

## Comparison of Pitch Range in Finnish (L1) and Russian (L2)

*Riikka Ullakonoja*

Department of Languages, University of Jyväskylä, Finland

riikka.ullakonoja@campus.jyu.fi

### ABSTRACT

The aim of the present study is to investigate whether the pitch range of a speaker can vary according to the language he speaks. The hypothesis is tested on Finnish university students studying Russian as a foreign language before and after their stay in Russia. First, the global pitch range (max – min) is determined. Second, the pitch range in different types of utterances (declarative, question, exclamation) is examined by superimposing pitch contours. The results indicate that the learners have a narrower pitch range and a less variable pitch than native speakers both in L1 and L2. However, the results also suggest that L2 experience seems to help most students to produce a more native-like pitch range, especially in questions.

**Keywords:** pitch range, foreign language acquisition, L2 experience, Finnish, Russian

### 1. INTRODUCTION

Research indicates that languages may differ in how pitch range is manifested [13]. For example, Russians are often referred to as using a wider pitch range and speaking on a higher tone than Finns whose speech is often characterized as monotonous. This is interesting considering foreign language (L2) learning: do Finnish L2 learners of Russian have to adjust their speech according to the pitch properties of the target language?

Pitch range can be defined in various ways, the simplest of which is the difference between  $F0_{max}$ - $F0_{min}$ . However, this figure does not give full information about the distribution of the  $F0$  values. Other ways to define pitch range is to include 95 % of the different pitch values around the mean or to study  $F0$  differences between the overall level and the range of frequencies used (span) [3, 6]. Patterson [10] suggests measuring pitch range as “the difference between average non-initial accent peak and average post-accent valley”, but that measurement was not adopted in this study. Also, pitch range can be investigated by

graphically superimposing all pitch contours of a speaker with time normalization [4].

It has been discovered that a speaker’s pitch range can vary according to e.g. emotions, speaking context and language [11, 8]. However, pitch range has hardly been studied in L2 context. In L2 speech e.g. a narrower pitch range for learners than native speakers has been observed [7, 1].

The aim of the research is to find out 1) whether the pitch range is different in Finnish and Russian and 2) if so, do learners acquire a more native-like pitch range of Russian during their stay in Russia?

### 2. ANALYSIS

#### 2.1. Participants and material

The corpus consisted of 9 Finnish female university students’ read-aloud speech, one dialogue in Finnish (c. 3 min/speaker with pauses) and two dialogues in Russian (c. 4 min/speaker with pauses). The Finnish dialogue consisted of 51 and the Russian dialogues of 50 utterances. The same texts were recorded before and after students’ 4-month-stay in Russia. 7 Russian women read the same Russian texts.

Most students had studied Russian as their 4th foreign language. As they were not exposed to Russian in their everyday lives outside the university studies, the exchange period in Russia was essential for the acquisition of communicative competence and a key factor in learning Russian pronunciation, prosody in particular.

#### 2.2. Procedure

The L2 material was recorded digitally on a computer (program Adobe Audition 1.0, sample rate 44100 Hz, 16 bit resolution) with AKG GN30 microphones in a recording studio. The students read the dialogues in pairs. The instruction was not to concentrate on pronunciation of single sounds but on presenting the dialogues naturally. The native speakers were recorded on a DAT-recorder with a Sony ECM-959A microphone.

### 2.3. Methods

The utterances and utterance types were segmented and annotated. The pitch was calculated with the autocorrelation method in Praat [2] and the pitch contours were graphically superimposed with time normalization. Furthermore, the results were statistically analyzed and tested (ANOVA) in SPSS.

## 3. RESULTS

The pitch range was investigated in the students' Finnish speech (L1), their Russian speech before and after their 4-month-stay in Russia, and in native Russian speech. Although the measuring unit is Hertz (Hz), the speakers' results are comparable since the variations of pitch are studied instead of absolute values.

### 3.1. Global pitch range

First, the global pitch range was measured by subtracting the minimum pitch value from the maximum pitch across the entire recording of each speaker. The pitch range of speakers varied according to the language and the amount of experience (Table 1).

**Table 1:** Pitch range (max – min) in Hz and [mean pitch] of all speakers in different recordings.

Finnish speaker	Finnish	Before the stay	After the stay	Russian speaker	Russian
Fi1	260[205]	250[210]	187[205]	Ru1	392[284]
Fi2	259[215]	259[221]	196[218]	Ru2	326[260]
Fi3	148[190]	116[194]	135[191]	Ru3	213[233]
Fi4	243[227]	208[237]	277[233]	Ru4	177[216]
Fi5	243[194]	233[198]	255[199]	Ru5	234[254]
Fi6	133[204]	204[210]	203[214]	Ru6	226[239]
Fi7	191[195]	224[206]	247[204]	Ru7	174[214]
Fi8	127[224]	160[229]	164[231]		
Fi9	279[200]	284[221]	323[233]		

Most Finnish speakers (8/9) used a different pitch range in Finnish than in Russian (either before their stay or after it): for most speakers (5/9) it was narrower than in Russian. In Russian, the majority (6/9) of the learners had a wider pitch range after their stay than before it. The native speakers' pitch range varied much, but its average (249 Hz) was wider than that of the learners (Finnish 209 Hz, Russian before the stay 215 Hz and after the stay 221 Hz).

All learners had a slightly lower mean pitch in Finnish than in Russian, with an average of 206

Hz. The mean pitch for all learners did not differ before and after their stay in Russia. The native Russians' mean pitch was 243 Hz. Some studies suggest that Russian women's mean pitch is usually a little higher, 260 Hz [5]. To summarize, the mean pitch of the Russians is much higher than that of the learners. However, on average, the learners use a higher mean pitch in Russian than in Finnish which seems to indicate that they have learnt to use a higher, more native-like pitch in Russian.

### 3.2. Local pitch range (different utterance types)

#### 3.2.1. Pitch range (max-min) and mean pitch

Secondly, the pitch range was studied in different utterance types (declarative, question, and exclamation) by measuring the pitch range for each utterance separately. First, the mean pitch of each speaker varies according to the utterance type. Most Finnish informants had the highest mean pitch in Finnish in exclamations whereas in Russian it was found in questions. No great differences were found between the recordings before and after their stay in Russia. The native Russians had the highest mean pitch in questions and exclamations. Thus, as also the learners produced the highest mean pitch in questions, they seem to have acquired this feature of Russian.

Furthermore, the narrowest pitch range varied according to the speaker (Table 2).

**Table 2:** Utterance type (D=declarative, Q=question, E=exclamation) having the narrowest pitch range (Hz).

Finnish speaker	Finnish	Before the stay	After the stay	Russian speaker	Russian
Fi1	E(114)	Q(119)	E(110)	Ru1	Q(162)
Fi2	Q(106)	D(126)	E*(80)	Ru2	D(173)
Fi3	Q(129)	E(112)	Q+(128)	Ru3	D(174)
Fi4	E(123)	E(142)	D(181)	Ru4	E(120)
Fi5	E(147)	E(141)	D,E(143,145)	Ru5	D(140)
Fi6	D(157)	Q(160)	D,Q(198,202)	Ru6	-
Fi7	D,Q(167)	E(171)	Q(179)	Ru7	Q(145)
Fi8	E(92)	E(151)	E(133)		
Fi9	Q,E(141)	D(204)	D,Q(198,200)		

\*) the difference between this utterance type and all other utterance types is significant at 0.032 level.

+) the difference between this utterance type and all other utterance types is significant at 0.005 level.

In Finnish, the learners had the narrowest pitch range in questions and exclamations. Before their

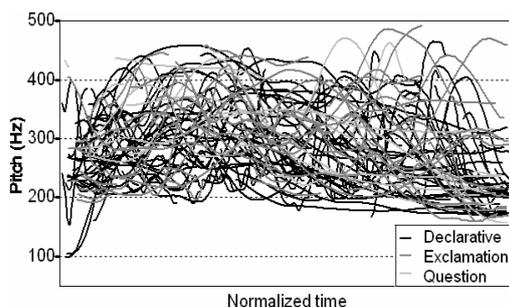
stay, most had the narrowest pitch range in Russian exclamations whereas after their stay there was not one utterance type that could be distinguished. Similarly, the native speakers did not have one single utterance type with the narrowest pitch range. Thus, the learners did not produce pitch the same way as they did before their stay (most of the students had the narrowest pitch range in a different utterance type before their stay than after it).

Considering the Finnish speakers as a group, it can be summarized that in Finnish the pitch range (Hz) and the mean pitch (Hz) depend on the type of the utterance so that exclamations differ statistically significantly from questions and declaratives in the mean pitch ( $p=0.000$ ) and the pitch range ( $p=0.037$ ). In their Russian, the utterance types differ significantly from each other ( $p=0.000$ ) in the mean pitch both before and after the students' stay in Russia. In native Russian speech, the declaratives differ statistically significantly ( $p=0.000$ ) from questions and exclamations.

### 3.2.2. Superimposed pitch contours

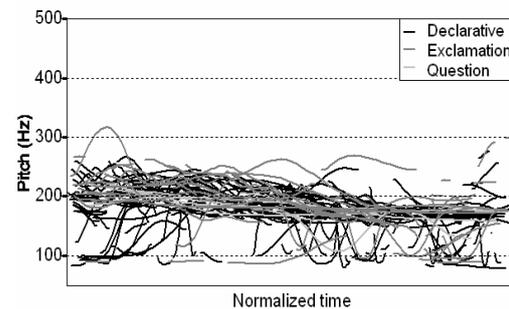
To get a better idea about the possible variations of the pitch in the utterance, all pitch contours of a speaker in each recording session were graphically compared by superimposing them with time normalization and using different colours for each utterance type (examples in Figures 1-4).

**Figure 1:** Pitch contours in native Russian utterances superimposed (speaker Ru1).



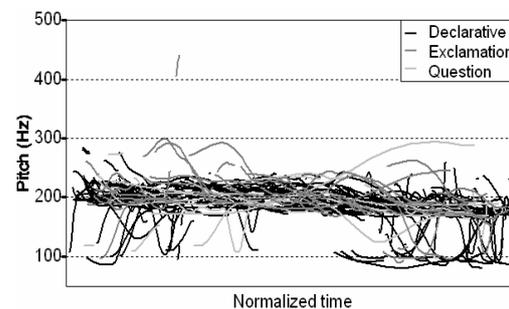
In general, the learners had less variation in their pitch contours both in Finnish and Russian. The native Russians typically used their whole pitch range more exhaustively, in a way that pitch values were spread more evenly around the whole range (Figure 1). In native Russian speech the high F0 peaks could occur anywhere in the utterance in all the utterance types, most often in questions.

**Figure 2:** Pitch contours in Finnish utterances superimposed (speaker Fi3).

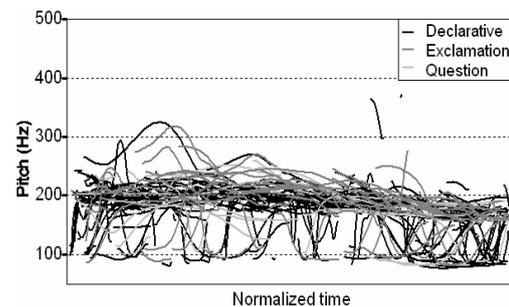


In Finnish, there was a clear concentration of the pitch values around the mean ( $c. \pm 30$  Hz) with a declination of the pitch contour towards the end of the utterance and a tendency of high F0 peaks (if there was any) to be situated in the beginning or middle of the declaratives (Figure 2). It has to be pointed out that one speaker (Fi9) used a rather varied pitch range also in Finnish. In Finnish the declaratives and questions seemed to follow a similar (rather flat) pitch contour whereas in Russian there was a lot of fluctuation even in the declaratives.

**Figure 3:** Pitch contours in L2 Russian speech before the stay in Russia (speaker Fi3).



**Figure 4:** Pitch contours in L2 Russian speech after the stay in Russia (speaker Fi3).



In Russian, learners began all utterances each at almost the same pitch height and ended them slightly lower, whereas the native Russians had a tendency to alternate the pitch in the beginning and at the end of the utterances (Figures 3 and 4). The L2 speech could also be characterized by production of high F0 peaks in questions, but not so much in other utterance types. 5/9 students produced F0 peaks in questions before their stay in Russia and all of them after their stay. This suggests that the learners have learnt to vary their speech more, especially in questions, thanks to their L2 experience.

#### 4. DISCUSSION AND CONCLUSIONS

To sum up, in Finnish (L1) the pitch range and mean pitch of exclamations differs statistically significantly from other utterance types. In Russian the mean pitch of the declaratives differ statistically significantly from exclamations and questions, but the pitch range does not seem to change according to the utterance type. Statistically significant mean pitch differences were also found in L2 speech in all utterance types.

Most L2 speakers of Russian have a narrower and less varied pitch range in Finnish than in Russian, and in both languages most of their pitch values are concentrated around the mean pitch. The native Russians have a wider pitch range than the learners, and their pitch values are more equally distributed around the whole pitch range. Furthermore, the L2 learners have a tendency to begin and end all their utterances at the same pitch level in L1 and L2 whereas the native Russians varied the utterance initial and final pitch height more.

The finding that the learners use a narrower pitch range in L2 than the native speakers is supported by earlier research [7, 1]. The results show that L2 experience seems to affect most students' L2 pitch range by making it more native-like (widening it and spreading the distribution of pitch values around the range). It also seems to encourage them to produce high F0 peaks in questions (in a native-like manner).

To conclude, further studies should consider the possibility that the Finnish informants' pitch could be affected by creaky phonation, which is a rather typical feature of Finnish [9] and L2 speech of Finns [12], but not of Russian. Currently, the research on voice quality is very scarce in both languages. It would also be interesting to

investigate more speakers and possible subtypes of the utterances (e.g. different question types, responses). To determine the mean pitch and pitch range for Russian and Finnish women, larger speech corpora with speakers from different age groups should be used.

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