

Effects of Language Ability on Phonetic and Phonological Variation of English Intonation by German Speakers

Volha Anufrieva

Institute for Natural Language Processing, Universität Stuttgart

E-mail: anufrieva@ims.uni-stuttgart.de

Abstract

*The present study investigates prosodic variation, as realized by L2 speakers of varying pronunciation aptitude in comparison with native speakers of English. The results demonstrate the distribution of the rising contours on both the phonological (ToBI accent frequencies) and phonetic (values for the six parameters of the F0 curve produced by the PaIntE model) levels. The rising contours, and pitch accents, have a wider distribution in German productions, which is therefore closer to the German prosodic pattern, as opposed to the native realizations. The subjects of excellent ability most closely approach native-like performance in this respect, but their values are still much higher. Another peculiarity concerns the F0 peak frequency parameter of L*H accents in the below-average samples. These values are significantly different from the corresponding percentages of the average, excellent and native speakers. Nevertheless no clear-cut trends could be found in the realization of the other PaIntE parameters. Their further phonetic differences and similarities are to be tested for consistency effects on the subsequent research stages.*

1 Introduction

Most modern theories of language acquisition suggest that L2 is a reduced system characterized by a basic variety [5] of language means, i.e. a limited set of exemplars [e.g. 6, 9] which a speaker reproduces, once he or she has been exposed to it.

Thus, it was claimed, for example, that Finns vary within a narrower pitch range in Russian [12] and Americans in Mandarin [3] than the respective native speakers. A number of other investigations determined an opposite trend on this matter: more variation was found in the tonal structures of Americans speaking Japanese [11], as well as in the

vowel representation of Spanish speakers of English [13].

The absence of consensus on the issue of variation across L1 and L2 implies that the outcome largely depends on the languages and phenomena involved.

It would be therefore interesting to have a closer look at the prosodic subsystem, as it per se allows of a considerable degree of variation within its categories. Irrespective of the linguistic component, variation seems to have a relation to an individual's language ability as it requires an expansion of the basic variety on the one hand, and accommodation to the L2 variation pattern, on the other.

A cross-linguistic study was conducted to test the above hypotheses, where a detailed analysis of F0 variation was carried out.

2 Data and subjects

Data consisted of English read speech samples from the classical text 'The North Wind and the Sun', recorded at the sampling rate of 16 kHz and produced by 30 native German speakers, whose pronunciation aptitude had been initially defined as excellent, average and below average (12, 10 and 8 speakers in each group, respectively), based on the tests performed as part of the DFG funded 'Language Talent and Brain Activity' project [4]. Apart from that, a control group of 12 native English speakers was recorded for the comparison of the experimental results.

3 Method

Data processing was carried out within the three subsequent stages.

Firstly the whole corpus was automatically segmented on the phone, syllable and word levels by forced alignment using the Aligner model for German and English [10]. An automatic extraction

of F0 values for each syllable followed with get_F0 ESPS. Finally we manually labeled the intonation events in accordance with the ToBI annotation convention [2].

Syllables carrying ToBI accents were parametrized using the PaIntE method [7, 8], which describes the F0 curve in terms of the six basic parameters: the steepness of the rising and falling sigmoids (in seconds); the alignment of the function within a syllable (a relative value from -1 to 1, for the syllable is taken as a unit); the amplitudes of the rising and falling sigmoids and the frequency of the F0 peak (the three latter parameters are measured in Hertz).

3 Results

The initial extraction of global PaIntE parameters, i.e. without regard to the ToBI accents, yielded a clear peculiarity in the realization of the rising sigmoid by the below-average German speakers, as compared to all the other subjects. This result was taken as an incentive to analyze the rising F0 contour in more detail.

Clear differences between the groups were evident already from the descriptive statistical analysis.

The rising F0 contour, i.e. the high boundary had a much wider distribution in German realizations than it was employed by the native speakers. The frequency was highest for the average group, followed by below-average speakers.

Another peculiarity concerned the distribution of the 'rising' pitch accent L*H in pre-boundary position. This ToBI event was also more typical of the German samples, with the highest percentages for the average and below-average groups and the lowest for the native speakers.

In both of the above cases the informants of excellent aptitude approached native-like performance, but their values were still much higher.

Given the fact that the speech samples were taken from a neutral text for reading, the German speakers' preference for rising contours can be interpreted as a typical pattern in this type of speech.

LH* was the only case where the percentages for excellent and native speakers were almost equal and exceeded those of the below-average and average groups. This can most probably be accounted for by the fact that this ToBI accent is absent from the German system, so of the German group only speakers of excellent aptitude are able to produce it in a near-native fashion.

Table 1. Distribution of rising contours and pitch accents.

Group	High boundary	L*H	LH*
below-average	37,6	16,7	1,7
average	48,8	17,4	1,5
excellent	31,3	10,4	3,0
native	10,2	6,1	2,6

As the next step we looked at the separate PaIntE parameters of L*H and LH* pitch accents to see if there were phonetic differences in their realization. The values for each parameter were normalized group-wise and substituted for the corresponding z-scores. Then we compared the samples by means of the Kolmogorov-Smirnov test. Whereas no significant differences were found for the LH* accent, the p-values for each two samples, i.e. speaker groups, of L*H events lay below 0.05 for at least a few parameters.

It is notable in this respect that the frequency of F0 peak was only significantly different for the below-average group, as opposed to the native and average speakers. This finding is also represented in the following boxplot: the values of the below-average informants stand out as the most centred and scattered at the same time.

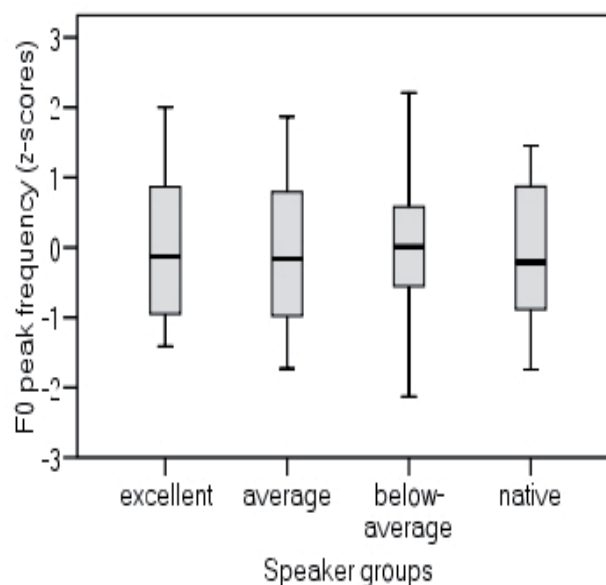


Figure 1. F0 peak frequency of L*H accent.

4 Summary

The results of the present study confirm the initial hypothesis of a correlation between prosodic variation and language ability. Significant differences between the groups were found both in the distribution of the ToBI categories and in the realization of the individual F0 curve parameters.

While the phonological findings were expected and showed a clear trend towards the native patterns in the German productions (a wider distribution of the rising contours was described in an earlier investigation by Anderson [1]), they only reflected the peculiarities of the rising pattern distribution. However, it is also important to explore the falling contours, as well as the remaining pitch accents, in order to find out whether the mother tongue predefines all L2 intonation patterns in general. Additionally, analyzing the corresponding German language samples of the same subjects is indispensable for comparing the general tendencies from the cross-linguistic, intra-speaker and inter-speaker perspectives.

The latter aspect has been touched upon in the present study to a certain extent, in that we determined the greatest degree of accommodation to the L2 variation pattern within the excellent aptitude group, i.e. the lowest percentages of the rising patterns and a native-like production of the LH* category, which is absent from the German system.

On the phonetic level the observable peculiarity of the F0 peak function in L*H accents, as realized by the below-average group in contrast to the other speakers, appeared to support the basic variety theory mentioned above. The majority of the values were significantly more centred and less varied than in the other groups. Nevertheless no clear-cut trends could be found in the realization of the other PaIntE parameters in that respect. Their elaborate differences and similarities across the speaker groups require further exploration for consistency effects.

5 Acknowledgements

The data for the current study was taken from the corpus of the 'Language Talent and Brain Activity' project supported by the German Research Foundation.

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