A CROSSLINGUISTIC VOT ANALYSIS OF EARLY STOP PRODUCTION: THE DEVELOPMENT OF THE FEATURE VOICING

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ABSTRACT

This paper focuses on the development of the feature voicing and its VOT implementation. The VOT values of early stops produced by German and Spanish monolingual children were analyzed and compared. A language-specific difference of the mean VOT values was already found at the babbling stage. Moreover, in early German word production significant voicing contrasts for coronals and labials were found. The Spanish data provided no statistically significant VOT differences.

INTRODUCTION

It has been proposed that at the phonological level voicing is a binary feature, phonetically implemented by means of two out of three discrete categories of the VOT continuum: voiced (=lead), voiceless unaspirated (=short lag) and voiceless aspirated (=long lag), depending on the particular language; and that, at the phonetic level, short lag is the unmarked option, whereas lead and long lag are marked [1]. This entails that voiceless unaspirated will always implement one of the terms of the phonological voicing contrast. In this respect, research on early child stop production provides relevant data to test the particular hypotheses, although the available literature - [2], [3], [4], [5], [6] and [7] among others - does not present a unitary picture and leaves many questions open.

This paper is concerned with the acquisition of the voicing contrast and with its implementation by means of VOT. It deals with some of those questions on the acquisition of VOT which current research has left partly open: When do the VOT values begin to constitute a contrast, and when is a voicing contrast of the target language acquired? Do stop consonants at the babbling stage already manifest a tendency to the VOT values of the target language? Do babbling data and early words exclusively contain voiceless unaspirated stops?

In order to find an answer to these questions, data on early stop production by four German and four Spanish monolingual children were selected for VOT analysis. The target languages German and Spanish were chosen because of their opposing implementation of the feature voicing: German, like English, implements voiceless by means of long lag and it implements voiced by means of short lag, whereas in Spanish voiceless corresponds to short lag and voiced to lead.

METHODS

The data reported here belong to a larger longitudinal investigation of five children acquiring German in Hamburg and four children acquiring Spanish in Madrid. Both groups were audio-recorded at their homes in unstructured play sessions, using a high-fidelity Sony TCD-D10 PRO cassette recorder and a portable Beyerdynamic microphone. Due to the nature of the recordings as unstructured play sessions, the collected data are heterogeneous, and the number of tokens for analyzable stops varies considerably within sessions and children. Many relevant data could not be taken into consideration, because of disturbing noise; this was especially true for the Spanish data, which had thus to be extensibly reduced.

Utterances beginning with stops (voiced and voiceless) in initial stressed CV sylables were selected for analysis, corresponding to three developmental points: babbling, 25 word point and 100 word point. The material for the word stage was classified according to the intended target consonant and not according to the produced sound; a stop was further considered for analysis only if it had the same place of articulation as the intended target consonant. In the babbling stage, no target model being available, the classification was made according to the produced sound. Stops selected for analysis belonged to the three places of articulation: labial, coronal and velar. The relevant speech signals were digitalized at a 22KHz rate from a Revox-B215 tape recorder. We used both wide band (300 Hz) and narrow band (59 Hz) FFT, with 6 dB pre-emphasis and 0.5 frame advance for the acoustic analysis. The acoustic analysis was made with a computer-implemented program (Sound Scope 16 for Macintosh). Two windows were used: the time signal in the lower window and the power spectrum in the upper window. Time as well as frequency signals were taken into account to calculate the values. If the time signal was not very clear we additionally measured the power spectrum (both narrow and wideband) and compared the results with the time signal values. Only if the results were similar, we took them into account.

To test statistical significance, variance measures (two-tailed student-t tests) were conducted on the VOT scores for the various places of articulation within each language group and across languages, at the three developmental points.

RESULTS AND DISCUSSION

Our results confirm some of the findings of other researchers, but bring some new points to light. At the babbling stage, German children made a statistically significant difference between two coronal categories, which were perceived as voiced and voiceless, respectively ($p = .001$). No other relevant differences could be ascertained neither in the German nor in the Spanish data.

A crosslinguistic comparison was only possible at the coronal articulation place. VOT values for coronals in both language groups cluster around the short lag and (short) lead, but a significant difference between the mean VOT values of the two language groups was found ($p =$

.0369), German children being more at the short lag side and Spanish children at the (short) lead side. Even though lead voicing predominates only in the Spanish data, it has to be emphasized that it is manifested in both language groups. As expected, in German lead voicing decreases in the course of time, i.e., at the early word stage, only two children manifest a preference for lead voicing in the production of target voiced stops. This result is only comparable to [5], who found more voicing lead than other researchers, i.e., [4].

At the 25 word point German children produce significant voicing contrasts for coronals ($p = .0118$), whereas there is no contrast for labials ($p = .4991$) nor for dorsals ($p = .5$). At the 100 word point, there is a significant contrast for coronals ($p = .0325$) as well as for labials ($p = .00592$). The values for target voiced and target voiceless velars are not significantly different at any of the two word points. At both word points, the categories implementing the voicing contrasts are different from those of the target language. Thus the mean values for voiced stops are slightly under null at the three articulation places and the values for the voiceless stops are within the short lag domain, showing the expected progression from a shorter lag for labials, slightly longer for coronals and definitely longer for dorsals, especially at the 100 word point.

The Spanish data provide no statistically significant differences of VOT, neither at the 25 word point nor at the 100 word point. This agrees with the findings of [4]: at the early word stage, VOT does not play a significant role in Spanish. In our data, this finding is also due to the scarcity of the data: very few target voiced stops fulfilled the criteria for analysis. As regards the target voiceless, their values lie in the short lag range, also showing the expected progression from a (short) lead for labials to a short lag for coronals and a slightly longer lag for velars.

A crosslinguistic comparison of the word data gives the following results. At the 25 word point stops corresponding to the target voiceless have a significantly higher VOT in German than in Spanish at the labial place ($p = .0253$). And at the 100 word point a slight tendency to significancy is manifested at the coronal point of articulation ($p = .115$).

These results agree with the expectations only insofar as the first phonetically implemented stops are in the domain of short lag. Unexpectedly, the first contrast produced in German appears between short lag and (short) lead, regardless of the target language distinction between short lag and long lag. In fact, according to at least part of the literature [6, 7], the first expected opposition should be established between short lag and long lag.

CONCLUSION

The data presented in this paper have shown that the short lag option is by no means the only category present at the babbling stage nor at the early word stage. Short lag and short lead were both present at this early stage in both languages, although only the target language Spanish contains lead voicing. Obviously, the VOT values do not match those of the target languages. This is especially true for the German data, the target language not implementing lead voice. Assuming that at the early stages of language acquisition unmarked options are chosen, the present results call into question the exclusive unmarked status of short lag. Lead voicing, although at the short range, seems to constitute an unmarked category as well, already present at the babbling stage. Interestingly, the first voicing opposition at the 25 word point is made between short lag and (short) lead, in spite of the fact that the target language opposes short lag to long lag.

As to the question when children start making a contrast between a voiced and a voiceless series of stops, no significant opposition could be found in Spanish. In the German data, a significant contrast was already found for coronals at the 25 word point and for labials at the 100 word point. Furthermore, at the babbling stage, German children made a statistically significant difference between two coronal categories, perceived as voiced and voiceless, respectively.

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