Tonal alignment under time pressure in the Bor dialects of Dinka

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BEYOND TEXT

Introduction

What are the structural divisions in the tone space?

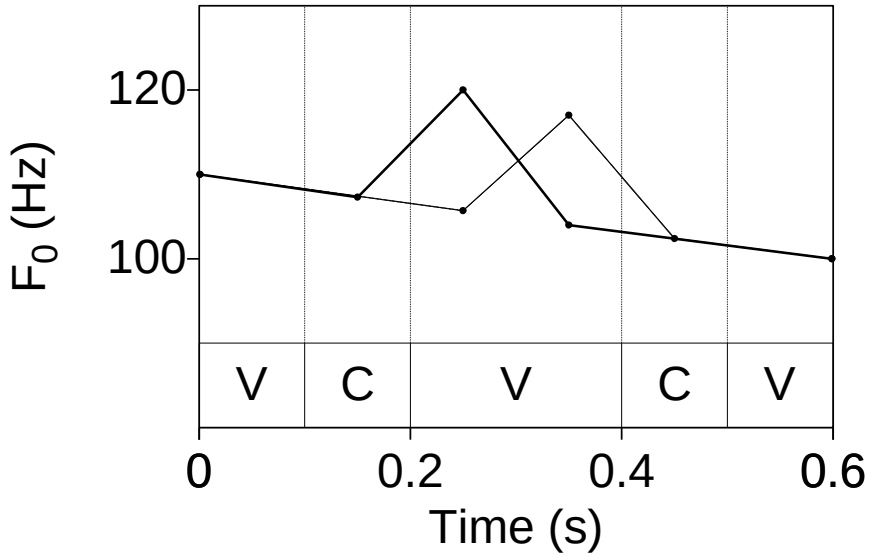
Tone height features

- Are problematic / irrelevant to phonological analysis (Mazaudon 1988; Clements, Michaud & Patin, to appear; Hyman 2010);
- Are not supported phonetically (Stevens 1989, Stevens & Keyser 2010).

Introduction

But what about tone alignment?

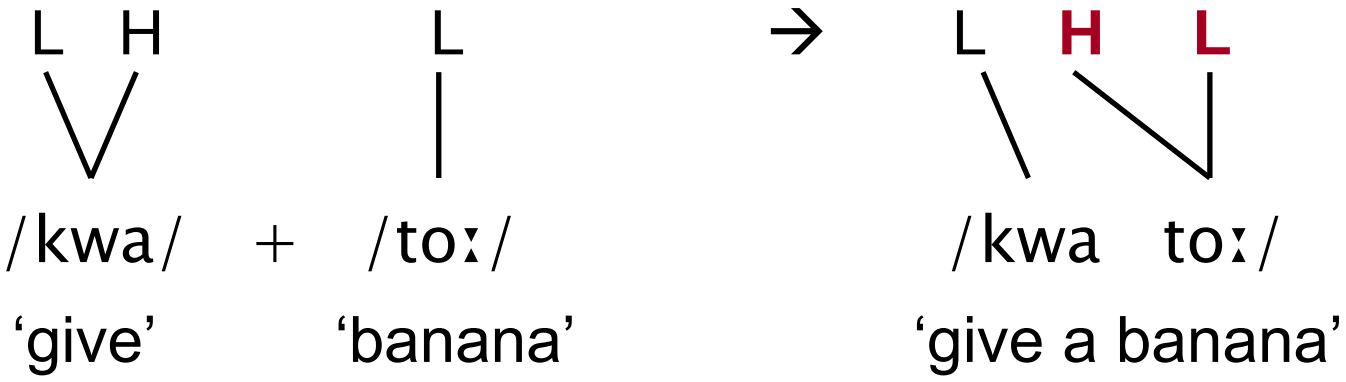
- Speech perception: it takes a difference in alignment of ±50 ms over the vowel for two otherwise identical contours to be reliably distinguished (House 2004);



- Many consider distinctive alignment to be impossible.

Example – Silverman (1997) on Comaltepec Chinantec (building on Anderson, Martínez & Pace 1990)

- The tone inventory of tone inventory includes 3 level tonemes, and 2 rises, but no underlying falls.
- Silverman (1997) postulates rightward High shift in Compaltepec Chinantec.



- Silverman (1997:479-480):

  - rightward High shift would result in loss of contrast if there also where underlying falls.

  - So only one falling pattern of alignment (HL) in the surface phonology.

- I will present counterevidence from Dinka. Here there is rightward High shift too – in spite of the existence of an underlying fall.

A distinction in alignment in falling tonemes in Dinka?

Dèeŋ ă-ʈi̱ŋ ràaan lèel
Deng DECL-see person:S isolate:3SG
‘Deng sees the person he isolated.’

Dèeŋ ă-ʈi̱ŋ ràaan lêel
Deng DECL-see person:S provoke:PASS
‘Deng sees the provoked person.’

Dèeŋ ă-ʈ̪îŋ ràaan lèel
Deng DECL-see person:S isolate:3SG
‘Deng sees the person he isolated.’

Dèeŋ ă-ʈ̪îŋ ràaan lêel
Deng DECL-see person:S provoke:PASS
‘Deng sees the provoked person.’

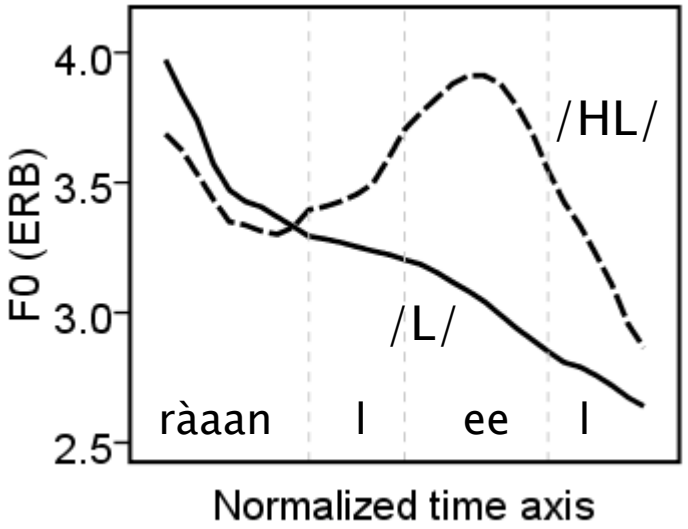


Figure – Averaged f0 traces on normalized time axis, showing the realization of HL vs. L following L. Traces averaged across 4 speakers.

… ràaan lèel
person:S isolate:3SG
‘the person he isolated’

ràaan ǎ–lèel
person:S DECL-isolate:3SG
‘He isolates a person.’

… ràaan lêel
person:S provoke:PASS
‘the provoked person’

ràaan ǎ–lêel
person:S DECL-provoke:PASS
‘The person is being provoked.’

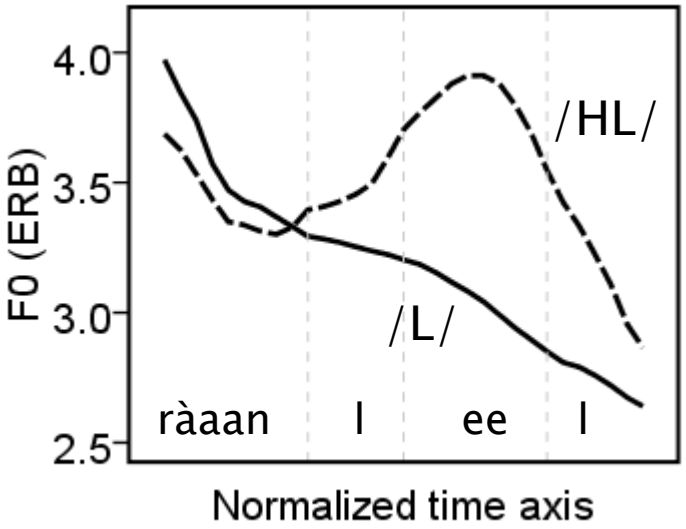


Figure – Averaged f0 traces on normalized time axis, showing the realization of HL vs. L following L. Traces averaged across 4 speakers.

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ràaan ă–lèel
person:S DECL-isolate:3SG
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person:S provoke:PASS
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person:S DECL-provoke:PASS
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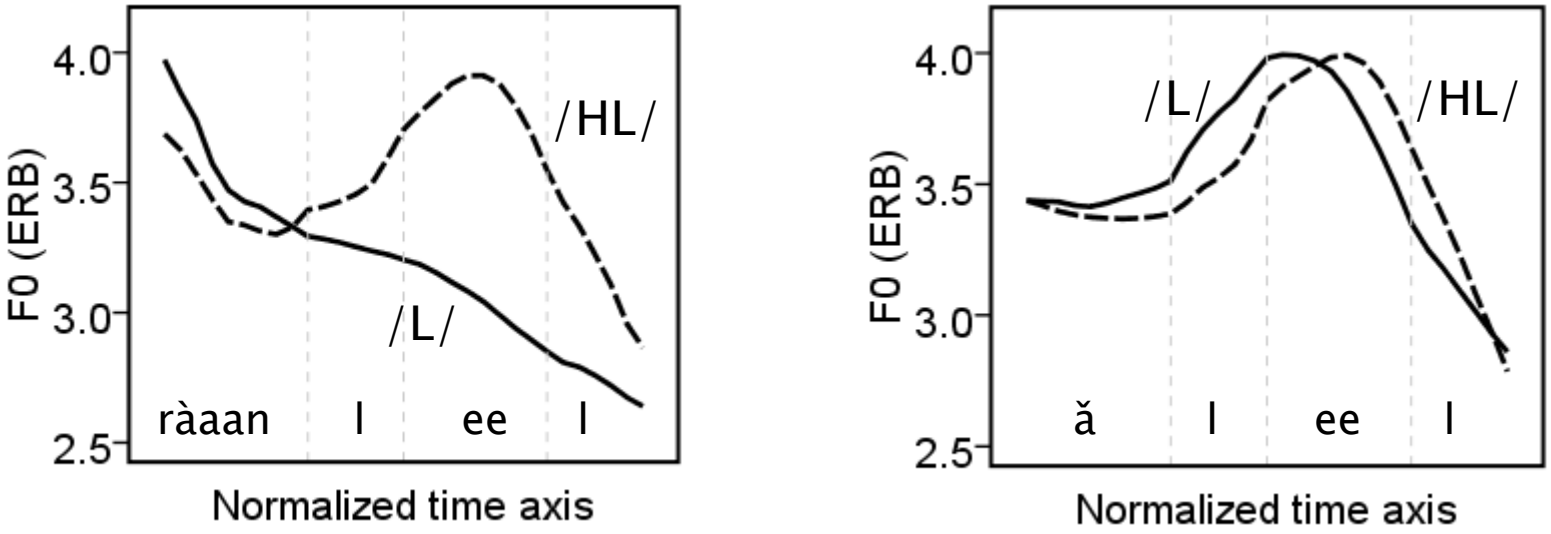


Figure – The realization of HL vs. L following L (left) and LH (right). Traces averaged across 4 speakers.

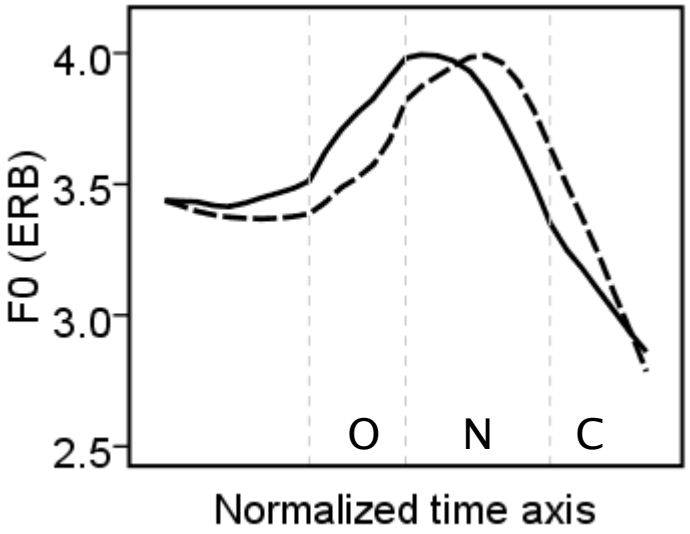
Sounds are embedded on this page; click in the grey rectangles to hear them.

- The contrast between Low(Fall) vs. Fall is found on short vowels as well:

ràaan ǎ–lèl	**ràaan ǎ–lêl**
person:SG DECL-isolate:PASS	person:SG DECL-isolate:PASS
‘You are isolating a person.’	‘The person is being isolated.’

Sounds are embedded on this page; click in the grey rectangles to hear them.

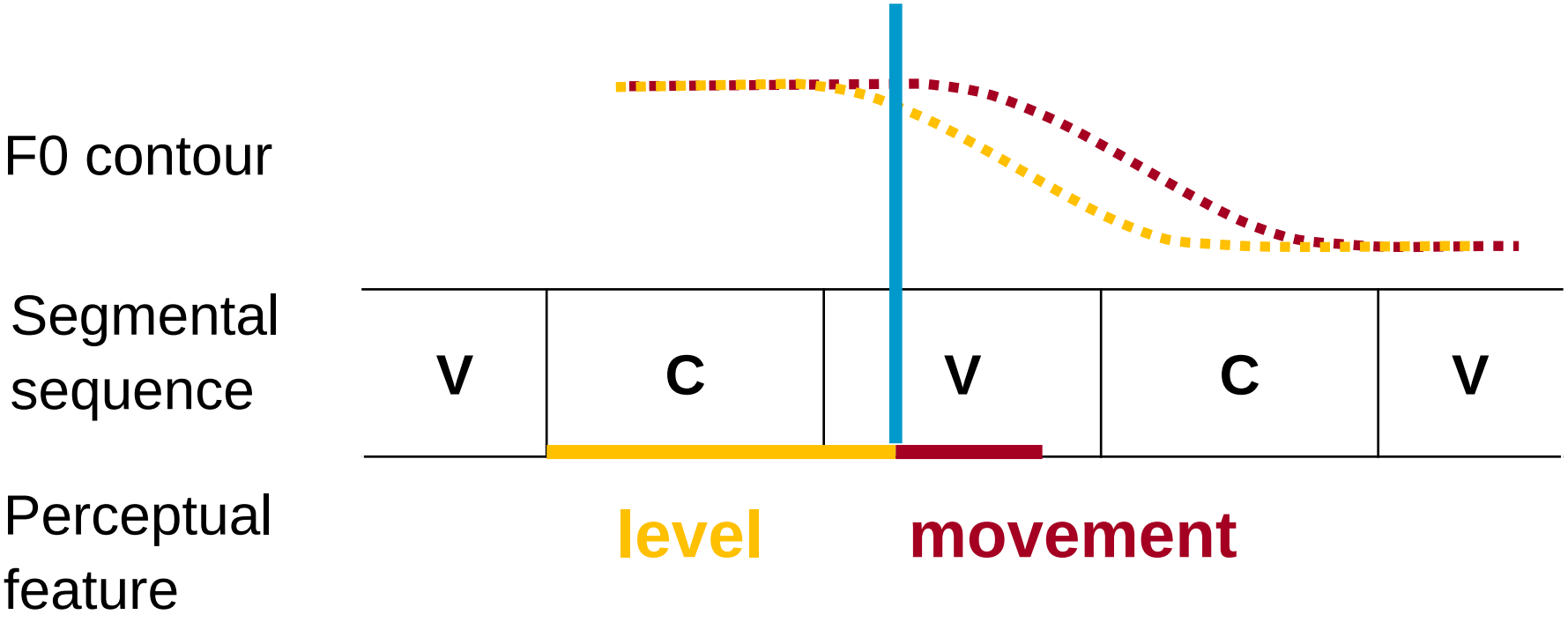
House (1990)



- There is a model of pitch perception that hypothesizes that such a contrast can be maintained: House (1990).

House (1990)

- Perception of falling f0 patterns (House 1990:133ff):



- This is a quantal threshold, in the sense of Stevens (1989).

- Are we overlooking a phonological parameter in the study of tone?

- I carried out a production study on the distinction between two falling contours in Dinka.

Research prediction (based on House 1990):

- If Dinka has two phonologically distinct tone patterns characterised by an f0 fall, then the start of the f0 fall for the two patterns should remain at opposite sides of a threshold at about 30 ms into the vowel.

Methods

Pitch movements under time pressure (Caspers & van Heuven 1993; Xu 1998; Ladd, Faulkner, Faulkner & Schepman 1999):

- Investigate variability in alignment by controlling the segmental space and tonal specification.

- The phonological tone contrast:

/L/ (falling allotone)	/HL/
ràaan ǎ-lèel	**ràaan ǎ-lêel**
person:SG DECL-isolate:3SG	person:S DECL-provoke:PASS
‘He is isolating a person.’	‘The person is being provoked.’

- Time pressure was controlled through vowel length:

Stem length	*Prefix length*	
	V-	*VV-*
V	**ràaan ă–lèl** person:S DECL-isolate:2SG ‘You isolate a person.’	**rn̰oor ăa–lèl** men DECL:P-isolate:2SG ‘You isolate men.’
VV	**ràaan ă–lèel** person:S DECL-isolate:3SG ‘He isolates a person.’	**rn̰oor ăa–lèel** men DECL:P-isolate:3SG ‘He isolates men.’
VVV	**ràaan ă–lèeel** person:S DECL-provoke:3SG ‘He provokes a person.’	**rn̰oor ăa–lèeel** men DECL:P-provoke:3SG ‘He provokes men.’

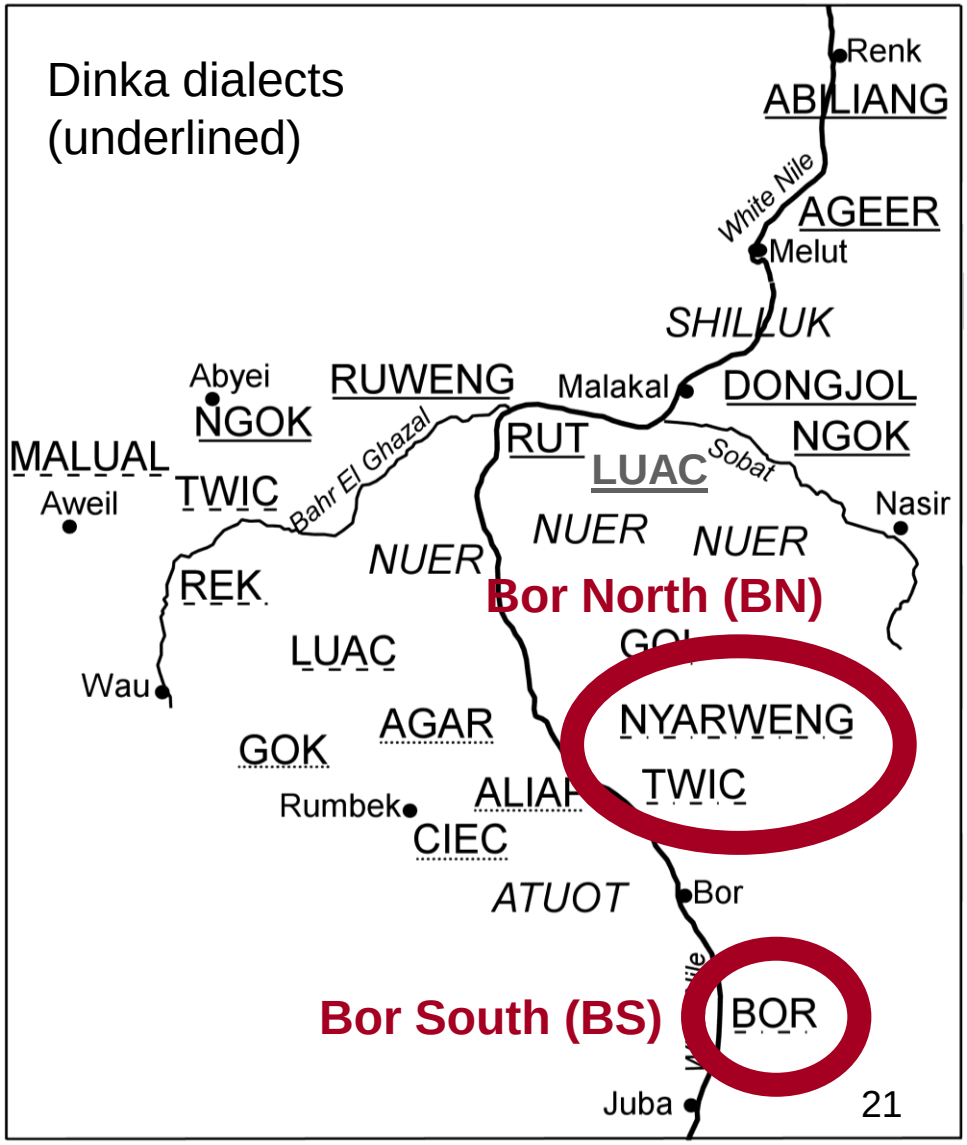
Sounds are embedded on this page; click in the grey rectangles to hear them.

Methods

- Dialect difference in phonological configuration: Bor North vs. Bor South.

Methods

Map of South Sudan region, showing Dinka dialects. The target dialects are highlighted:



Methods

- Dialect difference in phonological configuration: HL on a short stem vowel only in Bor North – Bor South has LH instead:

Bor North	**ràaan**	**ǎ-lêl**
Bor South	**ràaan**	**ǎ-lěl**

person:SG DECL-isolate:PASS

‘The person is being isolated.’

Methods

- 4 segmental sets, in which onset, vowel, and manner of the coda are kept constant:

  lel–leel–leeel

  maŋ–maaŋ–maaan

  wel–weel–weeel

  ŋop–ŋoop–ŋooot

- 40 types in total: 4 segmental sets * 10 prosodies
- 13 speakers: 7 from Bor North, 6 from Bor South

Methods

- Spikes in the f0 traces were trimmed using the algorithm reported in Xu (1999).

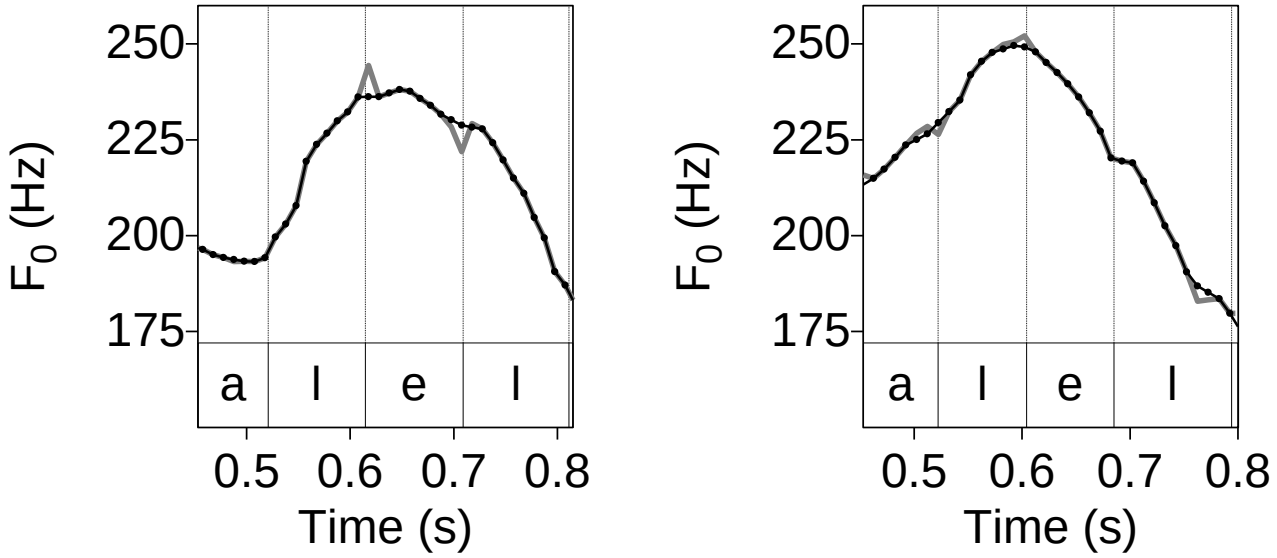


Figure – f0 traces, before (grey) and after (black) application of Yi Xu's trimming algorithm. This algorithm is available online as part of ProsodyPro [http://www.phon.ucl.ac.uk/home/yi/ProsodyPro/]

Results

Results

- Three-level vowel length conditions big differences in duration (cf. Remijsen & Gilley 2008 on Luanyjang):

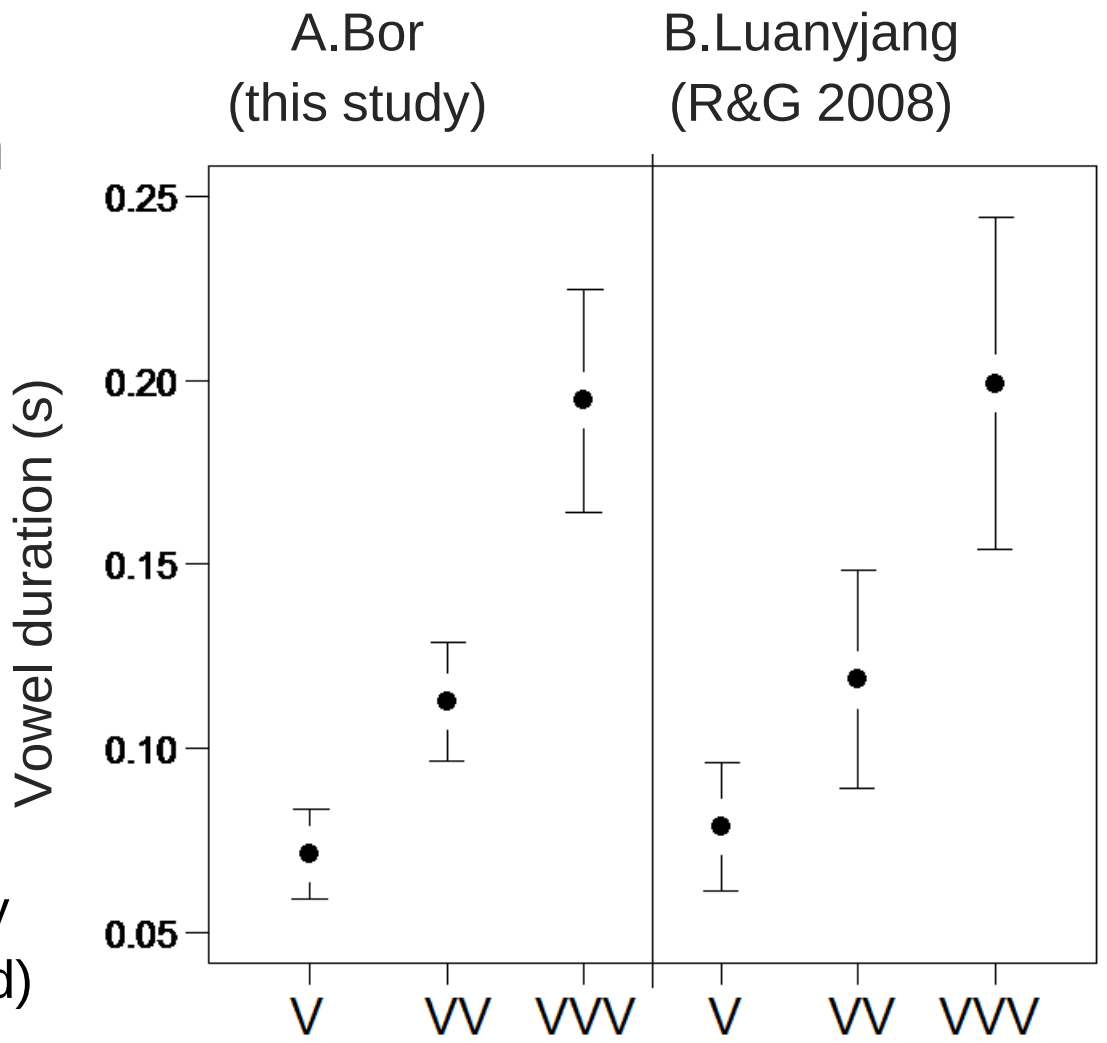


Figure: Vowel duration by vowel length (mn + 1sd)

Results

- Averaged f0 traces for Fall vs. Low^{Fall}:

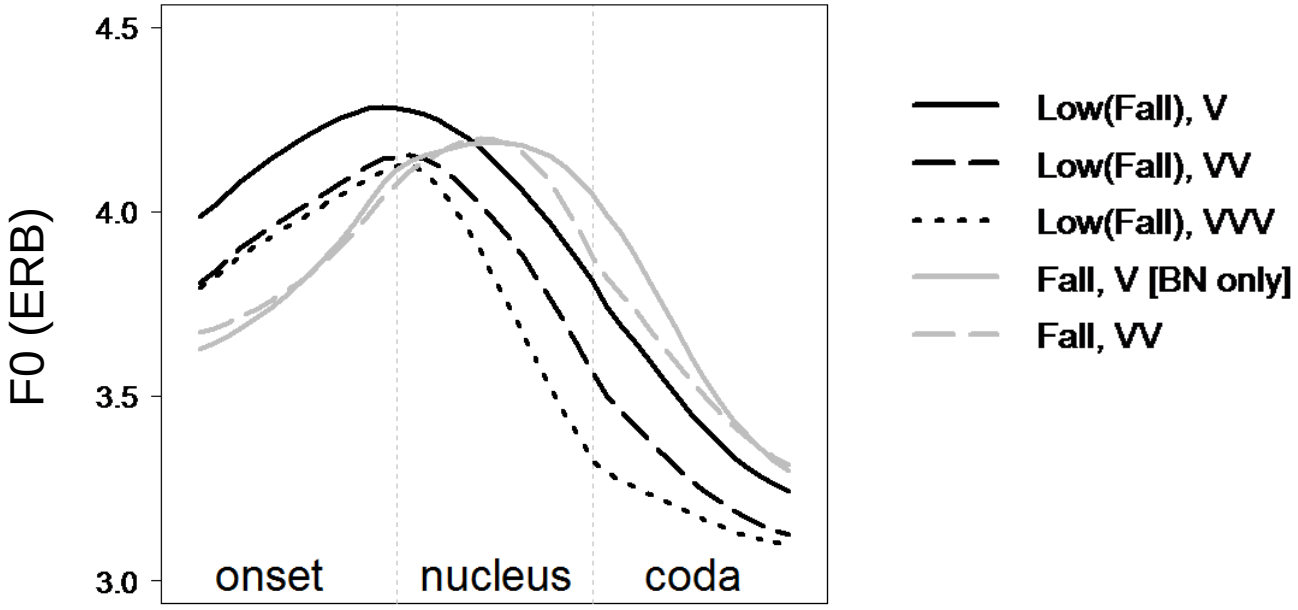


Figure – Averaged f0 traces on normalised time axis.

- The difference in peak height is small (2Hz) and not significant.

Results

- The differences in peak alignment between Low(Fall) and Fall lies around 44 ms.

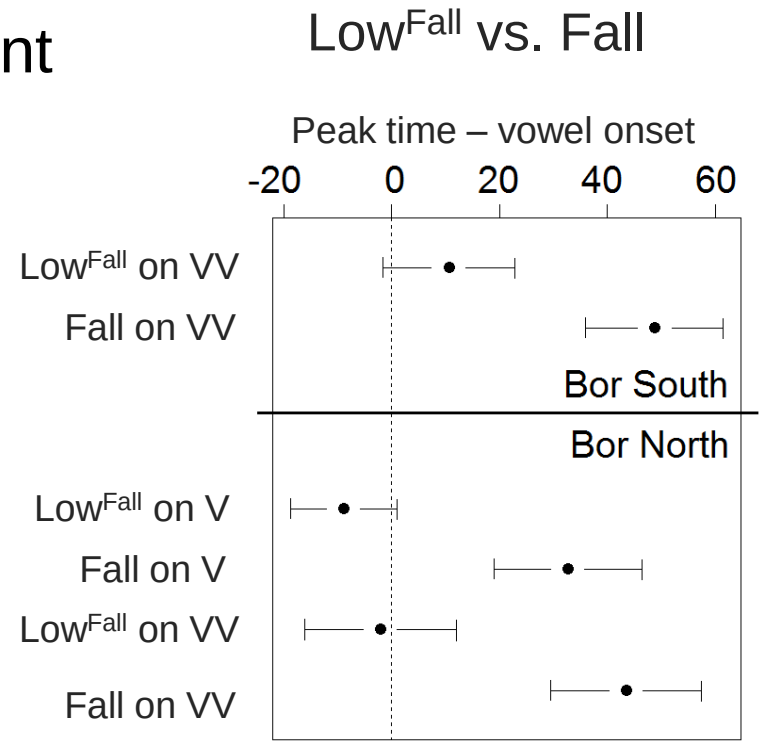
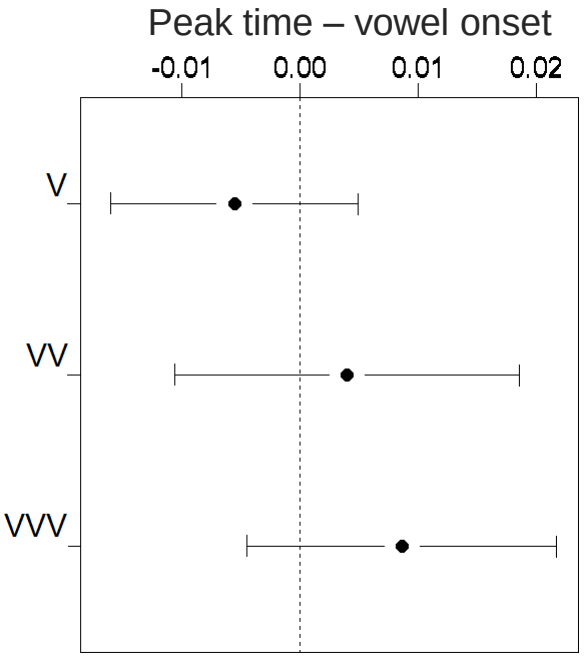


Figure – Means and standard deviations for peak alignment in the Low(Fall) vs. Fall tonemes.

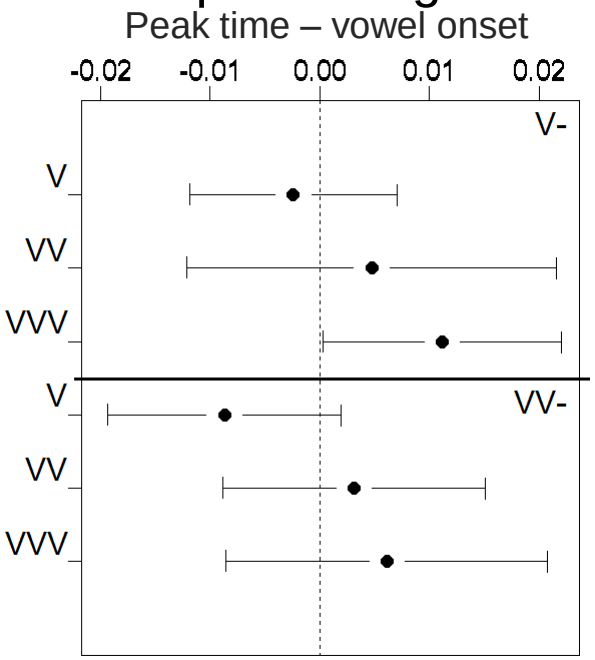
Results

- There is contextual variation in peak alignment of the Low(Fall):

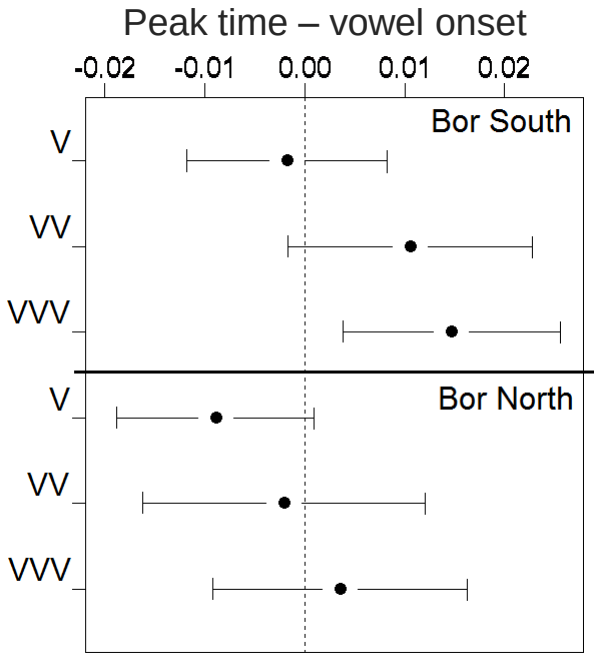
A. By stem length



B. By stem length + prefix length



C. By stem length + dialect



Results

- Linear mixed effects model (Bates 2004) with dependent peak alignment – random factors Speaker (13), Set (4):

Factor	Levels	t value	Probability
Stem length	V vs. VV	7.5	<0.0001
	V vs. VVV	9.5	<0.0001
	VV vs. VVV	3.1	0.002
Toneme	Low^{Fall} vs. Fall	33.3	<0.0001
Prefix length	V vs. VV	-3.1	<0.002
Dialect	SB vs. NB	-3.7	0.0003

- All factors are significant, and the contrast between Low^{Fall} vs. Fall registers the biggest effect.

Conclusion

Conclusion

- (House 1990, 1996) postulated a [±movement] feature, whereby alignment early in the vowel patterns along with alignment in preceding onset.
- Corroborated in Dinka: the start of Low(Fall) aligns early on in the vowel or in the onset; the Fall toneme is aligned well into the vowel.
- In response to Stevens (1989) Stevens & Keyser (2010): there is evidence of a quantal relation in tone. It relates not to tone height, but to tone alignment.

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- The Arts & Humanities Research Council (UK), for funding through two research grants.

Extra

Phonological evidence for distinction between Fall and Low^{Fall}

- A sandhi rule in Bor South turns any Fall (HL) tonemes into a High toneme, when it is not in prepausal position.

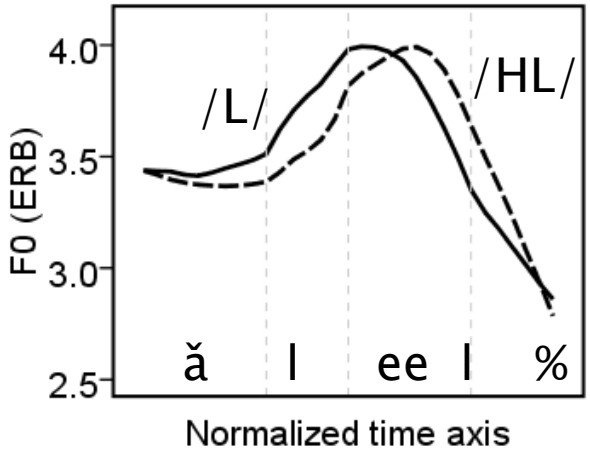
  /High-Low/ → H / __ #

- The Low^{Fall} – falling allotone of Low – is not affected – see example and descriptive stats on following slide.

ràaan ă-lèel (ę́-tɛ̨́nɛ̨)
person:S DECL-set.apart:3SG (EXT-here)
‘He isolates a person (here).’

ràaan ă-lêel (ę́-tɛ̨́nɛ̨)
person:S DECL-provoke:PASS (EXT-here)
‘The person is provoked (here).’

Utterance-final (no adverb)



Utterance medial (with adverb)

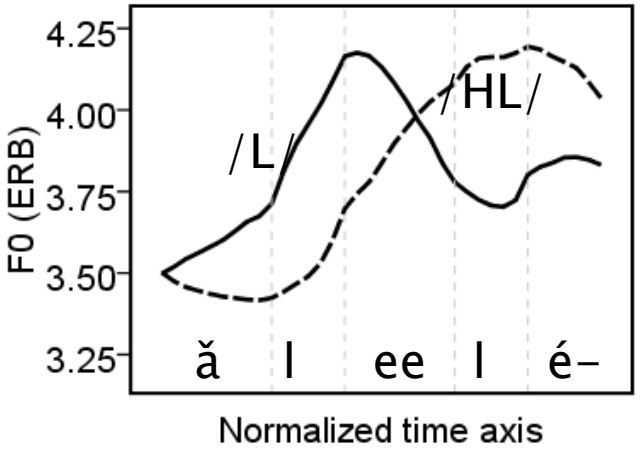
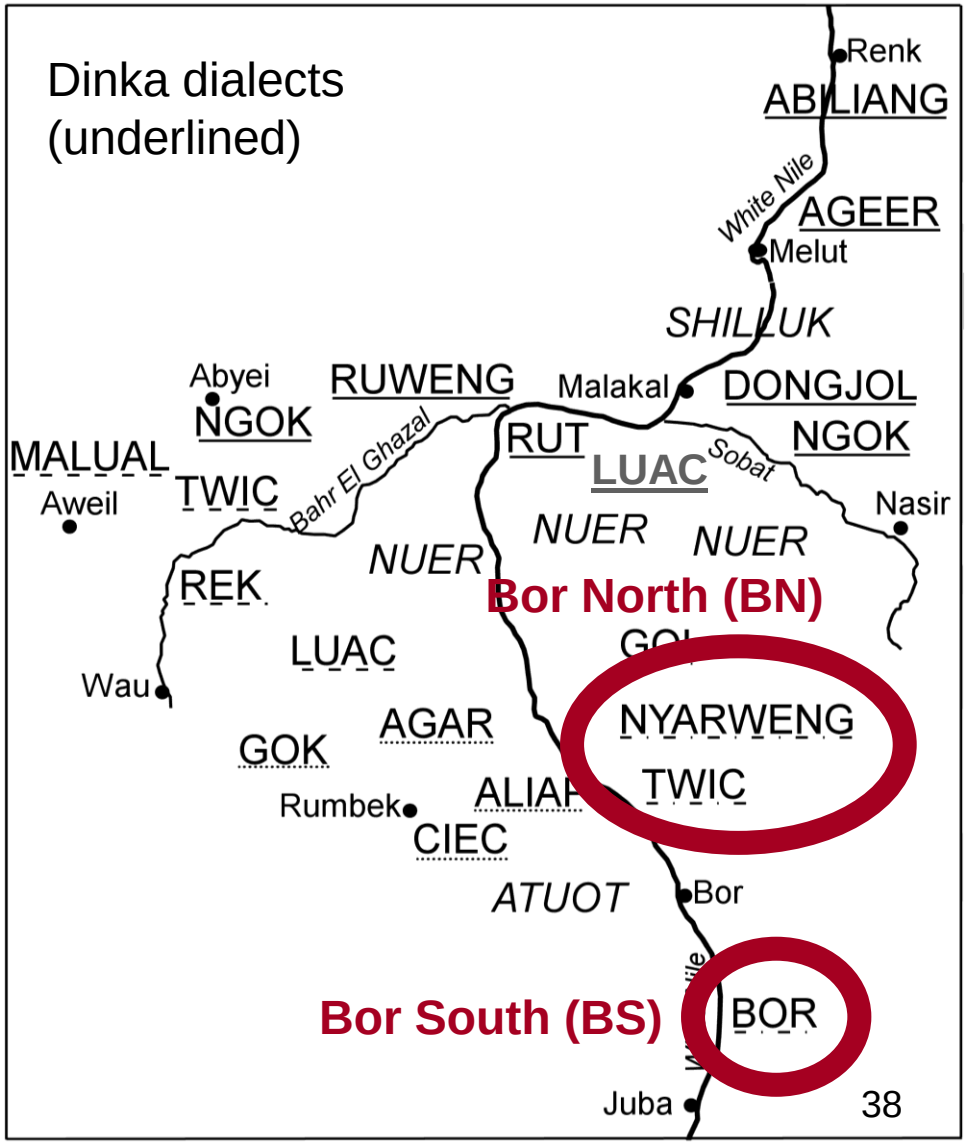


Figure – Averaged f0 traces on a normalized time axis, showing the realization of /HL/ vs. /L/ following /LH/, embedded in final (left) vs. medial position (right). Traces are averaged across 4 speakers.

Extra

Map of South Sudan region, showing Dinka dialects. The target dialects are highlighted:



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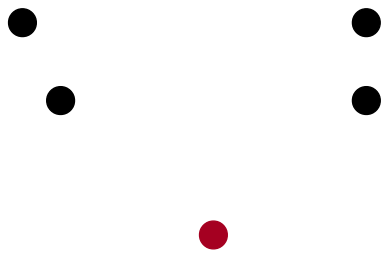
Bor South	**ràaan**	**ǎ–lěl**

person:SG DECL-isolate:PASS
‘The person is being isolated.’

Dispersion Theory

- Dispersion Theory (Liljencrants & Lindblom 1972): the realisation of categories evolves so as to maximise contrast relative to other categories in the same space.
- Example on vowel systems, from Becker-Kristal (2010):

Symmetrical systems (192 languages)



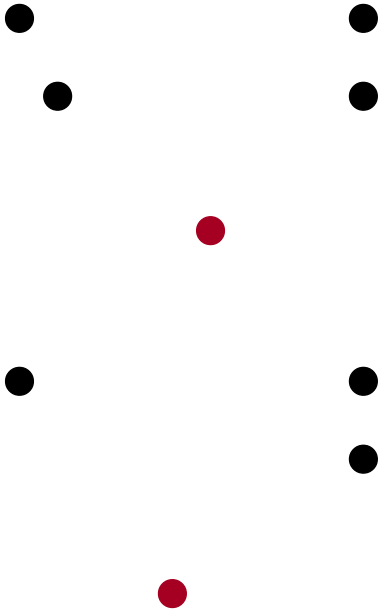
Right-crowded systems (26 languages)

Dispersion Theory

Becker-Kristal (2010) on /a/:

Symmetrical systems (192 languages)

Right-crowded systems (26 languages)



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Dinka /HL/ from rightward High shift:

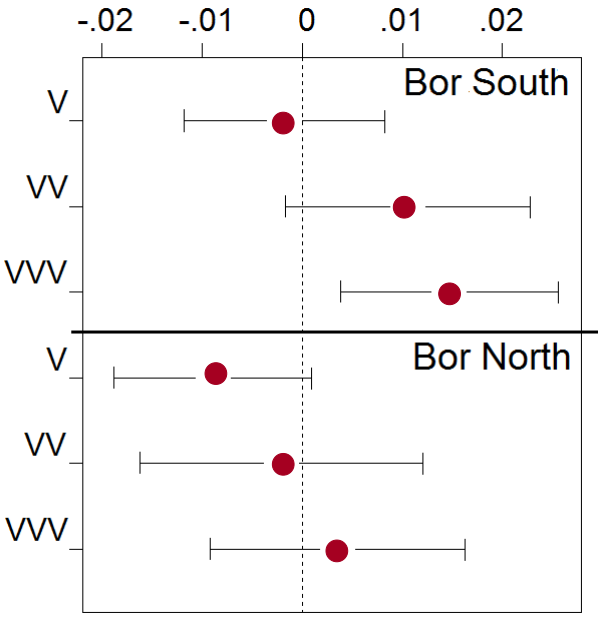

Figure: F0 peak time – vowel onset

Evidence for Dispersion Theory (Liljencrants & Lindblom 1972):

- Peak alignment of the fall allotone of Low is earlier in the Bor North dialect, where it contrasts with a later-aligned falling category on short vowels.
- The phonetic realisation of the fall allotone of Low in Bor North has evolved to maximise contrast.

Results

Table – Means for peak alignment in Bor North, by vowel length (V, VV) and tone.

		Toneme		
		/L/ [fall]	/HL/	Difference
Vowel length	V	-9	33	42
	VV	-2	43	45

Methods

- In summary, the dataset hinges on manipulation of stem toneme, stem length, prefix length, and dialect:

v̌-cv̀c	v̌v-cv̀c	
v̌-cv̀vc	v̌v-cv̀vc	
v̌-cv̀vvc	v̌v-cv̀vvc	
v̌-cv̂c	v̌v-cv̂c	(Bor North only)
v̌-cv̂vc	v̌v-cv̂vc	
v̌-cv̌c	v̌v-cv̌c	(Bor South only)