THE ACQUISITION OF VOICING CONTRAST IN NORMAL AND AT-RISK INFANTS

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ABSTRACT

This paper reports an acoustical investigation of the development of the voicing contrast in Italian word initial stops produced by three groups of infants: premature, low-birth and controls. The purposes of the study were to compare the patterns of acquisition of the acoustic-phonetic cues for voicing in the speech of at-risk infants and controls and to discuss the inter-group differences in relation to phonological proficiency. The cues investigated were VOT values for stops in initial word position. The productions of the subjects were recorded at the ages of 18,21,24,27 months. The results are discussed in terms of similarities and differences among the three subject groups, of the rate of changes in the acoustic-phonetic cues across ages, and in terms of the differences existing at each age level.

1. INTRODUCTION

This research is a part of a larger investigation concerning possible effects of different handicapping conditions present at birth on language learning. It is well known from the literature that newborn children at-risk have inferior maturation level as compared with controls, and that the alterations of language learning and phonology proficiency could be due to these causes. Speech timing and its variability as source of information about speech motor control development in children have been object of much recent interest. Developmental studies indicate that it takes children several years to establish the motor-control skills needed to realize phones in mature fashion.

However, the relationship between development of accuracy in the control of acoustic-phonetic cues and phonological development has not been investigated extensively. The purposes of this paper were: to compare the patterns of acquisition of the acoustic-phonetic cues for voicing in the speech of at-risk infants and controls; to discuss intersubject different results in relation to phonological proficiency. The measure studied was initial stop-consonant Voice Onset Time (VOT), which is known to be the most reliable acoustic cue separating voiced-voiceless stops. Apparent differences in the ages at which similar phonemic voicing distinctions are made across languages may actually be the result of the different phonetic categories employed in those languages.

The establishment of mature VOT does not arise from a single principle: both speech motor control capabilities and auditory factors are important in this regard.

The discrepancy in VOT acquisition between at-risk subjects and controls can be seen as an adaptation to perceptual constraints as well as to production factors.

2. PROCEDURE

The total population of this study consisted of 4 infants born at less than 37 weeks gestation and 4 full-term weighing less than 2500 grams. A control group of 4 children born full term at normal weight and 4 adult aged from 24 to 26 years also participated. The test was administered to small (S) and normal infants (N) at 18,21,24,27

recorded under standard recording conditions (using Uher model 4200 portable tape recorder with Electrovoice model 635A microphone) saying each of 12 test words at least three times. The test items were the following minimal pair pseudo-words, contrasting labial, dental and velar voiced and voiceless stops: *'papa, 'baba, 'pipi, 'bibi, 'tata, 'dada, 'titi, 'didi, 'kaka, 'gaga, 'kiki, 'gigi.* The infant and adult productions were collected in randomized order. VOT values of each initial stop were measured using Sygnalize 1.2 (1988-90 by Eric Keller). All VOT values reported here are from tokens produced with oral and velopharingeal complete closure.
Means and standard deviations were computed for each syllable for each subject group.

RESULTS

A pair-wise comparison of the VOT means in subject groups for age level is given below. As shown in Fig. 1 the adults' VOTs for voiceless and voiced stops are greater before high vowel /*i*/ than before low vowel /*a*/. Taken together the results shown in Fig. 2.3.4. indicate that: 1. the distinction between voiced and voiceless stops in word initial position emerges relatively late as measured by differences in mean VOT within each age group: 27 month-old normal children have acquired all voicing contrasts except /*k*/ vs. /*g*/, however as measured by differences in mean VOT they still do not produce /*d*/ or /*g*/ in an adult-like manner. 2. VOT values differed significantly between Normal and Preterm infants but not between Normal and Small infants. 3. the children's standard deviations are generally greater than the adults, and inter-Preterm subject's variability was greater than controls. We interpreted these findings as further evidence that long lead voicing is more difficult to produce than zero or short lag voicing. The ability to control relative timing of the articulatory and laryngeal events necessary for the production of voiced italian stops (long lead) appears to be physiologically more complex than initiating both events simultaneously and thereby producing phonemically voiceless stops. Thus, the frequent substitution of /*p*/, /*t*/, /*k*/ for /*b*/, /*d*/, /*g*/, in young children's meaningful speech are most likely a result of speech motor-control factors than of linguistically based rules.

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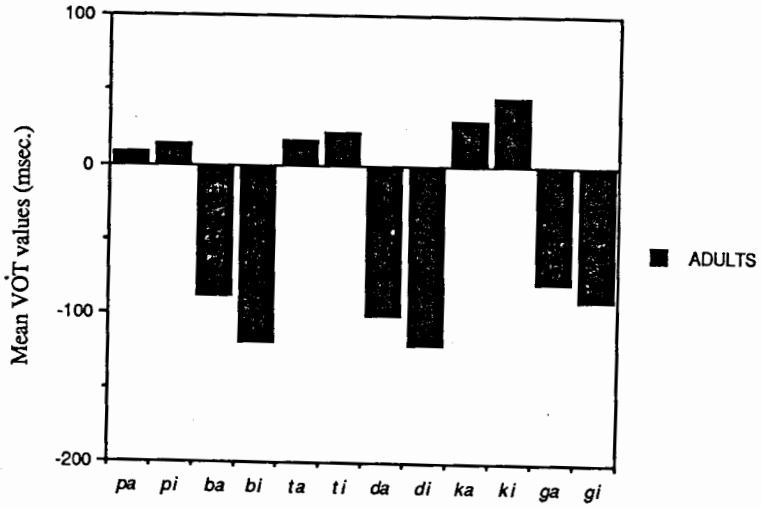

Fig.1. Mean VOT values for Adults

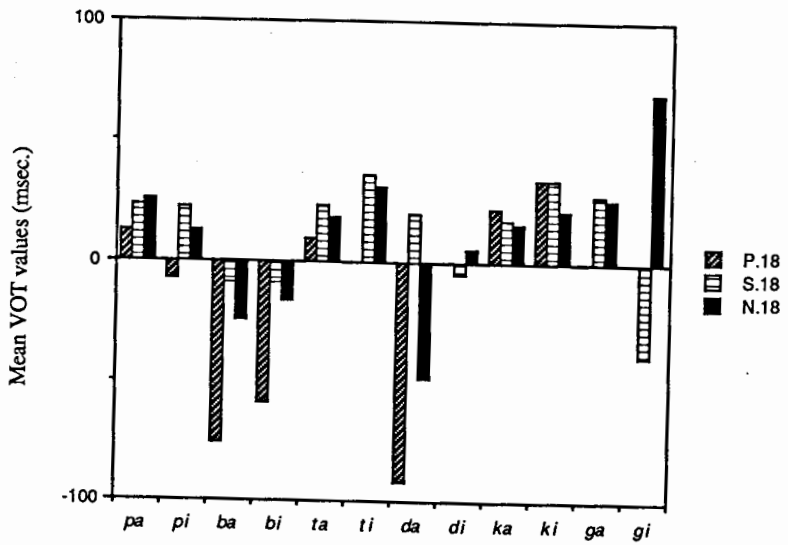

Fig.2. Mean VOT values at 18 months

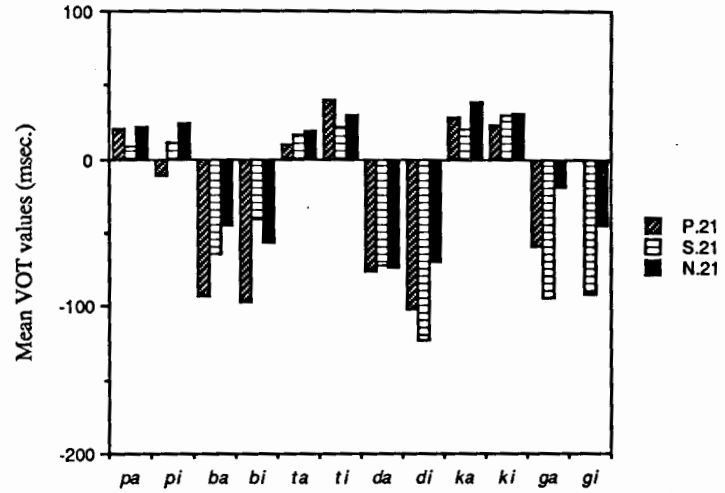

Fig.3. Mean VOT values at 21 months

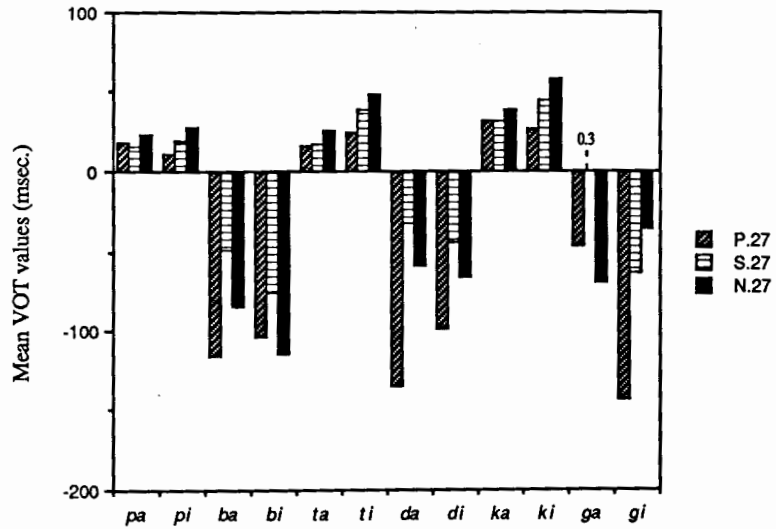

Fig.4. Mean VOT values at 27 months