age of 3 months to Baninko, a Bambara dialect which uses more prenasals than the Bamako dialect, produces far more prenasals than her peers SM and SS who are exposed to the variety of Bambara spoken in Bamako. But when we consider the inter-group data, here an early influence on the basis of the percentages of production of prenasalized sounds no longer holds. Indeed, for example, FC who is exposed to Fulfulde where prenasals are not only phonological but also very productive (prenasals are attested in 18 % of Fulfulde words including nouns and verbs), she produces fewer prenasals than SS, a Bambara child exposed to the dialect spoken in Bamako in which prenasals are rare: they are found in 9 % of the words in Bambara and they are restricted to some lexems. Indeed, while both have a peak of production at the end of their first year, FC's percentage at this age is 9.09 % whereas SS had 15.24 %. It, therefore, appears that the children's prenasalized sounds in this study do not show early specialization. Prenasals are not good markers of early specialization in this study. In fact, they are also reported in the babbled utterances of children exposed to languages where prenasals are not attested. For example, [16] on the development of the mandibular rhythm by a child growing up in a French speaking environment, shows that this French child also produces prenasalized consonant-like sounds yet prenasals are not attested in French. The hypothesis of a lack of control of the coordination between the velum and other articulators ([11]) may be proposed to explain these results. In support to the last hypothesis is the fact that prenasals appear both in onset and intervocalic position in the children's production of sound sequences regardless of the language they are exposed to. Yet in Bambara language, prenasalized consonants are found only at words' onsets whereas in Fulfulde they are found both at words' onsets and in intervocalic positions.

In this study, another aspect well documented in child language acquisition is observed: individual variation. Indeed, we show that FC (a Fulfulde child) produces no implosive sounds in her babbles yet she is exposed to Fulfulde as are MC and AT who produce these sounds. The absence of

implosive sounds in FC's production could be explained by the fact that this child has vocalic and consonant inventories smaller than that of the other Fulfulde children. She produced fewer sound sequences than MC and AT (Fulfulde children).

In sum, among Fulfulde and Bambara babblers, implosives appear to be good markers of early specialization unlike prenasals. These latter are not good markers of early specialization in this study as they seem to be highly related to aerodynamic aspects in children's productions.

A cross-linguistic study, based on a larger data set, focusing on the production of elaborate and complex sounds in babbling and applying statistical analysis on their frequency both in the output (children's production) and the input (parents/caregivers' child directed speech) would shed more light on the interplay between articulatory complexity, universal patterns and functional load in the presence or absence of linguistic features in the production of children in the babbling stage. We are currently analyzing the frequency of implosives and prenasals (among other phonemes) in the child directed speech in the data used in this study. The results would help us to better understand the relationship between frequency of occurrence of a feature in the input and its frequency of occurrence in the output in Fulfulde and Bambara babbling children.

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[1] The glottal stop /ʔ/ is problematic in the sense that it does occur in some Bambara dialects and in Fulfulde phonemically.

[2] Part of M's data was used in Cissé et al. 2011.

Acknowledgements

This paper is supported by a grant from the project ANR-10-BLAN-1916 APPSy: Phonetic and Phonological Asymmetries of the Syllable.