Vowel quantity contrasts in sung Estonian

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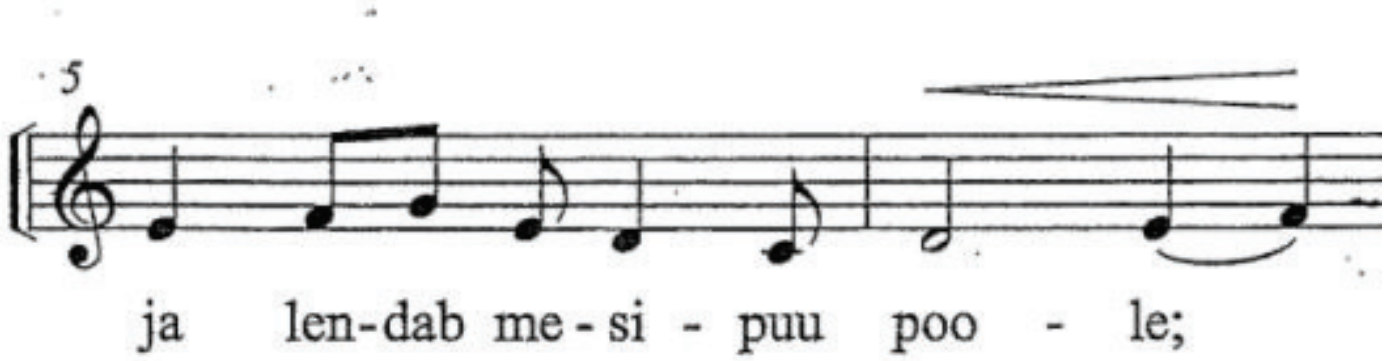
What's the idea?

pole	*poole*	*poole*
[po.le]	[poo.le]	[poo:.le]
COP.NEG	half.SG.GEN	toward



Overview

- Introduction & context
- Questions
- Part I: Corpus exploration
- Part II: Perception experiment
- Discussion & summary

Estonian

	Quantity 1 (Q1) short	Quantity 2 (Q2) long	Quantity 3 (Q3) overlong
(a)	*sada*	*saada*	*saada*
	[sɑ.tɑ]	[sɑɑ.tɑ]	[sɑɑː.tɑ]
	hundred	send.SG.IMP	get.INF
(b)	*koli*	*kooli*	*kooli*
	[ko.li]	[koo.li]	[koo:.li]
	trash.NOM	school.SG.GEN	school.SG.PART
(c)	*krabid*	*kraabid*	-
	[krɑ.pit]	[krɑɑ.pit]	-
	crab.PL.NOM	scrape.2SG.PRES	-
(d)	*koda*	*kota*	*kotta*
	[ko.tɑ]	[kot.tɑ]	[kotː.tɑ]
	chamber.SG.NOM	(big) shoe.SG.GEN	chamber.SG.PART/SG.ILL

(a) Lippus et al. (2009); (b) Ehala (2003); (c,d) author's; notation from Prillop (2013)

Quantity vs duration ratios

Lehiste (1960):

- Bisyllabic minimal pairs differing in quantity.
- Choose the sentence that fits. E.g.:

Jõe ääres ____ on järsk.	[kal.las]
"The ____ at the river's edge is steep."	shore.SG.NOM
Ta ____ kausist vett.	[kal:.las]
"She ____ water from the bowl."	pour.3SG.PST

Adapted from Lehiste (1960, p. 57)

Words of quantity II

	Number of words	Duration of first syllable in cs.	Duration of second syllable in cs.	Ratio of Syllables
100% agreement	10	29.8	19.6	Approx. 30/20
75-95%	25	29.2	18.1	29/18
75-100%	35	29.4	18.5	29/19
Below 75%	165			

σ1:σ2 durations

- Q1 ≈ 2:3
- Q2 ≈ 3:2
- Q3 ≈ 2:1

Common second term = 6

This project

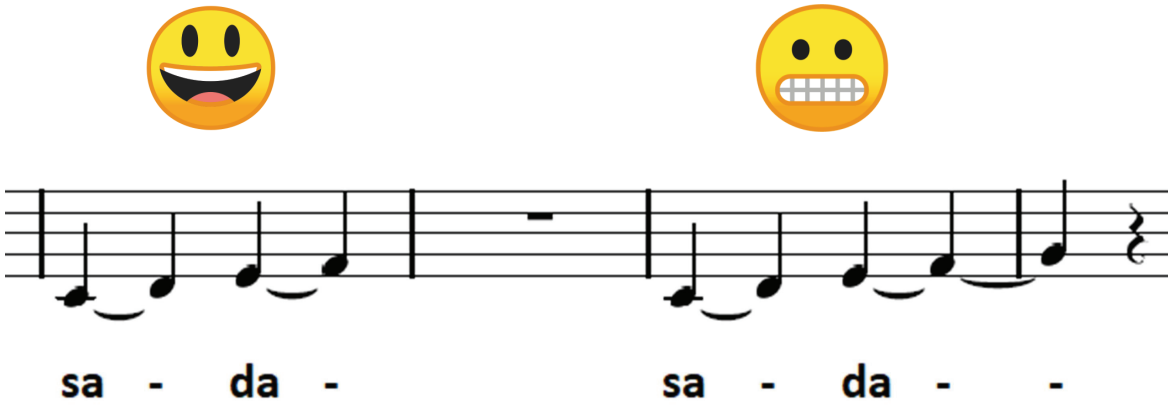
- How is vowel length expressed in music, where duration also has a musical role to play?

- Vowel length only.
- Q1 vs Q2/3 only.

- More on Q2 vs Q3 discrimination:
  Fox & Lehiste (1987, 1989); Lippus et al. (2007, 2009)

Why music?

- Western music vs Estonian σ1:σ2 ratios 2:3, 3:2.



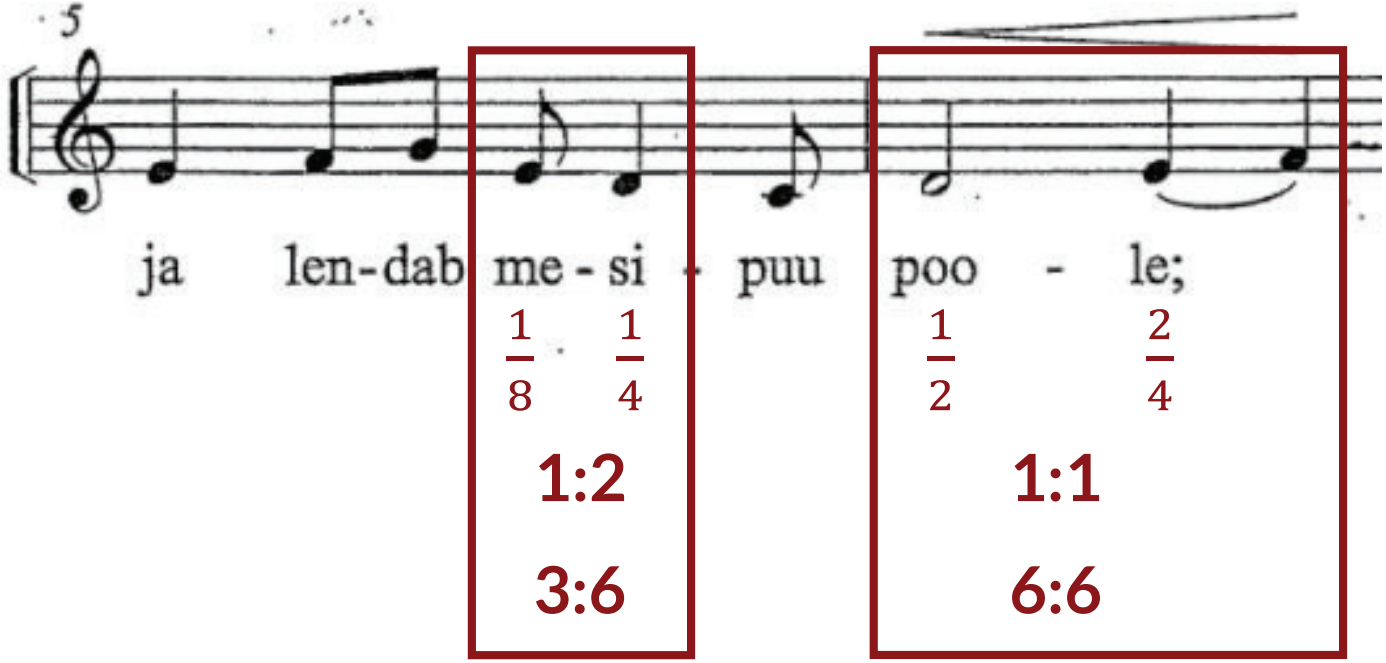
- Joint singing: national identity and cultural transmission in Estonia (Raudsepp & Vikat, 2009, 2011).

Questions

- In Estonian choral music, are Q1 and Q2 syllable pairs set to note pairs with ratios less than one and greater than one, respectively?
  - ➢ Corpus exploration
- Are quantity ratios for Q1 and Q2 in speech identified the same way in sung Estonian?
  - ➢ Perception experiment

Corpus exploration - data

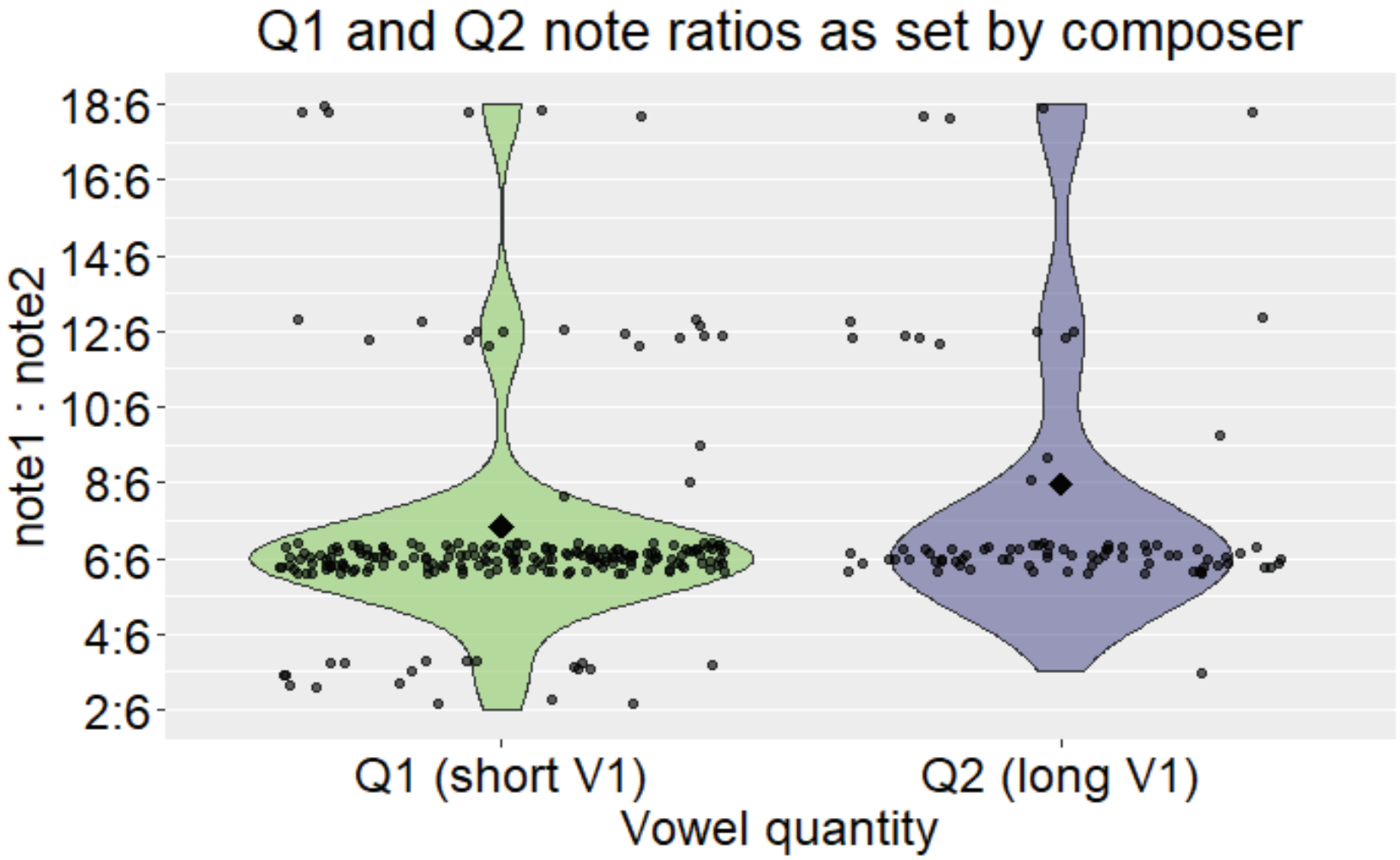
- 8 compositions (722 words → refined to 316).
- Determine each pair's note1:note2 ratio.
  - Normalize with second term = 6.



Corpus exploration - data

song	word	syl1	longv1	note1len	syl2	note2len	numover6
Isamaa	uneta	u	0	0.0833333	ne	0.0833333	6
Isamaa	öödel	öö	1	0.2500000	del	0.2500000	6
Isamaa	kõigil	kõi	1	0.0833333	gil	0.0833333	6
Isamaa	vaevastel	vae	1	0.0833333	vas	0.0833333	6
Isamaa	töödel	töö	1	0.5000000	del	0.3750000	8
Isamaa	ütelda	ü	0	0.1250000	tel	0.1250000	6
Isamaa	oled	o	0	0.1666667	led	0.0833333	12
Isamaa	seesama	see	1	0.0833333	sa	0.0833333	6
Isamaa	elu	e	0	0.0833333	lu	0.0833333	6
Isamaa	sinult	si	0	0.0833333	nult	0.1666667	3

Corpus exploration - results



Questions revisited

- In Estonian choral music, are Q1 and Q2 syllable pairs set to note pairs with ratios less than one and greater than one, respectively?
- Are quantity ratios for Q1 and Q2 in speech identified the same way in sung Estonian?

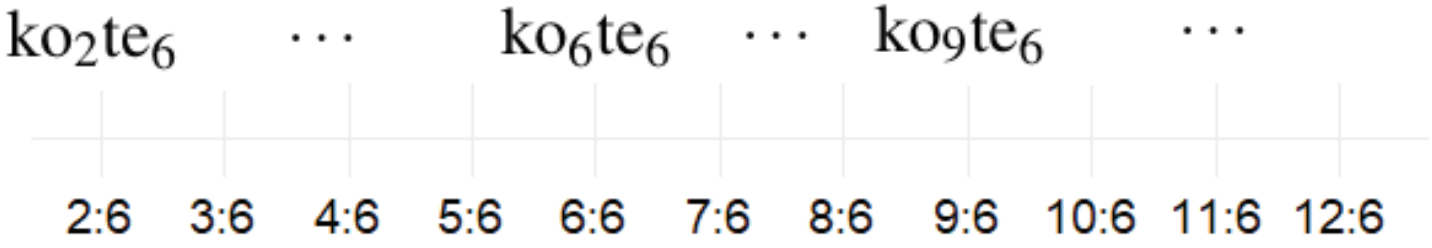
Perception experiment - methods

Perception experiment - stimuli

- 20 CVCV nonce words.

[ko(o)te], [me(e)ke], [pø(ø)te], [tɤ(ɤ)ke], . . .

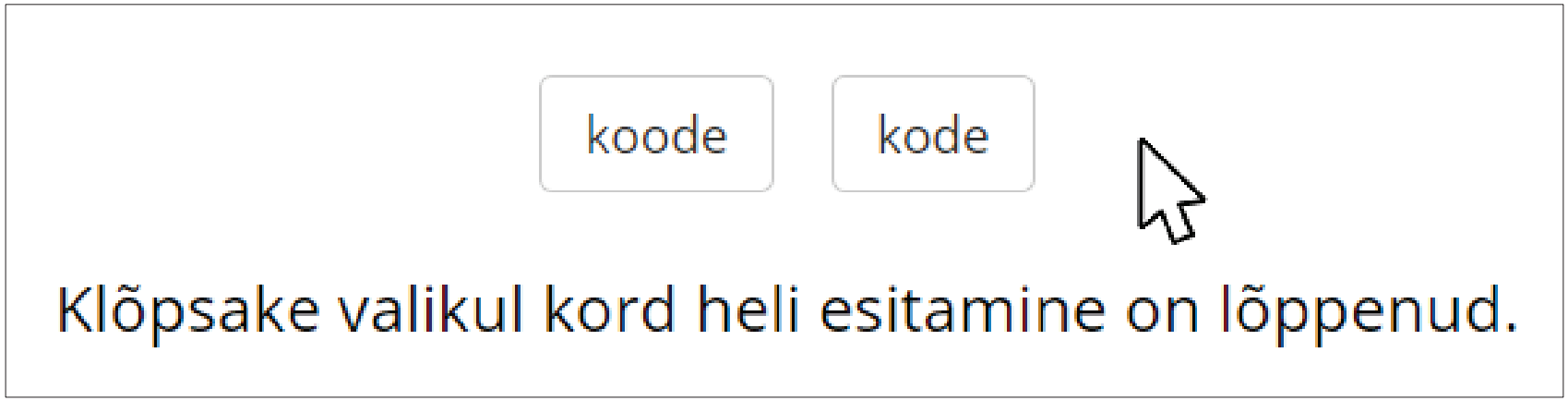
- 11-step continuum of σ1:σ2 duration ratios.



- 6 carrier phrases.

Perception experiment - task

- *Tule [kote] minuga.*
  "Come [target] with me."
- Is V1 short or long?

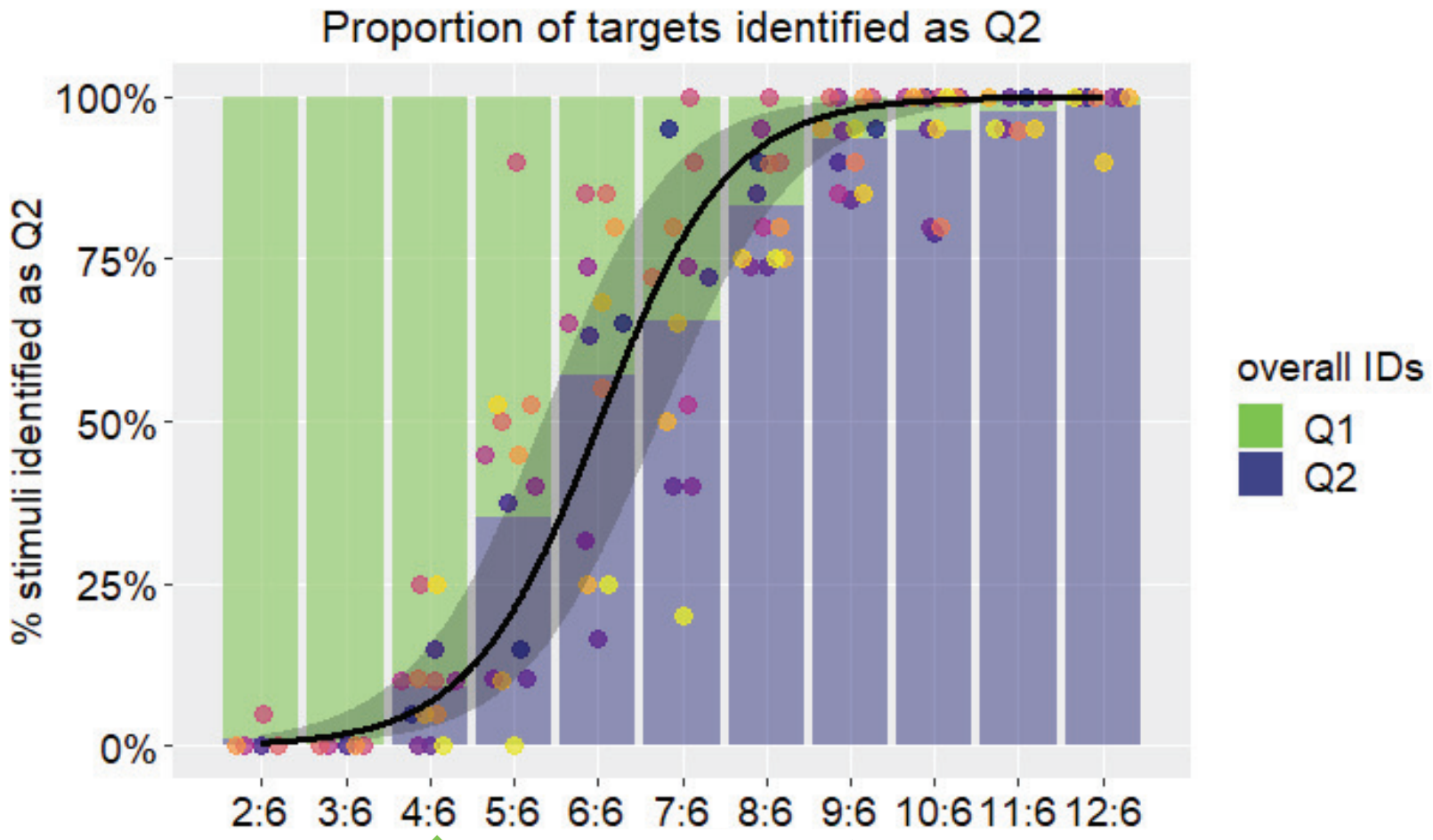


"Click your selection once audio has finished playing."

Perception experiment - data

nonce	carrier	ratio	participant	long_id	ratio_dec
poete	esim	10:6	AT3	TRUE	1.6666667
meke	esim	7:6	AT3	FALSE	1.1666667
moke	mine	5:6	AT3	FALSE	0.8333333
mo_pe	tahe	5:6	AT3	FALSE	0.8333333
moke	mine	10:6	AT3	TRUE	1.6666667
koete	tahe	5:6	AT3	FALSE	0.8333333
mo_pe	tahe	9:6	AT3	TRUE	1.5000000
koete	tahe	10:6	AT3	TRUE	1.6666667
mo_pe	tahe	4:6	AT3	FALSE	0.6666667
po_te	esim	6:6	AT3	TRUE	1.0000000

Perception experiment - results



Speech:

(Lehiste, 1960)

Quantity 1

σ1: σ2 = 2:3

Quantity 2

σ1: σ2 = 3:2

Discussion

Corpus:

- Is small!

Perception experiment:

- ≈ 50% Q2 at 1:1 → surprise!
- Brown et al. (2009); Theodore et al. (2015)
- Pind (1986)

Conclusion

- Composers do not adhere to the expected syllable duration ratios when setting Estonian text to speech.
- Listeners do use the same temporal cues to perceive short vs long vowels in singing as in speech.

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Thank you

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