

Perception and Production of Lexical Pitch Accent in Heritage Lithuanian

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Previous studies of heritage prosody

- Heritage languages are notoriously understudied: existing studies have focused mainly on morphosyntax.
- What phonological work has been done has generally investigated differences in vowel/consonant quality among native speakers, heritage speakers, and L2 learners (e.g., Chang et al. 2008, Saadah 2011, Lukyanchenko & Gor 2011, etc.)
- Generally: heritage speakers successfully acquire phonology, but there is variation.

Pitch accent in Lithuanian

Lithuanian is a *pitch accent system* in the following sense: pitch is used to signal the location of the prominent mora in the word (=realization of stress). (i.e., not Norwegian pitch accent, which is phrasal)

Three pitch accents (Balode & Holvoet 2001, Blevins 1993, Kenstowicz 1970, etc.):

- Acute (falling): \acute{V}
- Circumflex (rising, or even): \tilde{V}
- Grave (high): \grave{V}

Acute/Circumflex occur on bimoraic segments: long vowels, diphthongs (*au, ai, ei, ui, ie, uo*), “mixed diphthongs” (vowel-sonorant sequences: *Vl, Vm, Vn, Vr*)

Grave occurs on monomoraic segments: short vowels

Acute & circumflex are used contrastively (minimal pairs)

Pitch accent in Lithuanian

Nominal accentual paradigms – subject of many phonological investigations

There are 4 accent paradigms which are independent of the 5 morphological declension classes (any declension can exhibit any accent paradigm).

		Class I		Class II			Class III		Classs IV	
		MAN	CROW	FOX	WHEEL	ARM	WINDOW	HEAD	CHILD	SPEECH
SG	NOM	víiras	várna	laápe	raátas	ranká	lángas	galvá	vaikas	kalbá
	GEN	víiro	várnos	laápees	raáto	rańkos	lángo	galvoós	vaiko	kalboós
	DAT	víirui	várnai	laápei	raátui	rańkai	lángui	gálvai	vaikui	kaĺbai
	ACC	víiraa	várnaa	laápææ	raátaa	rańkaa	lángaa	gálvaa	vaikaa	kaĺbaa
	INST	víiru	várna	laapé	raatú	ranká	lángu	gálva	vaikú	kalbá
	LOC	víire	várnoje	laápeeje	raaté	rańkoje	langé	galvojé	vaiké	kalbojé
	VOC	víire	várna	laápe	raáte	rańka	lánge	gálva	vaíke	kaĺba
PL	NOM	víirai	várnos	laápees	raátai	rańkos	langaí	gálvos	vaikaí	kaĺbos
	GEN	víiru	várnu	laápiu	raátuu	rańkuu	languú	galvuú	vaikuú	kaĺbuu
	DAT	víirams	várnoms	laápeems	raátams	rańkoms	langáms	galvóms	vaikáms	kalbóms
	ACC	víirus	várnas	laaés	raatús	rankás	lángus	gálvas	vaikús	kalbás
	INST	víirais	várnomis	laápeemis	raátais	rańkomis	langaís	galvomís	vaikaís	kalbomís
	LOC	víiruose	várnose	laápeese	raátuose	rańkose	languosé	galvosé	vaikuosé	kalbosé
	VOC	víirai	várnos	laápees	raátai	rańkos	langaí	gálvos	vaikaí	kaĺbos

Acoustic studies of prosody in Lithuanian

No conclusive account of acoustic correlates of pitch accent production

A number of studies have looked at the acute/circumflex contrast:

- **Ekblom 1922:** short rise-fall for acute, steady rise for circumflex
- **Robinson 1968:** no pitch difference; first segment in circumflex is longer and tenser than corresponding segment in acute
- **Dogil & Möhler 1998:** looked at a variety of parameters; acute accent was always clearly defined, circumflex accent was variable (difference is salience vs. variance)
- **Kelly 2013:** individual differences in how the contrast is signaled: some use duration, others use maximum intensity – only looked at 3 speakers

No studies have been conducted to examine whether phrasal/sentence prosody interacts with accent

- Kundrotas 2008 examined Lithuanian phrasal prosody and identified 7 possible contours, but pitch accent was not looked at systematically

No studies have examined the perception of Lithuanian pitch accent, even among native speakers

Goals and predictions

The aims of the present study were the following:

1. Can we isolate unique phonetic correlates of NS production of pitch accent?
2. Are there significant differences in the processing of contrastiveness in lexical pitch accent between NSs and HSs, or among HSs of varying proficiency? **Hypothesis: NSs will have no difficulty perceiving the contrast. Less proficient HSs may have some difficulty.**
3. Do these differences correlate with speakers' linguistic experience or input during acquisition? **Hypothesis: Factors such as education, time in Lithuania, dialect, and generation/age should produce differences in HS performance.**
4. Does lexical frequency play a role in contrast perception (are more frequent words more likely to be perceived)? **Hypothesis: Lexical frequency will disproportionately affect HSs.**
5. Do HSs exhibit nonstandard stress/accent placement in the nominal system, and if so, is there any regularity to these patterns? **Hypothesis: Given the complexity of the system, we might expect paradigmatic leveling in HS's speech.**

Experimental design

Participants

- 14 participants
- Adult heritage speakers of Lithuanian (n=13)
 - Completed most of their schooling in the United States
- Adult native speakers (n=1)
 - Born and raised in Lithuania and have completed most of their education there

Experimental design

Linguistic interview

Both sets of speakers were interviewed about their experience learning and speaking Lithuanian and English (as well as their origins and those of their families).



This information was processed into the following variables:

- Category: heritage, native
- Age
- Age of departure from Lithuania
- Education: none, primary school, Saturday school, higher education
- Dialect: Žemaitian, West Aukštaitian, East Aukštaitian (broadest bins for participants)
- Generation: Older Native (40-60 years old, grew up during Soviet control of Lithuania), Older Heritage (speaker or speaker's family emigrated from Lithuania in 1950s or 1960s, 40-60 years old), Younger Heritage (speaker/parents are part of the most recent wave of immigration in early 1990s, 18-30 years old)

Experimental design

Task 1: Perception

- Participants were played 14 acute/circumflex minimal pairs (28 target tokens) and 32 fillers.

- Examples  
 - *káltas* ‘chisel’ (acute) vs. *kāltas* ‘guilty’ (circumflex)
 - *áukštas* ‘high’ (acute) vs. *aūkštas* ‘story/floor’ (circumflex)
 - *ántis* ‘duck’ (acute) vs. *añtis* ‘bosom’ (circumflex)
 - *šáuk* ‘shoot, fire (imp.)’ vs. *šaũk* ‘cry, shout (imp.)’
 - *kó:še* ‘he/she/they filtered; to sour’ vs. *kõ:še* ‘porridge’
 - *áusta* ‘to cool’ vs. *aũsta* ‘to come’
 - *drím̃ba* ‘lout’ vs. *drim̃ba* ‘to fall’
 - *rú:gštj* ‘acid’ vs. *rũ:gštj* ‘sourness’
 - *sú:ris* ‘cheese’ vs. *sũ:ris* ‘saltiness’

Experimental design

Task 1: Perception

- Items were played in a completely random order. Participants heard each token only once and would see a display like the following, including both potential minimal pair meanings for relevant items.

Select the meaning of the word you have just heard.

1 - melody 2 - guilty 3 - chisel 4 - fence 5 - two or more of the above

6 - I am unfamiliar with this word.

Experimental design

Task 2: Lexical Proficiency Test

- Participants were asked to translate 250 Lithuanian words into English as a metric for their relative proficiency.
 - 28 of these words were the target items from the perception task, to independently check whether participants are familiar with these particular lexical items
 - The remaining words were a randomized sample of mostly high-frequency lexical items, pulled from a corpus of movie subtitles (<https://invokeit.wordpress.com/frequency-word-lists/>)
- Responses were graded out of 2 points: 2 points for a completely accurate translation, 1 point for a close translation, and 0 points if the translation was completely incorrect or if no response was given.

Experimental design

Task 3: Production Task

Part 1

- Participants read 54 declarative Lithuanian sentences containing representative examples of the four accentuation classes.

	Class I		Class II			Class III		Class IV	
	MAN	CROW	FOX	WHEEL	ARM	WINDOW	HEAD	CHILD	SPEECH
NOM	vīras	vārna	laápe	raátas	ranká	lángas	galvá	vaikas	kalbá
GEN	vīro	vārnos	laápees	raáto	rańkos	lángo	galvoós	vaiko	kalboós
DAT	vīrui	várnai	laápei	raátui	rańkai	lángui	gálvai	vaikui	kaĺbai
ACC	vīraa	vārnaa	laápææ	raátaa	rańkaa	lángaa	gálvaa	vaikaa	kaĺbaa
INST	vīru	vārna	laapé	raatú	ranká	lángu	gálva	vaikú	kalbá
LOC	vīre	várnoje	laápeeje	raaté	rańkoje	langé	galvojé	vaiké	kalbojé

- Information collected:
 - Location of peak F0 in target word (according to Praat) as well as other acoustic correlates (intensity)
 - Location of prominent stress (coded by ear)

Experimental design

Task 3: Production Task

Part 2

Elicitation of minimal pair items from Task 1

Difficult to elicit particular words from the speakers

- Used only to determine whether speaker can produce the acute/circumflex contrast, for incorporation as a predictor in perception analysis.

Results: Accent Perception

Overall correctness

Significant results of logistic regression:

Variable	β	SE	z	Sig. (p)
Condition (Filler)	1.67	0.16	10.3	$p < 0.01$
Frequency	0.01	0.01	3.37	$p < 0.01$

Experimental items more difficult to identify than filler items:

- 42% average correctness on acute
- 50% on circumflex
- 81% on fillers (requiring no accent contrast)

Same pattern for native speaker: 64% on acute, 50% on circumflex, 81% on fillers

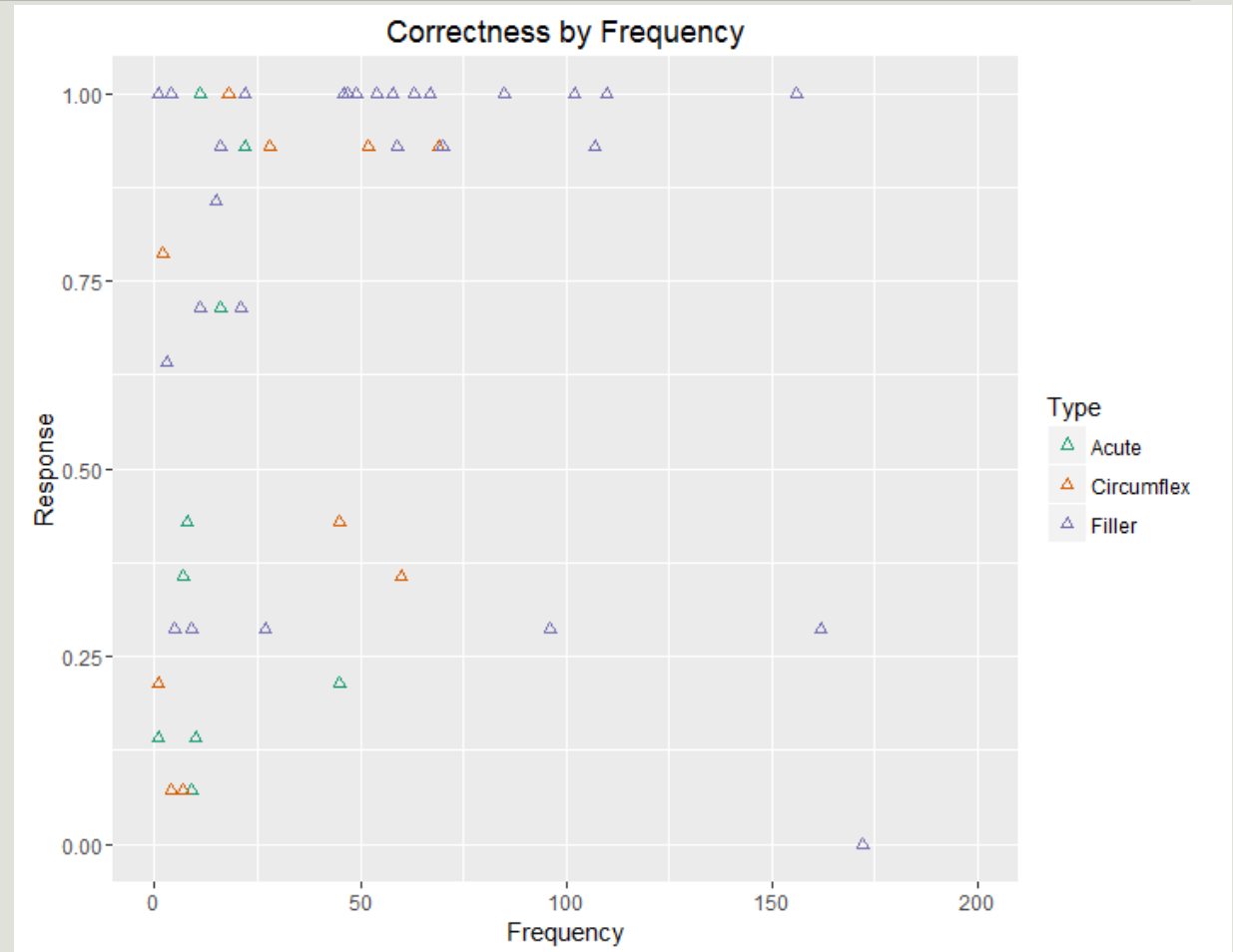
Significant effect of baseline vocabulary score only on fillers ($\beta=0.01$, $SE=0.01$, $t=3.32$, $p < 0.01$) – not significant on experimental items – either proficiency does not play a role, or lexical recognition task is not a good measure of proficiency

Results: Accent Perception

Effect of frequency

Positive effect of frequency: participants scored higher on more frequent items

- Also held true for the native speaker: about 68% for items with frequency < 50, 80% for all other items



Results: Accent Perception

Interaction effects for Frequency/Condition

Additional model looking at interaction effects between frequency and condition – could frequency be disproportionately affecting the accented items relative to the filler items?

No significant interaction effect obtained

Difference in performance on accent condition tokens is not an artifact of frequency differences

Results: Accent Perception

Probability of Accent Contrast

Overall correctness models only tell us that something aside from frequency or lexical proficiency of speaker is conditioning a difference in perceiving accented items vs. fillers

But we care about the contrastiveness of pitch accent in Lithuanian, and whether speakers can perceive this contrast

- ---> Must look at the particular ways they are reacting to minimal pair items, including both correct and incorrect answers

Recoded minimal pairs into individual items: contrast present vs. contrast absent (merger)

- Minimal pairs where participants indicated “I am unfamiliar with this word” for both items were excluded

Results: Accent Perception

Logistic model: likelihood of merger

Predictors tested:

- Baseline
- Education
- Age of departure
- Frequency difference (testing hypothesis that a higher difference in frequency might make speakers likelier to merge to the more frequent option—based on *jós* vs. *jõs* observation)
- Age
- Dialect
- Generation
- Contrast in Production?

→ **No significant effect.**

Results: Accent Perception

Smaller scale analyses

Although there were no significant differences, worth noting that the differences that do exist pattern exactly in the ways we expect:

Education		Community Engagement		Generation		Dialect	
High	66.9%	Engaged	64.9%	Older NS	71.4%	W. Aukštaitian	69.9%
Low	75.7%	Not Engaged	72.3%	Older HS	61.0%	E. Aukštaitian	71.4%
				Younger HS	75.9%	Žemaitian	64.9%

Education (excluding NS): speakers with more education preserve more distinctions

Community Engagement: speakers who are more engaged in community have more distinctions – possibly because they have a wider social network within which to use Lithuanian

Results: Accent Perception

Smaller scale analyses

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				Younger HS	75.9%	Žemaitian	64.9%

Dialect: East Aukštaitian has greatest conflation (as we expect based on language change in Lithuania)

**But note that different dialect groups were unbalanced and dialect differences should not be overstated

Generation: Most interesting result – older heritage speakers maintain distinctions more of the time than either the native speaker or the younger heritage speakers

- Indicative of changes taking place in Lithuania? Unclear—younger speakers mostly from West Aukštaitia, where contrast should be maintained
- Might indicate a shift in the community and the degree of maintenance in the community

Results: Production of Accent Paradigms

Acoustic Analysis

Elicited Nouns									
	Class I		Class II			Class III		Class IV	
	MAN	CROW	FOX	WHEEL	ARM	WINDOW	HEAD	CHILD	SPEECH
NOM	víiras	várna	laápe	raátas	ranká	lángas	galvá	vaíkas	kalbá
GEN	víiro	várnos	laápees	raáto	raíkos	lángo	galvoós	vaíko	kalboós
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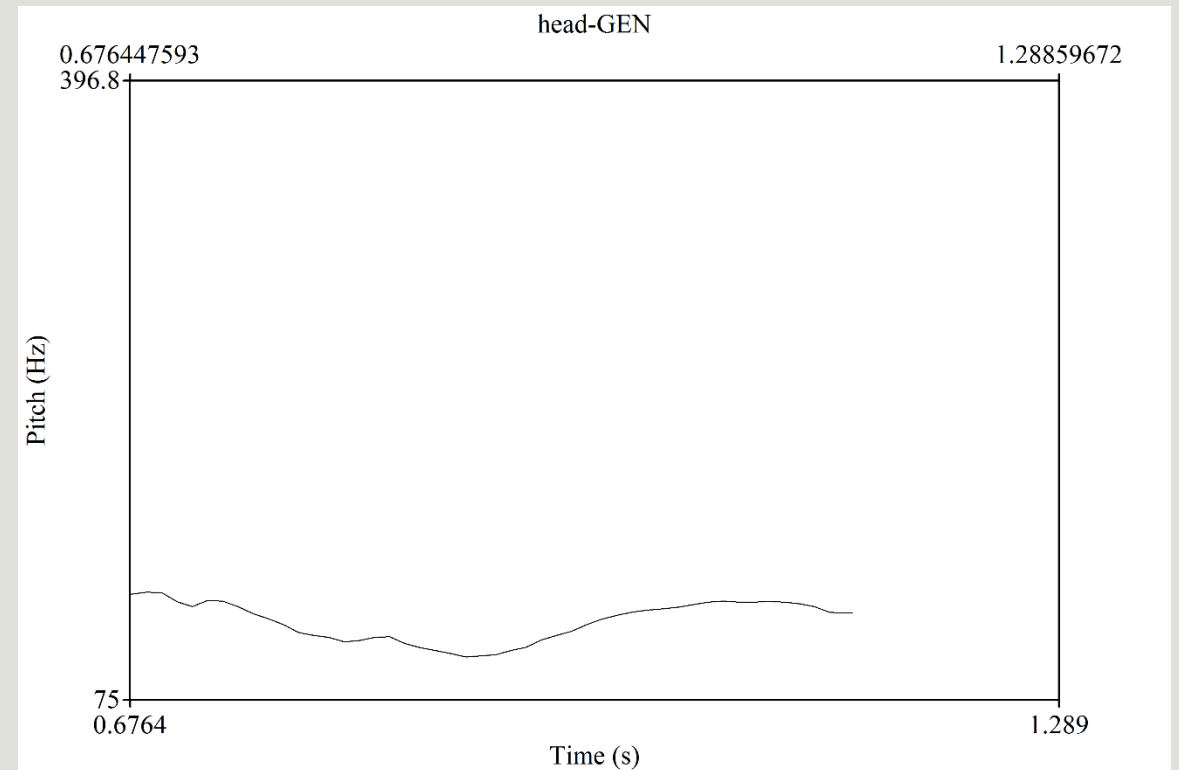
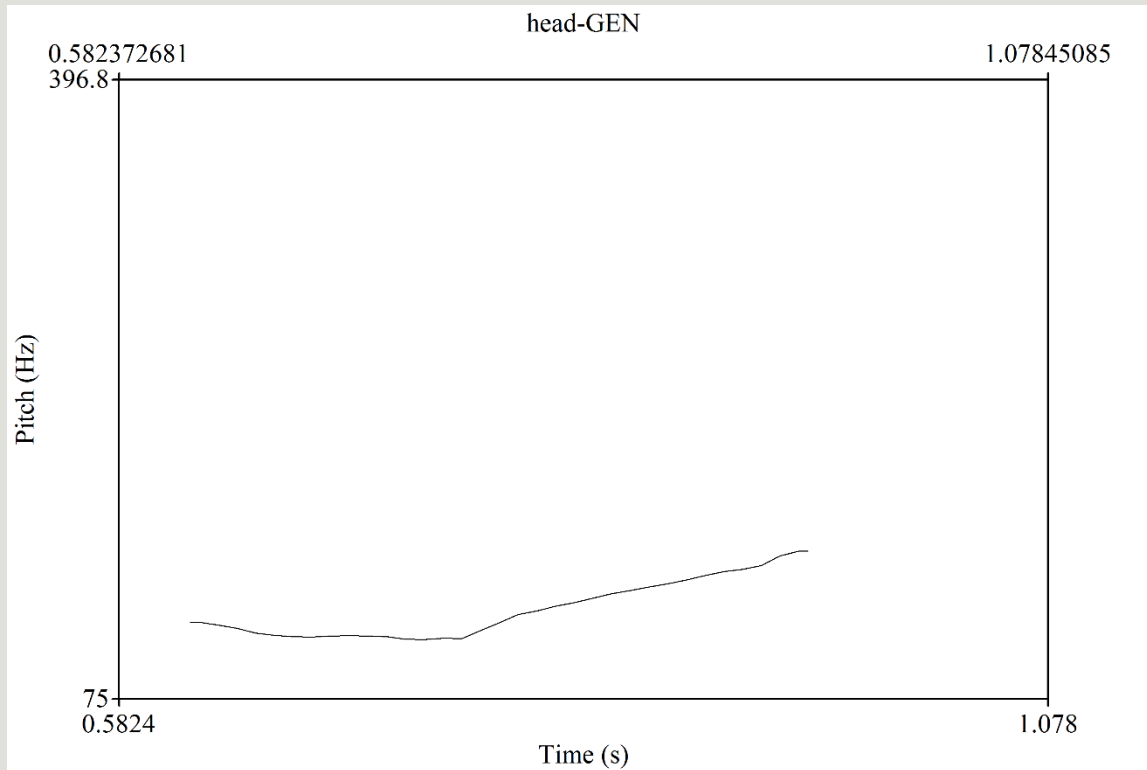
A total of 756 tokens were collected from 14 participants: 275 tokens were analyzed using Praat to locate peak pitch and intensity in target nouns.

Confirms the findings of previous studies: **speakers do not use peak pitch or even peak intensity on expected moras** (**though this study is not directly comparable to previous studies, which looked at minimal pairs)

Results: Production of Accent Paradigms

Acoustic Analysis

Difficult often to isolate a peak intensity or peak frequency: *galvoós* 'head-GEN'



Speakers produced tokens with peak pitch on the expected mora only 38.8% of the time—so low it seems that these cases are probably coincidental

Results: Production of Accent Paradigms

Acoustic Analysis

But the native speaker produced peak pitch on the expected mora 58.5% of the time

Similarly an older heritage speaker (who tended to maintain perceptual contrasts in the first task) had the expected patterns 54.2% of the time.

Younger heritage speakers exhibited the lowest overlap with expected patterns.

Significant variation in which accents were marked by expected pitch patterns: circumflex accent was by far the least likely to have peak pitch on expected mora – 24.3% of the time compared to 42.6% for acute and 55.1% for grave ($F(2,270)=9.22, p < 0.01$).

- Seems to confirm previous accounts that a tonal peak is not important for the circumflex accent, or possibly Dogil & Möhler's account that the acoustic correlates of circumflex are less salient (and therefore more prone to being lost)

Results: Production of Accent Paradigms

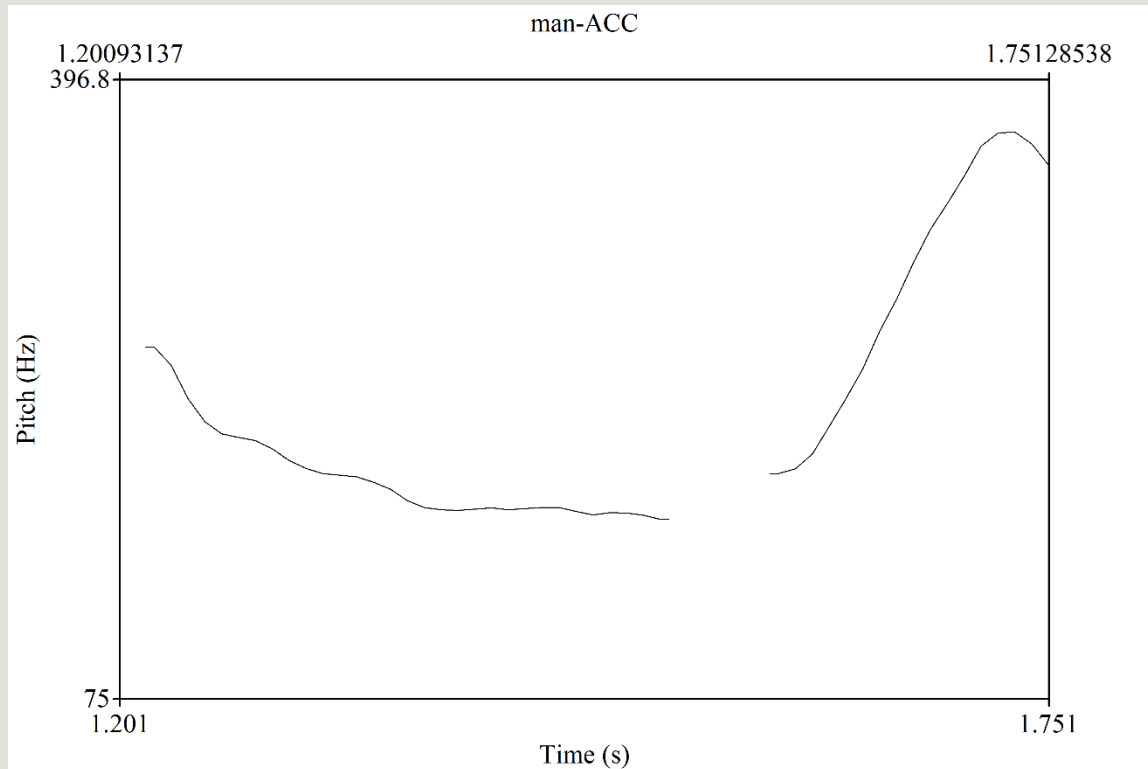
Acoustic Analysis

Peak pitch is a problematic metric – there is evidence that phrasal prosody is influencing pitch accent, such that peak pitch occurs elsewhere in the word even if there is a local maximum on the accented mora.

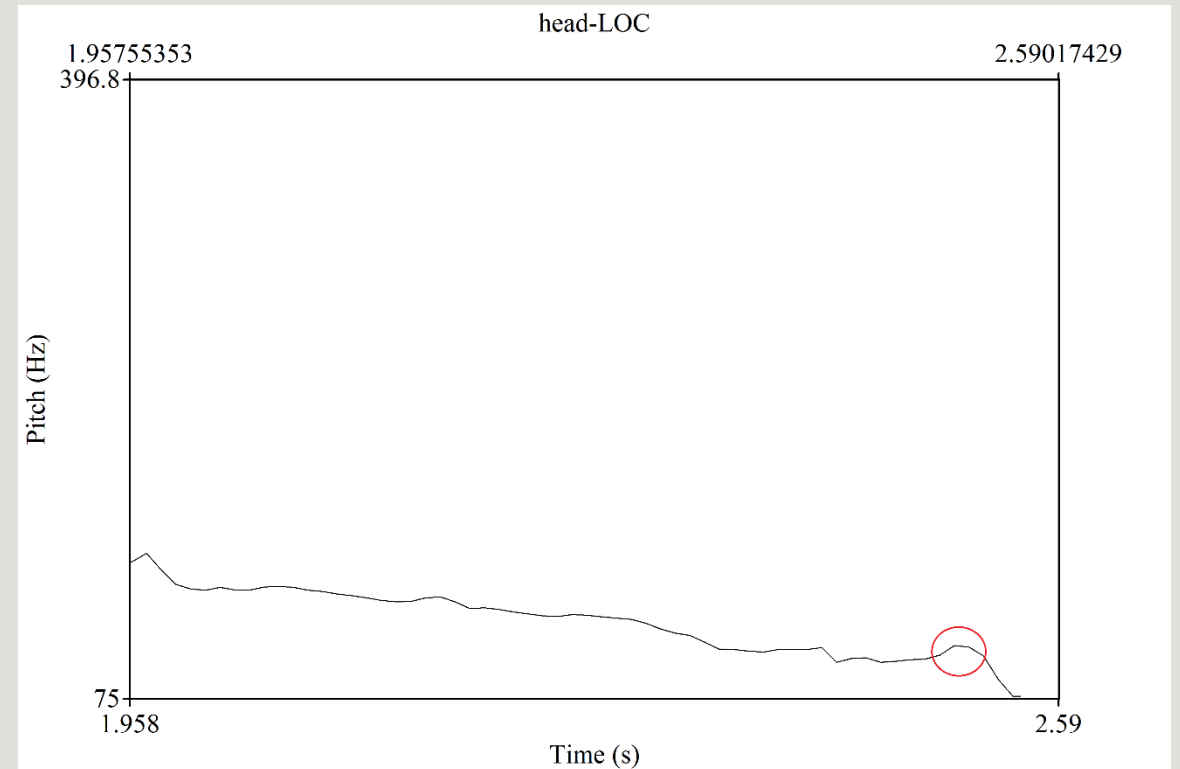
Less proficient heritage speakers were often affected by uptalk (among the younger female participants) and rising question intonation if they were having difficulty reading the word or were unsure of stress placement

Results: Production of Accent Paradigms

Acoustic Analysis



Šuo ikando víiraa. 'The dog bit the man.'



galvojé 'head-LOC'

Results: Production of Accent Paradigms

Patterns in Stress Production

Although pitch was not always a factor in the production of stress, it is clear to a listener that speakers are still mostly marking stress on the expected syllables in the paradigms.

- Heritage speakers produced expected stress 86% of the time

Stress is indicated using increased duration and variation in vowel quality (unstressed short vowels are reduced to a schwa-like vowel)

BUT there is still some inter-speaker variation that is worth discussing:

- Greatest variation between younger heritage speakers and older speakers (older HSs produced expected forms 95% of the time, compared to ~75% for younger HSs)

Conclusions

1. Can we isolate unique phonetic correlates of NS production of pitch accent? **Finding: Not even native speakers are always using pitch-based distinctions in their speech. Heritage speakers are likely not using pitch in a strategic way at all, marking stress with duration and differences in vowel quality.**
2. Are there significant differences in the processing of contrastiveness in lexical pitch accent between NSs and HSs, or among HSs of varying proficiency? **Hypothesis: NSs will have no difficulty perceiving the contrast. Less proficient HSs may have some difficulty. Finding: Both the native speaker and the heritage speakers have difficulty identifying even common words using accent alone.**
3. Do these differences correlate with speakers' linguistic experience or input during acquisition? **Hypothesis: Factors such as education, time in Lithuania, dialect, and generation/age should produce differences in HS performance. Finding: There are no statistically significant extralinguistic factors that were found to condition variation among heritage speakers, but there is some expected minor variation that warrants further study.**

Conclusions

4. Does lexical frequency play a role in contrast perception (are more frequent words more likely to be perceived)? **Hypothesis: Lexical frequency will disproportionately affect HSs. Finding: Both the heritage speakers and the native speaker were sensitive to frequency effects when it came to correctly identifying words. Variation in correct identification of accented words and filler words cannot be explained by lexical gaps alone.**
5. Do HSs exhibit nonstandard stress/accent placement in the nominal system, and if so, is there any regularity to these patterns? **Hypothesis: Given the complexity of the system, we might expect paradigmatic leveling in HS's speech. Finding: There was no systematic simplification of the heritage speakers' acquired system. Younger heritage speakers exhibit signs of incomplete acquisition of the stress patterns. Older heritage speakers have better acquired and retained the stress patterns, and exhibit the expected pitch patterns more often than younger heritage speakers.**

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