

FOREIGN LANGUAGE VOWEL PERCEPTION AND PERCEPTUAL SYSTEM OF VOWELS

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ABSTRACT

The aim of this work was to study the mechanisms of a foreign language vowel perception by the native speakers of Russian and Spanish, to describe some universal and specific features of perceptual vowel system and new qualities of "phonological ear".

Introduction

There exist three opposite viewpoints on the perceptual abilities of a person. According to one of them, traditional for linguists, a perceptual space is identified with a phonological one. L.V.Scherba thought a person distinguished as many different vowels as there existed phonemes in his language, all other differences were not "in the light point" of his language conscience /1/. The second viewpoint has been formed as the result of psychophysiological investigations of person's perceptual abilities. According to this standpoint the ability to discriminate various classes of sounds (vowels in particular) is universal, a perceptual space, thus, being independent of a particular phonological system /2/.

On the basis of data obtained in phonetic experiments one can formulate a third approach to person's perceptual abilities. According to this viewpoint a person is able to distinguish more sounds than the number of phonemes in his native language system. This ability, however, is also conditioned phonologically /3/.

A description of a perceptual system requires, in our opinion, the solution of the following problems: a) exposure of those features by which the units of a system are discriminated and classified; b) establishment of correspondence between the relevant features of a phonological system and the meaningful features of a perceptual system; c) stratification of perceptual system units (the relation between the units of different levels is obviously most close here); d) description of both the universal features of a perceptual system and the specific ones dependent on a concrete language system.

This paper presents a description of a part of a perceptual system functioning in modern Russian literary language, i.e. the description of foreign language vowel perception mechanisms (by the native speakers of Russian).

Such an investigation would allow us to specify such general concepts as the supposed foreign language vowel identification with the native language phonemes, the unification of "more or less resembling", and non-differentiation of what is indiscriminative in a native language.

"A phonological ear" of the Russian language speakers is formed under the influence of an extremely interesting vowel system: with a comparatively small vowel phoneme inventory there is a tremendous variety of their phonetic realization. This is due to the following two basic reasons: the influence of the neighbouring soft consonants and a considerable reduction in unstressed syllables. The problem of main principles of different sound realizations' perceptual unification into something resembling is of paramount importance for the Russian vowel system. As far as general characteristics of the Russian vowel perceptual system are concerned the following is known: vowels are actually organized in some "space"; the number of discriminated sound units being more than the number of phonemes, and the nature of each concrete sound phonemic interpretation depends on such factors as the length of a phonetic context, the type of a task being solved by identification, the participation of higher language levels. The specific character of "the Russian phonological ear" undoubtedly reveals itself by the analysis of natural vowel identification. The substantiality of investigation of a foreign language vowel perception depends greatly on the fact what language is to be chosen as "foreign" and what in this case is a native one. We examine a perception of English (the British variant) and Spanish (the Cuban variant) vowels by the native speakers of Russian. In our opinion, this is one of the "advantageous" experimental situations, the following circumstances

determining its preference: 1) considerable differences in the number of opposed phonemes in Russian and English, and minimum differences in Russian and Spanish; 2) fairly systematic knowledge of the nature of a native language vowel perception by the Russians; 3) great significance of data about the perception of English and Spanish vowels by the Russians for teaching English and Spanish phonetics.

In the present paper we'll also use the data obtained in groups of Cuban listeners /4/ since "from a linguistic point of view, what distinguishes the speakers of different languages when they perceive the same natural vowels and what can be interpreted as the influence of language phonology on speech activity is of prime importance" /3/.

Let's examine Russian, English and Spanish vowels from the point of view of their acoustic characteristics. Figure 1 presents formant distributions of Russian, English and Spanish vowels used in experiments.

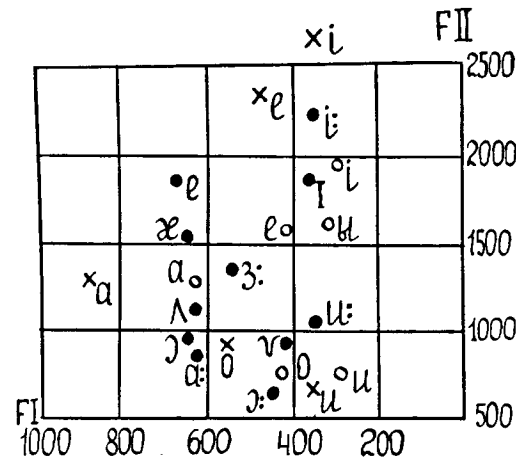


Fig.1 Position of Russian (o), English (•) and Spanish (x) vowels on a formant plane /5,6/.

Experimental Material and Listeners

Tape recordings of Russian, English and Spanish stressed vowels were used as a starting material. The vowels were cut out of the words in which they were pronounced by three male speakers of Russian, English (BE) and Spanish (Cuban variant). The listeners were 36 native speakers of Russian who didn't know either English or Spanish and 20 Cubans who were the beginners of Russian.

Stages of Experiment and Main Results

The first stage of the experiment was pair comparison of English and Russian vowels. The pairs included vowels which could prove to be potentially indiscriminate. Besides pairs including basic

vowel allophones, also the pairs containing one of the "soft" Russian vowel allophones were compiled. Thus, each of the English vowels was presented in a pair both with different allophones of one Russian phoneme and with allophones of different Russian phonemes. The listeners had to judge each pair of vowels for perceptual similarity or dissimilarity and to write "plus" if they considered the vowels identical and "minus" if they thought them different.

Let's see how English vowels are placed in a perceptual space of Russian listeners capable of discriminating 18 allophones of the 6 Russian vowel phonemes /7/. The pair comparison revealed the following (see the Table): only English /i:/ is placed in the area of Russian /i:/; English /i:/ and /I/ are placed in the area of /u:/; English /e/ - in the area of /e/; English /æ/, /a:/, /ɔ/, /ʌ/ are placed in the area of /a/; English /ɔ/ and /ɔ:/ in the area of /o/; English /v/, /u:/ and /ɔ:/ are placed in the area of Russian /u/. Within these areas most similarity is found between an English vowel and two Russian vowel allophones -V and V' - what appears to be one more proof of their close proximity (with the exception of Russian /u/, allophones of which are not discriminated from English /u:/).

It's obvious that most differences being noticed between vowels presented in pairs are connected with i-like soundings of Russian 'V and 'V' allophones, therefore, comparison with such allophones is the best situation for perceptual discrimination of Russian and English monophthongs. Comparison of these data with the results of the analogous test carried out in a group of Cuban listeners shows the following: as a whole the Cubans discriminate the same vowels better than the Russians (see the Table). In contrast to Russian listeners they differentiate Russian /u/ and English /I/, Russian [a] and English /ʌ/, Russian [e] and English /e/, Russian [a], [a'] and English /ɔ/, Russian [o] and English /ɔ/. Common features revealed in a pair comparison test are: perceptual confusion of Russian [i] and English /i:/, Russian [u] and English /i:/, Russian [a] and English /æ/ and /a:/, Russian [o], [o'] and English /ɔ:/, Russian [o] and English /u:/, Russian [u], [u'], [u'] and English /u:/, Russian [u] and English /v/ and /ɔ:/.

Both the Russians and the Cubans discriminate Russian /i/ from English /I/, allophones of Russian /o/ from English /ɔ:/. The results of this experiment testify to the fact that even in case of pairly presented vowels the formant characteristics of the latter are far from playing a leading part in vowel discrimination as it could have been expected. Speakers of different languages distinguish the same sounds differently /8/.

In another test the listeners were presented for identification only non-native vowels and were proposed to letter them either by means of their native alphabet or by means of transcription. Several different types of answers turned out to be possible in this test: 1) unanimous identification of an English vowel as one of the native language phonemes, as for instance, /i:/, /a:/, /ʌ/, /u:/, /v/;

TABLE

Position of non-native vowels in a perceptual space of Russian and Cuban listeners (results of 3 Tests: o- pair comparison; Δ - identification; □ - ABX-method)

a) the Russians

Russian English	i	ʌ	e	a	o	u
i:	○Δ□	○□				
I	Δ	○Δ	Δ	Δ	Δ	Δ
e			○Δ□			
æ			Δ□	○Δ□		
a:				○Δ□		
ʌ				○Δ□		
ɔ				○Δ□	○Δ□	
ɔ:					○Δ□	○Δ
u:					○	○Δ
v						○Δ
ɜ:			Δ	Δ	Δ	

b) the Cubans

Russian English	i	ʌ	e	a	o	u
i:	○Δ□	○				
I		□	Δ			
e				Δ		
æ				○Δ□		
a:				○Δ□		
ʌ				Δ□		
ɔ				Δ□		
ɔ:			Δ		○Δ□	○Δ
u:					○	○Δ□
v			Δ		Δ	○□
ɜ:				Δ		

2) phonetic interpretation of a vowel corresponding to its articulatory and acoustic qualities and reflecting listeners' ability for a more subtle analysis than phoneme classification, for instance, designation of /e/ as [a:], /u:/ as [o:] or [u:], /ɔ:/ as [o:], /æ/ as [a-x], /I/ as [u-i], /ʌ/ and /ɔ/ as [o-a]; 3) erroneous interpretation of a vowel testifying to the fact that a listener is not able to correlate a perceived sound with one of the Russian phoneme or with any single sound; it corresponds to /ɜ:/, interpreting this vowel the listeners use 20 different signs, and to /I/ where they use 6 signs; 4) refusal to identify a vowel, the main motive being "there's no such vowel in Russian".

Identification of English vowels as Russian phonemes presents additional data for the characteristics of Russian vowel perceptual boundaries. It's evident that the area of Russian /a/ is characterized by the most extensive boundaries, including English /a:/, /ʌ/, /ɔ/, /æ/, partially /ɜ:/. The areas of /i/ and /u/ are characterized by the most narrow boundaries: only English /i:/ is identified as Russian /i/, and only in isolated instances the realizations of some vowels are classified as /u/. The areas of Russian /e/, /o/ and /u/ occupy an intermediate position.

Let's examine, for comparison, the identification of the same English vowels by Cuban listeners. Their answers may also be divided in 4 groups: 1) unanimous identification of English vowels as one of the native language phonemes: for instance, /i:/, /I/, /e/, /æ/, /a:/, /ʌ/, /ɔ/, /ɜ:/, /u:/; 2) phonetic interpretation of vowels, for example, identification of English /ɔ:/ as [uo], /v/ as [u], /ɔ/ as [ao]; 3) erroneous interpretation of vowels, for instance, /ɜ:/; 4) refusal to identify a vowel.

In order to extend our knowledge of Russian vowel perceptual boundaries one more test was carried out. Spanish vowels (the Cuban variant) separated from the context were presented for identification to the native speakers of Russian.

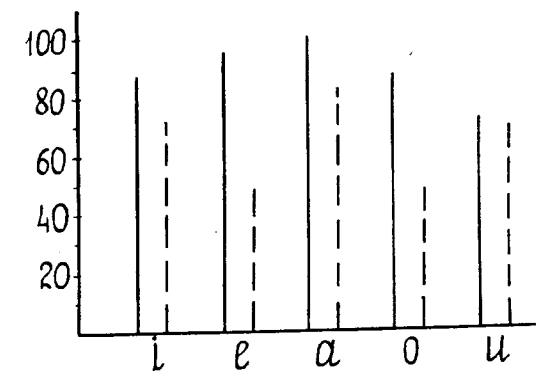


Fig.2 Identification of Spanish vowels by native speakers of Russian (dotted line in a figure) and Spanish (continuous line).

As shown in Figure 2, Spanish /i/, /a/, /u/ are identified by Russian listeners better than Spanish /e/ and /o/. In most cases Spanish /i/, /a/, /u/ are placed in the perceptual space of Russian /i/, /a/, /u/. It should be noticed that the Cubans identify their native /u/ vowel worst of all other vowels. Identification of /e/ and /o/ by Russian listeners is accidental. This fact is manifested in that, on the one hand, they are identified at the same time with several Russian phone-

mes, on the other hand, their phonetic interpretation is extremely various. For further elucidation of the features of a perceptual vowel system ABX-method tests were carried out. In such experiments the stimuli are presented in triads. The listeners are asked to determine which of the first two vowels (A or B) the third vowel (X) is most like. As A and B stimuli we used only those English vowels which in previous tests were identified with one of the Russian X vowel. The results of this test are of prime interest in two respects: 1) to what extent the correlation of native and non-native vowel depends on the type of a task; 2) what new characteristics of Russian vowels are revealed in this case. Quite a number of facts shows that a perceptual estimation does not depend on the type of a task. Thus, it's revealed that Russian /l/ and /b/ are close to English /l:/ and not to /l/ (it's also obvious from other tests). The listeners consider Russian /a/ vowel similar to English /æ/, /ɔ/, /ʌ/ and /ɑ:/, i.e. extensive boundaries of a vowel area identified with Russian /a/ are also present here. When estimating /e/, /o/, /u/ sounds, the listeners' responses give some new knowledge (see the Table). The ABX-comparison does not reveal similarity between Russian /u/ and English /v/, also between Russian /u/ and English /u:/ though in previous tests these vowels are identified. Comparing /'o/ and /'o:/ allophones with English /3:/ the listeners consider them equally alike what is not observed in other tests. The same vowel triads were presented for ABX-comparison to the Cubans (see the Table). In contrast to the Russians the Cubans estimate as most resembling vowels /u/ and /l/ (in a pair comparison test these vowels are also confused; English /l/ is classified as Spanish /e/ in an identification test).

Discussion

The study of foreign language vowel perception is only one of possible methods to obtain data for the description of a perceptual system. The results received are still insufficient for the presentation of this system in terms of quantitative correlations between perceptual and phonological units. However, one can draw quite definite conclusions as far as qualitative characteristics of the system are concerned: a) a perceptual system is more rich than a phonological one. The influence of a native language phonological system on non-native vowel perception is not absolute. The listeners always use the greater number of units than the number of native language vowels. Therefore, the phonology of speech hearing is not only the ability to identify a non-native sound with a native one, but also the ability to understand that it's not a na-

tive language sound; b) comparison of vowel perception results with vowel formant characteristics shows that vowel identification is far from being always explained only by their position on a formant plane. This testifies in favour of the fact that distances between the perceptual system units are determined by the properties of a mother tongue; c) comparison of both group results makes it possible to reveal certain universal and specific features of a perceptual system. The universal features are evident in that, first of all, the vowels located in the apexes of the cardinal vowel triangle (i-a-u) appear to be perceptually most "adapted" to this system; secondly, Russian vowel allophones with i-like transitions reveal perceptual independency: both the Russians and the Cubans are not inclined to identify English vowels with Russian 'V or 'V' allophones even in case when close acoustic proximity may be expected. However, this universal perceptibility to i-like transitions of Russian vowels reveals itself rather specifically when speakers of different languages identify Russian "soft" allophones /8/; d) foreign language vowel perception study gives an opportunity to expose those sound features which are alien to the perceptual system of speakers of a given language. Thus, English /l/, /3:/ and partially /v/ do not "go in" the perceptual system of Russian listeners. The data obtained testify to the complexity of a process providing non-native phonological system vowel perception and to the importance of its further study and comprehension.

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