Научная статья
УДК 81-119
DOI 10.52070/2542-2197_2023_6_874_131

Перцептивно-продуктивная связь в условиях просодической русско-английской интерференции (на примере терминальных тонов)

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Аннотация. Перцептивно-продуктивная связь в основном исследуется на сегментном уровне. В данной работе проводится анализ восприятия и порождения терминальных тонов (место слова с ядерным тоном и его характеристики) в английской речи русскоговорящих людей с разной степенью владения языком. Два проведенных эксперимента подтвердили корреляцию между выбором местоположения слов с терминальными тонами и тоновыми характеристиками при восприятии и речепорождении. Задание на восприятие показало, что местоположение тона совпадает примерно в 50 % случаев, что соответствует 56 % в задании на речепорождение. В задании на восприятие до 25 % случаев характеристики тонов совпадают, что в задании на речепорождение соответствует 27 %.

Ключевые слова: перцептивно-продуктивная связь, просодическая интерференция, ядерный тон, интонационная группа, русский вариант английского языка

Для цитирования: Сухова Н. В. Перцептивно-продуктивная связь в условиях просодической русско-английской интерференции (на примере терминальных тонов) // Вестник Московского государственного лингвистического университета. Гуманитарные науки. 2023. Вып. 6 (874). С. 131–137. DOI 10.52070/2542-2197_2023_6_874_131

Original article

The Perception-Production Link in the Russian-English Prosodic Interference (the Case Study of Terminal Tones)

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Abstract. The perception-production link has been studied mainly on the segmental level. The paper examines the perception and production of terminal tones (their placement, pitch level and movement) by Russian learners of English with different level of language proficiency. Two experiments have resulted in a correlation between the cases when the tone placement and its characteristics are identical. The former has shown up to 50 % of corresponding tone placement cases and the latter – 56 % of cases. The perception task has revealed up to 25 % of corresponding tone descriptions and in the production task there are 27 % of such cases.

Keywords: perception-production link, prosodic interference, nuclear tone, tone unit, Russian English variety

For citation: Sukhova, N. V. (2023). The Perception-Production Link in the Russian-English Prosodic Interference (the case study of terminal tones). Vestnik of Moscow State Linguistic University. Humanities, 6(874), 131–137. 10.52070/2542-2197_2023_6_874_131

INTRODUCTION

Humans vary in many ways. There is significant scientific evidence of considerable variation among speakers in language acquisition and processing [Kidd et al., 2018]. The background context of this evidence is twofold.

Firstly, the present study focuses on a result of foreign language acquisition, i.e. a foreign language proficiency. More concretely, the relationship between the perception of tonal units (other terms are: syntagms, sense-group, tone unit, intonational phrase, etc. [Roach, 2009; Vassilyev et al., 1980; Crystal, 1972]) and the free speech production is under scrutiny. A universal variant of a tonal unit is defined here as a stretch of speech semantically and prosodically complete; there is a nuclear tone there as an indispensable part and a perceivable pause at the unit's right edge.

Secondly, regardless of a vast research scope in the field [Метлюк, 1985; Вишневская, 1989; Первезенцева, 1996], prosodic interference in the Russian-English speech needs further investigation. Considering Russian as a Russian variety of the English language brings new insights into the understanding how both languages interact [Proshina, 2016]. The proponents of this idea suggest that "Russian English includes acrolectal, esolectal, and basilectal forms and usages depending on the user's proficiency, state of mind, and context of situation" [Proshina, 2016, p. 202]. In other words, the language proficiency is one of the distinctive features of a foreign language production and perception which can account for the interpersonal differences and be viewed as a reliable framework for the "*-lects*" stratification in Russian English.

The present study aims at analyzing perception-production link in the linguistic performance of the Russian learners of English. The research pinpoints the correlation between the perception task and the speech production task with the regard to a comparative study of two experimental variants different in language proficiency (the expert vs students' tasks performance). More precisely, the research addresses the following questions:

1) How accurate (0–100 % of cases) do the Russian learners of English perceive the meaningful information center (or focus; phrasal rheme) of the English phrases[1]?

2) How accurate (0–100 % of cases) do they perceive the nuclear tones?

3) How often do the Russian learners of English accentuate the meaningful information center (or focus; phrasal rheme) in their English phrases?

4) What are the tones they employ to the meaningful information centers in their English phrases?

PERCEPTION-PRODUCTION LINK

The speech perception neuroanatomy has been difficult to characterize. Perceptual tasks cause the difficulty: "tasks that require access to the mental lexicon (i. e. accessing meaning-based representations) rely on auditory-to-meaning interface systems in the cortex" [Hickok, Poeppel, 2000, p. 131], which is different from those that are required in tasks of syllable discrimination or segment identification [Wang et al., 2023; Steffman et al., 2022].

A body of previous research has suggested several explanatory models for perceptual difficulties nonnative learners face. For instance, the *Second Language Linguistic Perception model* focuses on learners' exploitation of acoustic cues in forming phonemic boundaries. The *Perceptual Assimilation Model* and its extension for nonnative speakers – The *Perceptual Assimilation Model L2* [Tyler, 2021] – attempts to explain the perception of phonotactic sequences and their boundaries.

The nature of perception-production link is not yet well-established [Lotto, Hickok, Holt, 2008]. *The Motor Theory* (MT) of speech perception with the discovery of mirror neurons have been revisited. The MT central tenets are contradictory to the latter. For the present study it is crucial to pinpoint that "it is possible that production can aid perception, especially in challenging listening situations" [Lotto, Hickok, Holt, 2008, p. 112]. Some scholars have proposed that "speech 'production' relies on speech 'perception' and the shared representations are auditory and general (non-linguistic)" [Lotto, Hickok, Holt, 2008, p. 112]. Thus, the exact nature of this relationship remains to be discovered, "existing evidence strongly indicates that perceptual systems have a much stronger influence on production than motor systems have on perception" [Lotto, Hickok, Holt, 2008, p. 112].

PROSODIC INTERFERENCE

Interestingly, the perception-production link implicitly has been in the focus of Russian phonetic research in the line with linguistic interference

[1]Phrase consists of more than one tonal unit.

[Вишневская, 1989]. Describing the foreign accent features, V. A. Vinogradov infers that "'I do not hear as it is', that is the starting point of a foreign accent"[1] [Виноградов, 1976, p. 52].

The interference as a phenomenon may be viewed in different perspectives taking into account what has already been achieved in this field with cutting-edge contemporary research.

Phonetic (segmental level), prosodic (prosodic speech characteristics) and intonational (melodic, rhythmical, temporal, etc.) types of interference are well-established through the native vs nonnative phonetic and phonological representations in a foreign speech. These representations form a third language: it can be Russian English [Proshina, 2016]; it can be interlanguage; it can be an interfered variant with a different degree of a foreign accent.

Regardless of those approaches, the empirical observations of foreign speech production demonstrate a vast pool of its new characteristics which reveal how the first language (L1) functions and how the foreign language (FL) reciprocates to such interaction. In other words, these observations allow enriching our knowledge of the Russian language (its current phonetic and phonological state) and revising the interrelations between English and Russian.

MATERIAL AND METHODOLOGY

Experiment 1. Eighty 2-year students (aged 18–19 years old; 3 seminar groups) were included in the experiment (Autumn 2022). They had to complete a perception task within a curriculum of "Theoretical Course on Phonetics" (Autumn 2022). The task was graded.

The students had to watch a 3-minute video[2], find the English equivalents for the given Russian phrases and mark the nuclei of the phrase as indicated: a word and a nuclear tone which this word takes. The Russian phrases were given with the exact number of nuclei which should be found in the phrase (see Example 1):

> *Example 1*: но до тех пор, пока они не созрели, их невозможно есть (они абсолютно несъедобны) [2 просодических ядра].

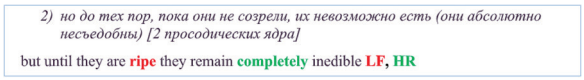
The task contained a closed list of nuclear tones (the list is adopted from the Intonation Contour System devised by E. Ya. Antipova and coauthors [Antipova et al., 1985] which students could and had to discern.

- LF – Low Fall
- LR – Low Rise
- HF – High Fall
- HR – High Rise
- FR – Fall-Rise
- RF – Rise-Fall
- HL – High Level
- ML – Mid Level
- LL – Low Level

The choice of these particular tones is justified by the fact that during their first-year studies these were the tones they had covered. On the other hand, exactly these tones were found in the discussed video episode. The expert annotation of the phrases was conducted and agreed upon by two course teachers (an author of the article is included).

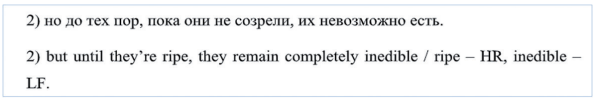
The time to do the task was not limited, it was a home task.

The students' work looked like that as a result (see Fig. 1, 2).


2) *но до тех пор, пока они не созрели, их невозможно есть (они абсолютно несъедобны) [2 просодических ядра]*

but until they are **ripe** they remain **completely** inedible **LF**, **HR**

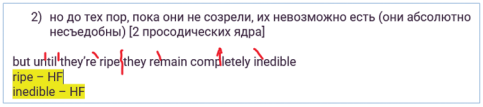
Fig. 1. An example of the student's work


2) но до тех пор, пока они не созрели, их невозможно есть.

2) but until they're ripe, they remain completely inedible / ripe – HR, inedible – LF.

Fig. 2. An example of the student's work

The expert piece is presented below (see Fig. 3).


2) но до тех пор, пока они не созрели, их невозможно есть (они абсолютно несъедобны) [2 просодических ядра]

but until they're ripe they remain completely inedible

ripe – HF

inedible – HF

Fig. 3. An example of the expert annotation

The experts marked 11 words as the words bearing a nuclear tone, and 11 correct tones, respectively, falling onto those words. The range of tones were: LF; HF; HL / ML; FR.

All the students' works were analyzed and marked as shown in Fig. 4: the number of correct nuclear words and the number of correct nuclear tones were assessed.

[1]The Russian original text is this: «Слышу не так» – это и есть отправной момент иностранного акцента». Translation is mine. – *N.S.*

[2]BBC Earth. «Meet the Face-slapping Food Thief». URL: Macaques SLAP Squirrels And Steal Their Food | Primates | BBC Earth– YouTube

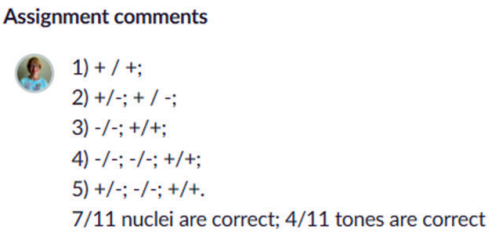


Fig. 4. An example of an assessed student's work, where: + / – means that the word bearing a nuclear tone is correct, however the nuclear tone on it is defined incorrectly

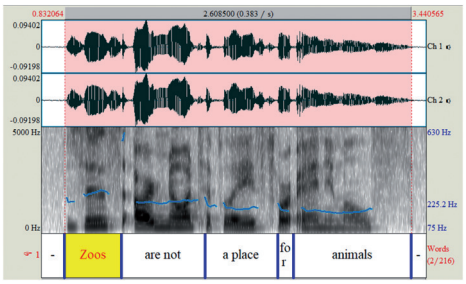


Fig. 5. An example of a texgrid for the experiment

All the data on the words and the tones were summarized across the groups and in total.

Experiment 2. The participants of the experiment were the 2-year students (aged 18–19) who attended the course "Voice Coaching" (Autumn 2021 – Spring 2022). The students had to prepare an essay of 150–200 words long. The topic was free. After writing and intoning the piece, they had to present it orally in class and then record it. The recorded essay was submitted as a home task to the Learning Management System *Canvas*. The audio version of the essay is a semi-prepared reading.

The narrow experimental scope (one recording) was selected out of 76 essays for the pilot study of prosodic interference in speech production. The file duration is 95 seconds. The audio file was analyzed in *Praat*[1]. There was the textgrid created and the further acoustic analysis conducted. The textgrid presented a "word tier" with the word segmentation (*see Fig. 5*).

The audio file was word-segmented to facilitate the auditory and acoustic analysis in *Praat*. Parallelly, information from *Praat* was registered in the Excel table in a twofold manner:

1) a nuclear word and its tone as in the original, how the student pronounces it; and

2) an expert annotation by the author of the article (see the annotation algorithm in *Table 1*).

[1]Boersma, Paul & Weenink, David (2023). Praat: doing phonetics by computer [Computer program]. Version 6.3.09, retrieved 2 March 2023 from http://www.praat.org/

The comparative analysis of two annotations consolidates the variability of Russian English of B1–B2 and C1-C2 proficiency levels.

The annotation table (*see Table 1* as an example) showed:

1) the number of student's tone units and the number of expert's tone units;

2) the words which take the nuclear tone (student's variant vs expert's variant);

3) the description of the nuclear tone which the picked word takes (its pitch level and its tone movement).

The tone nomenclature was selected in accordance with E. Ya. Antipova and colleagues [Antipova et al., 1985] to adjust to *Experiment 1*. However, in the student's speech there were tones which needed more descriptive details for the annotation accuracy than only the tone direction and its pitch level. Thus, the characteristics of the tonal end were considered, e.g. FL – Falling Level, means the melody falls down but the fall is not complete, the fall turns into the level tone.

RESULTS AND DISCUSSION

Experiment 1. The perception experiment has shown that across all three groups the results were approximately the same. Fig. 6 indicates the vertical y-axis is a number of students and the horizontal x-axis is a number of cases (there were 11 prominent words and 11 correct nuclear tones on these words).

Table 1

AN EXAMPLE OF THE AUDIO FILE ANNOTATION TABLE

File name	Number of tone units		Nuclear word		Nuclear tone	
	an expert	a student	an expert	a student	an expert	a student
PrA_3	31	36		not		HF
			animals	animals	LF	LF
			nowadays	nowadays	FR	HF

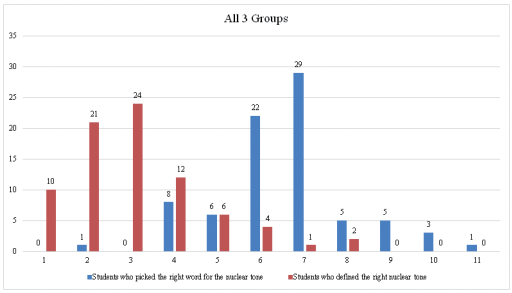


Fig. 6. The total numbers of the right choice of nuclear words and nuclear tones by all 80 students (3 groups)

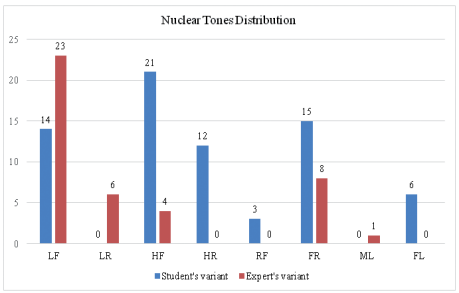


Fig. 7. Nuclear tone distribution in the expert's annotation and the student's speech

Thus, for example, the figures show that there were 29 students (students are marked in blue) out of 80 who picked up 7 right nuclear words out of 11 total; however, there was only 1 student out of 80 who defined 7 right nuclear tones out of 11 total.

Fig. 6 shows a tendency for the students to be quite good at defining the right prominent word: 29 students have chosen more than 50 % of right words. There was 1 student who picked up 100 % of right words. If measured in absolute figures (percent) than the results are even more illustrative (see *Table 2*).

Table 2 demonstrates that 73 % of students picked up 25–50 % of right words and only 4 % of students picked up 75–100 % of right words. There are 87 % of students who defined correctly only 0–25 % of nuclear tones. Nobody defined 75–100 % of nuclear tones correctly.

These findings attest that the choice of the information focus, i.e. the perception of the right word which takes the nucleus, is similar in 50 % of cases may be due to its illocutionary meaning rather than the perceived prominence. The right tone perception has very low score (0–25 % cases), which addresses the issue of pitch discrimination in L1 and L2, e.g. see [Aaron et al., 2023].

Experiment 2. The narrow research scope showed that there are 31 expert syntagms versus 36 student's syntagms. It is consistent with the previous research on English phonetics which prompts that the English phrase delimitation is less frequent than in the Russian language [Вишневская, 1989]. In other words, there are more syntagms in Russian. Our data proves the fact with the outnumbered student's syntagms.

There are 73 prominent words which take the nuclear tone in the student's speech whereas there are 42 of those in the expert's annotation. Forty words in this set coincide. More concretely, around 56 % of the words which both the student and the expert consider prominent and nuclear tone bearing are the same.

There are 11 cases out of 40 similarly placed nuclear tones which coincide in tonal description. That means that the tone pitch level and its tonal direction are identical in both variants. It amounts to 27 % of cases when the student has the same tone on the same word as an expert. This fact correlates with the perception task results.

Fig. 7 demonstrates the prevalence of Low Falling tone and Fall-Rising tone in the expert's annotation, the number of cases is calculated. The student uses more High-Falling tone, High-Rising tone and Fall-Rising tone in her speech. The student's speech peculiarity is the use of incomplete Falling tone, which is the Russian tone 'niskhodyashchiy rovnyi" (нисходящий ровный).

The tone usage is consistent with the phrase illocutionary meaning which can be understood very subjectively by the speaker. However, if opined, on the one hand falling tone is a feature of a narrative; they are frequent in Russian (84 % according to N.V. Cheremisina [Черемисина, 1989]), on the other hand, falling tones are perceived the best, e.g. see [Первезенцева, 1996].

Table 2

RESULT EVALUATION IN PERCENTAGE

Cases of words and tones (%)	Students who picked up the right words which take the nuclear tone (%)	Students who picked up the right tone which take the prominent word (%)
0-25	11	87
25-50	73	10
50-75	12	3
75-100	4	0

CONCLUSIONS

The present study has had some questions. The experiments have provided the answers to them. The perception task has shown that 73 % of students discern the tone placement in 25–50 % of cases and 87 % of students are right in the tone description (its pitch level and movement) in 0–25 % of cases. The production task reveals that tone placement coincides in a student's speech and an expert's annotation in 56 % of cases. There are 27 % of cases when the word and its nuclear tone features are similar in both variants.

As a result, the data demonstrates the perception-production link where there are up to 50 % of corresponding tone placement cases in the perception task and 56 % of such cases in the production task, respectively. The perception task has revealed up to 25 % of corresponding tone descriptions and in the production task there are 27 % of such cases.

The concomitant figures testify that the tone placement is more accurate in the Russian learners (50–56 %) both as a perception and as a production task, than the tone description (25–27 %). It may result from the fact that the illocutionary phrasal meaning is more connected with the general communicative aim which prompts where the rhemes are to be placed. The main difficulty has arisen in tone description in both experiments. The way one perceives the tone is the way s / he produces it.

It has been also hypothesized that the English proficiency can be a decisive factor in the perception-production link in Russian learners. Great differences in the annotators' and students' performance display the connection. Here the idea of Russian English acrolect and mesolect tends to uncover.

Furthermore, the present study findings open up a revisited pedagogical path in teaching suprasegmental elements to Russian learners of English.

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Статья поступила в редакцию	16.03.2023	The article was submitted
одобрена после рецензирования	18.03.2023	approved after reviewing
принята к публикации	20.04.2023	accepted for publication