NATIVE OR ALIEN: VERIFICATION OF FOREIGN ACCENT IN THE SPEECH OF RUSSIAN LEARNERS OF ENGLISH

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ABSTRACT

The paper reports on an attempt to obtain some objective criteria for measurement of prosodic interference. A new technique based on rank correlation analysis is suggested to relate perceptually valid cues with acoustic features signalling foreign accent in utterances as spoken by Russian learners of English (6 males) and compared with native speakers (2 males and 2 females).
The experiment was repeated with the same speakers reading the same material after two years' period of studies.
The calculated coefficients of cross-correlation between relative vowel durations and pitch values were compared within the same speaker and with native speakers. The intraspeaker correlation proved to be much higher than interspeaker data which was in agreement with experts' rates in listening tests by a force-choice and category judgement methods.

INTRODUCTION

Most phonetic investigations on foreign accent are primarily concerned with the detection of divergencies from the phonic norms of a target language, rather than its prosodic features /3;4/. One of the reasons lies in the inadequacy and incompatibility of the existing descriptions of prosodic systems/10/.

R. Collier /2/ stresses that the linguistic description remains incomplete as long as it does not account for all perceptually relevant pitch events, but only for those that are distinctive. That is why many relevant intonation phenomena are often overlooked when they are described in terms of tone units, pitch phonemes etc.

Durational properties seem to be a sort of the resultant of a number of speech factors such as degree of prominence, phonetic makeup, syntactic structure of an utterance, pausal effects, speaker's idiosyncrasy etc. Thus rhythm is believed to be the backbone of melody, the framework on which it hangs /11/.

Speech timing control along with melody are an integral part of the speaker's linguistic competence, and the interfering effect of a first language must manifest itself as distortions of temporal and pitch structure which are perceived by native users of the language /6; 7/.

Compared to grammar learning and pronunciation of phonemes in speech flow, prosodic features of a second language are acquired later, errors persist longer and are more difficult for the learner to realize and correct, since intonation has only marginal meaning.

It is agreed that learning the phonology of a second language is a process of gradual, progressive approximation toward target language norms. This is not the case with mastering intonation, the process extremely uneven, prone to cease at early stages /4; 5; 9/. This fact suggested an idea to reproduce the experiment after two years' period of studies by employing the same subjects reading the same experimental material.

This study was designed to reveal the departures from the authentic prosody in the Russian-accented English utterances. With this object in view an attempt was made to develop a formalized technique for analysis and measurement of prosodic interference. Besides, it seemed interesting to compare the results of listening tests in which two groups of auditors - native and non-native speakers took part.

I. ACOUSTIC EXPERIMENT

Method

Stimuli and Procedure. The experimental material consisted of five sentences embedded in short dialogues and one tongue-twister. Their length varied from 6 to 20 syllables, and they were of various syntactic structure and communicative type. These sentences are given below.

(1) Could you turn your TV down a fraction?
(2) Peter Piper picked a peck of pickled peppers.
(3) A friend told me I could find some accommodation here.
(4) I'd rather have a cup of coffee if you don't mind.
(5) Yes, and it matches your scarf perfectly.

(6) I'm sorry but I seem to have mislaid your scarf.

Six Russian learners of English (all male) and four native users (two male) of the same age group naive to the purposes of the experiment were asked to solo read the test material.

The Russian learners were half-way in their five-year course of studies at the English department, the University of Leningrad. They spoke English fluently with nearly all English sounds.

The material was recorded in a sound-proof studio and then subjected to an acoustic analysis. Electronically obtained fundamental frequency trajectories were manually smoothed by continuous curves throughout the utterance. Each contour was divided into a number of regular time intervals equal for all speakers. Depending on the length of an utterance the time lag could vary anywhere from 50 to 200 ms.

Frequency measurements were taken at these points to obtain a reduced contour description that would allow point-to-point comparison between different speakers. The oscillograms of the test utterances were segmented into vocalic and consonantal segments. To facilitate this task the sentences were purposefully made up of words carrying mostly voiceless plosives and fricatives. The durations of vowels were read to an accuracy of 5 ms.

Speech rate was calculated as the ratio of overall articulation time (ms) to the number of phonemes in the ideal (careful) transcription of the utterance.

The experiment was reproduced two years later with the same learners reading the same test material under the same experimental conditions.

It is customary to assume that human perception deals with relative properties of fundamental frequency and timing by rating acoustic events within a linguistic unit. This concept conforms to rank correlation statistics to the best advantage and, in particular, Spearman rank correlation coefficient.

The coefficients were computed to analyse the degree of agreement between different productions of the same sentence by different speakers and by the same subject two years later. The obtained data were presented in correlation matrices for each utterance, pitch and durations being considered separately. Two resultant (mean) matrices for each parameter were also calculated.

In order to visualize the degree of similarity of pitch contours as well as time patterns, correlation matrices were transformed into correlation graphs through the use of an algorithm of maximum correlation.

II. RESULTS AND DISCUSSION

Table 1 summarizes the data derived from the analysis of correlation matrices for for two parameters.

Table 1. Percentage of significant correlation coefficients computed separately for pitch and timing pattern similarity between native and non-native speakers of English at two levels of confidence

Speakers	Pitch patterns: Russian	Pitch patterns: English	Timing patterns: Russian	Timing patterns: English
Russian				
p = .05	48	42	83	74
p = .01	12	15	61	40
English				
p = .05		61		72
p = .01		25		56

The results presented in Table 1 clearly indicate that the subjects were able to approximate the timing organisation of the target language sufficiently well. The native speakers appear to allow greater variability of rhythmic structures than Russian speakers.

As far as pitch contours are concerned, the best agreement is observed for utterances produced by native speakers, though the group consisted of two male and two female subjects.

The difference in the percentage of significant correlations between the group of Russian learners and native speakers was found to be statistically irrelevant for pitch pattern correlation.

The data obtained from the same Russian subjects after two years of studies demonstrated that significant intraspeaker correlations accounted for 75-100 per cent of all coefficients. At the same time cross-correlation with one of the native speakers did not show any marked improvement compared to earlier performance.

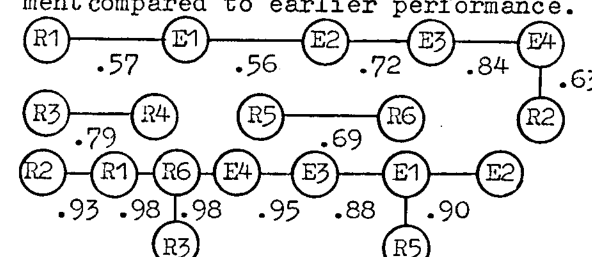

Fig. 1. Correlation graphs of pitch contour (top) and timing pattern similarity: sentence 6 as spoken by English (E) and Russian subjects (R).

Examination of correlation graphs made it possible to specify some utterances as most indicative for verification of the speaker's language background. These are graphs for sentences 4, 6 andthe resultant graph, based on the mean matrix for pitch contour correlation, and graphs for sentences 3 and 6 pertaining to the temporal structure of the utterances. It is easy to see that in these graphs native speakers form clusters which suggest that cross-correlation between native-spoken utterances is greater than correlation with the other Russian-accented utterances (Fig.1).

III. AUDITORY TEST

Material, Subjects, Procedure

The same test utterances as in the previous experiment were segmented from a broader context read by the same Russian speakers and two native speakers E2 and E4 (both male). The utterances were paired with each other and ordered at random, all samples occurring in the first and second position equally. Between the first and the second member of each pair, 1-2 sec silence was inserted; each pair was repeated once, and four seconds intervened between pairs of stimuli.

The listeners were 15 Russian teachers of English phonetics and 10 British students. They were instructed to choose from each pair the sample they thought preferable as regards intonation ignoring possible occasional mistakes in sounds.

In another series of listening sessions the task of listeners was to rate the degree of similarity between two successive utterances on a five-point scale. The listeners grades were expressed in per cent for each utterance and pooled in matrices which were transformed into correlation graphs. The latter were compared with the correlation graphs of acoustic similarity obtained earlier.

IV. RESULTS AND DISCUSSION

As can be seen from Table 2, there is a good agreement between the judgments made by both groups of experts. However, the values of rank coefficient vary from 0.72 to 0.90 that suggests the same divergences from the standard intonation pattern had a different effect on two groups of listeners.

It should be noted that non-native utterances were sometimes prefered to those spoken by native speakers. These data testify to the fact that native speakers may depart sufficiently from the commonly accepted norms of their native language.

The comparison of graphs obtained for pitch contour correlation and timing similarity, on the one hand, and graphs of perceptual likeness, on the other, revealed certain isomorphism in their structure, i.e. certain clusters in one graph corresponded to analogous subgraphs in the other. By pre-assigning thresholds on graphs we were able to obtain subgraphs composed mostly of native speakers.

The subjects made no overt analysis of their reasons for prefering a stimulus but they appear to weigh up temporal and melodic factors involved in the judgment and combine them into a single response. Native listeners were found to be more responsive to the distortions of rhythmic pattern of the utterance.

Using the available graphs as the base, we selected most representative utterances with faulty rhythm and melody for comparative analysis of sentence prosody.

The comparative study of pitch models and timing patterns has enabled us to establish the following acoustic cues which contribute to the detection of Russian accent in English prosody:

(1) Russian speakers tend to level out contrast in length between phonologically long and short vowels that affects the rhythmic structure of word-like phonetic units;

Table 2. Mean opinion scores (in per cent) assigned by English (E) and Russian (R) listeners in auditory tests by force-choice judgment method, and Spearman rank correlation coefficients between their responses

Speaker / Listeners	Sentences 1 E	1 R	2 E	2 R	3 E	3 R	4 E	4 R	5 E	5 R	6 E	6 R	Average percentage E	Average percentage R
R1	42	33	45	38	31	28	10	18	48	31	29	21	37.3	38.5
R2	71	56	50	21	50	35	49	32	55	57	47	65	51.2	56.0
R3	69	41	71	59	59	44	60	63	31	27	69	46	58.8	58.8
R4	3	26	30	33	49	15	5	27	70	50	58	31	39.6	38.5
R5	48	33	15	17	21	45	82	37	53	41	37	19	46.4	44.1
R6	72	44	85	72	62	62	78	64	39	39	54	40	65.2	67.2
E4	82	71	75	76	87	79	81	83	75	86	82	78	80.5	78.7
E2	91	98	85	80	83	91	94	80	75	71	91	91	86.7	85.1
Rank correlation coefficients, ro	0.97		0.95		0.72		0.79		0.96		0.81		0.99	

(2) slower overall speech rate of Russian speakers (87.91 ± 7.95 ms as against 80.3 ± 7.45 ms per sound);

(3) greater relative duration of auxiliaries and other grammatical words in an utterance;

(4) less distinct lengthening of vowels at the end of an utterance;

(5) Russian speakers are apt to lengthen excessively stressed syllables and shorten unstressed ones;

(6) timing pattern distortions result from inability of Russian learners to observe stress shifts under the influence of rhythmic tendency;

(7) pitch rise on the first pre-stressed syllable occurs much more often and is greater in magnitude;

(8) there is a strong tendency among Russian learners to use less contrastive rise-falls at the begining of an utterance;

(9) preferable use by non-native speakers of downward glides on tonic syllables;

(10) the first pitch rise occurs earlier in utterances spoken by native speakers due to a higher relative speech rate on the segments preceding the major stress.

V. CONCLUSION

As a result of the considerations presented in this paper, it appears that fluently speaking Russian learners are able to reproduce English sentence rhythm to a rather high accuracy in terms of relative durations of vowels. By contrast, sentence pitch movement proved to be much more informative for the detection of residual effects of a second language.

Intraspeaker correlations between utterances replicated by the same speaker after two years of studies were found to be greater than interspeaker correlations, especially, with native speakers. This outcome strongly suggests that in the learning process the speaker tends to adjust earlier acquired melodic prototypes to the target language by working out a prosodic idiolect.

Non-native speakers are prone to lapse into vernacular pitch and rhythm patterns unless special attention is paid to remedial exercises.

Prosodic interference seems to be caused by language-specific phonetic factors rather than phonological aspects of melody and rhythm. These phonetic peculiarities influence the authenticity of foreign language speech production to a great extent.

The present study explores only one aspect of speech performance - prepared reading aloud, and does not tackle the problem of spontaneous foreign speech.

Indications are that interlanguage prosodic interference becomes more apparent in casual speech.

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