

Relating the sonority hierarchy to articulatory timing patterns



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Sonority and Syllabification
Cross-linguistic evidence and theoretical perspectives
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The question

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- All languages with complex phonotactics have sonority-obeying complex sequences
- But many of these languages also allow sonority reversals and plateaus
- Why do these rare patterns develop?
- How?

Goals of this talk

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- Relate the sonority hierarchy to articulatory timing patterns
- Consider what syllabic organization may mean when examined from the perspective of dynamic phonological representations
- Assess the explanatory power of generalizations across timing patterns compared with that of the sonority hierarchy

Structure of the talk

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- 1.** Premises of the approach
- 2.** The data – three languages, three timing patterns
- 3.** Proposal – patterns of articulatory timing can explain syllabic organization that departs from sonority generalizations

1. Considering the role of the syllable

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- In speech, the syllable is a unit of information
- Information is transmitted with maximum speed and intelligibility
- The coarticulatory properties of the speech signal are crucial for maximum intelligibility and maximum speed in communication
 - Coarticulation allows the simultaneous transmission of multiple information in the speech signal

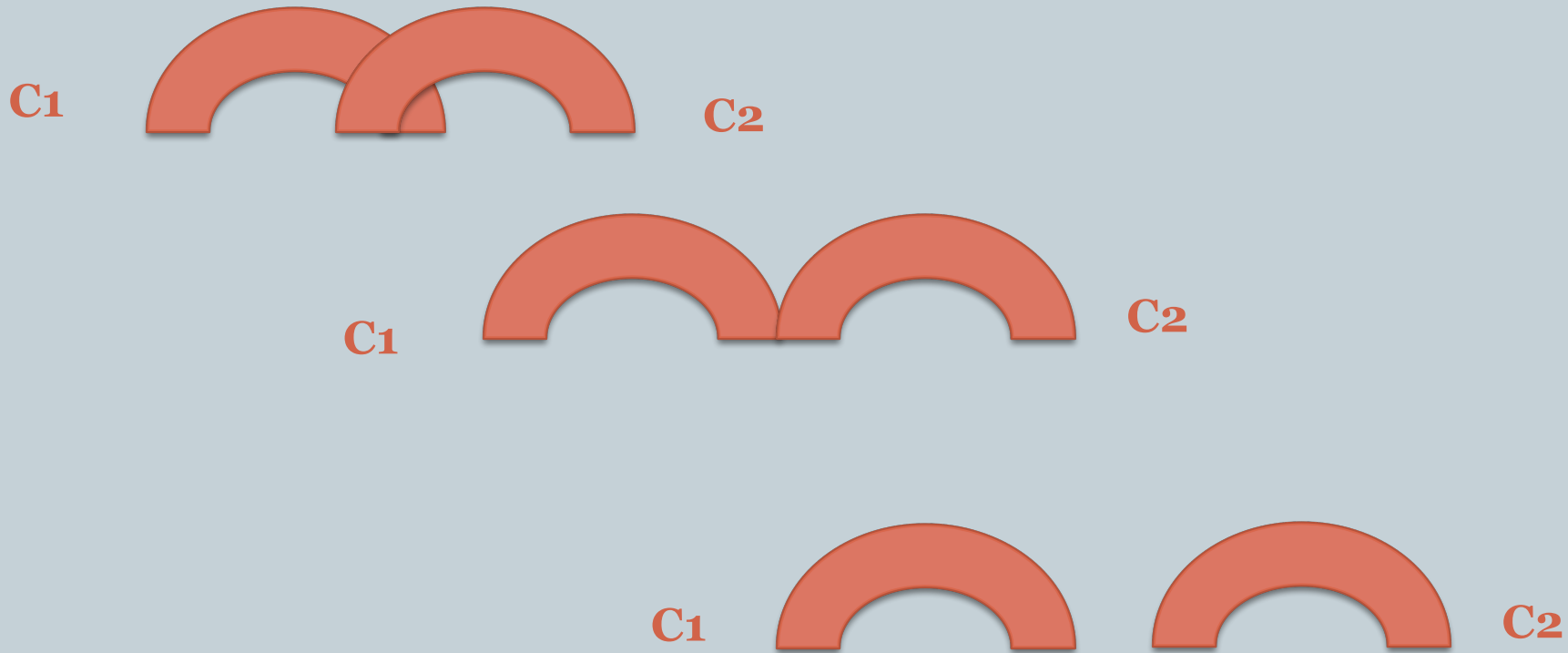
parallel transmission (Mattingly 1981, 1998)

- **The sonority hierarchy** is one way of capturing an internal organization of the syllable with coarticulation that ensures parallel transmission
- But consider other possible generalizations, based on
 - **aspects of articulatory timing**
 - ✦ **in a complex onset, the relative timing of C1 and C2**

Schematic relative timing of C₁ and C₂

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Shorter timing lag = more overlap, more coproduction



Longer lag = less (no) overlap, less coproduction

- Articulatory timing is controlled on a language-specific basis and as a function of syllable position
 - Supported by experimental studies in several languages
 - Models proposed: *Browman & Goldstein 1988, 2000 (Articulatory Phonology)*; *Nam et al., 2009*; *Tilsen 2013*; *Shaw & Gafos 2015* – involve symbolic and dynamic representations

Relying on the framework of Articulatory Phonology

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Main assumptions:

- Articulatory gestures are proposed units of representation - abstract, discrete, combinatorial
 - Also units of continuous action in space and time
- Gestures as phonological representations have a temporal dimension
 - The discrete specifications of gestures are dynamic (*e.g.*, *lip closing gesture; tongue tip release gesture*)
 - Pairs of gestures are dynamically coupled
 - The coupling accounts for contextual variation – assimilation, insertion, deletion are accounted for by variable relative timing between gestures

2. Data

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- Phonotactic patterns and timing patterns in:
 - Georgian (*Chitoran et al. 2002; Chitoran & Goldstein 2006; Chitoran & Kwon 2016a,b*)
 - Slovak (*Pouplier & Beňuš 2011*)
 - Tashlhiyt (*Dell & Elmedlaoui 2002; Ridouane 2008; Hermes, Ridouane, Mücke, Grice, 2011*)

Criteria for defining these patterns

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- What constitutes a syllable **nucleus**?
- What constitutes a syllable **onset**?

What constitutes a syllable **nucleus**

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Georgian: vowels only

rbe . na ‘to run’

t’k’bi . li ‘sweet’

mtkna . re.ba ‘yawn’

Slovak: vowels, syllabic liquids

mrk

‘wink’

smrk

‘sniff’

mrak

‘darkness’

Tashlhiyt: vowels, syllabic consonants

s . mun

‘accompany’ caus.

ts . mun

‘accompany’ 3fs. caus.

What constitutes a syllable **onset**

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- **Georgian** – complex onsets, plateaus, reversals
rb-, *mtkn-*, *t'k'b-*
- **Slovak** – complex onsets, plateaus
sm-, *mr-*, *kr-*
- **Tashlhiyt** – no complex onsets
t-

Summary

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	Georgian	Slovak	Tashlhiyt
NUCLEI	Vowels	Vowels Syllabic liquids	Vowels Syllabic liquids Syllabic nasals Syllabic obstruents
ONSETS	Complex onsets Sonority plateaus Sonority reversals	Complex onsets Sonority plateaus	No complex onsets

- **Increase** in the types of segments eligible for nucleus
- **Decrease** in combinatorial complexity of onset

The sonority hierarchy

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The generalization:

An alternation of sonority peaks (V) and troughs (C)

- Corresponds to the preferred cross-linguistic ordering of manner classes by degree of constriction:

obstruent – nasal – liquid – glide – vowel

(Jespersen 1899 – Clements 1990)

*The cross-linguistically preferred order of rising sonority in onsets,
opposite in rhymes*

3. Proposal

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- The same generalization can be reformulated based on details of articulatory timing patterns
- Returning to Mattingly's (1981, 1988) concept of *parallel transmission* of information

- The preferred ordering of manner classes in a syllable onset corresponds to *the ordering of constriction degrees*
 - – captured in the sonority sequencing generalization
- But it may also correspond to other ways in which information can be efficiently encoded through *the ordering of constrictions and constriction releases*, when variation in timing patterns is considered.

Patterns of articulatory timing

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Georgian:

a function of the order of constriction
location

- *Generally long timing lag*
- *In stop-stop, liquid-stop, stop-liquid sequences:*
Front-back (*bg, dg, rk, pl*) more overlapped, shorter lag
Back-front (*gb, gd, rb, kl*) less overlap, longer lag

Georgian

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Long lag, sometimes with vocalic transitions

- If at least one C is voiced
- Most frequent in stop-stop sequences with minimal overlap (*i.e.*, *back-to-front*)
 - **58%** back-to-front – *agdeba*, *dagbera*, *gberavs*, *gdeba*
 - vs.
 - **23%** front-to-back – *abga*, *adgeba*, *bgera*, *dgeba*

Timing in Slovak stop-liquid sequences

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The Slovak pattern is a function of consonantal or vocalic nucleus (*Pouplier & Beňuš, 2011*)

- Stop-liquid:
 - generally long lag with vocalic transitions
- Onset-nucleus **k^vrb** has longer lag
- than onset-onset **k^vr**ab****

Slovak

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- Vocalic transitions are found in both:

k^Vrb

k^Vrab

- They emerge between stop release and /r/ apical gesture
- Liquids in Slovak (/r,l/) are “dark”. They involve
 - a characteristic tongue body retraction gesture
 - which precedes the apical gesture

Timing in Tashlhiyt

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Vocalic transitions *(Ridouane & Fougeron 2011)*

- If at least one C is voiced
- Most frequent at C1 release in stop-stop sequences with minimal overlap
 - They do not add duration to a cluster (argument that they are not full vowels)
 - **But** they are metrically counted
 - They serve as anchors of tones

Summary of the patterns

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All sonority-disobeying patterns often involve:

- ***long timing lags*** (*minimal overlap*)
- ***vocalic transitions***

These patterns ***are available to*** be phonologized in a grammar, depending on language-specific factors

A generalization based on “parallel transmission”

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- Parallel transmission is maximized:
 - “if less open constrictions are being released or applied in the presence of more open constrictions” (*Mattingly 1981*)
 - Corresponds to the preferred ordering of manner classes by degree of constriction
obs – nasal – liquid – glide – V
- or
- “Corresponds to the degree to which information can be encoded during the release and application of the constriction.” (*Mattingly 1981*)

Beyond the description

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Why do sonority reversals and plateaus exist in many languages?

Cross-linguistic combinatorial restrictions (including the sonority scale) follow from coordination patterns that ***allow gestures to be maximally coproduced, while still being recoverable.***

Some of these patterns may involve sonority plateaus and reversals.

Proposal

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- The preferred sequencing of applied constrictions is one that allows tighter intergestural coordination and faster transmission
 - *A sequencing that follows the sonority scale* consists of more closed constrictions released into gradually more open ones. The coordination pattern in this case results in relatively short timing lag, with high overlap between gestures.
 - *When sequences develop with a reversed order*, the coordination pattern results in longer timing lag, with less overlap (Georgian)
 - In such languages with long lags, the emergence of systematic vocalic transitions characterizes a coordination pattern corresponding to *syllabic consonants* (Slovak, Tashlhyit)

Conclusions

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- What goes into a syllable onset is whatever can be maximally coproduced with the margins
- Building on Pouplier & Beňuš (2011): “*longer lags provide a favorable environment for syllabic consonants to emerge*” :
 - Also for vowels to (re)emerge
- Thus, sonority reversals and plateaus exist as a result of a natural process of (re)organization
- It may be captured by models with dynamic phonological representations

Thank you
Merci

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