

# 24.901/931, 2026

## Introduction to Phonology

### Lecture 8

## Work this week

- Amy will discuss solution to quiz1 in recitation.
- Problem set 3 posted: due 3-17. Submissions accepted until 3-20.
- Nothing new to read. If you become interested in vowel harmony, the 1<sup>st</sup> part of Rose and Walker (2010) is a relatively accessible survey of this class of processes. The discussion of analysis presupposes Optimality Theory (OT).
- I will have more reading recommendations on tone and Vowel Harmony once OT is introduced.

# TOC

- More Tones
- Vowel Harmony

# Angas (Chadic, Nigeria)

|       |               |       |                   |       |                   |
|-------|---------------|-------|-------------------|-------|-------------------|
| tén   | ‘rope’        | tén   | ‘rope (case)’     | tên   | ‘rope (modified)’ |
| mús   | ‘cat’         | mús   | ‘cat (case)’      | mûs   | ‘cat (mod.)’      |
| tʰén  | ‘hoe’         | tʰén  | ‘hoe (case)’      | tʰên  | ‘hoe (mod.)’      |
| ní    | ‘elephant’    | ní    | ‘elephant (case)’ | nî    | ‘elephant (mod.)’ |
| ʔās   | ‘dog’         | ʔās   | ‘dog (case)’      | ʔās   | ‘dog (mod.)’      |
| ɜwāl  | ‘boy’         | ɜwāl  | ‘boy (case)’      | ɜwāl  | ‘boy (mod.)’      |
| jēm   | ‘child’       | jēm   | ‘child (case)’    | jēm   | ‘child (mod.)’    |
| màs   | ‘locust bean’ | màs   | ‘bean (case)’     | màs   | ‘bean (mod.)’     |
| pùk   | ‘soup’        | pùk   | ‘soup (case)’     | pùk   | ‘soup (mod.)’     |
| ʔàs   | ‘tooth’       | ʔàs   | ‘tooth (case)’    | ʔàs   | ‘tooth (mod.)’    |
| dʒólì | ‘ape’         | dʒólì | ‘ape (case)’      | dʒólì | ‘ape (mod.)’      |

Data from Odden Intro Phonology 2013

# Angas simplified

| Tone | N in isolation | N case-marked | N modified |
|------|----------------|---------------|------------|
| H    | tɛŋ            | tɛŋ           | tɛŋ        |
| M    | ʒwāl           | ʒwǎl          | ʒwǎl       |
| L    | màs            | mǎs           | màs        |
| H L  | dʒólì          | dʒóľl         | dʒólì      |

Any constant change in case-marked Ns?  
In modified Ns?

# Angas URs

| N in isolation   | N + case morph        | N + modifier morph     |
|------------------|-----------------------|------------------------|
| ten<br> <br>H    | ten<br> <br>H    H    | ten<br> <br>H    L     |
| 3wal<br> <br>M   | 3wal<br> <br>M    H   | 3wal<br> <br>M    L    |
| mas<br> <br>L    | mas<br> <br>L    H    | mas<br> <br>L    L     |
| d3oli<br> <br>HL | d3oli<br> <br>HL    H | d3oli<br> <br>H L    L |

# Angas SRs

| N in isolation       | N case-marked SR             | N modified SR                |
|----------------------|------------------------------|------------------------------|
| ten<br> <br>H        | ten<br>    \<br>H   H        | ten<br>    \<br>H   L        |
| 3wal<br> <br>M       | 3wal<br>    \<br>M   H       | 3wal<br>    \<br>M   L       |
| mas<br> <br>L        | mas<br>    \<br>L   H        | mas<br>    \<br>L   L        |
| d3oli<br>     <br>HL | d3oli<br>        \<br>HL   H | d3oli<br>        \<br>HL   L |

Across-the-Board (ATB) tone changes

# Shona. $V = \text{High}$ ; $V = \text{Low}$

(Bantu, Zimbabwe; Odden 1986 *Language*, Myers 1997 *NLLT*)

| H       | L          | LH    | HL*                              |
|---------|------------|-------|----------------------------------|
| bángá   | sadza      | badzá | séndere                          |
| ‘knife’ | ‘porridge’ | ‘hoe’ | ‘place forbidden<br>for farming’ |

# Prefix Lowering

(Bantu, Zimbabwe; Odden 1986 *Language*, Myers 1997 *NLLT*)

| N          | with N  | like N  | of N     |
|------------|---------|---------|----------|
| mbwá 'dog' | né-mbwà | sé-mbwà | ché-mbwà |
|            |         |         |          |

# Prefix Lowering

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| mbwá 'dog' | né-mbwà    | sé-mbwà | ché-mbwà |
|            | sé-nè-mbwá |         |          |

# Prefix Lowering

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| N          | with N     | like N  | of N     |
|------------|------------|---------|----------|
| mbwá ‘dog’ | né-mbwà    | sé-mbwà | ché-mbwà |
|            | sé-nè-mbwá |         |          |
| H → L/H_   |            |         |          |

# Why write $H \rightarrow L/H\_$ ?

- Why not:  $V_{[+highT]} \rightarrow V_{[+lowT]} / V_{[+highT]} C_0 \_$ ? ( $C_0$  = any number of Cs, incl. 0)
- C features almost never condition/interfere in T rules:

I'm unaware of rules like:  $V_{[+highT]} \rightarrow V_{[+lowT]} / V_{[+highT]} \mathbf{C}_{[+cont]} \_$

- V features don't matter either.

no rules like:  $V_{[+highT, \mathbf{-back}]} \rightarrow V_{[+lowT]} / V_{[+highT, \mathbf{+round}]} C_0 \_$

- This non-interference by non-tonal Fs in tonal rules seems systematic.  
Perhaps if a process changes tone, it can access only tones.

Then  $H \rightarrow L/H\_$  is not only a simpler statement but also the right one.

# Across-the-Board (ATB) tonal change in Shona

(Bantu, Zimbabwe; Odden 1986 *Language*, Myers 1997 *NLLT*)

| N                   | with N         | like N         | of N            | gloss     |
|---------------------|----------------|----------------|-----------------|-----------|
| mbwá H              | né-mbwà        | sé-mbwà        | ché-mbwà        | dog       |
| hóvé H*             | né-hòvè        | sé-hòvè        | ché-hòvè        | fish      |
| mbúndúdzí H*        | né-mbùndùdzì   | sé-mbùndùdzì   | ché-mbùndùdzì   | army worm |
| hákàtá H*L          | né-hàkàtá      | sé-hàkàtá      | ché-hàkàtá      | bones     |
| bénzìbvùnzá<br>H*LH | né-bènzìbvùnzá | sé-bènzìbvùnzá | ché-bènzìbvùnzá | fool      |

# Questions

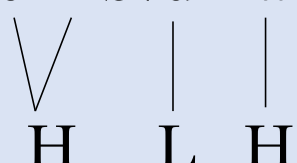
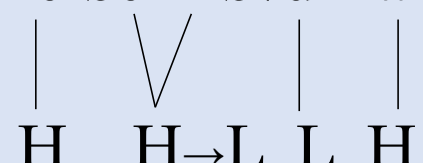
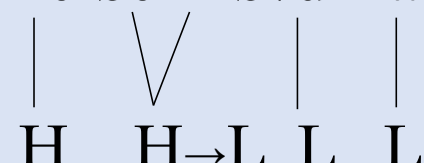
- Given  $H \rightarrow L / H + \_\_$  (+ = a prefix boundary)  
= H becomes L after H in another morpheme.
- Why  $né-mbúndúdží \rightarrow né-mbùndùdzì?$   
Why not strictly local change  $*né-mbùndúdží?$

$T^i T^i = \text{long } T^i$  'long' = 1T linked to more than 1V

| N                   | with N                                  |
|---------------------|-----------------------------------------|
| mbwá<br> <br>H      | né - mbwà<br>         <br>H      H→L    |
| hóvé<br>∨<br>H      | né-hòvè<br>        ∨<br>H      H→L      |
| mbúndúdzí<br>∨<br>H | né-mbùndùdzì<br>        ∨<br>H      H→L |

The rule applies on tones, unaffected by the number of Xs that the H is linked to

Non-adjacent Hs don't form one H:

|                                                                                                  |                                                                                                      |                                                                                                         |
|--------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|
| bénzíbvùnzá<br> | né-bénzíbvùnzá<br> | * né-bénzíbvùnzá<br> |
|--------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|

(They couldn't, without crossing lines)

Do we predict *sé-ne-hóvé* ‘like with fish’?

|          |    |    |      |
|----------|----|----|------|
| UR       | se | ne | hove |
|          |    |    |      |
|          | H  | H  | H    |
|          | se | ne | hove |
| Lowering |    |    |      |
|          | H  | L  | H    |

What excludes *sé-nè-hòvè* ‘like with fish’?

|           |    |    |      |
|-----------|----|----|------|
| (1)       | se | ne | hove |
|           |    |    |      |
|           | H  | H  | H    |
|           | se | ne | hove |
| Lowering1 |    |    |      |
|           | H  | H  | L    |

|            |    |    |      |
|------------|----|----|------|
| (2)        | se | ne | hove |
|            |    |    |      |
|            | H  | L  | L    |
|            | se | ne | hove |
| Lowering 2 |    |    |      |
| + OCP      | H  |    | L    |

# Many approaches to a solution

## 1. Lowering operates *directionally*, LR

|     |    |    |      |
|-----|----|----|------|
| (1) | se | ne | hove |
|     |    |    |      |
|     | H  | H  | H    |

|     |    |    |      |
|-----|----|----|------|
| (2) | se | ne | hove |
|     |    |    |      |
|     | H  | L  | H    |

On step 2, no more  
input to the rule: no HH.

2. Minimal number of changes must affect UR, consistent with SR result that OCP is satisfied.
3. All else equal, HLH is preferred to HL: (but why?)
4. Prefer to change prefix. (could be, affixes more likely to change)

## Shona summary

- $H \rightarrow L / H + \_\_$
- H becomes L after H in prefix
- ATB effect arises from prohibition on \*HH in one morpheme.
- Unresolved: how a process applies when it has multiple foci, e.g. H-H-H

Recall *né-mbúndúdzí*  $\rightarrow$  *né-mbùndùdzì*

- Why not strictly local effect \**né-mbùndúdzí*?
- If a language showed such a strictly local effect, could you analyze it?
- What would be the rule? Would it be consistent with the OCP?

# Summary of tonal patterns inspected

- Tone stability:  
non-tonal Fs can delete or coalesce, leaving tones behind.
- ATB changes:  
one long tone, linked to many Vs across Cs
- Tones unlinked to Vs in UR  
may seek to land on some V in SR
- Vs unlinked in UR to any Ts
- ATB tonal changes

# Interpreting \*CrossedLines

- Association = overlap in time
- Intuition: pairs of events that overlap in time have mutually consistent precedence relations

- If  $V_a$  —  $T_1$

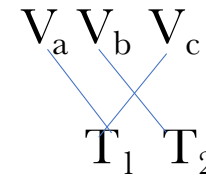
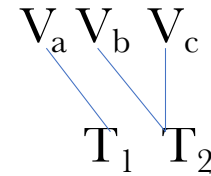
- If  $V_b$  —  $T_2$

- And if  $T_1$  precedes  $T_2$

- Then  $V_a$  precedes  $V_b$

- In the crossed-lines case

$T_1$  precedes  $T_2$ , but  $V_c$  does not precede  $V_b$



# Vowel Harmony

VH: all Vs in a word, or all Vs in a contiguous region of the word, have the same value for some vowel feature(s).

# Front Harmony (FH)

All vowels are front (e.g. *bebi*).

Or all are non-front or back (e.g. *bobu*).

Not both (no *\*bebu*).

| Front |   |   | Back or central |       |       |
|-------|---|---|-----------------|-------|-------|
| i     | y | e | u               | ɨ     |       |
| e     | œ | æ | o               | ɜ (ʌ) | a (ɑ) |

# Rounding Harmony (RH)

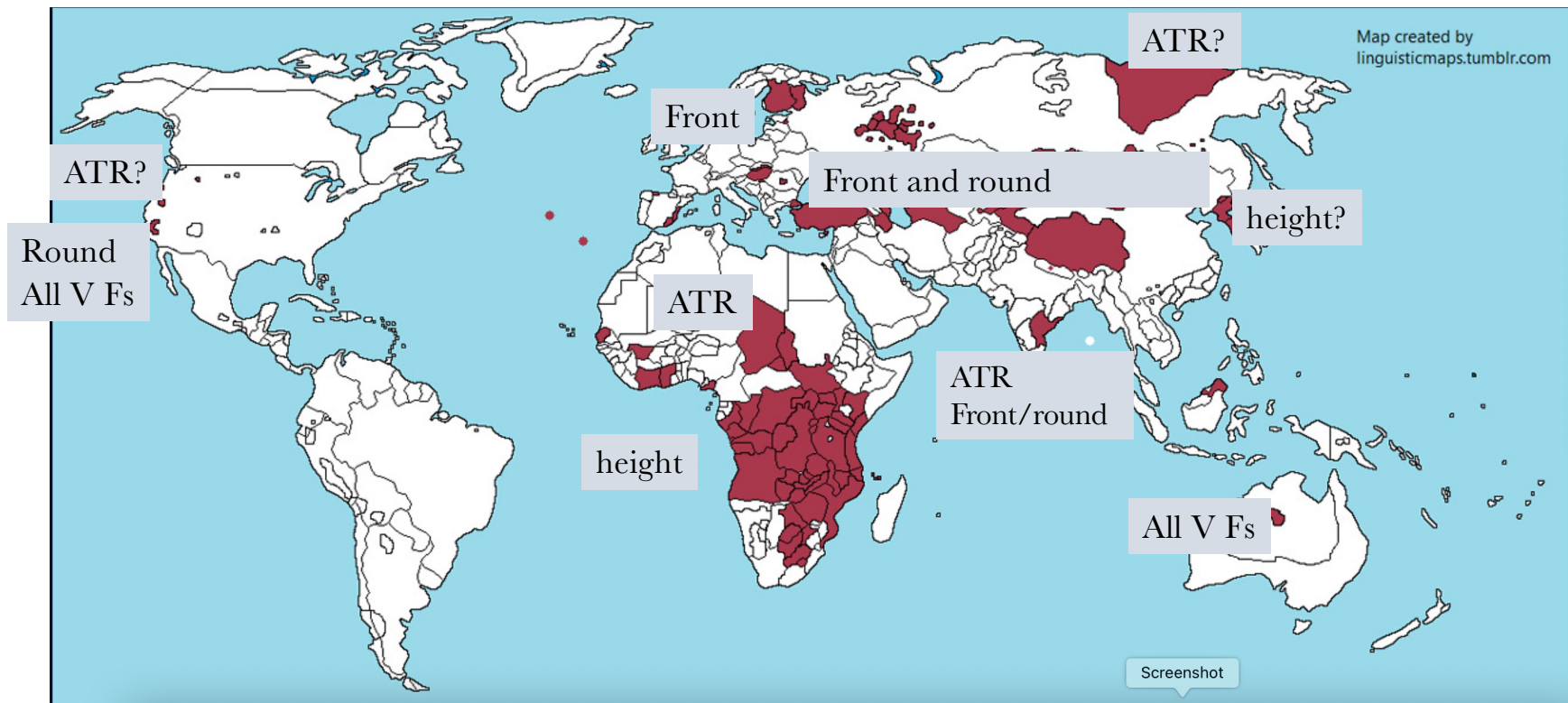
All vowels are rounded (e.g. *bubobu*).

Or all are unrounded (e.g. *babibe*).

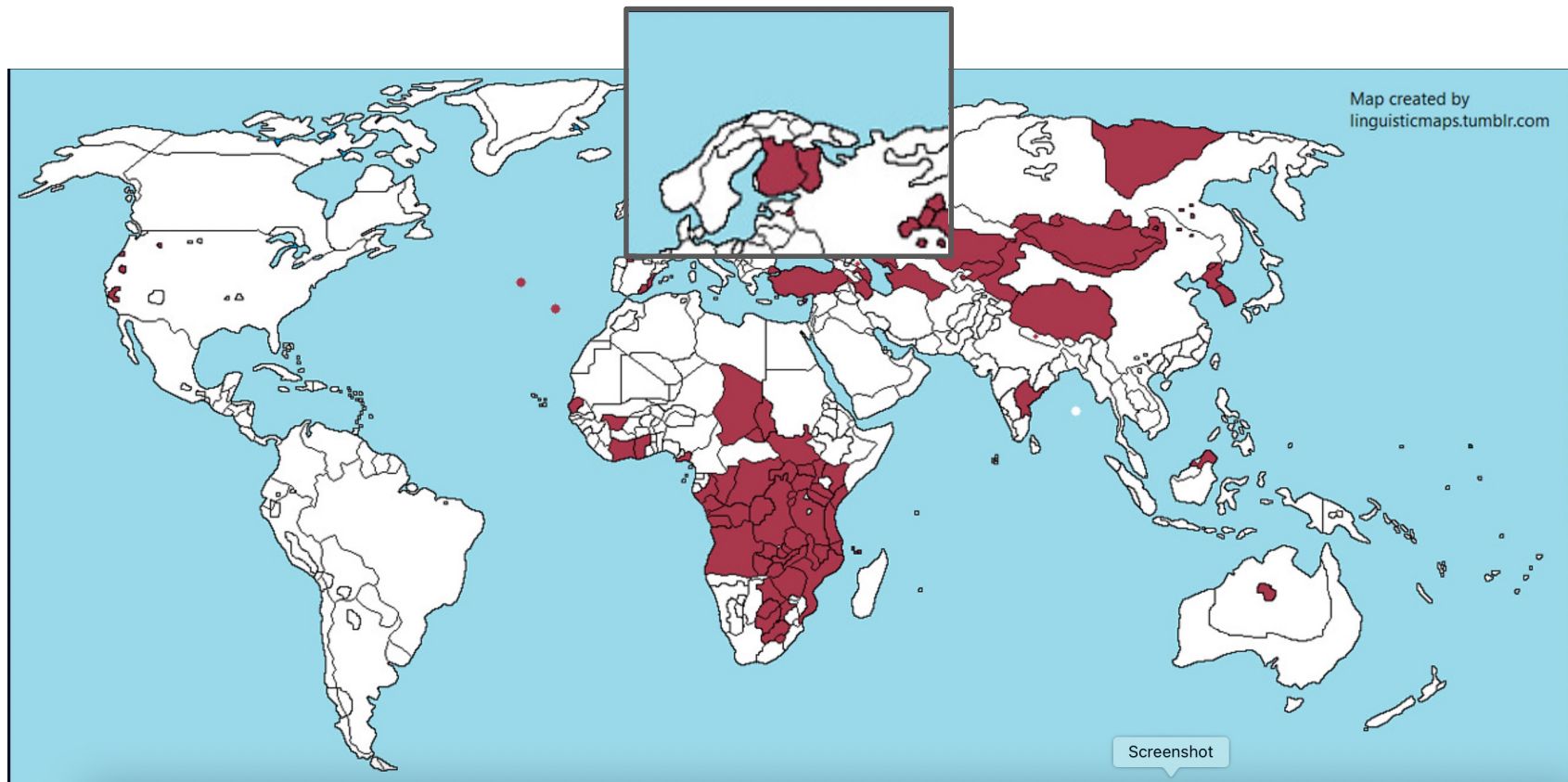
Not both (no *\*babu*).

| Rounded |   |   |   | Unrounded |   |   |   |
|---------|---|---|---|-----------|---|---|---|
| u       | y | œ | o | ɪ         | ɨ | e | a |

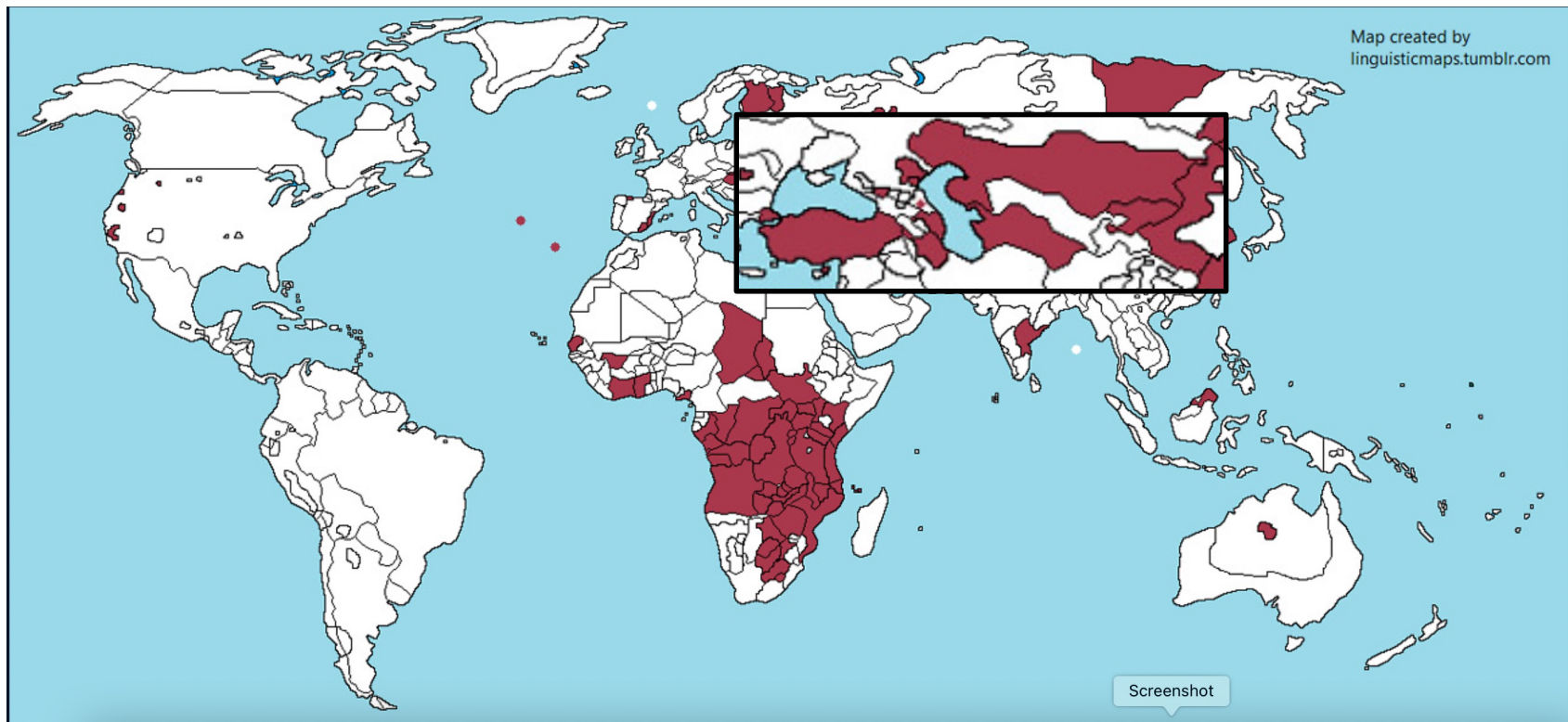
# VH in the languages of the world



# Uralic



# Turkic



# Vowel Harmony points previewed

- (a) VH stems from a *condition on surface representations* (SRs),
- (b) Some evidence that *VH obeys the OCP*: one F value linked to many Vs
- (c) VH is satisfied modulo conditions *prohibiting some Vs from changing their Fs*
- (d) Tests of VH productivity

# Turkish Vowel Harmonies

|     |         | <b>Nom</b> | <b>Poss</b> | <b>Dat</b> | <b>Your X</b> | <b>Nom Pl</b> | <b>Poss Pl</b> |
|-----|---------|------------|-------------|------------|---------------|---------------|----------------|
| 1.  | fish    | balık      | balığı      | balığa     | balığınız     | balıklar      | balıkları      |
| 2.  | room    | oda        | odası       | odaya      | odanız        | odalar        | odaları        |
| 3.  | river   | dere       | deresi      | dereye     | dereniz       | dereler       | dereleri       |
| 4.  | fox     | tilki      | tilkisi     | tilkiye    | tilkiniz      | tilkiler      | tilkileri      |
| 5.  | iron    | çti        | çtisi       | çtiye      | çtiniz        | çteler        | çteleri        |
| 6.  | end     | son        | sonu        | sona       | sonunuz       | sonlar        | sonları        |
| 7.  | pipe    | boru       | borusu      | boruya     | borunuz       | borular       | boruları       |
| 8.  | school  | okul       | okulu       | okula      | okulunuz      | okullar       | okulları       |
| 9.  | village | köy        | köyü        | köye       | köyünüz       | köyler        | köyleri        |
| 10  | coal    | kömür      | kömürü      | kömüre     | kömürünüz     | kömürler      | kömürleri      |
| 11. | motel   | motel      | moteli      | motele     | moteliniz     | moteller      | motelleri      |
| 12  | book    | kitap      | kitabı      | kitapa     | kitabınız     | kitaplar      | kitapları      |

# Turkish Vowel Harmonies

|     |         | <b>Nom</b> | <b>Poss</b> | <b>Dat</b>          | <b>Your X</b> | <b>NPl</b> | <b>Poss Pl</b> |
|-----|---------|------------|-------------|---------------------|---------------|------------|----------------|
| 1.  | fish    | balık      | balıki      | balika              | balikiniz     | balıklar   | balıkları      |
| 2.  | room    | oda        | odasi       | odaja               | odajaniz      | odalar     | odaları        |
| 3.  | river   | dere       | deresi      | dereje              | dereniz       | dereler    | dereleri       |
| 4.  | fox     | tilki      | tilkisi     | tilkije             | tilkiniz      | tilkiler   | tilkileri      |
| 5.  | iron    | yty        | ytysy       | ytyje               | ytynyz        | ytyler     | ytyleri        |
| 6.  | end     | son        | sonu        | sona                | sonunuz       | sonlar     | sonları        |
| 7.  | pipe    | boru       | borusu      | boruja              | borunuz       | borular    | boruları       |
| 8.  | school  | okul       | okulu       | okula               | okulunuz      | okullar    | okulları       |
| 9.  | village | kœj        | kœjy        | kœje                | kœjynyz       | kœjler     | kœjleri        |
| 10  | coal    | kœmyr      | kœmyry      | kœmyre              | kœmyryny      | kœmyrler   | kœmyrleri      |
| 11. | motel   | motel      | motel       | ‘disharmonic’ stems |               | moteller   | motelleri      |
| 12  | book    | kitap      | kitapi      | kitapa              | kitapiniz     | kitaplar   | kitapları      |

# Turkish Vs: F1-F0 ( $\approx$ height) by F3-F2 ( $\approx$ back-round)

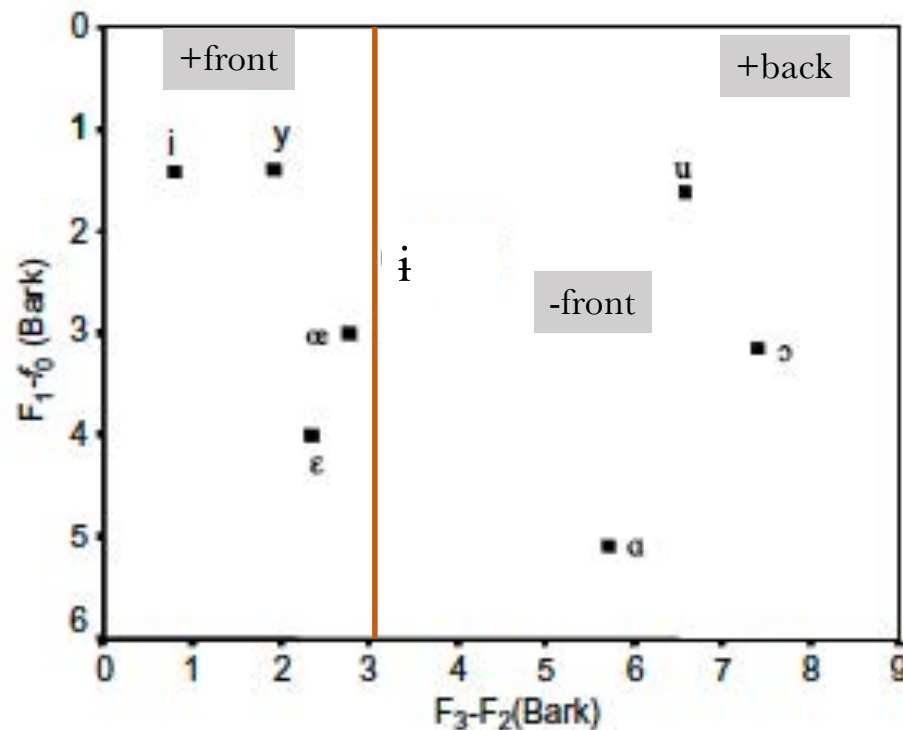


Fig. 1.  $F_2-F_1$  plot marking the averaged positions of Turkish vowels related to men. According to Kiliç's (2003) data.

Bark scale: a frequency scale where numerically equal distances correspond to perceptually equal distances

# Turkish Vs and their features; $\pm$ front

|       | i | y | ɨ | u | e | œ | o | ɑ |
|-------|---|---|---|---|---|---|---|---|
| high  | + | + | + | + | - | - | - | - |
| low   | - | - | - | - | - | - | - | + |
| front | + | + | - | - | + | + | - | - |
| back  | - | - | - | + | - | - | + | + |
| round | - | + | - | + | - | + | + | - |

# Turkish Vs and their features: $\pm$ round

|       | i | y | ï | u | e | œ | o | ɑ |
|-------|---|---|---|---|---|---|---|---|
| high  | + | + | + | + | - | - | - | - |
| low   | - | - | - | - | - | - | - | + |
| front | + | + | - | - | + | + | - | - |
| back  | - | - | - | + | - | - | + | + |
| round | - | + | - | + | - | + | + | - |

# Alternations

Plural:        lar/ler

Dative:        (j)a/(j)e

Possessive:    (s)i/(s)i/(s)y/(s)u

Your X:        iniz/iniz/ynyz/unuz

UR's for these suffixes:

## 2 observations about [+round] Vs and URs

- There typically aren't any [u, y, o, œ]'s in Turkish words except
  1. in 1<sup>st</sup> syllable of a root e.g. **oda, julaf,**
  2. or as a result of RH e.g. **bor-u, son-un-uz**
- Almost no native words like **baru, boralu** (loanword exceptions)
- Essentially no native words like ...**baro..., boro..., ...œo...**; same for **œ**
- Similar in essentially all Turkic, Mongolian languages with RH
- This suggests that non-initial vowels, incl. suffix vowels, have invariant [-round] values in UR;  
or are *underspecified*: no UR [round] values at all.

## Some options for specifying $[\pm\text{front}]$ in URs

- Suffix Vs have distinctive height,  $[\pm\text{high}]$ ,  $[\pm\text{low}]$ 
  - (i) They could lack  $[\pm\text{front}]$  in URs.  
If so, they get these Fs through VH and later rules.
  - (ii) Or a fixed value for  $[\pm\text{front}]$  in UR:  
e.g.  $[-\text{front}]$ , as in Pl.  $/\text{lar}/$ , Poss.  $/\text{i}/$  in items like *boru-lar-i*
- Stem Vs also have distinctive height in all positions
  - (i) They could have  $[\pm\text{front}]$  values in UR, in 1<sup>st</sup> syllable.
  - (ii) Unspecified  $[\pm\text{front}]$  in later Vs
  - (iii) Or fixed  $[\pm\text{front}]$  values in later sylls, as in suffixes.
- Disharmonic stems like *motel* must have  $[\pm\text{front}]/[\pm\text{round}]$  values for all Vs

# Vowel harmony rules

Front Harmony

V = [+syllabic], C = [-syllabic]

Round Harmony

Both rules operate *iteratively* = until they run out of potential input strings.  
For now, we stipulate this feature. Later we may try to derive it.

# Vowel harmony rules (prelim.)

Front Harmony

$V = [+syllabic], C = [-syllabic]$

$V \rightarrow [\alpha \text{ front}] / V_{[\alpha \text{ front}]} C_0 \_$

$C_0$  = any number of Cs including 0

**iterative** = applies to its own output

Could add a boundary symbol, e.g. +, to say that only suffixes undergo VH

$V \rightarrow [\alpha \text{ front}] / V_{[\alpha \text{ front}]} C_0 + C_0 \_$

Round Harmony

$V_{[+high]} \rightarrow [+round] / V_{[+round]} C_0 \_$

**iterative**

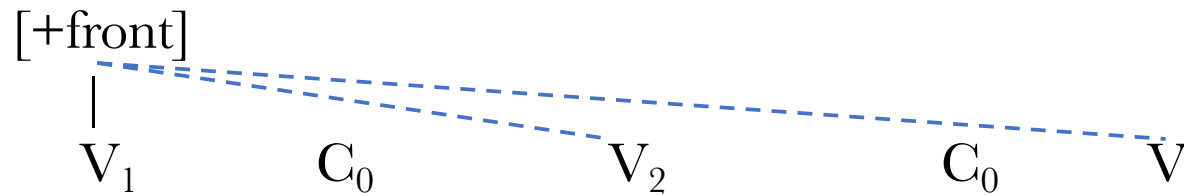
Add  $V_{[0round]} \rightarrow [-round]$

if suffix Vs lack any  $[\pm round]$  in UR

Height adjustment

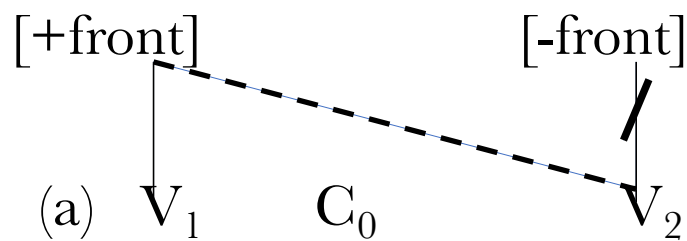
$V_{[+front]} \rightarrow [-low] \quad (\text{æ} \rightarrow \text{e})$

A different statement satisfies the OCP:  
*VH spreads* [ $\alpha$  front], [ $\beta$  round]



derivation of VH in *kæmyrler*

# Autosegmental rule of Front Harmony



(a)  $V_1$

$C_0$

$V_2$

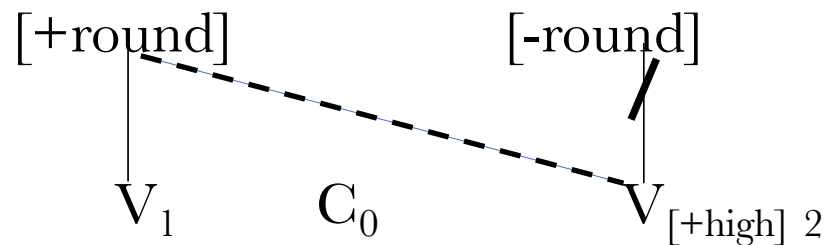
(i) iterative

(ii)  $V_{1,2}$  not in same root (cf. *motel*); preliminary

Need to delink  $[-front]$  if target  $V$  is specified as  $[-front]$  in UR.

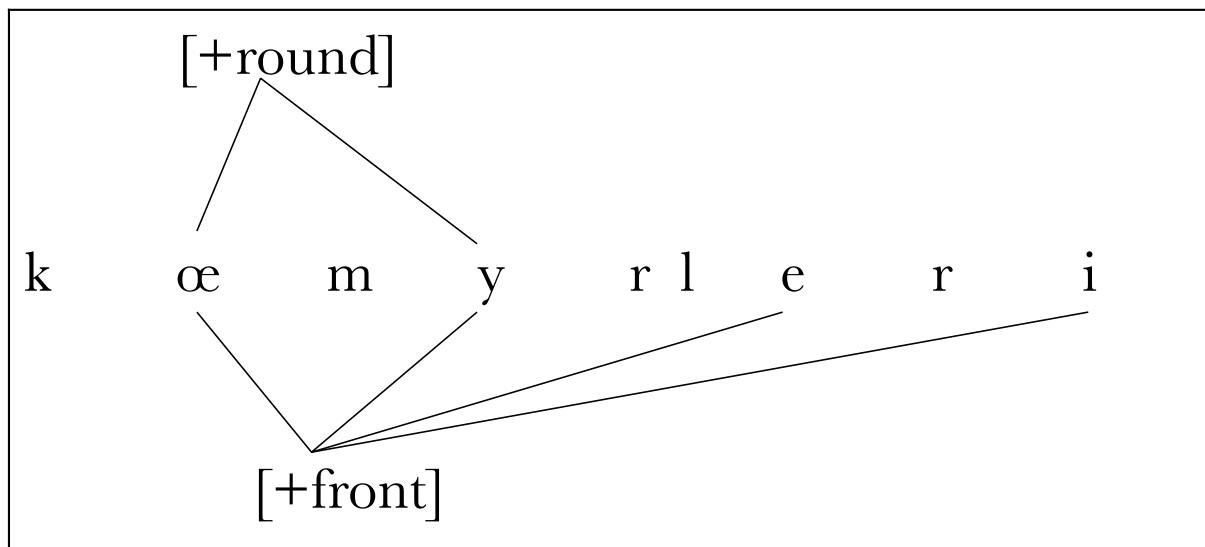
Rule could also specify that both values of  $[\pm front]$  spread: substitute  $[\alpha front]$  for the spreading value,  $[-\alpha front]$  for the value delinked

## Autosegmental rule of Round Harmony (prelim.)

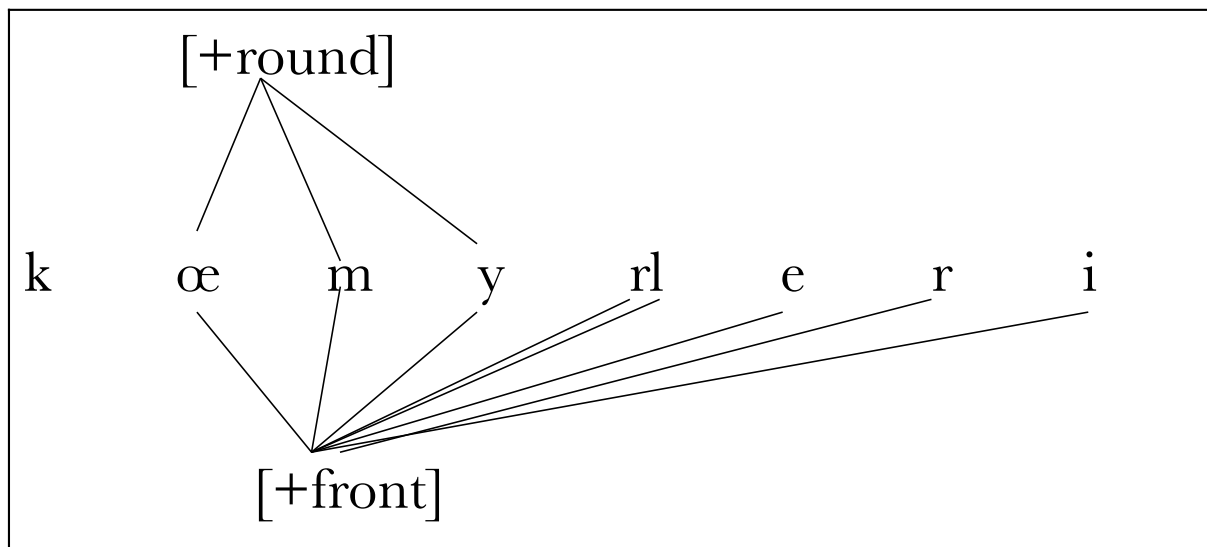


- (i) Iterative (e.g. *jol-unuz*, *jol-lar-iniz* ‘your road(s)’)
- (ii) Might need to say: “ $V_{1,2}$  not in same root”, but see below.  
(a loanword like *polis* (= *police*) is realized as *polis*, not *\*polys*)

Autosegmental representation  
resulting from harmony; OCP is satisfied.



# Perhaps even Cs participate



## Direction: Turkish VH & inserted Vs

|            | Careful  | Casual               |
|------------|----------|----------------------|
| a. France  | Fransa   | Firansa              |
| b. prince  | prens    | pirens               |
| c. test    | prova    | purova, pirova       |
| d. Prussia | prusja   | purusja, pirusja     |
| e. protest | protesto | purotesto, pirotesto |

### Analysis of casual loanwords?

|               |          |                   |
|---------------|----------|-------------------|
| g. blue jeans | blacgin  | bulacgin, blacgin |
| h. bromide    | brom     | burom, birom ...  |
| i. brake      | fren     | firen ...         |
| j. cruiser    | kruvazor | kuruvazor ...     |
| k. group      | grup     | gurup ...         |
| l. Dracula    | drakula  | dirakula          |
| m. speaker    | spiker   | sipiker, ...      |
| n. stage      | sta3     | sitaz             |

## Direction: Turkish VH & inserted Vs

|           | Careful | Casual         |
|-----------|---------|----------------|
| a. France | Fransa  | Firansa        |
| b. prince | prens   | pirens         |
| c. test   | prova   | purova, pirova |

(1) Epenthesis of *i*, followed by oblig. FH, optional RH, *Right-to-Left*  
So speakers infer that VH *operating RL* is possible.

They also infer that *VH is possible inside roots*

(2) How do they know this? Loanwords are recent and infrequent.  
Not a rich source of evidence.

Other words suggest VH doesn't happen in roots: *motel, kitap, bludzin*

|            |         |              |
|------------|---------|--------------|
| k. group   | grup    | gurup ...    |
| l. Dracula | drakula | dirakula     |
| m. speaker | spiker  | sipiker, ... |
| n. stage   | staʒ    | sitaz        |

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