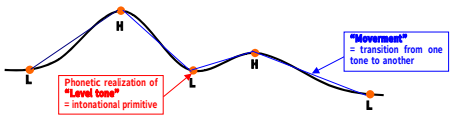
“Segmental Anchoring” of F0 Under Changes in Speech Rate: Evidence from Russian

Introduction

The assumption of recent intonational research

- Intonation contour is a sequence of phonological level tones such as Hs and Ls, occurring at specific points in the segmental string.
- F0 movements such as rises and falls *per se* are merely transitions from their beginning point to its ending point.

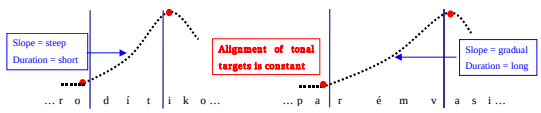


The levels vs. configurations debate

- Two views are in a controversy in intonational research
  - **Configuration view**: Intonational primitive is movement or “configuration”
  - **Level view**: Intonational primitive is a level tone.
- Two views entail different predictions as to variability of F0
  - Configuration view: Duration and/ or slope of F0 should be constant.
  - Level view: Alignment and F0 level of tonal targets (= the beginning and ending points of F0 movement) should be constant.

“Segmental anchoring” (Arvaniti et al. 1998)

- The beginning and ending points of F0 rise (related to prenuclear pitch accent) in Greek are consistently anchored at the specific points in the segmental string.
  - **The beginning point (L target)**: aligns just before the onset of the accented syllable
  - **The ending point (H target)**: aligns at the onset of the vowel following the accented syllable
- The rise duration and slope are not constant but are depended on the duration of the segments that accompany the F0 rise.



Segmental anchoring as a support for the level view

- Phenomenon of “Segmental anchoring” is argued to be evidence for the **“level view”**, because it shows:
  - The alignment and F0 level of tonal targets (=phonetic realization of level tones) are constant.
  - The duration and slope of F0 movement (which are regarded as the constant properties in the configuration view) are not constant but are determined by the alignment and F0 level of tonal targets.

Segmental anchoring in other languages

The existence of segmental anchoring is confirmed for other languages. For example:

- English: (Ladd et al. 1990)
  - The alignment of both the L and H target of an English rising prenulear accent is unaffected by changes in segmental duration brought about by modifications of speech rate
  - The duration and slope of the accents become shorter and steeper as rate increases.
- Dutch: (Ladd et al. 2000)
  - The L target of rising prenuclear accent in Dutch consistently aligns at the onset of the accented syllable.
  - The H seems to align with the end of the accented syllable, depending on whether the vowel of the accented syllable is phonologically long or short: it aligns late in the accented vowel when the vowel is long and midway in the following consonant when the vowel is short.

Is there segmental anchoring in **Russian**, too??

–the aim of this study

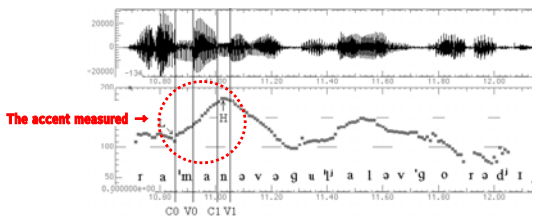
Experiment

Purposes

- To investigate what properties of Russian rising pitch accents are constant under changes in segmental duration brought about by modifications of speech rate.
- To examine whether the “segmental anchoring” of F0 is observed in this language.

Methods

- Basic approach of the experiment:
  - Measurement of 1) the rise duration, 2) the alignment of the L and H tonal targets and 3) the slope of rising prenuclear pitch accents in sentences read at three different speech rates. (The same approach adopted in Ladd et al. 1999 for English)
- The expectations:
  - Regardless of changes in speech rate both L and H targets should be anchored at specific points in the segmental string
  - Two tonal targets should be closer together as speech rate increases and the rise should therefore be shorter and steeper.
- Materials
  - Twenty sentences with the Subject- Verb- Object or Adverbial syntactic structure
  - A typical sentence: *Románova guljála v górode* (*Romanova was walking in the city*)
  - Measurement of the accent on the first word.



- Speakers
  - Seven native speakers of Russian, four females and three males.

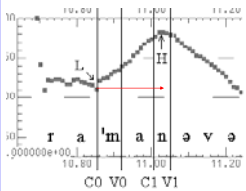
Yosuke Igarashi

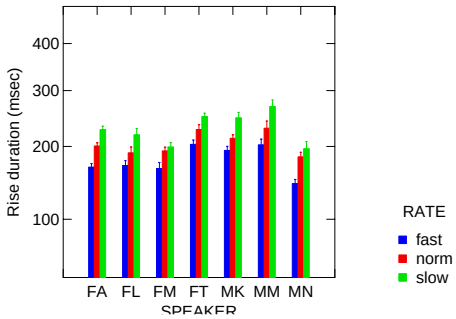
The Graduate School of Area and Culture Studies, Tokyo University of Foreign Studies

Japan Society for the Promotion of Science

Results

Result 1 : Rise duration

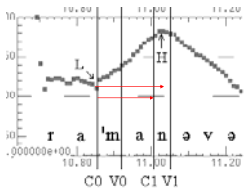




Means for rise duration (ms)

Rise duration increases as speech rate slows.

Correlation between duration of the accented syllable (ms) and rise duration (ms)



Speaker	R	P
FA	*0.832*	*<0.001**
FL	*0.677*	*<0.001**
FM	*0.747*	*<0.001**
FT	*0.812*	*<0.001**
MM	*0.688*	*<0.001**
MN	*0.834*	*<0.001**
MK	*0.774*	*<0.001**

Rise duration is correlated with duration of the accented syllable.

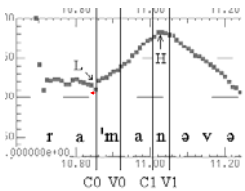
■**Rise duration is not constant**

➢It increases as speech rate slows (as the syllable duration increases)

Result 2 : Alignment of L target

Temporal distance between L and the onset of the accented syllable (ms)

(negative values indicate that the L precedes the onset of the accented syllable)



Speaker	*Fast*	*Normal*	*Slow*	*F(2, 59)*	*P*
FA	*-3.9(3)*	*-4.8(2)*	*-6.1(2)*	*0.122*	*0.886*
FT	*-10.9(4)*	*-9.0(4)*	*-5.3(3)*	*0.953*	*0.404*
FL	*-9.2(4)*	*-14.2(6)*	*-3.2(4)*	*1.099*	*0.355*
FM	*-0.2 (3)*	*4.7(2)*	*5.9(4)*	*1.030*	*0.377*
MM	*-30.5(7)*	*-25.7(9)*	*-24.0(7)*	*0.368*	*0.698*
MN	*-10.1 (3)*	*- 6.7 (2)*	*1.4(3)*	*3.561*	*0.050**
MK	*-17.6(5)*	*-13.9(5)*	*-5.9(5)*	*1.066*	*0.365*

■ **Alignment of L is reraltively constant**

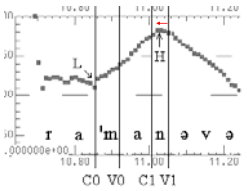
(except for one speaker):

➢L aligns just before the onset of the accented syllable

Result 3 : Alignment of H target

Means for temporal distance between H and the vowel onset of the following syllable (ms)

(negative values indicates that the H precedes the vowel onset)



Speaker	*Fast*	*Normal*	*Slow*	*F(2, 59)*	*P*
FA	*-4.4(3)*	*0.9(1)*	*-4.3(3)*	*1.317*	*0.292*
FL	*-28.9(7)*	*-40.1(8)*	*-20.4(6)*	*1.958*	*0.170*
FM	*-4.0(5)*	*-9.0(4)*	*-4.6(3)*	*0.426*	*0.660*
FT	*-6.6(5)*	*-24.0(5)*	*-16.6(5)*	*3.201*	*0.065*
MM	*-4.1(5)*	*-9.3(8)*	*-1.2(8)*	*1.207*	*0.322*
MN	*-16.6(3)*	*-13.8(8)*	*-16.9(5)*	*0.048*	*0.953*
MK	*-19.3(5)*	*-7.6(3)*	*-0.0(5)*	*3.330*	*0.059*

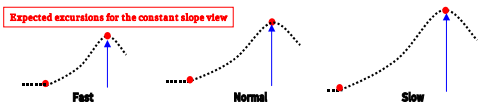
■**Alignment H is relatively constant**

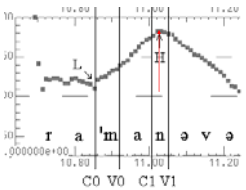
➢ H aligns somewhere in the onset consonant of the following syllable

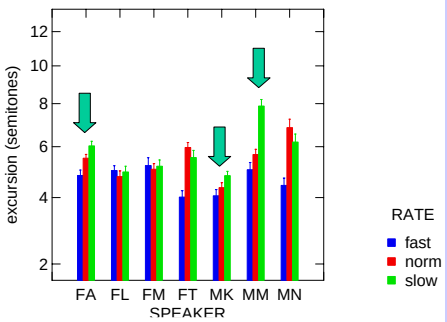
Result 4 : Slope

✧If the slope is constant, the F0 excursion should be greater as rate decreases, because there would be more time between L and H.

✧If the slope is not constant, there should be no effect of speech rate on the excursion.





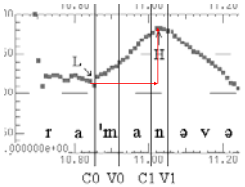


Means for F0 excursion (semitones)

Three speakers produced larger excursion as rate slows:

Is slope constant??

Correlation between rise duration (ms) and F0 excursion (semitones)



Speaker	R	P
FA	*0.496*	*<0.001**
FL	*-0.055*	*0.679*
FM	*0.091*	*0.489*
FT	*0.277*	*0.032**
MM	*0.541*	*<0.001**
MN	*0.417*	*0.001**
MK	*0.270*	*0.037**

Five speakers showed a significant correlation between rise duration and excursion:

Is slope constant??

Summary of Experiment

1. The rise duration was not constant but it increases as rate slows.
2. Both the beginning and the end of the rise were anchored with specific points in the segmental string, regardless the changes in speech rate
3. For some speakers, rate had those effects on F0 excursion which suggest that the slope is constant

Conclusion

- The existence of “segmental anchoring” was confirmed in Russian. (The results of the study by Ladd et al. (1999) for English were partially replicated.)
- The results also seemed to support the view that a given type of pitch accent has the constant slope.