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II

SPEECH RATE AS AN INDICATOR OF FLUENCY IN THE RUSSIAN OF FINNISH LEARNERS

by

Riikka Ullakonoja 2009

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Speech rate as an indicator of fluency in the Russian of Finnish learners

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Abstract

This study focuses on the speech rate development of 12 Finnish university students of Russian during their 3.5-month-study abroad experience. Speech and articulation rates are measured in phonetic words per second and syllables per second in the Russian read-aloud speech of the subjects. This is done at three recordings: prior to, during and following their stay in Russia. The results are compared to their read-aloud Finnish speech. The students are also compared depending on the residence (host-family vs. dormitories) in Russia. The study shows that speech and articulation rates correlate with the evaluated fluency of the speech samples. It was found that speech rate is a better indicator of fluency than articulation rate in non-native read-aloud speech. The results also show that articulation rate in mother tongue (Finnish) and foreign language (Russian) correlate with each other more than speech rate.

Keywords: speech rate, fluency, Finnish (L1), Russian (L2)

1 Introduction

When asking foreign language learners what aspects they consider important in learning the new language, their answers might include a desire to become fluent in that language. Also in the words of their teacher, in the syllabus and in also the Common European framework of reference for languages (Council for Cultural Co-operation. Education Committee, Modern Languages Division, Strasbourg and Council of Europe 2001) the term fluency and its derivations occur frequently. However, when teaching oral skills, it is perhaps not the fluent features of speech that are in the focus of attention, but instead the grammatical and lexical features or the pronunciation of segments. The purpose of the study is to follow the fluency development of 12 Finnish students of Russian during their 3.5-month-stay in Russia by studying their speech and articulation rates and comparing them to fluency evaluations of teachers.

Fluency can be defined in a number of ways, e.g. by studying pausing (pause frequency, duration and placement), hesitations or tempo (see e.g. Cucchiari *et al.* 2002,

Lauranto 2005, for a review). In this study speech rate is regarded as an important factor of fluency. Cucchiarini *et al.* (2002) have shown that speech rate and pause frequency are the most important factors in read-aloud speech fluency perception. Also Riggenbach (1991) concluded that the central elements of foreign language (L2) fluency are pausing, speech rate and repairs. Moreover, several researchers (Riggenbach 1991, Freed 1995, Towell *et al.* 1996) have found that as L2 fluency increases, the speech rate increases also. My previous study (Ullakonoja 2008) focused on pausing and its relationship to foreign language fluency. In this paper, the same data is studied, but speech and articulation rates are regarded as acoustic correlates of fluency.

The speech rate (tempo) indicates the total time of a speaker uttering his speech, including pauses whereas the term articulation rate is commonly used to refer to the speech rate without pauses. In this study speech rate refers to reading rate. There are multiple factors affecting the habitual speech rate of individual speakers, and speakers can also vary their speaking rate in different situations (see Trouvain 2003 for a review). In this study the speaking context and content are the same for all speakers at all recording sessions. The speech and articulation rates of a L2 learner are often shown to be slower than these of a native speaker (e.g. Riggenbach 1991, Cenoz 2000, Paananen-Porkka 2007). In addition, learners possibly transfer the prosodic characteristics (e.g. stress) of their mother tongue to the language they are learning:

When the Finn transfers the habit of pronouncing all of the syllables of each word unreduced and manifesting word boundaries with phonetical juncture segments (instead of linking) the rate of his speech is inevitably slower (Lehtonen 1981, p. 331).

A foreign language learner often has the impression that native speakers of the language speak very fast (Abercrombie 1967, p. 96). Also, when native speakers are listening to L2 speech, they would often prefer about 10 % faster speech rate than what the learner is producing (Munro & Derwing 2001, p. 464).

It has been found in several studies (Simoes 1996, Freed *et al.* 2004, Lafford 2004, Trofimovich & Baker 2006) that a good way to improve fluency in L2 is to spend some time in the country where L2 is spoken. For example Segalowitz & Freed (2004) established that the students who studied abroad improved their fluency more (on several measures including speech rate) than the students who stayed at home. Trofimovich & Baker (2006) found that L2 learners could not achieve a native speech rate no matter how long they stayed in the country of the L2 language. On the contrary, a study by Freed *et al.* (2004) suggests that the study abroad did not result in better fluency than an “intensive domestic immersion” context. In their study it was in fact the immersion context that turned out to be the most effective in fluency learning. To summarize, all the studies show the positive influence of L2 context to the fluency development.

There have been a few studies (e.g. Lehtonen 1979, Iivonen *et al.* 1995, Moore & Korpijaakko-Huuhka 1996, Suomi 2007) about speech rate in native Finnish speech. In Russian, pausing and its influence on prosodic phrasing and speech rate have been researched also in spontaneous speech (e.g. Shtern 1988, Volskaya forthcoming). To my knowledge the current paper is the first study investigating non-native speech rate in Russian and comparing it to the speakers' native language, Finnish, and contrasting different stages of learning. The aim of this study was to find out, firstly, whether speakers who are considered fluent speak/read aloud faster than disfluent speakers (both in terms of speech and articulation rates). In other words, speakers with faster speech or/and articulation rates are evaluated more fluent than slower speakers. Secondly, the speech and articulation rates in Finnish (mother tongue, L1) were compared to speech and articulation rate in Russian (L2) to find any similarities between the two.

2 Material

12 native Finnish students of Russian read two Russian and one Finnish dialogue in pairs. The reading was recorded in different stages of their university studies: prior to, in the middle of and following their stay in Russia. Only the longest turn of the Russian dialogues and two turns of the Finnish dialogue were analyzed of each student. The Russian material, hence, includes the reading of the same text three times (c. 11 minutes in total), whereas the Finnish material is from the first recording session (c. 3 minutes in total). The students are undergraduate major students of Russian who have studied Russian for 1–10 years prior to university studies. At the beginning of their 2nd year of university studies they participated in a 3.5-month-study-abroad-program. Half of the students (subjects Fi3, Fi4, Fi5, Fi7, Fi9 and Fi10) resided in the dormitories for foreign students during their stay in Russia with the remaining (subjects Fi1, Fi2, Fi6, Fi8, Fi11 and Fi12) living with a host family. The two groups were compared for speech and articulation rates development where applicable.

3 Methods

For evaluating the perceptual fluency of the speech samples, 30 Russian as a foreign language teachers in Finland were asked to determine the fluency of each sample on 1–5 scale (1 = not fluent, 5 = very fluent). Teachers listened to the samples in a random order without knowing that multiple samples of the same speaker were included. The reliability of the fluency ratings was good (Cronbach's alpha = 0.92). The procedure of the fluency evaluation task is more thoroughly reported in a parallel study (Ullakonoja 2008).

Segmentation and acoustic analysis of the samples were completed in Praat (Boersma & Weenink 2008). The segmentation consisted of annotation of phonetic words and syllables. The term 'phonetic word' comes from the Russian research tradition (e.g. Avanesov 1956, p. 61), and usually corresponds to a lexical word, but also to some two word combinations, where e.g. a preposition is pronounced together with the main word and where there is only one lexical stress. For example, in this data the preposition and pronoun *k nam* [knəm] ('to us') are treated as a phonetic word. The term prosodic word has sometimes been used to describe the same phenomena in Finnish (see e.g. Aho & Yli-Luukko 2005). In Finnish, I decided that lexical words always correspond phonetic words in the annotation. The syllables were determined according to auditory analysis, hence the syllable means a realized syllable. Syllable nuclei were determined and proportioned with time (counting syllable nuclei instead of syllables has been used e.g. by Simoes 1996). In Russian the number of syllables corresponded the number of vowels in the utterance. In Finnish, single vowels were treated similarly as in Russian, as a syllable nucleus. Vowels in the vowel combinations in Finnish were mostly pronounced very closely together and consequently, they were also regarded as one syllable. Sometimes the syllabification in Finnish did not respect the traditional (or textual) syllabification, if e.g. the word *teorioita* ('theories (partitive case)') was pronounced [teoriotɑ], it was considered trisyllabic: teo-rio-ta (speaker Fi7). Similarly also the phrase *mä en oo* ('I'm not') was pronounced mostly as [mæeno], [mæeo] or [men:o:] and in all cases it only had two syllables. Syllable omission was quite frequent in Finnish, e.g. *no en* [non] ('well no', Fi7), *huomenna* [huomen] ('tomorrow', Fi7).

The duration of phonetic words was measured with a script in Praat. Phonetic words per second and syllables per second were used for measuring speech and articulation rates (i.e. speech rate without pause time). Both measures were used in order to find out the differences, if any, between them and to make the language comparison as thorough as possible. Based on earlier results of a comparative study of English and Finnish speech rate (Lehtonen 1981), it was expected that the comparison of syllable-timed Finnish and stress-timed Russian would yield different results depending on the measure chosen. Syllables per second would show the influence of hesitation better, since hesitation is often not only one or two syllables but one phonetic word. Also syllables per second as a measure would show mispronunciations (e.g. omission of a syllable, see examples above) better than phonetic words per second. For example, following her stay in Russia speaker Fi12 has much hesitation in her speech and the segmentation gives quite different results depending on the measure chosen (Figure 1). The sentence has 6 phonetic words and 18 syllable nuclei, when the original text only had 5 phonetic words and 13 syllable nuclei.

Microsoft Excel was used for calculating speech rate and articulation rate as well as for the graphical representation of the results. SPSS was used to determine the correlations in the data and their statistical significances. The existence of linear

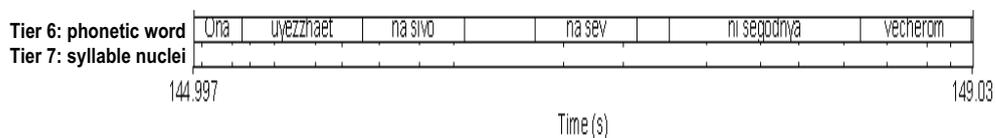


Figure 1: An example of the segmentation of the corpus *Ona uyezhaet ne segodnya vecherom* ‘She will leave not today at night’ into phonetic words.

correlation was verified in scatterplot graphs. Paired samples *t*-test was used to find out the differences between different stages of learning. Speech and articulation rates of each sample were compared to its average fluency rating in order to determine the connection between speech and/or articulation rates and fluency. When comparing Finnish (L1) with Russian (L2) the individual variations in speech and articulation rates were minimized by comparing the within group ranking of each student in both languages (i.e. seeing whether the 2nd fastest student in Russian was also the 2nd fastest in Finnish etc.).

4 Results

In a previous study (Ullakonoja 2008), it was found that the majority of the speakers (9/12) developed in terms of their read-aloud fluency during the first half of their stay in Russia, and slightly over a half of them (7/12) further increased their perceived fluency during the rest of their stay. Furthermore, the study showed that pausing was closely related to read-aloud fluency in a foreign language.

4.1 Speech and articulation rates development during study abroad

In all subjects’ speech the *speech rate* increased during the first half of their 3.5-month stay in Russia (0.2 phonetic words per second or 0.5 syllables per second on average) (Figures 2, 3; SR). Also, the majority of the subjects had a faster speech rate following their stay than before it (0.2 phonetic words per second or 0.5 syllables per second on average). Hence, the speech rate increases as the amount of experience increases. The development in speech rate is statistically significant ($p < 0.05$) when comparing before the stay results with middle of stay and before the stay results with after the stay in both phonetic words and syllables per second. However, the speech rate of some students (4/12 students when measuring phonetic words per second, 6/12 students when measuring syllables per second) decreased slightly between the recordings done in the middle and after their stay. This decline is possibly due to the

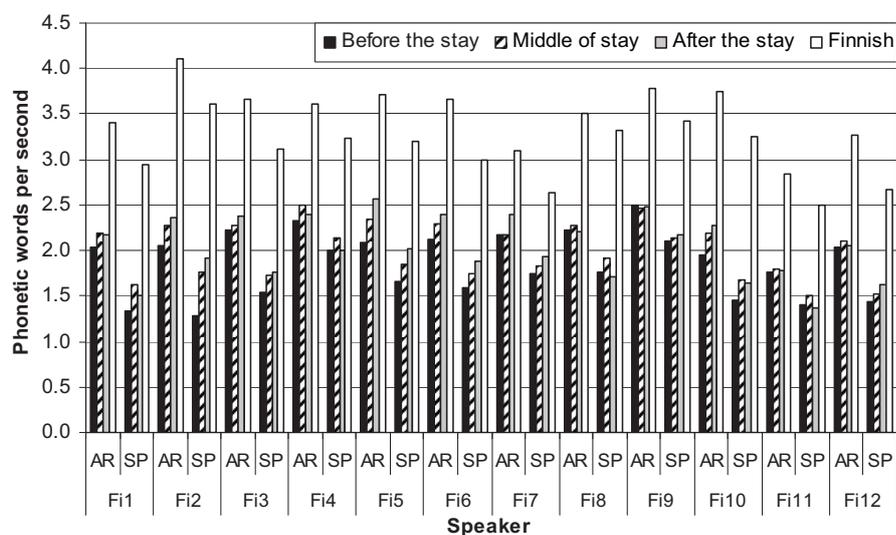


Figure 2: Articulation rate (AR) and speech rate (SR) in phonetic words per second in Finnish (L1) and in Russian (L2) at different stages of learning.

fact that their Russian reading was more “activated” while in the Russian speaking context than in the recording done following their stay.¹

The measurement of *articulation rate* indicated a tendency similar to speech rate (Figures 2, 3; AR). Articulation rate also increased (0.1 phonetic words per second or 0.3 syllables per second on average) during the first half of the stay in the speech of most students (9/12). Between the 2nd and 3rd recordings, the articulation rate further increased for the majority (7/12) of the students (0.1 phonetic words per second on average), but also decreased or remained the same for some subjects. When comparing only the recordings done prior to and following the stay in Russia, it can be seen that the majority (9/12) of the students had a faster articulation rate after their stay than before it (0.2 phonetic words per second on average). The increase in articulation rate was statistically significant ($p < 0.05$) between before the stay and middle of stay results and between before the stay and after the stay results in both phonetic words and syllables per second.

The students were also divided into two groups according to their *residence* in Russia (host family vs. dormitories). The groups were neither balanced nor equal in their speech rate before their stay in Russia. When measuring phonetic words, students residing with a host family did not increase their speech rate on average

¹The last recording was completed approximately one month after the students returned to Finland from Russia. It is possible that they had somewhat “forgotten” their Russian during that month, because some students had not used Russian at all after returning to Finland.

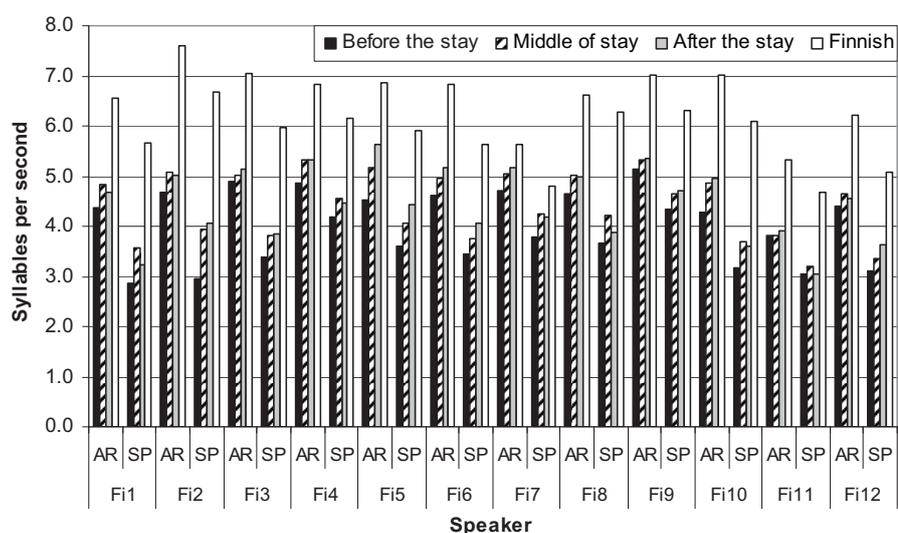


Figure 3: Articulation rate (AR) and speech rate (SR) in syllables per second in Finnish (L1) and in Russian (L2) at different stages of learning.

more than students living in the dormitories (Table 1). Contrary to what might have been expected, in syllables per second the dormitories group increased their speech rate more than the host-family group both during the first half and the whole length of their stay. In fact, the students residing with a host family had on average a slower speech rate at all recording sessions but as they also had a slower rate in Finnish, it seems that this is a random result. Similarly as in speech rate, the results of the articulation rate do not indicate that residence in the host family would make students speak faster during their stay in Russia. As a matter of fact, students residing in the dormitories increased their articulation rate more during the second half of their stay and during their entire stay in Russia (Table 1). The dormitories group might have had a better Russian competence and motivation already before the stay, which might have also been reflected in their speech rate.

4.2 Speech and articulation rates and fluency

What then is the relationship between speech or articulation rates and L2 fluency? The comparison of speech and articulation rates with perceived mean fluency rating flagged significant correlations (Table 2). The correlation was stronger between the speech rate and fluency rather than articulation rate and fluency. This indicates that pausing (hesitations and total pause time) also affects the fluency perception. The samples were also studied at the individual level where it was also noted that speech

Table 1: Mean speech and articulation rate of the students living with a host family and in the dormitories.

Residence	Before the stay	Middle of stay	After the stay	Finnish
Speech rate: Phonetic words per second				
Host-family	1.47	1.68	1.67	3.01
Dormitories	1.75	1.89	1.92	3.14
Speech rate: Syllables per second				
Host-family	3.18	3.68	3.65	5.66
Dormitories	3.74	4.17	4.20	5.87
Articulation rate: Phonetic words per second				
Host-family	2.04	2.16	2.16	3.47
Dormitories	2.21	2.33	2.41	3.60
Articulation rate: Syllables per second				
Host-family	4.42	4.72	4.72	6.52
Dormitories	4.73	5.12	5.27	6.73

rate correlates more reliably with the perceived fluency rating. For example, it was found that the least fluent (evaluated fluency = 1.3) sample was the speaker Fi2 prior to the stay. She was also the slowest of all speakers when measuring speech rate in phonetic words (Figure 2) and the second slowest when measuring speech rate in syllables (Figure 3). However, her articulation rate was not the slowest; in fact it was just below the average (Figures 2, 3). Correspondingly, the speaker who was evaluated the most fluent was Fi9 following their stay in Russia, who was also found to be the fastest of all speakers in speech rate and among the two fastest in articulation rate (Figures 2, 3).

4.3 Speech and articulation rates in Russian (L2) and Finnish (L1)

Next, speech and articulation rates in Finnish (L1) and Russian (L2) were compared. It was found that speech rate in Finnish correlates with the speech rate in Russian (Table 3). The correlation is however stronger between the articulation rate than speech rate in L1 and L2. This suggests that it is the amount of pause time that differs in L1 and L2, because the articulation rate indicates the speed of “uttering sounds,” whereas speech rate includes pauses. As mentioned above, when comparing the in-

Table 2: Pearson correlations (*R*) between mean perceived fluency rating and speech and articulation rate.

	N cases	Correlation (<i>R</i>)	Significance (<i>p</i>)
Mean perceived fluency rating and articulation rate:			
Phonetic words/s	36	0.484	0.003
Syllables/s	36	0.416	0.012
Mean perceived fluency rating and speech rate:			
Phonetic words/s	36	0.722	< 0.001
Syllables/s	36	0.697	< 0.001

terspeaker performance, the speakers were ranked by speech rate and articulation rate from slowest to fastest in Finnish and at each recording session in Russian in order to be able to normalize the effect of differences in the structure of the two languages.

In Finnish (L1) the differences were small between syllables per second and phonetic words per second in articulation rate and speech rate. An individual speaker almost always received the same ranking position among the speakers in L1. In speech rate, 6/12 speakers received a similar (maximum difference between ratings being 2) rating on average in Russian and in Finnish. In articulation rate 8/12 speakers (when measuring phonetic words) and 7/12 speakers (when measuring syllables) were ranked similarly in Finnish and Russian. This also indicates, that articulation and speech rates in L1 and L2 are related. Hence, speech rate seems to be a speaker-specific rather than a language-specific phenomenon.

5 Discussion and Conclusions

Overall, the majority of the students increased their L2 speech and articulation rates during their 3.5-month-stay in Russia statistically significantly as their perceived fluency increased also. This clearly shows that students seem to benefit from their stay in Russia so that they become faster and more fluent in Russian. Consistently with Towell *et al.* (1996, p. 103) the increased speech rate was found to be more significant than articulation rate in determining the L2 fluency of the speakers. When comparing the results with Lehtonen's (1978) study, it was found that the L1 Finnish reading rate was faster in this study when measuring phonetic words, but speech rates in syllables were similar in both studies.

The comparison of the students who stayed with a host family and students who resided in the dormitories was not very yielding as it turned out that the dormitories

Table 3: Pearson correlations for articulation rate (AR) and speech rate (SR) in phonetic words/s (pw) and syllables/s (syll) in Russian (L2) and Finnish (L1).

	Russian				Finnish		
	AR pw	AR syll	SR pw	SR syll	AR pw	AR syll	SR pw
Russian							
AR pw	1	0.966**	0.868**	0.861**	0.579**	0.556**	0.577**
AR syll	0.966**	1	0.811**	0.848**	0.586**	0.557**	0.574**
SR pw	0.868**	0.811**	1	0.985**	0.333*	0.282	0.424**
SR syll	0.861**	0.848**	0.985**	1	0.335*	0.279	0.423*
Finnish							
AR pw	0.579**	0.586**	0.333*	0.335*	1	0.985**	0.931**
AR syll	0.556**	0.557**	0.282	0.279	0.985**	1	0.913**
SR pw	0.577**	0.574**	0.424**	0.423*	0.931**	0.913**	1
SR syll	0.559**	0.552**	0.381*	0.376*	0.922**	0.929**	0.989**
N	36	36	36	36	36	36	36

** $p < 0.001$, * $p < 0.05$

group was already faster prior to the stay. Still, the results showed that in fact the students in the dormitories increased their speech and articulation rates more than the students living with host families. It can also be concluded that the speech and articulation rates in L1 are related to the speech and articulation rates in L2, consistently with Towell *et al.*'s study (1996, p. 96), where a strong correlation in L1 and L2 speech rate was established. Not surprisingly, the results also show that L1 is spoken faster than L2 (see e.g. Paananen-Porkka 2007).

The rhythmical features of speech were not taken into the account in this study. However, it is possible that the speech rate varies across the speech sample in the way as e.g. Deese (1980, pp. 74–76) has found that the majority of the faster sequences of speech occur either at sentence initial or terminal position. This study included recordings in Finnish only at the beginning and it was assumed that speech and articulation rates do not change significantly over time in one's L1 in the same reading task.

It has to be acknowledged that, naturally, there are other factors influencing speech and articulation rates and perceived fluency than the study abroad. Firstly, there is much individual variation in reading rate (even in L1). Also, in a reading task the subject might read very fast without comprehending everything being read (Lehtonen 1981, pp. 328–329; Perfetti 1985, p. 10) The student's motivation and interest are essential in L2 learning, therefore in this study also e.g. the motivation of the student towards Russian oral skills in general might have increased during the

stay in Russia. Furthermore, the findings concern only read-aloud speech in a laboratory setting and the analysis of spontaneous speech in a real communicative situation might have yielded different results.

It can be concluded that faster L2 speech (either in measures of speech or articulation rate) is perceived more fluent than slower L2 speech and that speech and articulation rates come closer to L1 speech and articulation rates as experience with L2 increases. Because native speakers of a language have been found to evaluate fast speech rate in non-native speech more positively than a slower speech rate (Munro & Derwing 1998; 2001, Paananen-Porkka 2007, p. 340), L2 teaching should pay more attention to practising appropriate speech rate in order to improve the communicative competence of the learners.

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