

# Systems of phonological quantity

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# Overview

## Phonological quantity

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- Swedish: basics of Swedish quantity (duration)
- Inari Saami: basics of Inari Saami quantity (duration)
- Swedish and Inari Saami: fundamentally different quantity systems?

# Quantity

## Phonological quantity

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- Phonetic realizations: pitch, duration, intensity

# Duration distinctions cross-linguistically

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- Some languages make duration distinctions only in stressed syllables.
- Some languages make duration distinctions only in vowels or only in consonants.

# Vowel and consonant length in Finnish

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	[play all]
I come	tulen
of wind	tuulen
I may blow	tuullen
of the blown (one)	tuulleen
into fire	tuleen
into wind	tuuleen
I may come	tullen
of the one who has come	tulleen

# Finnish

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- short and long vowels and short and long consonants
- duration distinctions in stressed and unstressed syllables

# Italian

## Phonological quantity

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nono    ninth  
nonno    grandfather

- singletons and geminates
- stressed vowel lengthened in open syllables
- Basically: long and short consonants. Vowels are longer before short consonants.

# Italian

## Phonological quantity

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no: no ninth

non no grandfather

- singletons and geminates
- stressed vowel lengthened in open syllables
- Basically: long and short consonants. Vowels are longer before short consonants.
- Stressed syllables are “heavy” in Italian.



# Quantity

## Phonological quantity

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- Quantity is a *phonological* construct, as opposed to phonetic.
- Quantity is a concept that makes sense when we talk about our knowledge of language.
- Quantity can be realized phonetically in different ways.
- General goal of research project: to better understand how speakers of different languages represent and express/process quantity.

# Ylinen (2006)

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- Based on an ERP (MMN) study of Finnish, Ylinen proposes that phoneme quantity and quality are processed differently, using different brain representations.

# Realizations of quantity

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- Vowel duration or consonant duration or both
- Pitch
- Intensity

# Challenges

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- Quantity interacts with stress, but quantity  $\neq$  stress
  - Finnish: *túpakka*, *pérheet*
- Quantity interacts with sentence intonation
- Duration is gradient.

# Complementary quantity

## Phonological quantity

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- Short vowel – long consonant
- Long vowel – short consonant
- North Germanic
- Scots
- Washo? (Yu 2008)
- Swedish:

[ha:t]	'hatred'	[hat:]	'hat'
[ka:l]	'bare'	[kal:]	'cold'
[he:ta]	'be called'	[het:a]	'heat'

# Complementary quantity

## Phonological quantity

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Even in languages that don't have complementary quantity, durational differences in a sound tend to influence the duration of neighboring sounds.

# Swedish

## Phonological quantity

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- Swedish has complementary quantity in stressed syllables
- Does the distinction lie in the consonant (spelling, Italian) or the vowel? Or both?
- Benediktsson 1963, Elert 1964, Eliasson 1985, Kristoffersen 2000, Rice 2003, Schaeffler 2005

# Do both vowels and consonants really signal the distinction?

- Recordings of eight native speakers, same dialect of Swedish
- Read 60 words each, from a word list. Each word read five times.
- Words produced in a carrier phrase.
- TASCAM Solid state recorder, PRAAT (phonetic analysis), R (linear regression)



# *känna* 'to feel'

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# Long and short consonants

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# Short and long vowels

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# More details on Swedish study

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- Words with one syllable (*kal* 'bare') and two (e.g., *tallar* 'pine trees')
- Controlled for vowel and consonant, number of syllables, speaker

# Swedish results

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The results were very clear:

- Short vowels are shorter than long vowels
- Short consonants are shorter than long consonants

# Inari Saami

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- Spoken in Northern Finland
- About 350 speakers
- Part of the Saami language group, about 20,000 speakers total

# A ternary distinction

- Inari Saami has short and long vowels
- Inari Saami has short, half-long and long consonants
- A true ternary distinction?
- Phonetically ternary? Phonologically?
- There are alternatives, e.g., short & long, singletons & geminates (Itkonen)
- Ternary quantity distinctions are very rare (Estonian, other Saami languages)

# Goal of Inari Saami study

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- Is the ternary distinction phonetically real?
- Inari Saami does not have complementary quantity. Effects on vowels?



# njuᅇ ‘nose’

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# Examples

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- chicken: kääni kääni (NOM NOM ACC ACC) play

# V and C length: combinations

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WORD TYPE	NAIVE PHONEMIC
VCV	/tʃælæm/
VC·V	/mɑn˙ɑn/
VCCV	/kɑnnun/
VVCV	/moonəm/
VVC·V	/lɑɑn˙ɑn/
VVCCV	/pæænnin/

All combinations of short/long V and short/half-long/long C allowed

# Cross-linguistic pattern

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- Negative correlations
  - The longer  $C_x$ , the shorter  $V_1$
  - The longer  $C_x$ , the shorter  $V_2$

# The phonetic study of Inari Saami

## Phonological quantity

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- 5 native speakers
- 99 words (types)
- 1003 tokens
- words uttered in carrier phrase
- words with [l] and [n] as middle consonant, low or mid back vowel as  $V_1$
- words with two syllables

# Analysis

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- PRAAT and R
- regression models permitted control for duration and quality of each segment, and closed vs. open syllables
- we also checked for differences between speakers
- See Bye, Sagulin & Toivonen (2009) *Phonetica*

# Consonants: long, half-long, short

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# Long vowels

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# Short vowels

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# Interactions

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- There are significant interactions between speaker and consonant type (short, half-long, long C)
- We therefore analyse the speakers separately.
- We also analyse words with short and long first vowel separately.

# Words with short V1

## Phonological quantity

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Speakers:	KM	IM	ES	SK	AK
<b>Consonant</b>					
$C < C^\bullet$	✓	✓	✓	✓	✓
$C^\bullet < CC$	✓	✓	✓	✓	✓
<b>V<sub>1</sub></b>					
$\_C > \_C^\bullet$	✓			✓	
$\_C^\bullet > \_CC$	✓	✓	✗	✓	✓
<b>V<sub>2</sub></b>					
$C\_ > C^\bullet\_$	✓				
$C^\bullet\_ > CC\_$	✓	✓	✓	✓	✓

# Words with long V1

## Phonological quantity

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Speakers:	KM	IM	ES	SK	AK
<b>Consonant</b>					
C < C̣	✓	✓	✓	✓	✓
C̣ < CC	✓	✓			
<b>V<sub>1</sub></b>					
__C > __C̣	✓	✓	✓	✓	✓
__C̣ > __CC	✓	✓	✓	✓	
<b>V<sub>2</sub></b>					
C__ > C̣__					
C̣__ > CC__	✗	✗		✗	

# Words with long V1

## Phonological quantity

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University

Speakers:	KM	IM	ES	SK	AK
<b>Consonant</b>					
$C < C \cdot$	✓	✓	✓	✓	✓
$C \cdot < CC$	✓	✓			??
<b>V<sub>1</sub></b>					
$\_C > \_C \cdot$	✓	✓	✓	✓	✓
$\_C \cdot > \_CC$	✓	✓	✓	✓	
<b>V<sub>2</sub></b>					
$C\_ > C \cdot \_$					
$C \cdot \_ > CC \_$	✗	✗		✗	

# Words with long V1

## Phonological quantity

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Speakers:	KM	IM	ES	SK	AK
<b>Consonant</b>					
$C < C \cdot$	✓	✓	✓	✓	✓
$C \cdot < CC$	✓	✓			
					pitch
<b>V<sub>1</sub></b>					
$\_C > \_C \cdot$	✓	✓	✓	✓	✓
$\_C \cdot > \_CC$	✓	✓	✓	✓	
<b>V<sub>2</sub></b>					
$C\_ > C \cdot \_$					
$C \cdot \_ > CC \_$	✗	✗		✗	

# Words with long V1

## Phonological quantity

Ida Toivonen,  
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University

Speakers:	KM	IM	ES	SK	AK
<b>Consonant</b>					
$C < C \cdot$	✓	✓	✓	✓	✓
$C \cdot < CC$	✓	✓			
<b>V<sub>1</sub></b>					
$\_C > \_C \cdot$	✓	✓	✓	✓	✓
$\_C \cdot > \_CC$	✓	✓	✓	✓	
<b>V<sub>2</sub></b>					
$C\_ > C \cdot \_$					
$C \cdot \_ > CC \_$	✗	✗		✗	??

# V and C length: combinations

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WORD TYPE	NAIVE PHONEMIC
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VVCCV	/pæænnin/



# Words with long V1

## Phonological quantity

Ida Toivonen,  
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University

Speakers:	KM	IM	ES	SK	AK
<b>Consonant</b>					
$C < C \cdot$	✓	✓	✓	✓	✓
$C \cdot < CC$	✓	✓			
<b>V<sub>1</sub></b>					
$\_C > \_C \cdot$	✓	✓	✓	✓	✓
$\_C \cdot > \_CC$	✓	✓	✓	✓	
<b>V<sub>2</sub></b>					
$C\_ > C \cdot \_$					
$C \cdot \_ > CC \_$	✗	✗		✗	foot

# Foot structure, pááñán (tooth.ILL.SG)

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Ft

$\sigma$        $\sigma$

$\mu$     $\mu$     $\mu$

p   a   n   a   n

# Foot structure, päännin (tooth.ESS)

Phonological  
quantity

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Ft Ft

$\sigma$   $\sigma$

$\mu$   $\mu$   $\mu$

p a n i n

# Words with long V1

## Phonological quantity

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University

Speakers:	KM	IM	ES	SK	AK	
<b>Consonant</b>						
$C < C \cdot$	✓	✓	✓	✓	✓	
$C \cdot < CC$	✓	✓				pitch
<b>V<sub>1</sub></b>						
$\_C > \_C \cdot$	✓	✓	✓	✓	✓	
$\_C \cdot > \_CC$	✓	✓	✓	✓		
<b>V<sub>2</sub></b>						
$C\_ > C \cdot \_$						
$C \cdot \_ > CC \_$	✗	✗		✗		foot

# Inari Saami: conclusions

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- There is phonetic evidence for a ternary consonant length distinction in Inari Saami. This is especially clear in words with a short vowel.

# Comparison of Inari Saami and Swedish

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# Complementary or not?

- Do Swedish and Inari Saami have fundamentally different quantity systems?
- Hypothesis: Inari Saami effects on vowels are simply phonetic side effects; the Swedish interaction between vowels and consonants is a fundamental part of the phonology
- Can we look for acoustic evidence for the hypothesis?

# Within-category analysis

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- Duration is gradient.
- So far: between-category analysis.



# V and C length: combinations

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WORD TYPE	NAIVE PHONEMIC
VCV	/tʃælæm/
VC·V	/mɑnˈɑn/
VCCV	/kɑnnun/
VVCV	/moonəm/
VVC·V	/lɑɑnˈɑn/
VVCCV	/pæænnin/

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VCC	/hat:/
VVC	/hɑ:t/

# Within category

## Phonological quantity

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- Do we find a negative correlation in duration between vowels **within** categories?
- Example: several instances of words of the type [ha:t]
- If the duration of consonants and vowels are fundamentally co-dependent in Swedish, then perhaps we would expect a negative correlation within categories in Swedish, and not in Inari Saami

# Inari Saami

## Phonological quantity

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- *Category*: For example, words with short V1 and short C.
- Within categories, there is no negative correlation in duration between vowel and consonant in Inari Saami.
- Within categories, there is either no significant correlation, or else a (weak) positive correlation
- Positive correlation probably due to weak speech rate effects

# Speaker IM, short V1 short C

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# Swedish

## Phonological quantity

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- *Category*: For example, words with long V and short C.
- Within categories, there is sometimes negative correlation in duration between vowel and consonant in Swedish, for some speakers and categories.
- For some speakers and categories, there was no correlation or a weak positive correlation
- Again, positive correlation probably due to weak speech rate effects

# Speaker GT, long V short C

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# Results of within-category study

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- In Swedish, but not in Inari Saami, there are within-category negative correlations between consonant and vowel duration.

# Conclusions

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- What native speaker see as a single distinction may have several phonetic correlates.
- The within-category results may reflect a deeper difference between complementary and non-complementary phonological systems.



# Thanks

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The Inari Saami and Swedish native speaker informants

Finnish sounds from the UCLA phonetics lab web site:  
<http://www.phonetics.ucla.edu/>

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