CLUSTER SIMPLIFICATION IN A NONWORD REPETITION STUDY OF RUSSIAN CHILDREN WITH SLI

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Outline of the talk

1. Introduction
2. SLI
3. The setting: villages in the Russian north
4. The experimental study
5. Results and discussion

Introduction

Introduction

- We present preliminary results of a nonword repetition study involving two groups of children in several villages of the Russian north
- One group of children is diagnosed with SLI (Specific Language Impairment); the other is typically developing
- The nature of phonological impairment in SLI is complex. Grammar-related? Memory-related? other?
- A controlled comparison may shed some light on this

SLI

Defining SLI

- Atypical language development with no apparent neurobiological pathology
- Most common term is Specific Language Impairment (SLI)
  - "Specific" in a sense that the impairment of language occurs in otherwise normal development (non-verbal IQ within normal range, no obvious sensory-motor deficiencies)
  - Specificity of SLI has been questioned (e.g., Bishop 1994, Hill 2001, Plante 1998, Ullman & Pierpont 2005)
  - Other terms used: developmental language impairment, developmental dysphasia, developmental language disorder (DLD)

Bishop (1992); Leonard (1998); Tomblin et al. (1997); Rakhlin et al. (2013)

Defining SLI

- SLI is a heterogeneous disorder with several different profiles possible that can be responsible for the low performance on the standardized verbal tests
- The diagnosis is based on broad exclusionary criteria, so individuals can exhibit a wide range of symptoms, e.g.,
  - Smaller receptive and expressive vocabulary
  - Word-finding difficulties
  - Omission or incorrect use of morphological forms
  - Low syntactic complexity
  - Poor performance on nonword repetition tests

The Setting:
Villages in the Russian North

A cluster of SLI

- SLI participants were recruited from a small cluster of villages in Northwestern Russia
  - As of 2012, the number of residents is 861
  - Substantial rate of distant intermarriages
  - More than 31% of the population (children and adults) exhibit atypical language development

Rakhlin et al. (2013)

A cluster of SLI

- This population is characterized by a high degree of genetic and environmental uniformity
  - 120 km to the nearest train station; 600 km from the nearest major city
  - 45 km to the provincial center by a dirt road
- The population has been geographically and culturally isolated since the time of its establishment in the early 15th century
  - Surrounded by forest and swamp; difficult to settle or navigate; harsh climate
- Same socioeconomic class: Russian rural poverty

Rakhlin et al. (2013)

SLI study subjects

- 7 monolingual Russian-speaking children aged 7.3:9.5 years old classified as DLD (SLI)
- 7 Typically Developing (TD) children matched to the SLI group in age
- Non-verbal IQ for all children within normal range: 88-113
- Standard measures, adapted to Russian, used to assess language development

Control group: TD subjects

- Goal: matched comparison populations
- Typically developing (TD) participants were recruited from a demographically similar population (a village in the same administrative region of Russia)

Rakhlin et al. (2013)

Participants compared

- Same type of schools
- Same types of jobs for parents
- Similar social behavior
- Same peers
- No labeling (SLI not an identified disability)
- No intervention at school

Participants

- All participants' parents agreed that their child could participate in this and related studies conducted at the same time under guidelines approved by the Yale University Human Subjects Research Review Committee and Northern State Medical University
- The data were collected as a part of a larger study of familial Disorders of Spoken and Written Language

Raklin et al. 2013 and references therein

The experimental study

Study design

- Nonword imitation task, testing ability to correctly reproduce disyllabic words varying in whether or not they begin or end with consonant clusters

  ptkoka patugmn tabont krata paran

- Why clusters?
  - Consonant clusters are famously difficult in L1 acquisition and in L2 acquisition for L2 learners whose L1 has different cluster restrictions
  - Russian has a variety of different cluster types

Phonology of Russian

- Russian has both onset and coda CC and CCC clusters
- Not all clusters in Russian obey the Sonority Sequencing Generalization (SSG)
  - rta ‘mouth-GEN.SG’
  - lba ‘forehead-GEN.SG’
  - mxa ‘moss-GEN.SG’
- Not all combinations of Russian consonants are attested in CC and CCC clusters

Study design: tokens

- Nonwords
- No palatalization
- Vowels: a, o, u
- Clusters in stressed syllables only
- CC vs. CCC clusters
  - CC: bnapa, dbota, lbuka
  - CCC: gmrota, ptkoka, nzboka
- Onset vs. coda clusters
  - Onset: brupa, pflata
  - Coda: tabolk, takodnl

Study design: tokens

- Rising, falling, level sonority clusters
  - Rising: brupa, gmruka
  - Falling: lbata, rskupa
  - Level (obstruent and sonorant): dbota, ptkoka, mnota
- Lexically attested vs. unattested clusters
  - Attested in Russian: lbata
  - Unattested in Russian: nbota
- Fillers without clusters: dopa, kalus

Study design

- Total number of tokens
  - 144 tokens in a list
  - 2 lists (2 testing blocks)
- Each word repeated once after pronounced by experimenter
- Recording done in the villages' schools
- Experimenters spoke the same Northern Russian dialect as the children

Transcription and coding

- Transcription in Berkeley
- Random cross-checking for accuracy
- Some tokens too noisy or inaudible

Results and discussion

The focus of this talk

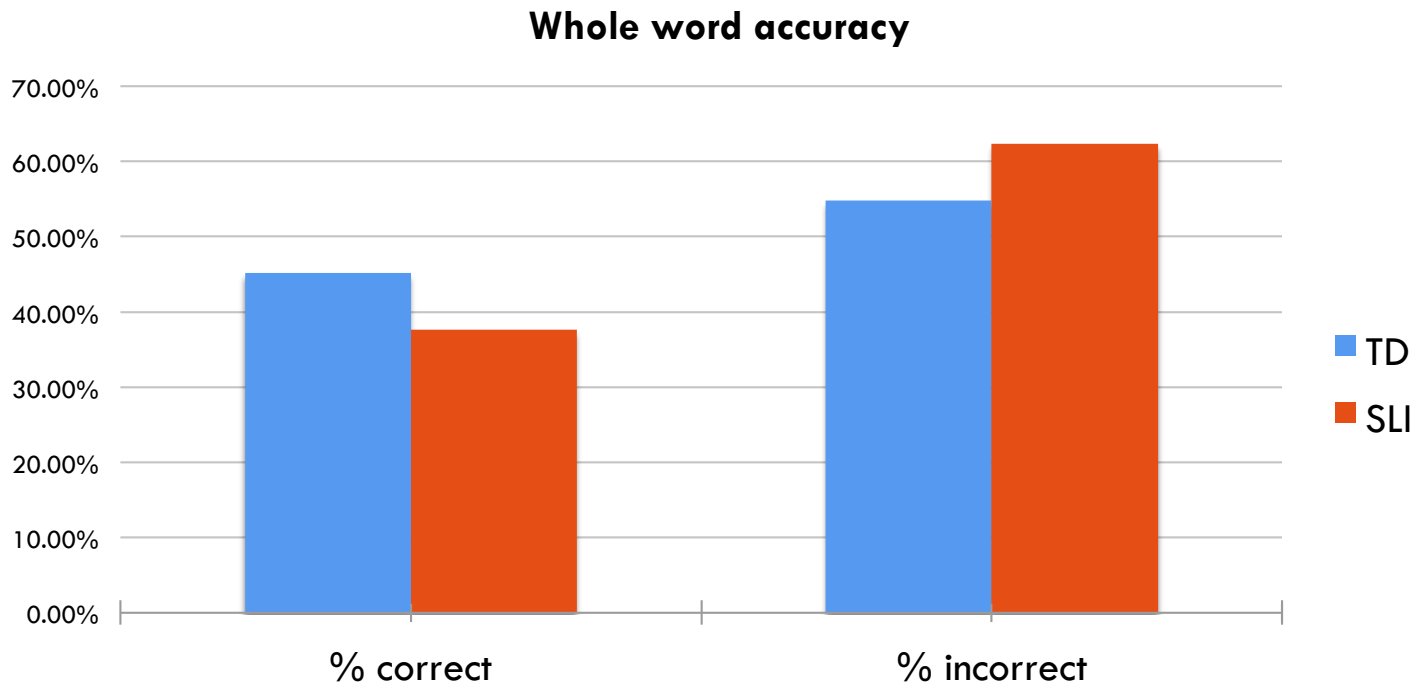
- Word and cluster repetition accuracy as a function of
  - SLI vs. TD
  - Cluster size
  - Typological markedness of cluster (by syllable position)
  - Lexical attestedness of cluster type

Examples of errors

Repair to cluster	# tokens	Example target word	Pronunciation
Deletion	624	ptkoka	ptoka
Segmental change	436	patubml	patugmn
Epenthesis (C or V)	128	pmota mtupa	ptmota mutupa
Assimilation	129	mnota	n:ota
Metathesis	124	pakatp	pakapt

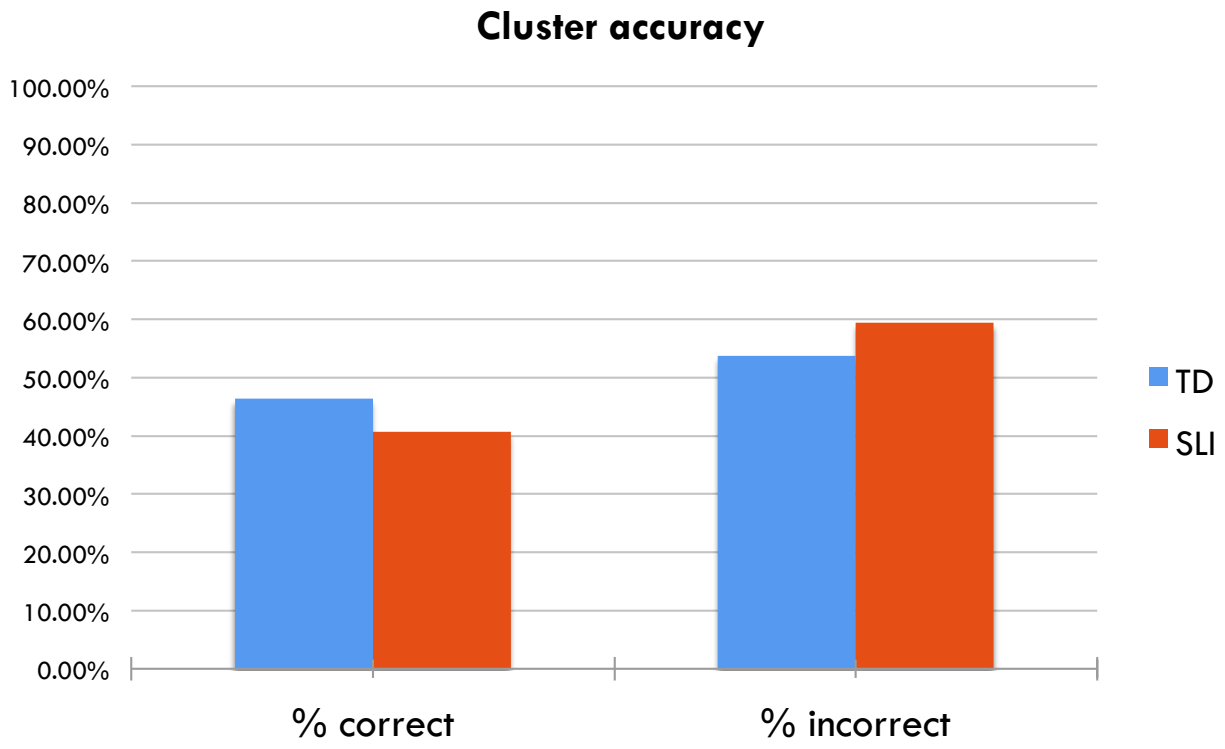
Word accuracy, SLI vs. TD

- SLI subjects produce fewer words correctly than TD subjects do ($p < .008$)



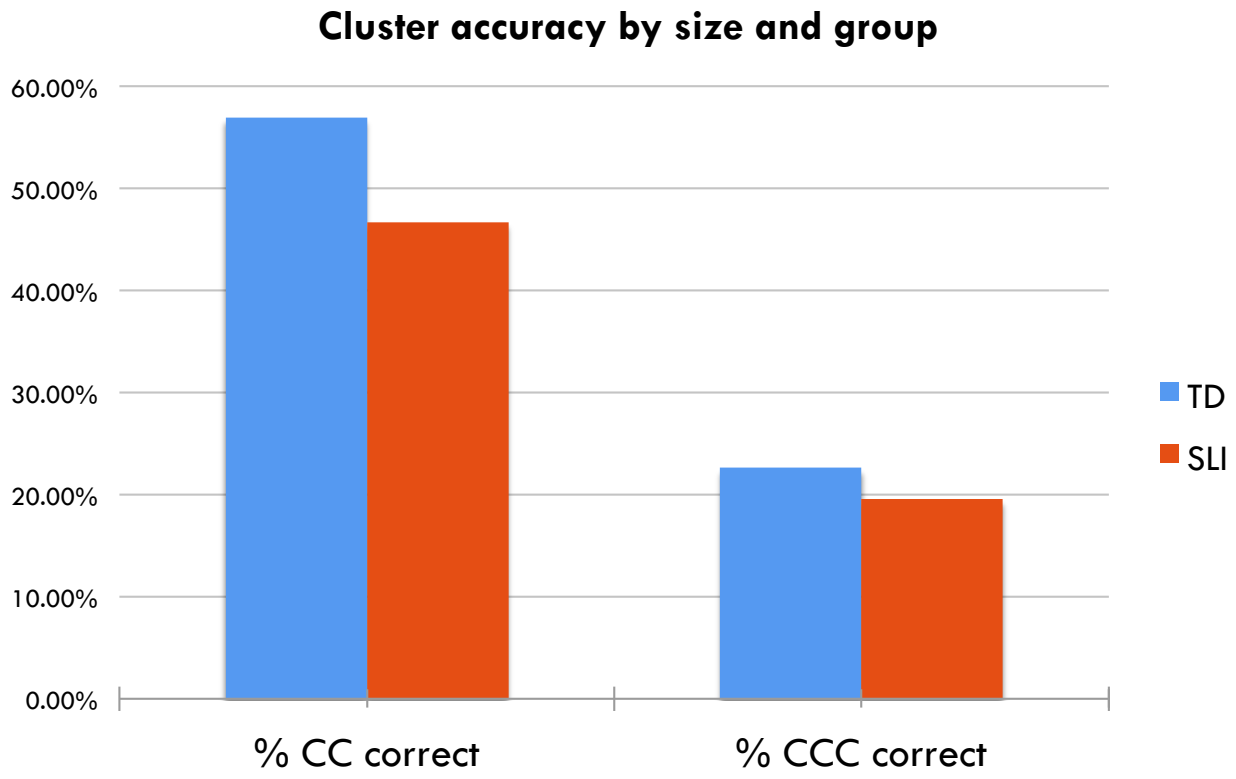
Cluster accuracy, SLI vs. TD

- SLI subjects make more errors in clusters than TD subjects do ($p > .003$)



Cluster size: CC vs. CCC

- Both groups make more errors with bigger clusters than with smaller ones (for TD, $p < .001$; for SLI, $p < .001$)

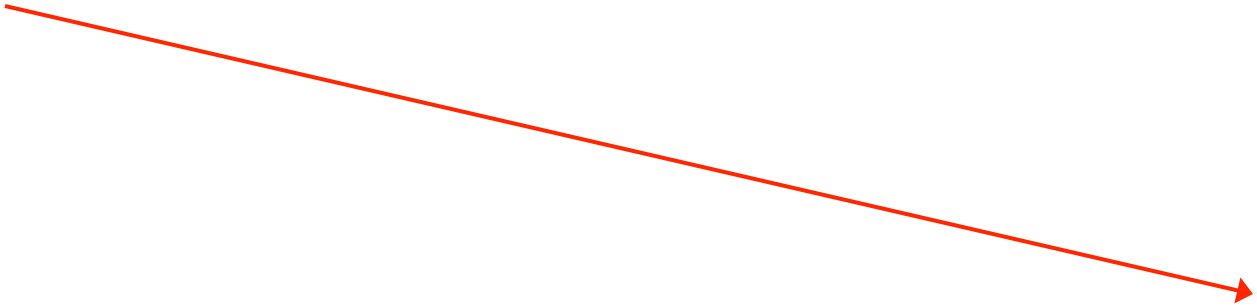


Typological markedness

- From a cross-linguistic perspective, clusters obeying the Sonority-Sequencing Generalization are unmarked
- Hypothesis: performance should be better on unmarked clusters.

Rising onsets, Falling codas…

BEST



WORST

Falling onsets, Rising codas

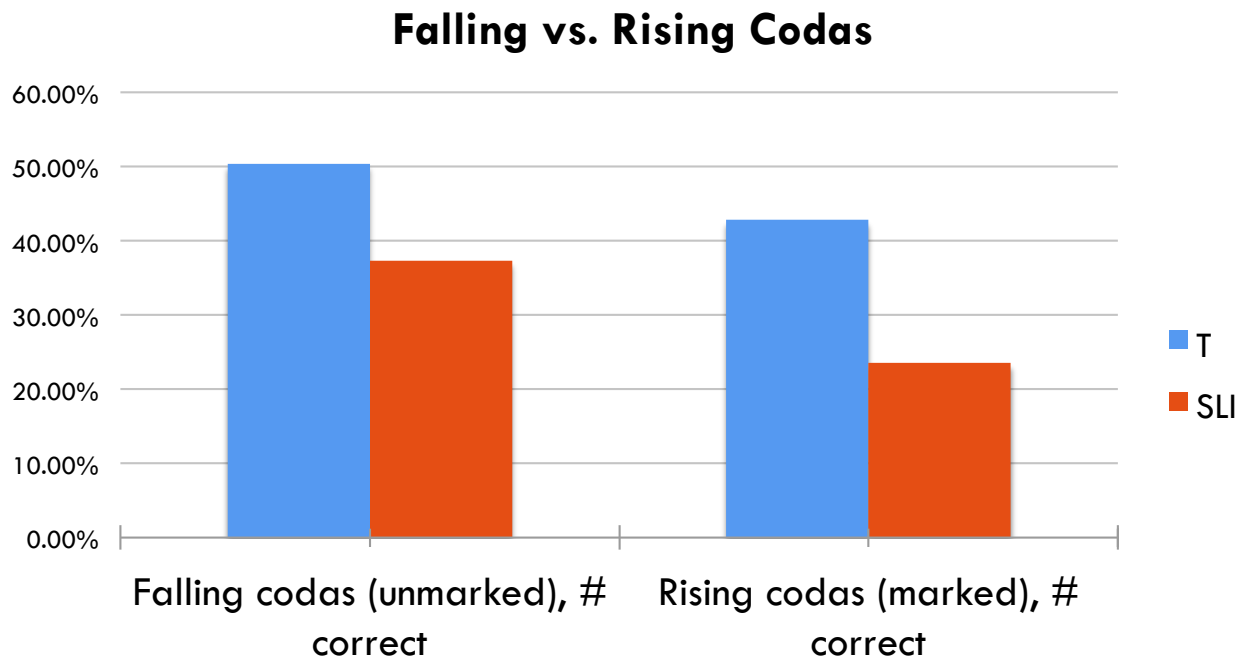
Typological markedness

- Russian exhibits unmarked and marked clusters:
  - rising sonority onsets brat ‘brother’
  - level sonority onsets kto ‘who’
  - falling sonority codas volk ‘wolf’
  - level sonority codas gʲimn ‘anthem’
  - falling sonority onsets lba ‘forehead-GEN.SG’
  - rising sonority codas bobr ‘beaver’

- Marked clusters are less frequent than unmarked clusters

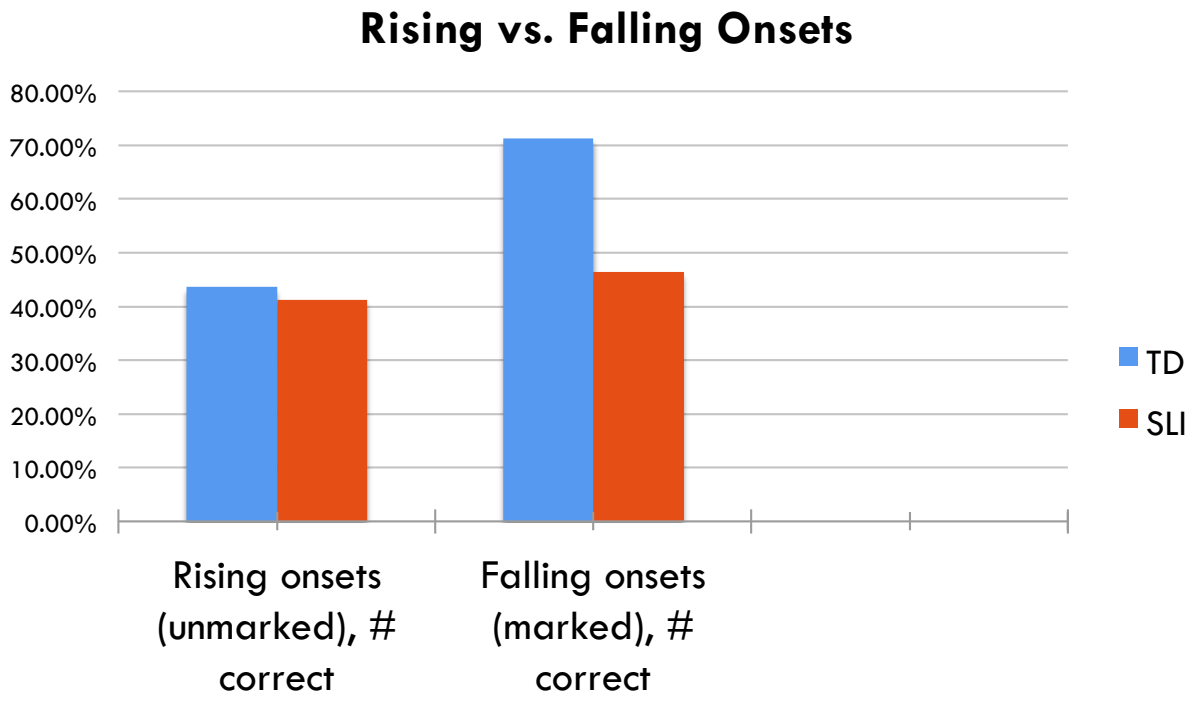
Typological markedness

- For codas, both SLI and TD do better on **unmarked** clusters (e.g., kabukr, patabm), as expected. Significant for SLI ($p < .02$)



Typological markedness

- But: For onsets, TD subjects do better with **marked** clusters (e.g., lbuka, nbota) than with unmarked ($p < .001$)

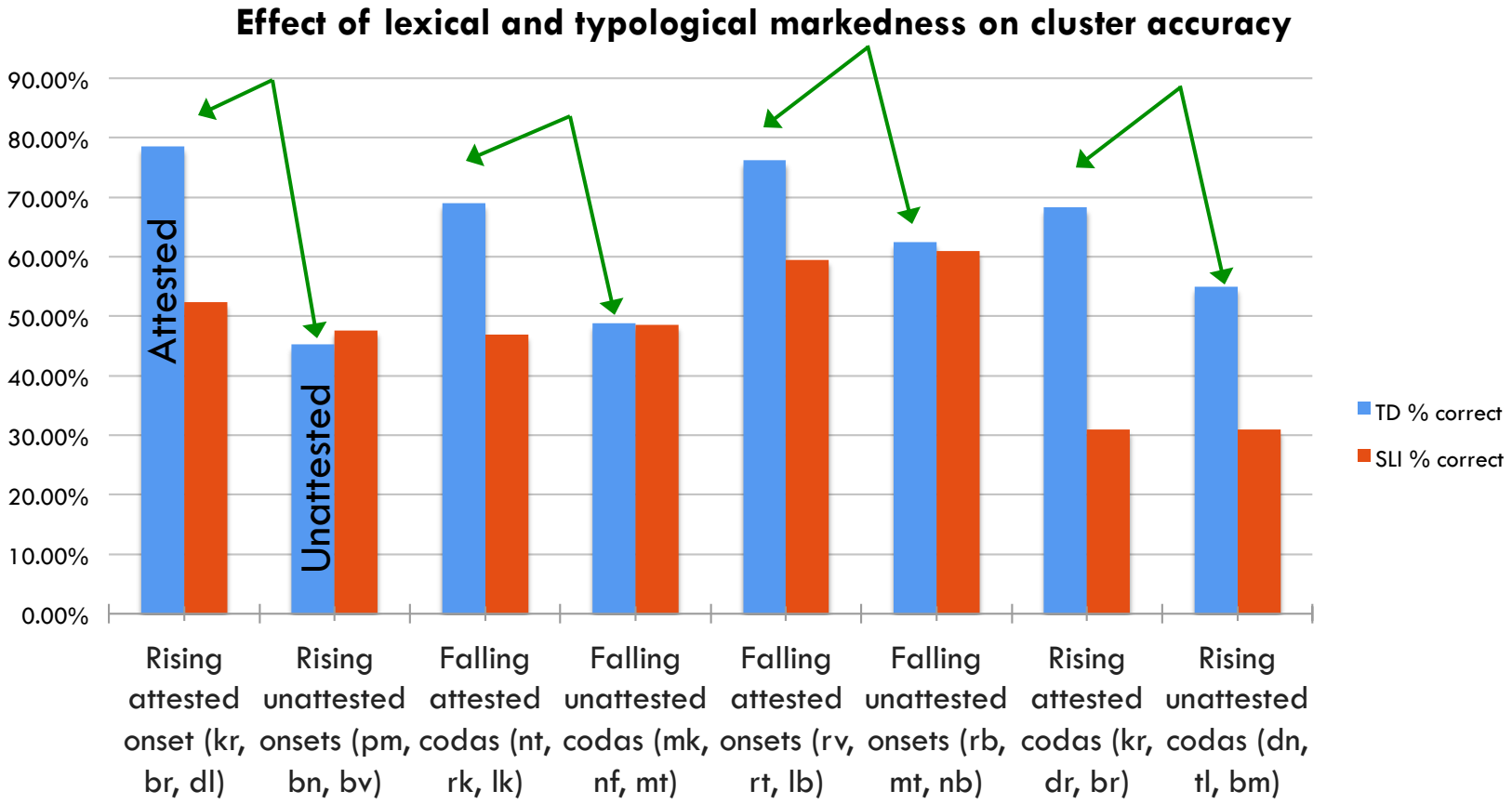


Lexical attestedness of clusters

- 50% of the CC clusters are attested in Russian
- 0% of the CCC clusters are attested in Russian (though Russian does have other CCC clusters)
- If the preference for marked onsets is due to a lexical effect (the existence of clusters like /lb/ in experimental tokens and actual Russian words), then the preference should only be exhibited in experimental tokens with CC clusters.
- **Hypothesis:** subjects do better at attested clusters

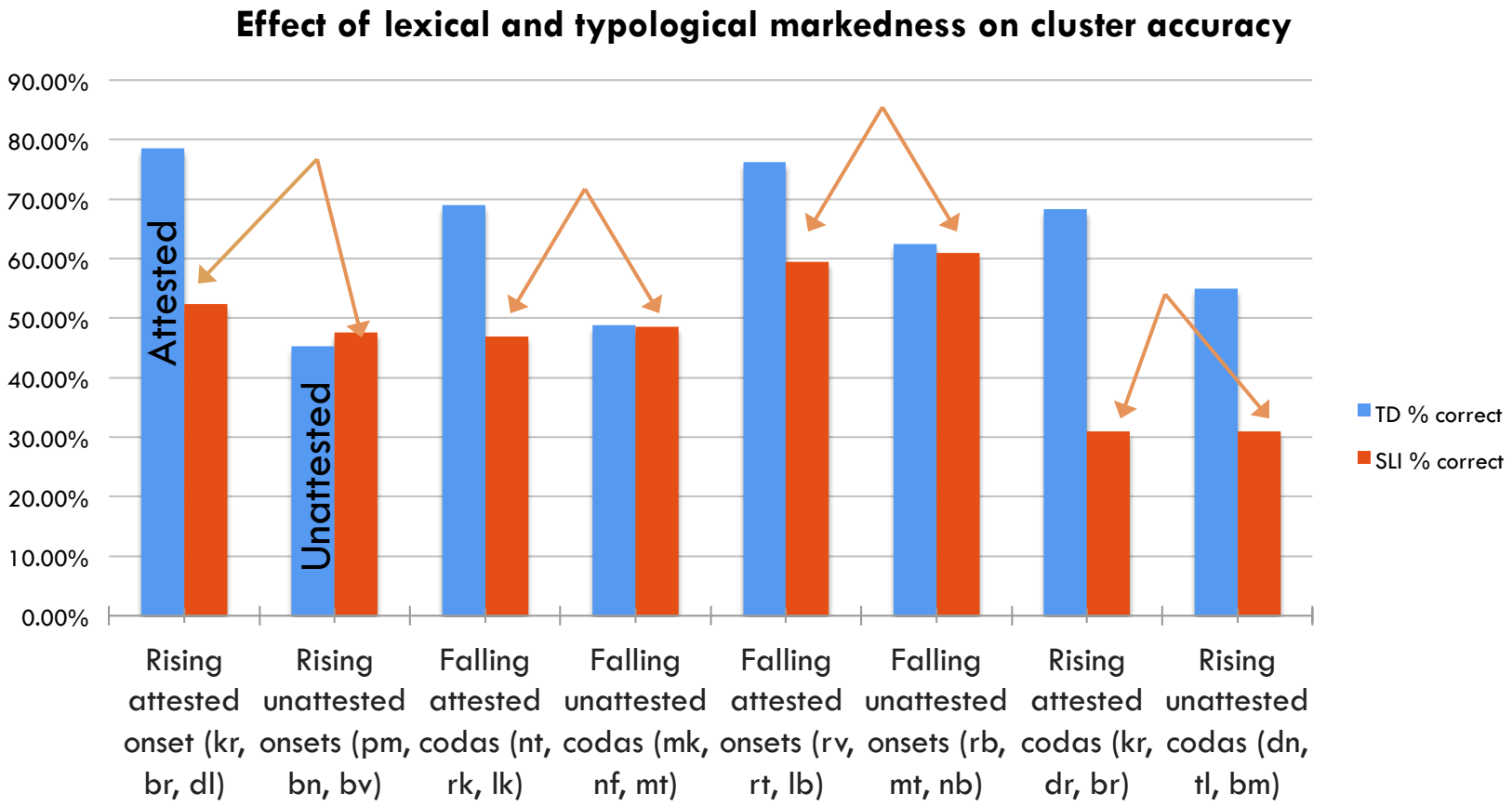
Lexical attestedness of clusters

- TD subjects do better at attested clusters

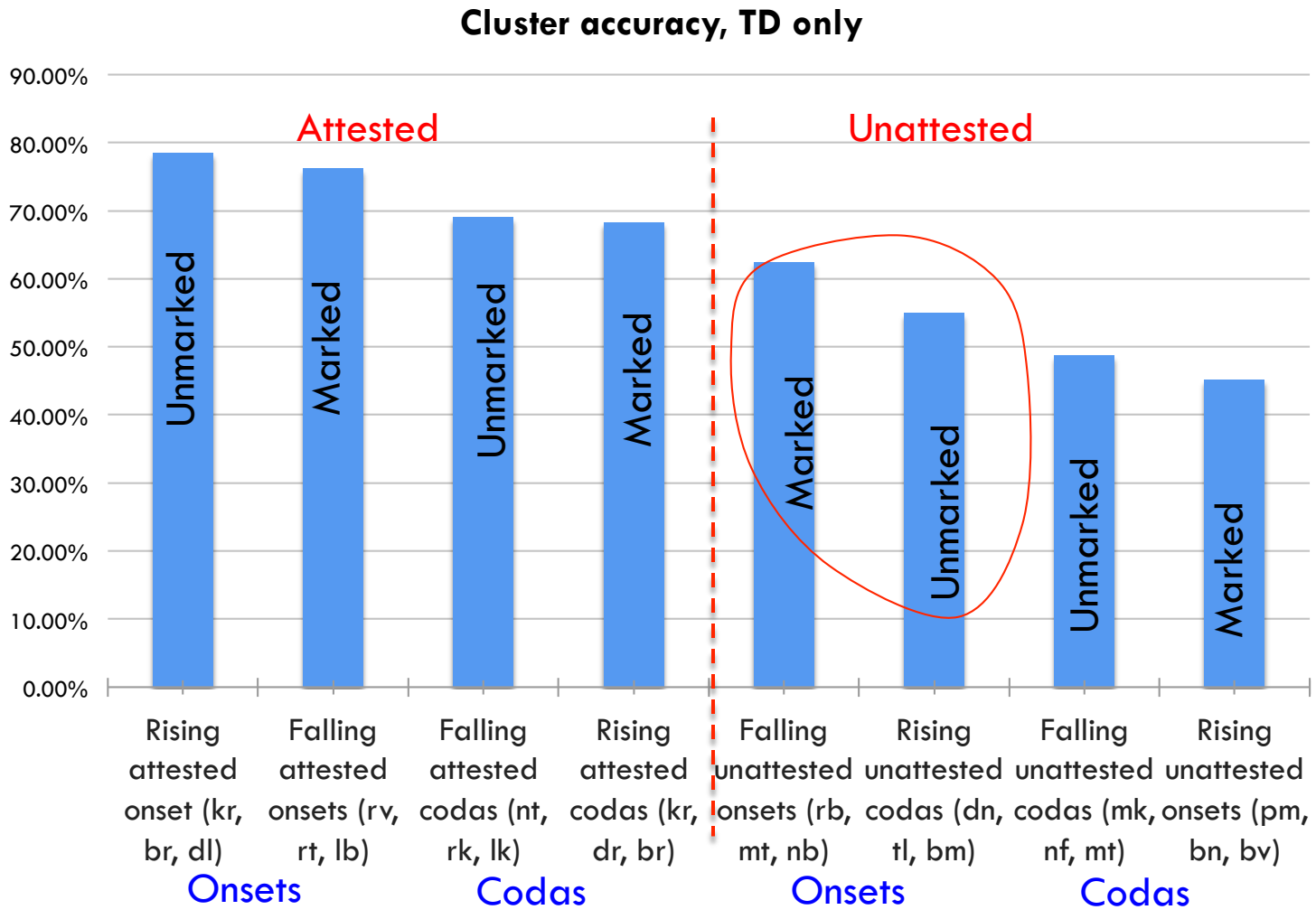


Lexical attestedness of clusters

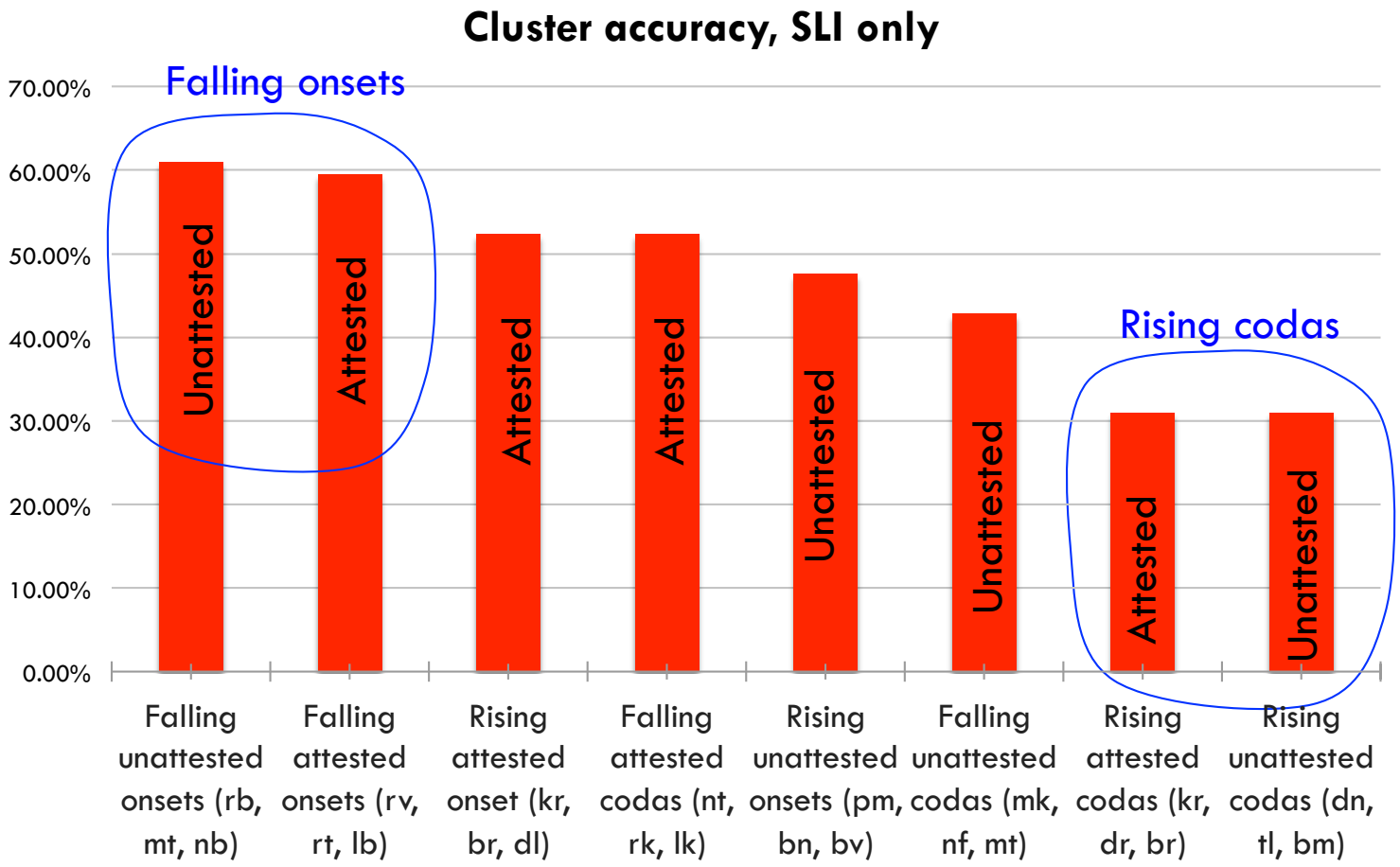
- SLI subjects are indifferent to cluster attestedness



Falling onsets: TD



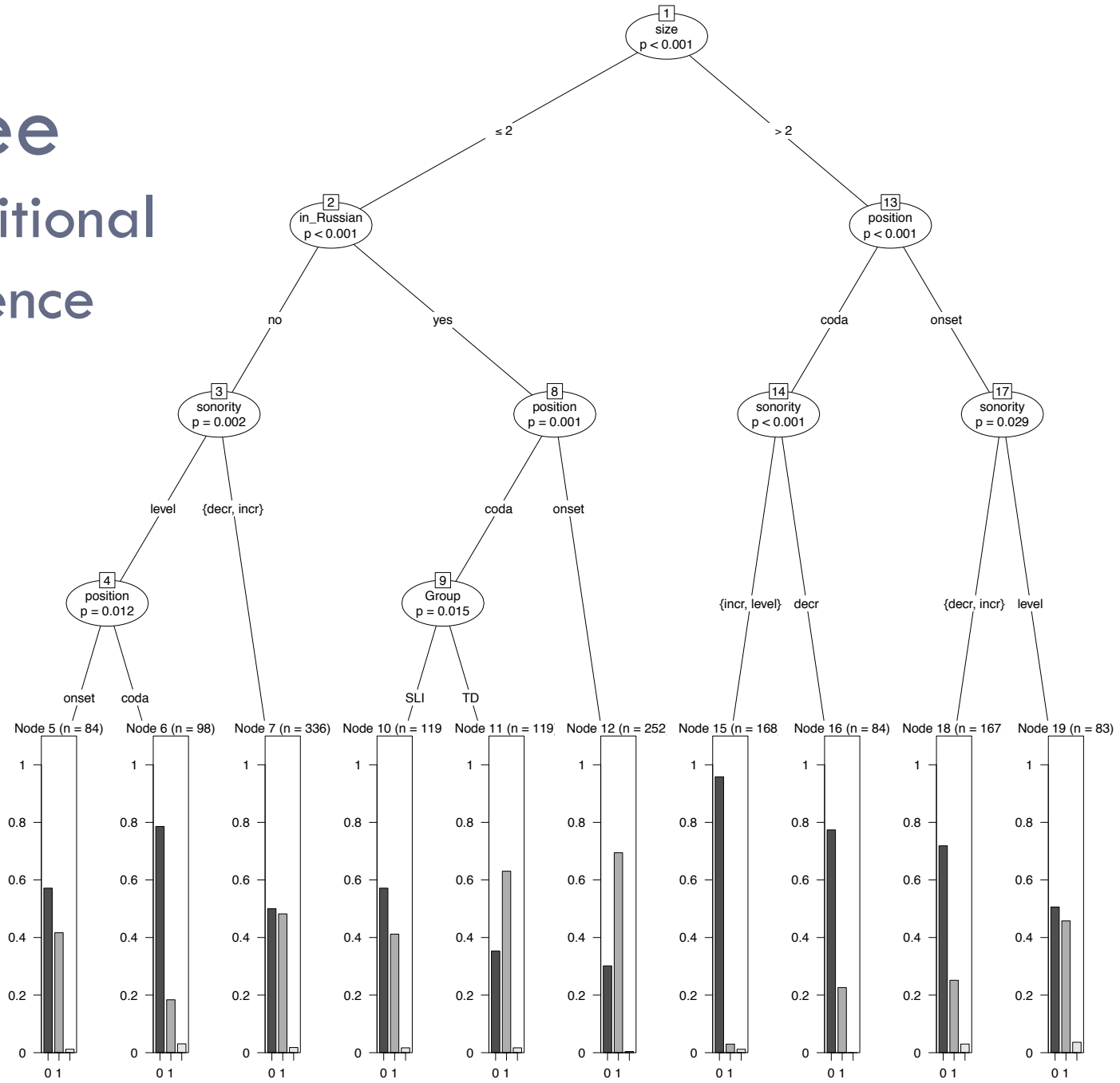
Falling onsets: SLI



Summary, word & cluster accuracy

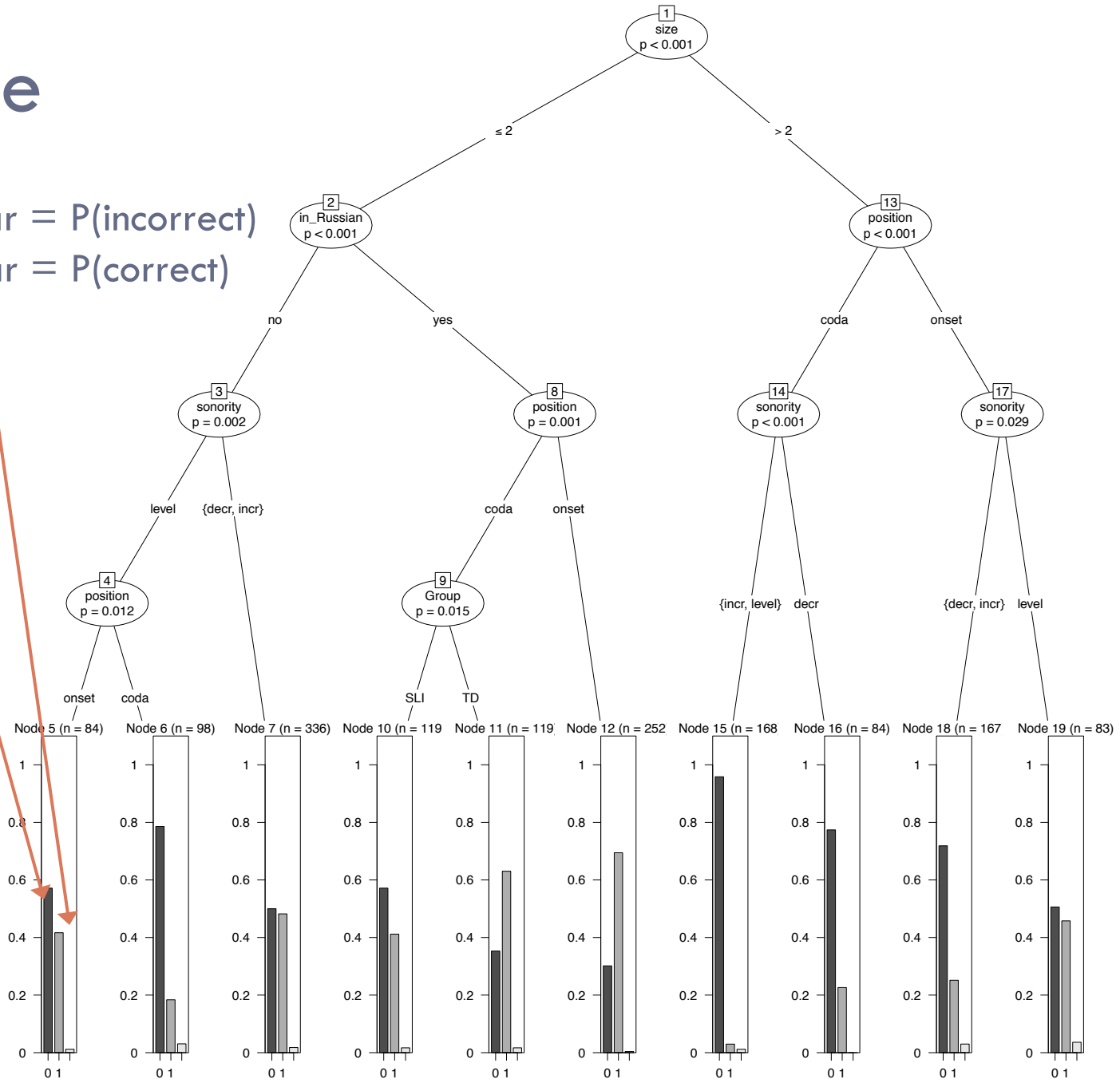
- Cluster size: CC better than CCC for both SLI & TD
- Lexical attestedness of cluster type
  - TD perform better on lexically attested clusters overall
  - SLI subjects are generally insensitive to lexical attestedness
- Typological markedness of cluster (by syllable position)
  - Both groups do better on onset clusters than on coda clusters
  - Codas: as expected, both groups do better on rising than on falling codas
  - Onsets: For SLI subjects, and for TD subjects on unattested clusters, **falling onsets** do better than rising onsets

Ctree
(conditional inference tree)

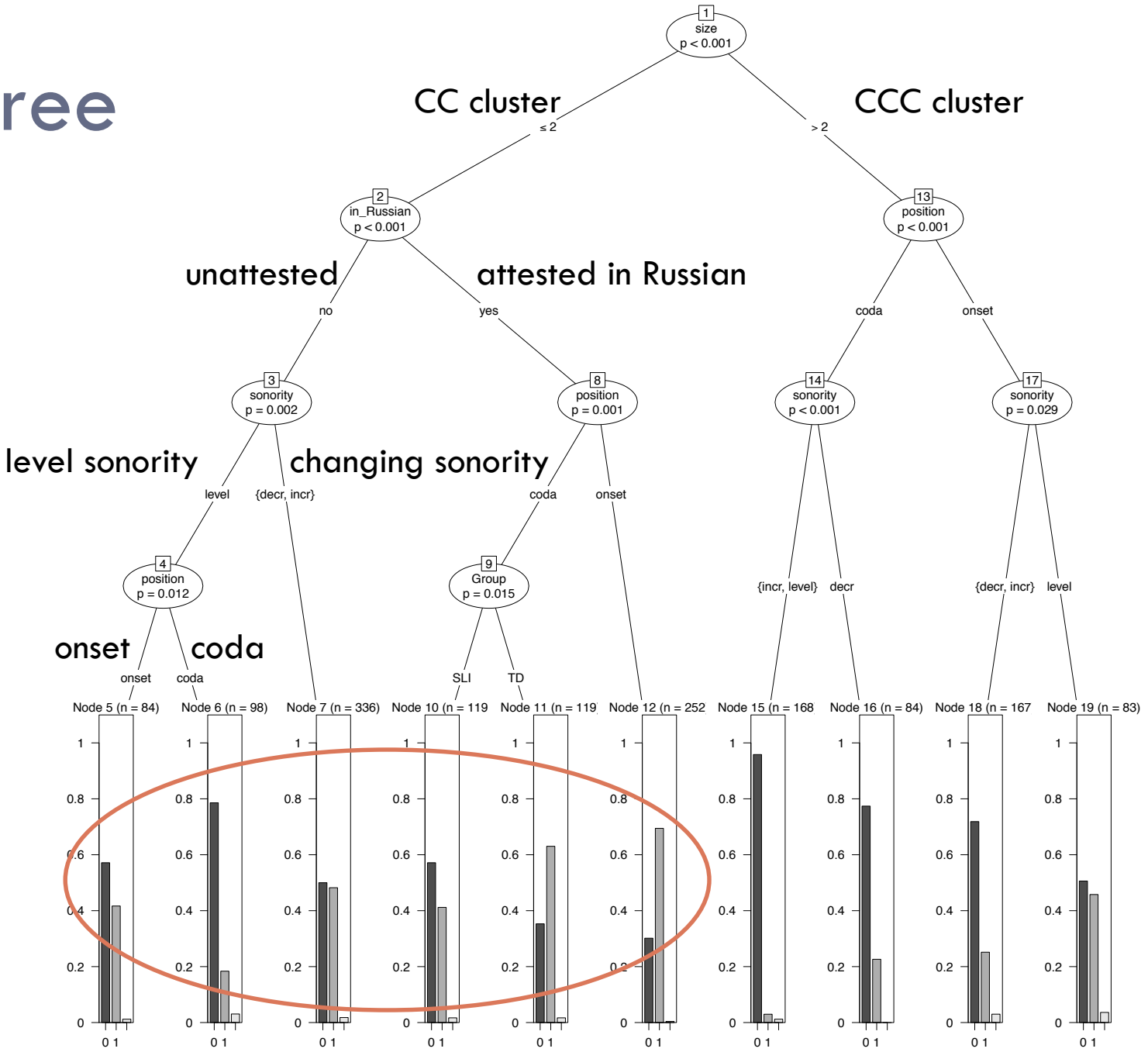


Ctree

Black bar = P(incorrect)
Gray bar = P(correct)



Ctree


CC cluster
CCC cluster
unattested
attested in Russian
level sonority
changing sonority
onset
coda
1
size
p < 0.001
≤ 2
> 2
2
in_Russian
p < 0.001
13
position
p < 0.001
no
yes
coda
onset
3
sonority
p = 0.002
8
position
p = 0.001
14
sonority
p < 0.001
17
sonority
p = 0.029
level
{decr, incr}
coda
onset
{incr, level}
decr
{decr, incr}
level
4
position
p = 0.012
9
Group
p = 0.015
onset
coda
SLI
TD
Node 5 (n = 84)
Node 6 (n = 98)
Node 7 (n = 336)
Node 10 (n = 119
Node 11 (n = 119
Node 12 (n = 252
Node 15 (n = 168
Node 16 (n = 84)
Node 18 (n = 167
Node 19 (n = 83)
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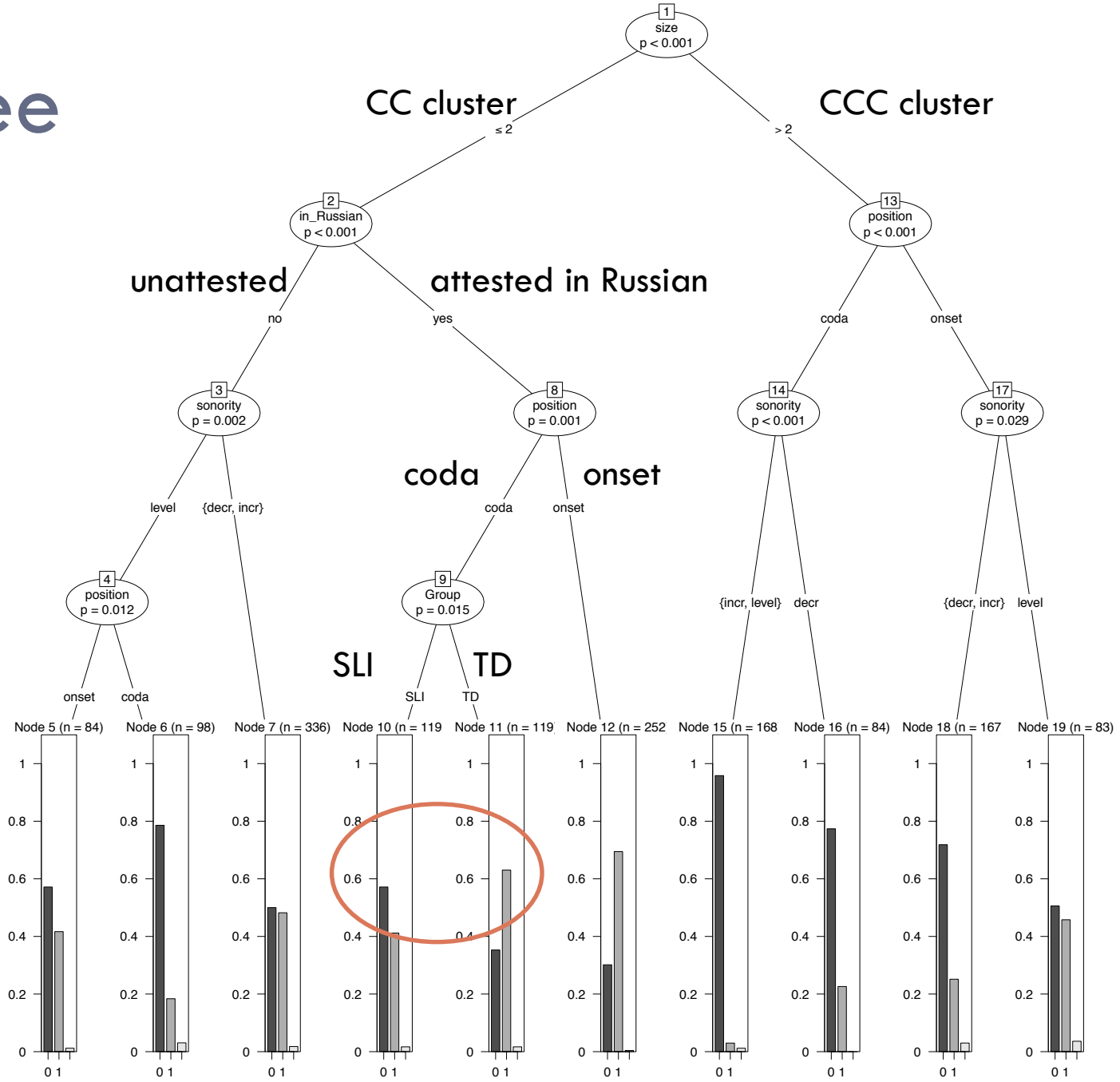
0.2
0.4
0.6
0.8
1
0 1

Ctree


1
size
p < 0.001
CC cluster
CCC cluster
≤ 2
> 2
2
in_Russian
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position
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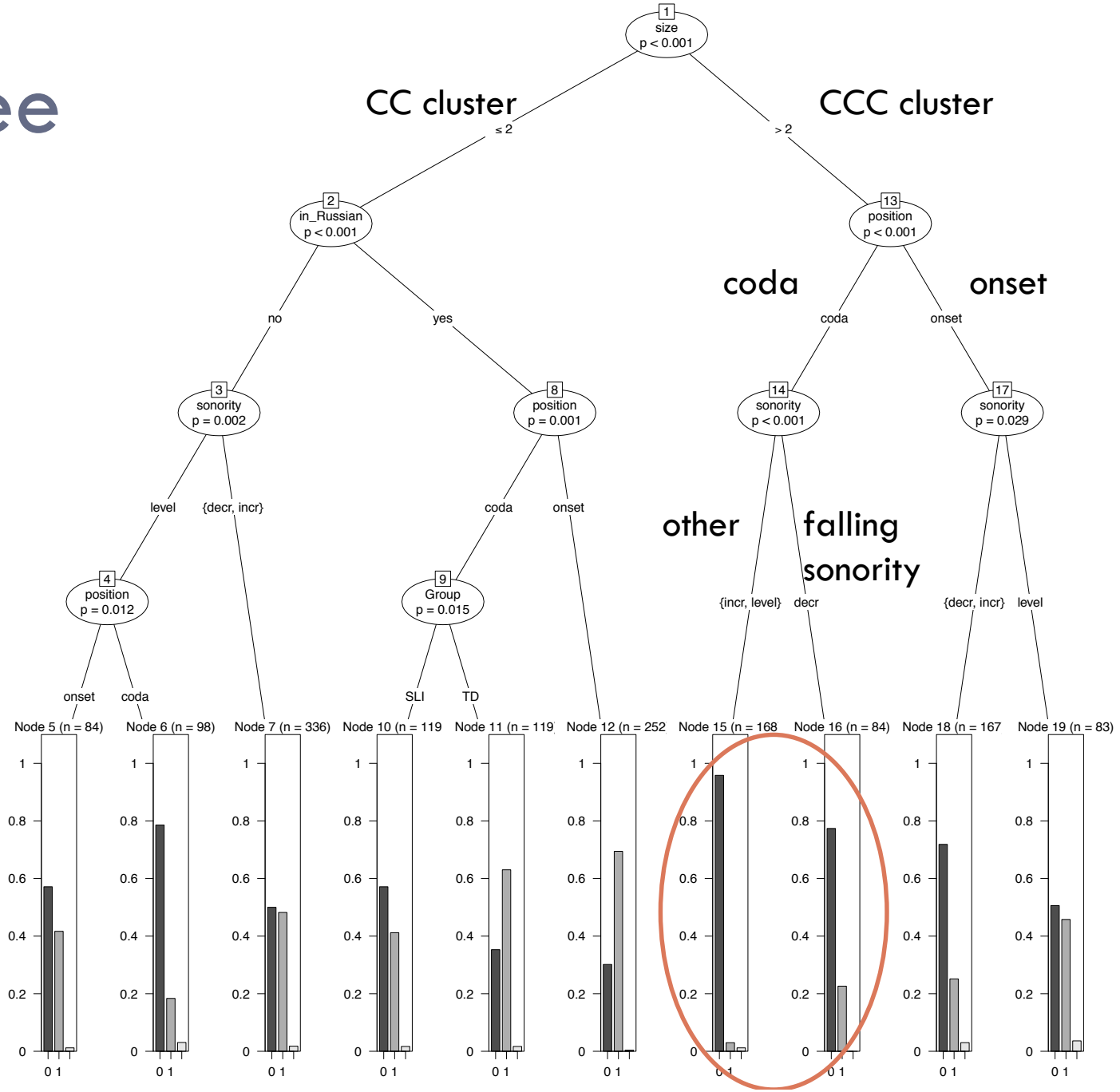
Ctree


CC cluster
CCC cluster
coda
onset
other
falling sonority
1
size
p < 0.001
≤ 2
> 2
2
in_Russian
p < 0.001
13
position
p < 0.001
no
yes
coda
onset
3
sonority
p = 0.002
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position
p = 0.001
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sonority
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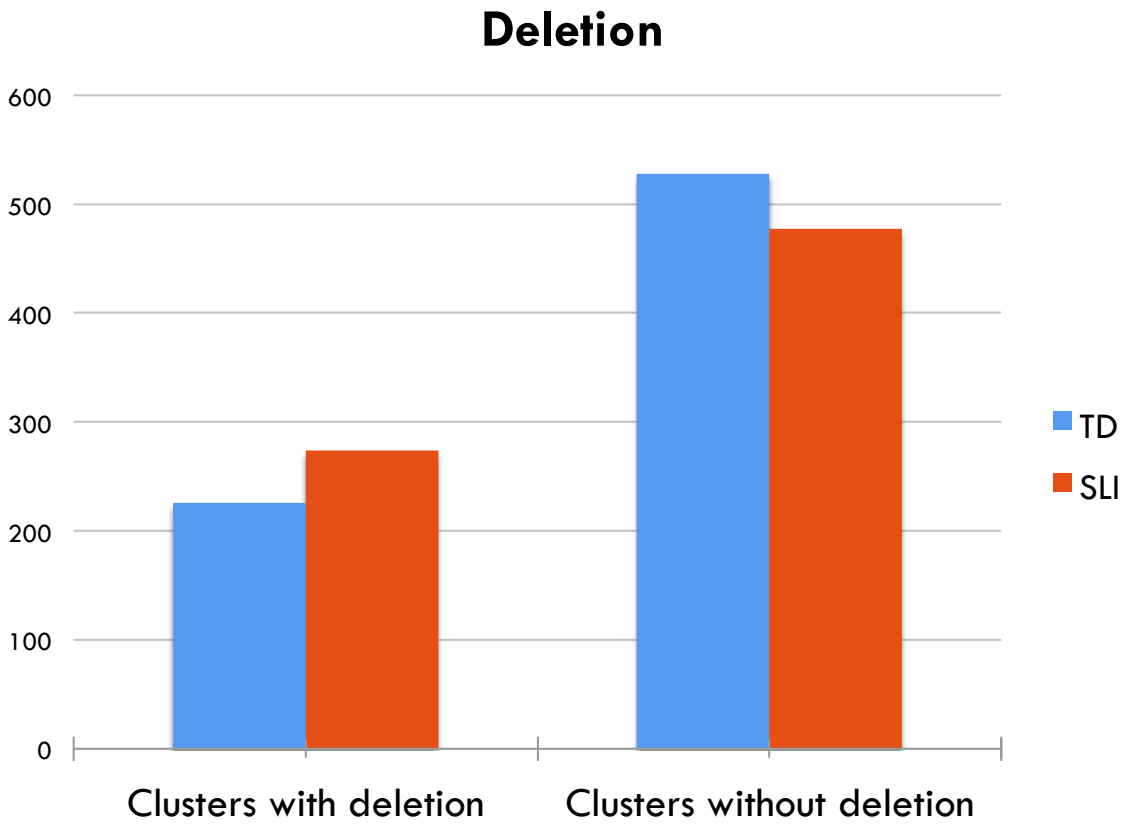
0
0.2
0.4
0.6
0.8
1
0 1

Deletion

Deletion is most common error type

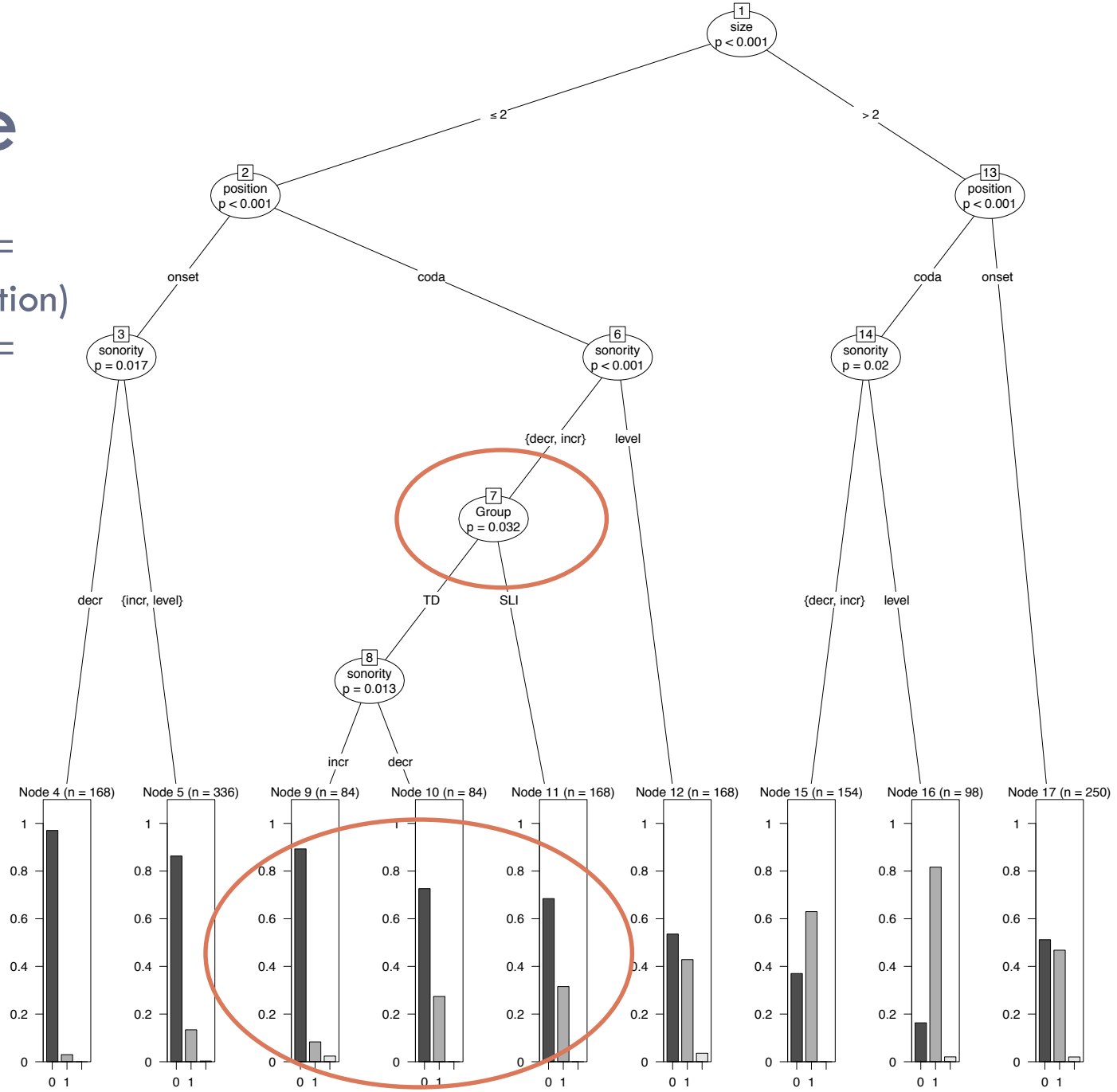
Repair to cluster	# tokens	Example target word	Pronunciation
Deletion	**624**	ptkoka	ptoka
Segmental change	436	patubml	patugmn
Epenthesis (C or V)	128	pmota mtupa	ptmota mutupa
Assimilation	129	mnota	n:ota
Metathesis	124	pakatp	pakapt

Deletion by group

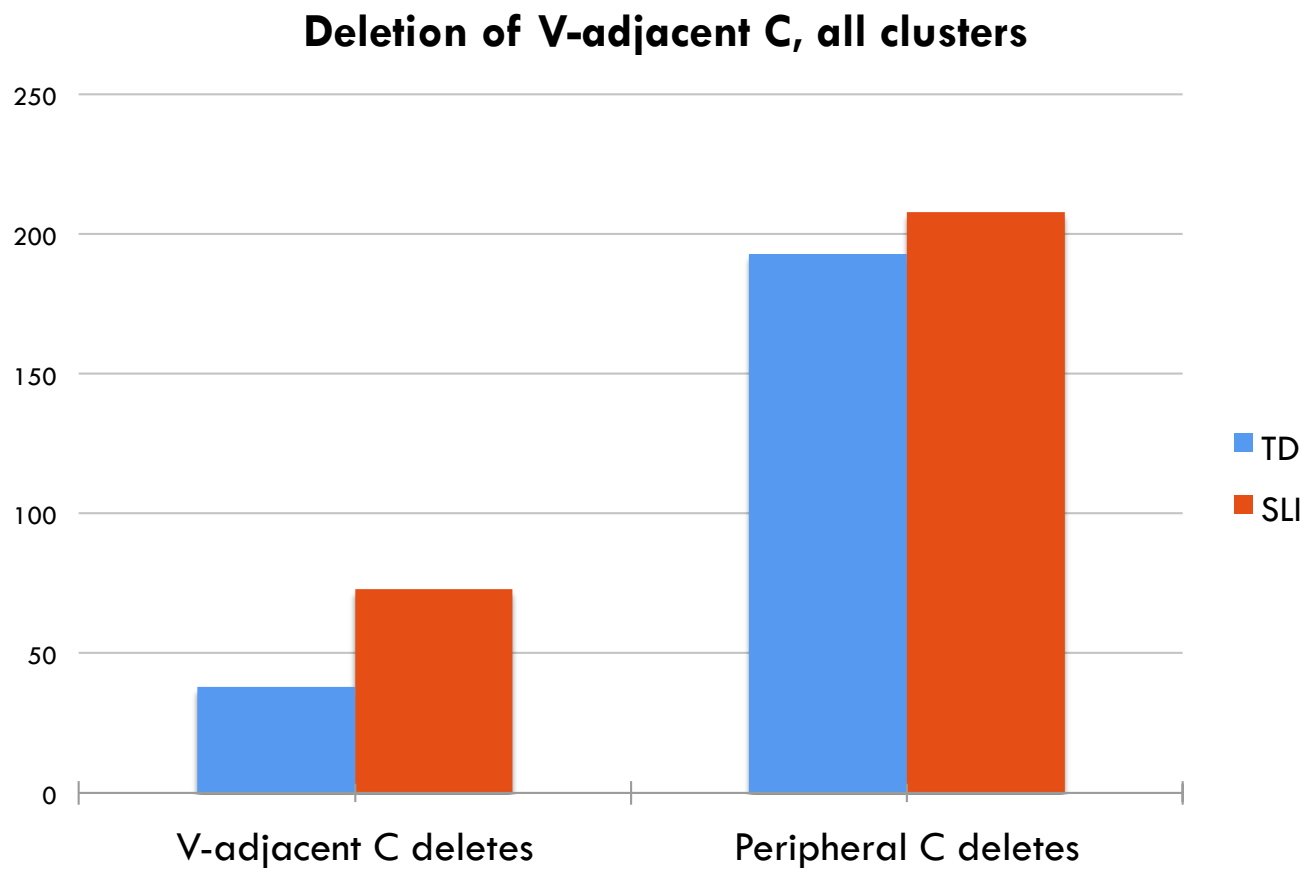


Ctree

Black bar = P(preservation)
Gray bar = P(deletion)



Deletion inhibited adjacent to V

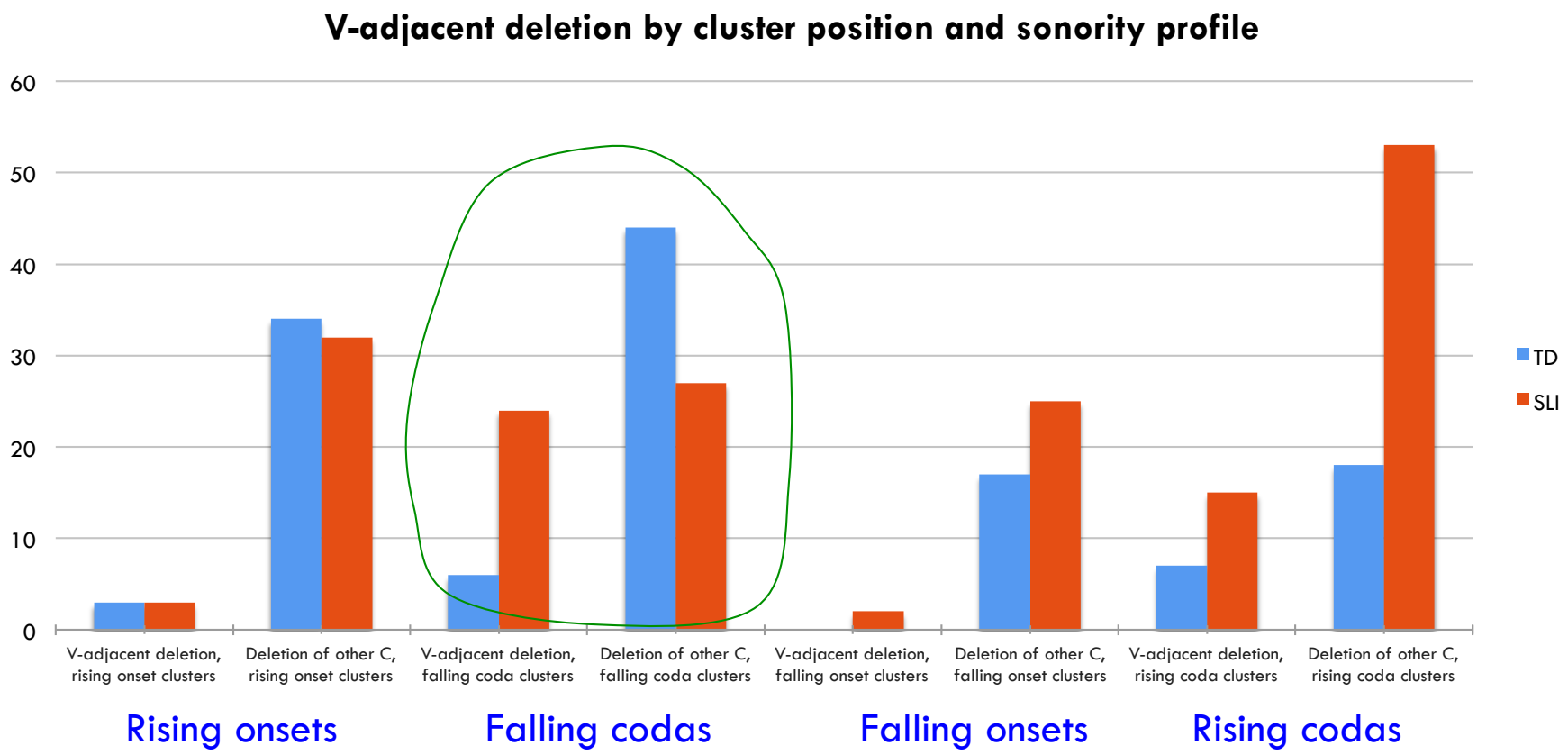


V-adjacent C preservation

- A similar effect is observed in L1 acquisition (e.g. Gerlach 2010) ('snow' → [no]) and in a study of onset cluster production in the speech of two individuals with impaired speech secondary to aphasia and apraxia of speech (Miozzo & Buchwald 2013) ('flow' → [lo])
- The opposite effect is observed in those rare situations in adult language in which clusters are reduced; e.g. in reduplication, sonority tends to determine the outcome (Tagalog *trabaho* → *ta-trabaho*, etc.)

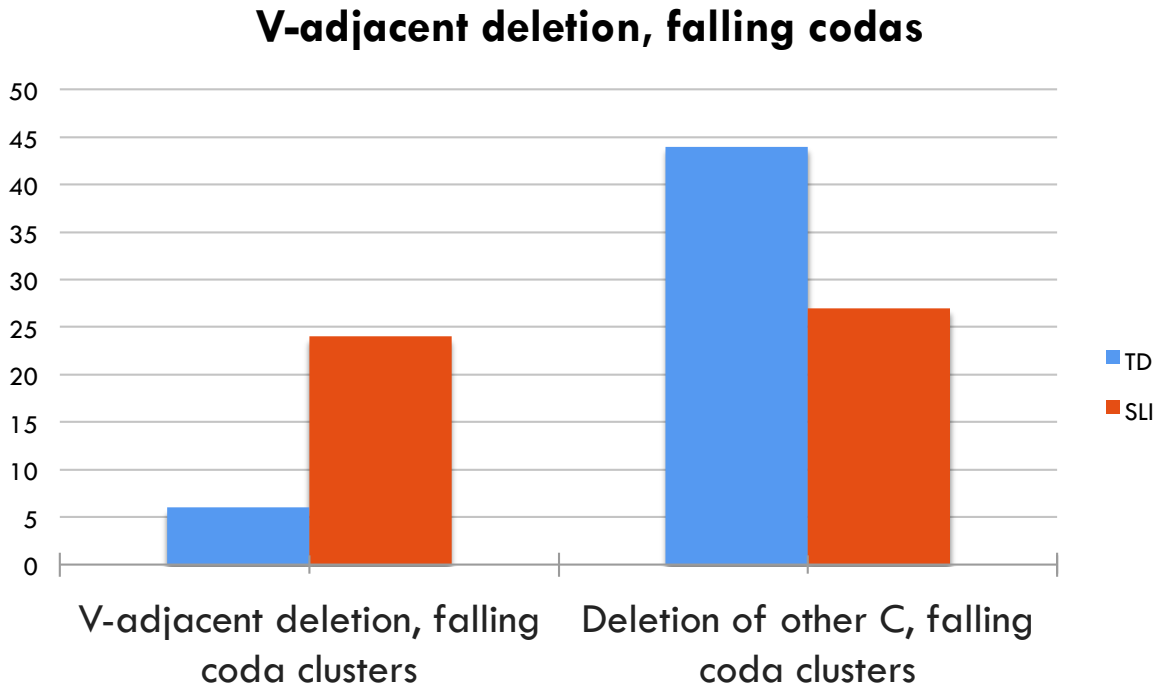
Falling codas

- The two groups differ in the effects of position and sonority profile for falling codas



Exception: Falling codas for SLI

- With *SLI subjects only*, the preference for preserving V-adjacent C is not observed in falling codas (e.g., rk)



Exception: Falling codas for SLI

- The effect is observed mainly with liquid-obstruent clusters, not with nasal-obstruent clusters

	V-adjacent C-deletion	Other C deletion
Initial liquid (4/7 items)	18	13
Initial nasal (3/7 items)	5	12

Wrapup

- This talk is a first attempt at mapping the terrain of the results
- Key initial landmarks deserving further inspection:
  - TD subjects are very influenced by lexical attestedness; SLI subjects apparently are not
  - SLI and TD subjects generally preserve the V-adjacent C if there is any deletion involved in a cluster
  - Cross-linguistic sonority-sequencing preferences are not always respected: Both groups are more accurate with **falling** (e.g. lb) onsets than **rising** (e.g. kr) onsets

Acknowledgments

- We thank:
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Thank you!

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