ARTICULATORY PREFERENCES IN FIRST WORDS: THE FRAME CONTENT HYPOTHESIS

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ABSTRACT

Phonetically transcribed utterances for 1.) babbling, 2.) early speech and 3.) concurrent babbling in three normally developing infants were analyzed to asses the ratio of labials to alveolars in the three contexts. Prediction based on the "Frames then Content" hypothesis was that early words would show a predominence of labials indicating a return to more simple production patterns based on the requirements of simultaneous lexical and phonetic coding. Results showed predominence of labials in first words contrasted with a predominence of alveolars in babbling for all three infants.

INTRODUCTION

In contrast to Roman Jakobson's early theory [1] proposing discontinuity in sound use between babbling and speech, recent work has shown continuity between the two [2, 3]. With few exceptions, output patterns in babbling seem to correspond to output patterns in first words. Phones most frequently used to describe canonical babbling and early speech output in phonetic transcription studies are stops [b], [d]; nasals [m], [n],glides [j], [w], and [h] [4] and vowels [ɛ], [æ], [a], [ʌ], [ɔ] [5, 6] in CV and CVCV forms. Acoustic studies of early vowel development [7, 8, 9, 10, 11] are consistent with transcription based studies in showing early preferences for vowels located in the lower left quadrant. Evidence of continuity from prelinguistic behaviors to early words in both sound preferences and temporal organization increases the importance of understanding babbling as a crucial first phase of development toward first word production patterns.

Some evidence suggests that an aspect of use of babbling patterns in first words consists of even higher frequency of usage of certain aspects of babbling patterns in words than in babbling. For example, the favored number of syllables in babbling is one, the favored consonant is a stop consonant and the favored mode of consonant repetition, reduplication. There is evidence that these preferences actually increase in first words and concurrent babbling. Alveolars are the most frequent stops in babbling [12]. It has been noted that there is a strong trend towards favoring labials in first words and concurrent babbling, both in English and in other languages [13]. It is tempting to propose that with the onset of the demand to interface the lexicon with the motor system, the infant enters a conservative motor phase in which he/she focuses mainly on the simplest of available motor capacities. However, a simplicity based hypothesis has a circular quality as simplicity is taken as synonymous with frequency rather than being defined independently. This circularity has been a persistent problem with Markedness which is fundamental to phonological theory, and in principle is a problem for any approach that emphasizes relative frequencies. In this case the claim that this incidence of labials represents regression to simpler forms is not necessarily circular. An additional finding from babbling-to speech studies offers a potential means of avoiding the circularity problem for a simplicity hypothesis.

MacNeilage & Davis [14, 15, 16] have proposed a "Frames then Content" metaphor to describe spatio-temporal and biomechanical characteristics of babbling and continuity in transition to early speech output. Frame applies to the rhythmic regularity of mandibular oscillation cycles resulting in listener perception of syllable-like and therefore speech-like output. It is claimed that close and open phases of the cycle may often have no associated neuromuscular activity other than movement of the mandible and consequently no sub-syllabic organization of Content elements. The syllabic Frame thus constitutes the earliest temporal envelope within which segment specific Content elements develop as the child gains increasing independence of control over articulators in speech movement sequences. This perspective allows testable hypotheses regarding organization of babbling and speech The CV Co-occurence Hypothesis predicts strong associations between labial closure and central vowel open phase, alveolar closure and front vowel open phase, and velar closure with back vowel open phase as emerging from mandibular oscillation in the temporal domain. The Variegation Hypothesis predicts manner changes across successive closure (consonant) phases and height changes over successive open (vowel) phases, consistent with the principle of mandibular oscillation during output sequences. Both hypotheses are generated from an ease of articulation perspective suggesting the driving force behind sound qualities observed in pre-speech output is production based rather than perceptual. In a study of six normal infants [17], tests of the CV co-occurrence hypothesis showed either significant associations or expected trends for the three consonant places of articulation. A potential conclusion from these results is that earliest CV relationships represent a lack of independence in place of articulation between close and open phases of canonical sequences. Tests of the variegation hypothesis revealed highly significant trends for height over front back changes for vowels and manner over place changes for consonants for all subjects. This result is suggested as being due to change in tongue height based on degree of openness of the jaw over successive cycles.

The default mode for producing speech like output is considered to be found in the labial central vowel association as no tongue presetting is required to realize the sound qualities produced. A predominence of labials in first words would thus allow an additional piece of evidence to confirm the ease of articulation hypothesis suggested by "Frames then Content".

METHOD

Data analyzed for this study were collected as a part of a larger longitudinal project tracking early normal speech development from the onset of canonical babbling through age 3 1/2. Data for three infants were analyzed for this study. Normal development was established through parent case history report. In addition, each infant was administered the Battelle Developmental Screening Inventory [18] and hearing screening using sound field techniques.

Three observers collected and analyzed data for the infants. Each observer tracked the same infant over the course of the study. One hour weekly sessions were audio taped in the subject's home. An ATW-20 digital audio recorder was used for both data collection and subsequent transcription. Each infant wore an Audiotechnika ATW-1030 remote microphone in a cloth vest. The microphone was clipped at the shoulder to keep a consistent mouth to microphone distance and to keep the infant from handling the microphone.

Data selected for analysis included all speech-like canonical babbling and word forms occurring during the sessions. Vocalizations analyzed were produced with an eggressive airstream, including minimally a consonant like closure phase (articulatory obstruents, sonorants, and glides), and vowel like open phase within a single utterance string. This criterion resulted in either CV or VC monosyllables as minimal units for analysis; polysyllables included CV or VC alternations. The non-oral closant /h/ was included when it was present in rhythmically alternating sequences. All utterance strings analyzed were comfort state vocalizations produced without simultaneous background noise or speech. Tokens selected as single utterance strings were bounded by 1 second of silence, noise, or adult vocalization.

All utterances which met these criteria were phonetically transcribed

by the primary transcriber using broad phonetic transcription supplemented by diacritics available for infant speech [19]. All transcribed data was entered using a phonetic keyboard and software developed for analysis of infant data [20]. Data analyzed for this investigation included 8158 alveolar and labial consonants.

RESULTS

Results for all three subjects are displayed as ratios of alveolar consonants to labial consonants. Included in Table 1 are ratios for prespeech babbling, concurrent babbling and speech, and first words.

Table 1. Ratios for prespeech babbling, concurent babbling and first words

	Prespeech Babbling	Concurrent Babbling	First Words
S1	1.35	.50	.28
S2	4.33	3.34	.35
S3	1.65	1.76	.40

All three subjects favored alveolar consonants in prespeech babbling. Ratios were 1.35, 4.33, and 1.65. In first words, all three favored labials strongly. Ratios were .28, .35, and .40. One subject also favored labials in babbling produced concurrently with first words (S2; ratio 3.34).

DISCUSSION

The dominant perspective in the area of early speech production has been one of linguistic theory, which includes the use of linguistic formalisms to capture regularities in early child productions. The object of formal linguistic inquiry is an abstract system shared by members of a community rather than the actual phonetics of speech output. The consequence for study of acquisition is emphasis on phonological contrast rather than on details of output; the message level rather than the level of signal generation. One statement of this position on speech development is that of Macken [21] "Phonology is a cognitive/linguistic system which exists independently of the phonetic system on which it is based" (pg.436). At the same time, the limitations children have in producing speech correctly have frequently been acknowledged as being largely motor control limitations, without a corresponding attempt to develop a coherent theory of speech motor control.

A second consequence of the formalist approach to speech development has been a relative emphasis on the onset of meaningful speech as the legitimate starting point for description, although recent work has shown continuity between late babbling and early speech and dramatic similarities across languages in babbling and early speech inventories. A coherent theory of speech motor control in early development thus might more properly be seen as beginning at the onset of canonical babbling, the initial manifestation of speech-like motor behavior.

Findings of this study, viewed in the context of "Frames then Content" as well as in the context of these infants pre-speech babbling preferences for alveolars support the strength of a production-based explanation for early speech patterns as an alternative to development of linguistic categories based on perceptual distance; extensions of the child's mechanical production constraints rather than as rule-driven cognitive operations. Predominance of labials in first words related to preference for alveolars in babbling is viewed as use of basic production patterns to realize early lexical items. At the very least, more knowledge of early motor constraints will allow more careful evaluation of claims related to cognitive or phonological factors which have been suggested as being independent of motor constraints. This independence must develop at some point. The question then arises of how the child achieves this independence if it is not a given as a starting point.

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