# PATTERNS IN THE ACQUISITION OF SOME COGNATE CONSONANTS IN PORTUGUESE*

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## 1. INTRODUCTION

Acquiring the phonology of a language requires the development of a high complex series of processes on which, unfortunately, we still lack much information.

As a result of the uniqueness of languages we are faced with the problem of identifying these processes and their ordering of appearance in apparently a quite distinct manner within each language and from child to child.

While the general trend is that children use systematic patterns to distinguish between cognate pairs of sounds, these patterns may vary from language to language. Moreover, this discrimination task may be a result of the acquisition of different skills acquired at different stages (cf. Macken and Barton, 1979).

> "The skill interaction hypothesis assumes that the child has broken the voicing contrast down into two (or more) fairly distinct perceptual components and that in one stage the child is attempting to match one component and in stage

*This paper is taken from: Marigia Viana, "The Acquisition of the Phonology of Brazilian Portuguese, With Particular Reference to Stop Consoants", University of Reading (England), 1984, PhD thesis, sponsored by CAPES, Grant nº 4046/80-1.

two changes his or her productions to incorporate the second component" (Macken and Barton, op. cit., p.70).

While the principle may be general the number and list of these components vary from language to language. Aspiration, for ex., was found to be associated with voicing in English but not in Spanish.

The ages in which these skills are acquired may vary as well. For the English language, for ex., results from studies with voicing discrimination have shown that even by age four children's productions were not completely adult-like:

> "It has been proposed that in terms of duration children's productions do not become adult-like until age 7" (Barton and Macken, 1980, p.168).

Results from different languages are nevertheless in common agreement as to developmental changes taking place during the process of phonological acquisition defined by the progressive control of most of the phonological oppositions. Children seem to follow the same stages and to have as their aim to match the adults patterns.

This work aimd to describe the acquisition of the stop consonants by Brazilian Portuguese speaking children, living in the Northeast region of Brasil, in the State of Pernambuco.

Its main concern was to establish the acquisition stages in the discrimination of cognate pairs normally said to be related by voicing contrast.

The basic hypothesis adopted was that voicing, or voicing contrast defined phonetically, is indeed the main cue for the discrimination and consequently productive acquisition of these pairs of stops and that by age four the child has acquired all the necessary distinctions.

The timing of laryngeal vibration as determined by the examination of sonograph records was chosen as the basis for the acoustic measurement considering not only that the results obtained so far with other languages enable a comparison and provide a precise guide for the present work, but also that this is one of the most reliable measures instrumental phonetics has offered in the last years.

The subjects for this study were eight children with ages ranging from 2:1 to 4:0 years, all of them from monolingual families, living in Recife, Pernambuco.

Due to the lack of data from Brazilian Portuguese adult speakers a parallel analysis with these children's mothers had to be carried out to provide a data point for comparison with the children's results.

Therefore, the first part of the analysis dealt with the ways adults actually produce the voicing contrast, and establishes the patterns commonly used to distinguish between pairs of stop consonants. For this purpose, the tests applied to elicit data from children were first applied to each child's mother as well as the procedures adopted.

Subsequently an instrumental analysis was carried out and measurements on duration of voicing were obtained with the aim of determining the basic patterns adults use according to voicedness and voicelessness periods present in each stop token.

The results obtained were taken as parameters for the establishment of the targets to be produced by children who are said to have acquired the voicing contrast when they are able to match the adult's patterns.

## 2. RESULTS

Results from the present data showed that voiced/voiceless cognate pairs are to be distinguished by a period of voicing preceding and following release for word-initial voiced stops, as against a period of voicelessness following release up to the beginning of next vowel for word-initial voiceless ones. Nevertheless, there are some cases where word-initial voiced stops present no voicing following release whatsoever (cf. ages 2:8, 3:2, and 3:8), probably related to the fact that within adults, that period is very short (0.4 msec for voiced labial and 1 msec for voiced apical stops). The opposition between these stops and the voiceless ones may be marked by voicing preceding release as against voicelessness for a short period after release for voiced and voiceless stops, respectively.

Word-medial voiced stops are characterized by a period of voicing preceding and following release, while voiceless ones, by a voiceless period preceding and following release as well.

Overall, the main points found in the present analysis may be summed up as follow:

1) voicing distinction follows a general pattern discribed as presence (voicedness) as against absence (voicelessness) of voicing for voiced and voiceless stops, respectively;

2) children seem to be aware of this distinction as early as age 2:1, with no significant difference between adult's and children's mean values;

3) tokens for initial labial voiceless stops were produced as early as age 2:1 and persisted up to age 4:0. Initial labial voiced stops were produced for all age groups with an exception for age 3:3 in $AG_3$. Tokens for the dental place of articulation were produced for both voiced and voiceless stops at age 2:8 and persisted up to age 4:0. Velar stops were consistently produced from age 3:3 on for voiced stops. Voiceless stops, on the contrary, were produced as early as age 2:1, both initially and meadilly in a word, for the three places of articulation.

4) word-medial stops, both voiced and voiceless, were produced as early as age 2:1 and persisted up to age 4:0;

5) at age 4:0 the voicing contrast is established both initially and medially in a word.

Overall, children follow adult patterns as early as age 2:1 with no significant difference as to mean values, except for /p/ word-medially which is higher among children ($T = 2.17$; 26 d.f.; $P = 0.05$) as far as period following release is concerned, and /b/ word-initially with mean volue for voicing following release much higher among children ($T = 3.33$; 20 d.f., $P = 0.05$) At ages 3:3 and 4:0 the mean values for /p/ word initially are significantly higher than for adults ($T = 2.38$; 34 d.f., $P = 0.05$, age 3:3; $T = 4.17$; 37 d.f., $P = 0.05$, age 4:00).

However, these are the only significant differences between children and adults for voiceless initial stops.

Among medial stops another significant difference was found for voiceless velar stops at age 4:0, with the mean for /k/ higher among children than among adults ($T = 2.04$; 43 d.f., $P = 0.05$). At this same age, there is a significant difference between children and adults' labial ($T = 3.54$; 24 d.f., $P = 0.05$) and apical ($T = 5.12$; 27 d.f., $P = 0.05$) voiced stops initially in a word.

The ranges are displayed to provide a developmental picture of the voicing distinction through the different places of articulation.

In figures 1-4 all these results are displayed to give the curves for the development of voicing in relation to adult targets.

In Figure 1 the mean values for stops among children across ages follow the adult values with no significant difference up to age 4:0 when the children overshoot adult mean values for /p/ as discussed above.

Figure 2 shows the difference between children at age 4:0 and adults for labial and velar voiced stops. There is no other significant difference.

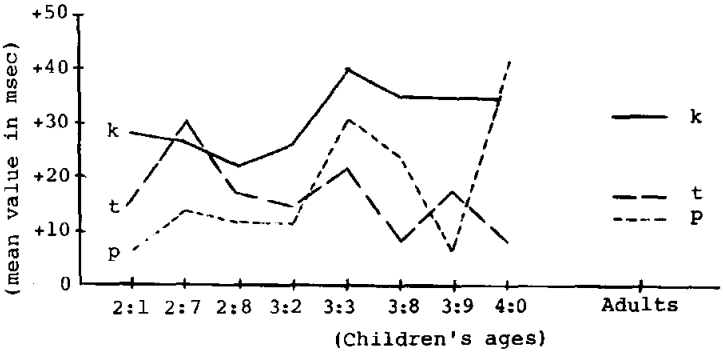


FIGURE 1 - Mean value for initial voiceless stops by place of articulation for children and adults.

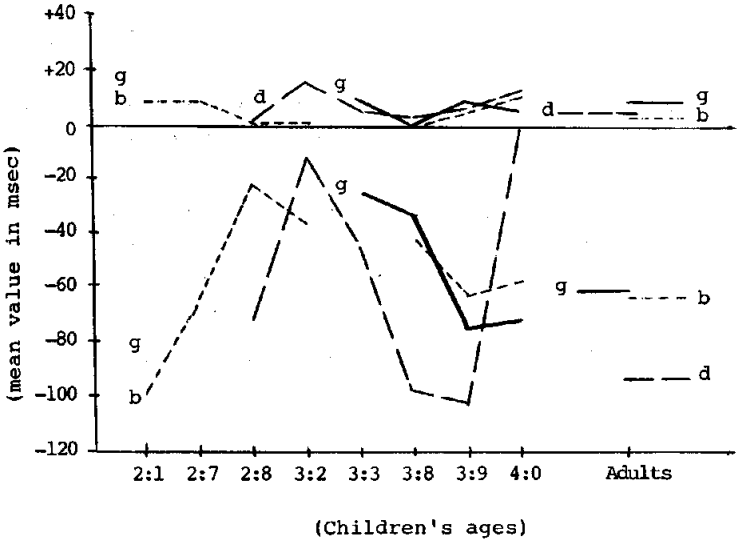


FIGURE 2 - Mean value for initial voiced stops by place of articulation for children and adults (voicing periods preceding release are below 0, and voicing following release above 0).

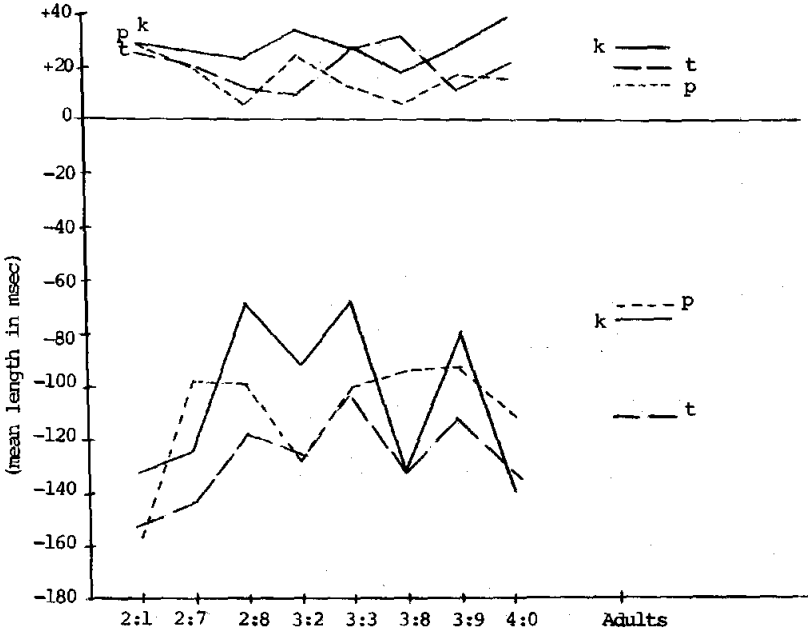


FIGURE 3 - Mean value for medial voiceless stops by place of articulation for children and adults (voiceless periods preceding release are below 0, and voicelessness following release above 0).

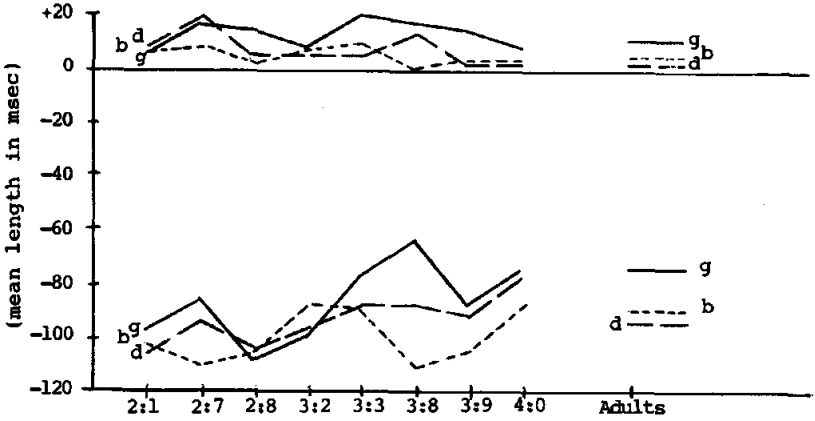


FIGURE 4 - Mean value for medial voiced stops by place of articulation for children and adults (voicing period preceding release are below 0, and voicing following release above 0).

## 3. CONCLUSIONS

Results from physiological , acoustic and perceptual data (Lisker and Abramson, 1967; Abramson and Lisker, 1965, among others) have shown relations between laryngeal events and supraglotal gestures which are decisive in differentiating between stops. It is through the

> "control of the timing of laryngeal adjustments relative to supra-glottal gestures" (Lisker and Abramson, 1971, p.770),

that the speakers of a language distinguish between /p,t,k/ and /b,d,g/.

The present work has considered laryngeal events (vocal fold vibration) and their relation to articulatory gestures (actual constrictions at different places of articulation) and looked for patterns used by children to distinguish between homorganic pairs of segments (p/b; t/d; k/g) during the process of phonological development in Brazilian Portuguese speakers.

Our findings support the extraction of the dimension of voicing - here described more precisely as the relative timing of supra-glottal closure and vocal fold vibration (represented instrumentally by low-frequency harmonic components identified in spectrograms by vertical striation) - as a reliable correlate of the phonological 'voice' contrast for stops.

The data show that children followed adult patterns in distinguishing cognate pairs by contrasting periods of voicedness as agaisnt voicelessness for stops both initially and medially in a word. Stops initially are distinguished by a period of voicing preceding and following release for voiced stops as against a period of voicelessness following release up to the beginning of the next vowel for voiceless ones. Voiced medial stops show a period of voicing preceding and following release, and voiceless stops are characterized by a voiceless period preceding and following release. This difference between the realization of the contrasts initially and medially is, of course, more a function of our inability to identify the voiceless pre-release phase of initial stops than it is an indication of any fundamental articulatory difference.

The order of acquisition of voicing follows the order of acquisition of stop positions proposed by Jakobson (1968) in which labials come before apicals, which come before velars. Voicing distinctions within the children's speech in the present work first appeared between labial stops, than apicals, and finally velars, as far as data for word-initial segments are concerned. Word-medial stops seem to be acquired at an earlier stage (before age 2:1) and for that reason no statement can be made about order of acquisition in that position. There is no apparent correlation between age group and distribution for voiced and voiceless periods as far as the means found for the patterns are concerned. The means did not progressively approximate the adult's figures as the child got older. For voiceless stops, for example, at age 2:8 the children presented the closest figures to those found among the adults, and at age 3:3 the means overshoot the adults' means. At age 3:9, the means are once again closer to the adults' means. This would corroborate Macken and Barton's (1980) findings if the figures for age 4:0 were not again singnificantly higher than the adult's. The same is true for voiced initial stops.

At first glance, from the data analysed it seems that two particular factors prevent any simple generalization about the acquisition of the voicing contrast:

1) the uneven distribution of tokens for the three places of articulation, apicals being the most frequent type of stops, followed by labials and then velars; and

2) the asymmetry in the acquisition of the voicing distinction for word-initial and word-medial stops: while for medial stops a distinction seems to be established as early as age 2:1 at the three places of articulation for word-initial stops the distinction is not established until age 3:3.

The first point mentioned above might be interpreted both as a natural result of the distribution of the stops in the language itself, and as a possible strategy used by children to mask their difficulty in producing the more difficult sounds. Such a strategy could itself, of course, be a consequence of the

distribution of the stops in the language. That is to say, children do not attempt to produce the voicing contrast at the three places of articulation at the same stage because they are exposed to a less frequent number of target stops or, putting it in other words, /g/ is less frequent than /b/ which is in turn less frequent than /d/.

This issue is also realsed by Macken (1980) in discussing the difference in distribution of word-initial phonemes in her data on Spanish speaking children, despite the application of techniques to obtain equal proportion of each stop. In the Children's data, labial stops are distinguished as to voicing before apicals and velars. As early as age 2:1 in the present data, children were consistently distinguishing the labial stops both initially and medially in a word. This order of acquisition seems to be corroborated by Spanish children acquiring the stop voicing contrast. Macken and Barton (1980) found that children first acquired a phonemic contrast at the labial place of articulation and then, at the velar and the apical ones. The ages in which these contrasts were acquired in Spanish varied from child to child, and ranged from ages 1:7;16 to 2:0;7, for labials, and from 2:0;6 to 2:4;8 for apicals and velars initially in a word.

Our overall situation is, however, different from that found by Macken and Barton who discovered a parallel between the order of acquisition of the stops and the asymmetry in the distribution of stops in the corpora: frequency of occurence for labials in their data was higher than for apicals and velars up to the point when these stops were acquired, several months after the acquisition of voicing contrast between /p,b/. Even when the contrast seemed to be acquired there remained an asymmetry in the distribution of the stops, suggesting that this was a property of Spanish

> "rather than merely a function of some aspect of children's speech..." (Macken, 1980, p.158).

Macken (op. cit.) in discussing the problem of distribution of stops in Spanish, mentions works from Hinofotis (1976), and Drachman and Drachman (1973) in Greek, in which the same sort of asymmetry was found. We find a similar order of acquisition

but no parallel in distribution. While contrary to Spanish, the Portuguese distribution of stops does not seem to correlate with order of aquisition nevertheless, the voiced velar stop is indeed the least frequent one in the corpora for the children and was acquired at a rather late stage (age 3:8).

It is also very revealing that while the distribution for English stops is distinct from Spanish, and in this particular case similar to Portuguese, children acquiring stop voicing contrast in English which

> "maximally utilizes the voicing contrast (in initial position) at the dental place of articulation" (Macken, 1980, p.161),

also produce that distinction in the apical place of articulation before labial and velar stops.

The second point mentioned - the asymmetry between the acquisition of the voicing distinction for word - initial and word-medial stops-might be related to the fact that intervocalically voiced stops are easier to produce as a result of being already within a voiced context. Children are said to use some strategies in producing the voicing contrast which support this view. For example, French children studied in Allen (1983) produced words containing an initial voiced stop with an initial epenthetic element identified as a voiced phoneme and interpreted grammatically either as a definite or as an indefinite article. This strategy might be extracted from the child's awareness that the typical context for voiced segments is intervocalic which leads to a reinterpretation of those segments initially in a word. Following this argument we may conclude that Brazilian Portuguese stops are first acquired medially in a word because they are easier for the child to produce. Only some stages later is he able to produce voiced segments initially in a word.

Lack of data on word-medial stops from other languages do not allow us to make a comparison between results from Portuguese as found in the present work and results from children acquiring other languages. Nevertheless, our results clearly showed that at age 2:1 children have already started to distinguish between cognate pairs, and that by age 3:3 the

distinction is established for the three places of articulation, both initially and medially in a word.

To conclude, voicing as measured phonetically in the present study by reference to the duration of voiced and voiceless periods both preceding and following stop release has proved to be a highly relevant parameter in the study of the discrimination and, consequently, productive acquisition of stops. Considering that results from studies with languages other than Portuguese applying VOT measurements seem to corroborate our main findings for word-initial stops, we may perhaps conclude that the more extensive types of measurement used in the present work are appropriate ones when interest is to be focused on not only word-initial but also word-medial stop positions.

It is suggested from our present findings that further research into the acquisition of contrast, considering voicing (interpreted as here) as the feature used by children in distinguishing between cognate pairs, should be carried out to cover the productive acquisition not only of stops but also of other obstruent types.

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