ARTICULATORY PATTERNS IN EARLY SPEECH PRODUCTION

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ABSTRACT

At the beginning of their lexical development children do not acquire segments or phonemes as claimed by e.g. Jakobson [1], Ingram [2], and others. Instead they operate with a limited inventory of articulatory patterns usually extending over more than one segment of traditional segmental phonology. The evidence is based on a longitudinal study of 8 L1 German monolingual children.

INTRODUCTION

It has often been reported that several of a child's first words may be highly similar to each other in terms of their phonetic structure and that the pronunciation of these words is fairly stable. This observation has led to the assumption that the mental 'construction' of phonetically similar forms is based on the same pattern or protoform that may be 'exploited' for the imitation of several, sometimes surprisingly different adult words. In the literature these patterns have been termed differently, e.g. prosodic schemata [3], vocal motor schemes [4], or gestural routines [5]. Here they are referred to as articulatory patterns since the structure of each pattern is obviously due to certain articulatory movements a child is able to control and to coordinate from a very early stage onwards. Although a number of studies have described such patterns, their true status in early child speech has not been clarified sufficiently yet, since they have primarily been discussed only on the basis of individual words from individual children. No attempts have been made, however, to interpret those findings within the framework of a comprehensive set of developmental data which cover the range of early vocabulary items of a larger number of subjects. This paper looks at a) the extent to which children at the onset of speech really make use of articulatory patterns and b) the origin, nature and development of these patterns.

METHOD

Leon is one of 8 L1 German monolingual children whose data were collected within the Kiel Project on Early Phonological Development [6]. In the following sections his early utterances serve to illustrate some typical phenomena occurring at the onset of speech. Leon's linguistic development was followed with weekly recording sessions from age 0;11,22 to 2;03,26. During the time of investigation he produced 148 different lexical items. Their identification and differentiation was aided by his parents' recognition. For the 61 audio taping sessions, lasting for about an hour each, Leon wore a beyerdynamic TS 42 radio microphone concealed in a small pocket. The recordings were carried out with a Uher 4000 IC Report Automatic tape recorder connected to a beyerdynamic NE 42 receiver. The Kiel Project particularly focuses on the types and the extent of phonetic variation at the onset of speech. During each recording session the experimenters therefore tried to elicit as many tokens as possible of Leon's first words by the use of picture books and things familiar to him (food, toys, tools etc.). At the same time commands and questions such as "Please say X!" or "How do cats, dogs etc. go?" were avoided. Immediately after each recording session the experimenters transcribed the tapes, using the symbols of the 1993 revised edition of the IPA. A second 'control transcription' was carried out after the data collection had been finished.

THE STRUCTURE OF ARTICULATORY PATTERNS

It is hardly possible to determine the status of a chain of sounds in early child speech on the basis of its first occurrence. So when is it reasonable to suggest that a sound sequence represents

Table 1. 11 articulatory patterns determining the structure of 126 of Leon's first 148 words. OF = onomatopoeic form, PW = protoword (word without model in adult lg.).

Pattern refl. from reflected by X words	Structure of Pattern (short segmental description, IPA-symbols)	Examples	
		target word [target structure] (meaning)	**examples of Leon's tokens**
Pattern 1 0;11,22 8 words	[n ~ ɲ ~ ŋ] + [a ~ æ ~ ɛ] or [ae], from about 1;09,14 also + [ə ~ ɵ ~ ɪ]	*nein/nee* [naen ~ neː] (no) PW 'hurry up' *nicht* [nɪçt] (not)	[nɛ ~ ŋa ~ nːaŋ] [næʰŋa ~ naŋnaŋ] [ʔə'neç ~ ʔŏhŏ'neç]
Pattern 2 0;11,22 22 words	[t̪ ~ t ~ d̪ ~ d] + [a ~ æ ~ ɛ] or [ə ~ ɪ ~ ɣ ~ ɵ], from about 1;08,10 also + [i ~ e] and [ɔ]	*du* [d̪a] (here/there (it is)) *'scheiß Katze'* ['ʃaes'kʰatsə] *zwei* [tsɣae] (two)	[d̪a ~ d̪æ ~ d̪ɛ ~ ta] ['d̪ɛtʰɛ ~ 'dadat̪ʰɛ] [d̪æ]
Pattern 3 0;11,22 25 words	glottal activity before V-syll., i.e. [ʔ ~ h ~ ɦ ~ ø] + V., e.g. [a ~ æ ~ ɛ], [ə ~ ɵ], [ae ~ eɪ]	*ey/hey* *Affe* ['ʔafə] (monkey) *blau* [k̥laɵ] (blue)	[ʔeɪ ~ heɪj ~ ʔɛː] ['ʔqpa ~ 'ʔabe] [ʔɵlʲ ~ ʔɵʎ ~ ʔɵl]
Pattern 4 1;00,00 26 words	[p ~ pʰ ~ k̥ ~ b] + [a ~ ɑ], [ə ~ ɵ] or [ae], from about 2;01,22 also + [e ~ u] and [ɪ]	*Ball* [k̥al] (ball) *Papa* ['pʰapʰa] (daddy) *Bauer* ['k̥aɵ̯e] (farmer)	[pʰa ~ baeː ~ paɪ] ['bak̥a ~ 'pap̥ʰə] ['bɵtʰæ̃ː ~ bɵːda]
Pattern 5 1;00,14 22 words	[m] + [a ~ ɑ ~ ɛ], from about 1;11,20 also + [ə ~ ɪ ~ ɣ ~ ɵ]	*Mama* ['mama] (mum) *Mann* [man] (man) *Müll* [mɣl] (garbage)	[mɑmː ~ 'mama] [man ~ man] [mɵl ~ ʔŏ'meʎ]
Pattern 6 1;00,14 4 words	[v ~ w] + [a ~ ɑ], [ə ~ ɵ], from about 1;11,13 also + [i ~ i]	PW 'turning/rotating' OF 'dog' OF 'flying etc.'	[ə̆'vqw ~ ʔə'vqwə] [wəwə ~ wɵw] [wi ~ 'wiɵ.wɨ]
Pattern 7 1;01,11 18 words	[h] + [a] or [ae], from about 1;06,23 also + [ə ~ ɪ], [u ~ y ~ i] and [ia]	*Vogel* ['foːgl] (bird) *hallo* ['halo] (hello) *zwei* [tsɣae] (two)	[hu'huː ~ 'ɸuhu] [hae ~ 'hae.a̯] [hae]
Pattern 8 1;03,17 5 words	[g] + homorganic syllabic nasal [ŋ] (velar plosive released through the nose)	PW 'pointing at s.o./s.th.' *Andrea* [ʔan'dʉeːʁe] (a name) OF 'church'	[gŋ̩ ~ gŋ̩.gŋ̩] ['gŋ̩.q ~ 'gŋ̩.ga] [gŋ̩.gŋ̩.-gŋ̩.gə̃]
Pattern 9 1;03,24 6 words	coronal fricative, i.e. [θ ~ s̪ ~ s ~ ð ~ z̪ ~ ʑ ~ ʃ], often very long	OF 'insects' OF 'merry-go-round' *waschen* ['vaʃn] (wash)	[dɪɕː] [ð̩ːː ~ z̪ ɪː] [ɕ]
Pattern 10 1;08,10 6 Wörter	[aɵ ~ aɔ], at first often preceded by [ʔ] or [h], from about 2;02,27 also preceded by [m]	*auf* [ʔaɵf] (on/onto) *Haus* [haɵs] (house) *Maus* [maɵs] (mouse)	[ʔaɔfʰ ~ ʔaɵ̃f] [haɵf ː ~ haɵɸ], [mːaɵf ~ maɵɸː]
Pattern 11 1;10,14 6 words	[ʃ ~ ɕ] + [i ~ y ~ u ~ o] or [ɪ ~ ə ~ ɵ], from about 2;02,27 also + [ae]	*tschüs* [tʃys ~ ʃys] (bye-bye) *Kerstin* ['kʰɛɛstin] (a name) *Fleisch* [flaeʃ] (meat)	[ʃɥ ~ ʃyʃː ~ ʃiʃ] ['ɕi.ɛ ~ 'ʃi.ɛ ~ 'ʃi.q] [ɕaɪɕ ~ ʃaɪʃ ~ ʃaeʃ]

an articulatory pattern? We start from the assumption that a phonetic structure represents an articulatory pattern only if it is used for a certain time to render at least two distinct lexical items. Moreover, it only appears legitimate to suggest that the pronunciation of an individual word is based on a specific pattern if the majority of its tokens over some period of time reflect a certain phonetic structure that is characteristic of other words as well. Following these two criteria, it is possible to assign 126 of Leon's first 148 words, that is about 85% of his total early lexicon, to 11 different patterns, some of which seem to be responsible for the structure of up to 26 different words. (See Table 1 for examples.)

What are the structural characteristics of the 11 articulatory patterns Leon relied on? A comparison of the words

listed under 'Pattern 5' in Table 1 shows that the production of many (22) of Leon's first words was obviously based on an articulatory pattern whose most characteristic element was a bilabial nasal [m] that was at first preferably combined with open or mid-open vowels, i.e. [a ~ ɑ ~ ɛ]. Later, from about 1;11,20 on, however, the bilabial nasal was also produced in combination with central or centralized vowels, i.e. [ə ~ ɪ ~ ʏ ~ ɶ]. Leon's imitations of words that were produced at a later stage thus indicate that in the course of time the patterns become more flexible with regard to their structural properties. The word *Mama*, which was first registered when Leon was 1;00,14, seemed to function as a kind of trigger for pattern 5 because he soon started to reproduce several target words in a form very similar or even identical to his renditions of *Mama*. All these words were apparently coded on the basis of the same articulatory pattern or protoform.

The second column of table 1 offers a short segmental description of the structure of each individual pattern. Some of the typical characteristics of these patterns should be noted here. Each of the 11 patterns was obviously based on those articulatory movements Leon could already control in a more or less safe way at a very early stage. It is striking that some time or other almost every early word was integrated into one of the 11 patterns. In other words, at some point Leon tried to produce almost every word by relying on preferred articulations. On the whole he operated with a rather restricted inventory of articulatory routines. He clearly preferred coronal articulations as far as consonantal elements are concerend. Plosives and nasals were much more often produced than fricatives, approximants or trills. At least until age 1;8 front vowels, i.e. open and mid-open unrounded front vowels, clearly dominated over close and back vowels. The majority of Leon's patterns can be described as a combination of a rather stable consonantal element and a more variable vocalic element, because many of his early words involved sequences like [na ~ nə], [da ~ də], [ba ~ bɶ]

or [ma ~ mɛ]. But even structures that were not CV, e.g. [gŋ̩], took over the function of patterns, cf. e.g. the examples listed under patterns 8 and 9 in Table 1.

THE DEVELOPMENT OF PATTERNS

If the production of a word is based on articulatory movements a child is able to control and to coordinate in a more or less consistent way, the pronunciation of this word will of course be fairly stable. This phonetic stability provides the grounds for guaranteeing a crucial and indispensable feature of communication: intelligibility. The more uniform and consistent the use of patterns, the easier the task for the interlocutor to get involved in communicating with the child. If a child's pronunciation of a word varies too much, the people he or she talks to will have difficulties in identifiying the objects of reference. Yet phonetic stability also competes with the necessity to reproduce a word in a fairly target-like way. Consequently, the early articulatory patterns will have to undergo further development so that structurally more complex words can be produced. Leon's data and the data of the other Kiel children indicate that there are basically 5 ways in which the original patterns change over time.

1) All patterns that are characterized by an initial consonantal element reflect a kind of 'internal' development. While the consonantal element serves as a kind of basic element within the pattern and remains fairly stable, the vocalic element tends to be subject to a higher degree of variation after a given time. One effect of the internal change of a pattern is that the degree of homophony among the words based on the same pattern decreases gradually.

2) From about 1;08,04 on Leon obviously started to 'combine' already established patterns with each other. This has different effects: a) patterns with a fairly simple structure such as CV are expanded into more complex patterns that allow the production of forms that may, for example, have a $C_1V_1C_2V_2$ structure; b) 'integrating' a word into a pattern or a combination of patterns may also lead to a stabilization of its pronunciation. Initially Leon's forms for

the word *Bauer*, for example, varied drastically. Later, however, he produced very stable renditions of this word and these were obviously based on a combination of patterns 2 and 4. (See Table 1 for examples.)

3) The development of patterns through combination does not only involve the combination of patterns as a whole. Patterns may also be expanded by adding just components of other patterns. This facilitates the production of words with a C_1VC_2 structure. Such a development is, for example, illustrated by Leon's forms for *Mann* (c.f. Table 1) and *gemein*. In this case the typical structure of pattern 5 [ma] is expanded by adding an alveolar nasal [n] in final position. From the first recording session onwards [n] was the most characteristic element of pattern 1.

4) Leon also combined already established patterns with new components, i.e. elements that are not characteristic of any other pattern. Between 2;01,22 and 2;06,06 he, for example, started to expand patterns 3 and 5 by producing several words, e.g. *blau* and *Müll* (c.f. Table 1), that showed the typical structure of these two patterns but that additionally had a lateral approximant [l ~ ʎ] in final position. Before that period of time lateral approximants had hardly been produced at all.

5) Several words also changed from one pattern to another. In most cases the words changed from a rather early pattern to one that only developed at a later stage. Such a development was, for example, reflected by Leon's forms for *zwei*. Initially they reflected the structure of pattern 2 and later that of pattern 7 (cf. Table 1). It seems as if by changing the patterns the child tries to develop a more target-like but at the same time still stable pronunciation of a word.

SOME CONCLUSIONS

On the whole an analysis of Leon's first words shows that his early phonological development cannot adequately be described as the acquisition of individual phones or phonemes acquired within a given developmental sequence. Leon rather

seemed to operate with a limited inventory of articulatory patterns. The more Leon's motoric and organizational abilities developed, the more complex these patterns became. Moreover, his data suggest that it is not quite adequate to assume that initially phonological organization is strictly based on the individual lexical item as claimed in most studies on early phonological development. Leon's early utterances rather show that articulatory patterns which have provided the framework for a fairly stable pronunciation of one word are 'exploited' for the reproduction of other words. The patterns seem to enable children to organize the phonological information specifying a word in such a way that a fairly stable pronunciation of this word is facilitated. At the same time they seem to establish the first systematic links between children's early words. Consequently, patterns represent a first possiblity for children of going beyond the domain of the individual lexical item when they organize their early speech production.

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