

# Geminate!

## Sonority beyond syllables

Mohamed Lahrouchi

CNRS & Université Paris 8

Réseau Français de Phonologie Conference, Amiens 2024

## Classical Arabic

katab ‘he wrote’

kattab ‘he made write’

### Prosodic Morphology

1970’s => templates as fully-fledged morphemes (autoseg. phon.)

Form I:  $\sqrt{\quad}$  + CVCVC + vocalic melody / Form II:  $\sqrt{\quad}$  + CVCCVC + vocalic melody

1990’s => templates are not primitives; they “[...]are a particular kind of constraint of the large align family” (McCarthy & Prince 2001: 109).

Berber

χðəm ‘work’

χəddəm ‘work.imperf’

## Tashlhiyt Berber

lkm ‘arrive’

l**kk**m ‘arrive.imperf’

frn ‘sort’

f**fr**n ‘sort.imperf’

Q1: Assuming that morphology is additive and linear, what kind of morpheme does gemination stand for?

Q2: How is it processed in the phonology? What does such an operation tell about the phonology of the language?

Q3: Is there any principled way to predict which verb undergoes which operation (gemination vs. prefixation)?

# Roadmap

I. Types of morphemes

II. The syllable in Tashlhiyt

III. Gemination

1. Geminate the onset

a) The basics

b) Crosslinguistic evidence (if any)

c) Counterexamples

2. Geminate the head

3. Add a mora

IV. Sonority again

1. Loanword adaptation

2. Perception (Zellou, Lahrouchi & Bensoukas 2022, 2024)

3. Rhyme Prime

V. Concluding remarks

# Types of morphemes

- Affixation generally mobilizes 3 types of morphemes:
  1. Canonical morphemes (meaning and form).
  2. Defective (phonetically uninterpretable) morphemes such as a mora affix integrated in the prosodic structure (Trommer & Zimmermann 2014).
  3. Empty or null morphemes, often referred to as zero affixation or conversion (linguists may disagree on the meaning of these labels, see Lieber 1981, 2016: 75).
    - $[\text{v}]$  or  $[\text{n}] \Leftrightarrow \emptyset \{\sqrt{\text{chair}}\}$
    - $[\text{+PL}] \Leftrightarrow \emptyset \{\sqrt{\text{sheep}}, \sqrt{\text{deer}}\}$
    - Bosnian:  $\sqrt{\text{okvin}}$  'window' +  $\text{Gen}(\emptyset)$  +  $\text{Num}(\emptyset)$  +  $\text{Case}(\emptyset) \Rightarrow [\text{okvir}]$  (Lampitelli 2021: 43)
  4. Semantically empty morphemes: e.g. tarte-**l**-ette vs. char-ette (Plénat 2005, Lahrouchi 2022).

# Tashlhiyt syllable structure: almost everything goes!

- Tashlhiyt makes extensive use of complex consonants clusters; many words consist exclusively of consonants.

↳ A highly marked syllable structure (Dell & Elmedlaoui 1985, 2002):

- Any segment – even a voiceless obstruent – can act as the nucleus of a syllable (see also Boukous 1987).
- The competition for the nucleus position is driven by the relative sonority of segments: the most sonorous segment within the domain of syllabification is selected as the head of the syllable.
- Sonority scale : a > high vocoids > liquids > nasals > fricatives > stops (Dell and Elmedlaoui 2002: 76).
- Syllabic nuclei are selected first, then, any remaining unsyllabified segment is attached to the coda.
- Additional constraints hold for onsets (\*onsetless syllables, \*complex onsets), codas, and geminates (\*onset + nucleus).

# Tashliyt syllable structure: almost everything goes!

- Dell & Elmedlaoui (2002 : 144)

UR	Syllabification	Phonetic Form	Gloss
/i-χng/	i.χn̩g	iχ@n@g	'he strangled'
/t-sbɁ/	t̩.s̩bɁ	ts@bɁ	'she painted'
/smd/	s̩m̩d	s@md	'add'
/lmd	l̩.m̩d	l@md	'learn'

- Words with exactly the same number of consonants may display different syllabic structures:
  - Monosyllabic **smd** vs. disyllabic **lmd**.
- [ @ ]'s stand for transitional vocoids that have no syllabic status (*contra*. Coleman 1996, 2001).
- Morphological gemination corroborates the alleged syllabic difference.
- Verbs that undergo gemination must not contain:
  - more than 3 segments
  - a vowel (except in final position)
  - a lexical geminate



# Geminate the onset

- Imperfective gemination: Tash.:  $C_1C_2C_3 \rightarrow \mathbf{C_1C_1}C_2C_3$  or  $C_1\mathbf{C_2C_2}C_3$   
Other Berber varieties:  $C_1C_2C_3 \rightarrow C_1\mathbf{C_2C_2}C_3$
- The choice of geminated consonant in Tashlhiyt relies, Dell & Elmedlaoui (1988) argue, on the information provided by the syllabification algorithm.
- The consonant undergoing gemination is the one “...syllabified as an onset by Core Syllabification in the basic stem” (D&E 1988: 11).

# Geminate the onset

*Aorist*

ṃ.g̣ṛ

ṃ.ḍʳ̣ḷ

ɸ̣.ḅṛ

ḅ.ṣṛ

ḳ.j̣ṃ

ŋ̣.ṭḷ

*Imperfective*

mggr

mddʳl

ɸbbr

bssr

kjfm

nttl

‘harvest’

‘burry’

‘disappear’

‘spread’

‘enter’

‘hide’

# Geminate the onset

*Aorist*

*Imperfective*

sṃd

ssmd

‘add’

kṛz

kkrz

‘plough’

fṛn

ffrn

‘sort’

fṛg

ffrg

‘enclose’

χṛb

χχrb

‘scratch’

ḥḥlb

ḥḥlb

‘eat (liquid food)’



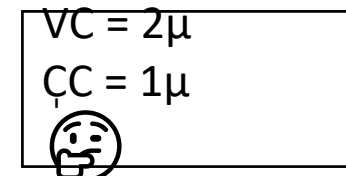
# Constraints on the input?

- The statement that the verbs must not contain a vowel in a non-final position for them to undergo gemination “*is curious in two regards: first, it is nothing else than the formulation of surface characteristics of geminating bases; second it needs to make reference both to the segmental composition and the syllabic make-up of the base*” (Jebbouir 1999: 107).
- Why do CVC and VCV verbs resist gemination?
- CVC verbs display the same syllabic structure as CÇC verbs, and VCV the same structure as Ç.CÇ.

# A constraint on the output

- The output to gemination must contain 2 light syllables or moras (Jebbouir 1999, Bensoukas 2001).

<i>Verb base</i>	<i>Onset gemination</i>	<i>Syllabic structure</i>	<i>Type of syllables</i>
frs	ffrs	f.frs <u>C</u> .O <u>CC</u>	LL
fsr	fssr	fs.sr O <u>C</u> .O <u>C</u>	LL
gru	grru	gr.ru O <u>C</u> .O <u>V</u>	LL
mun	*mmun	m.mun <u>C</u> .O <u>VC</u>	*LH
amr	*ammr	am.mr <u>VC</u> .O <u>C</u>	*HL
aru	*arru	ar.ru <u>VC</u> .O <u>V</u>	*HL





# The onset as a target

- Would Tashlhiyt be the only language that displays a highly unusual pattern, where a morphological operation targets an onset constituent?
- An onset that may be in word-initial or medial position.
- Any crosslinguistic evidence?
  - Alabama (Muskogean, US)
  - Keleyi (Malayo-Polynesian)
  - Hausa (Chadic)
  - Tagalog (Austronesian)
  - Samoan (Oceanic), Yoruba (West Africa)

# The onset as a target

- Alabama Imperfective gemination (Hardy & Montler 1988, Samek-Lodovici 1992).

	<i>Base</i>	<i>Imperf</i>	
a.	atakaa-li	atá <b>k</b> kaali	‘hang one object’
	afinap-li	afinnapli	‘lock up’
b.	atak-li	át <b>t</b> akli	‘hang more than one object’
c.	is-i	í <b>i</b> si	‘take, catch’
	campo-li	camp <b>o</b> oli	‘taste good’

- Words with an open antepenultimate syllable geminate the second onset.
- Disyllables and words with a closed antepenultimate but a light penultimate syllable lengthen the vowel of the penultimate syllable.

# The onset as a target

- Keleyi, Malayo-Polynesian (Hohulin & Kenstowicz 1979, Samek-Lodovici 1992).

	<i>Base</i>	<i>Subject focus</i>	<i>Object focus</i>	<i>Accessory focus</i>	
a.	pili	um-pilli	pilli	ʔi-ppili	‘to chose’
	dujag	um-dujjag	dujjag	ʔi-ddujag	‘to pour’
b.	duntuk	um-duntuk	duntuk	ʔi-dduntuk	‘to punch’

- Gemination is part of a complex of morphological alterations by which verbs relate to the focus-status of specific NP’s.
- It marks the non-perfect.
- It triggers the second onset if the first syllable is light.



# The onset as a target

- Hausa (Newmann 2000: 414, Součková 2011: 90): CVC-redup. > gemination.

<i>Verb</i>		<i>Pluractional</i>	
bugàa	‘beat’	bub <b>bb</b> ugàa	< /bugbugàa/
kiraa	‘call’	kik <b>kk</b> iraa	< /kirkiraa/
mutù	‘die’	mum <b>mm</b> utù	< /mutmutù/
tàmbajaa	‘ask’	tà <b>tt</b> tàmbajaa	< /tàm <span style="font-variant: small-caps;">t</span> tàmbaj/
fìta	‘go out’	fì <b>ff</b> ita	< /fì <span style="font-variant: small-caps;">f</span> fita/

# The onset as a target: infixation

- Tagalog (Spencer 1991: 12, Lieber 2016: 84): Insert <um> after the 1<sup>st</sup> consonant of the root (= word-initial onset).

## *Base*

ganda

'beauty'

hirap

'difficulty'

sulat

'epistolary, letter'

gradwet

'graduate'

preno

'brake'

## *Verb*

**gum**anda

'become beautiful'

**hum**irap

'become difficult'

**sum**ulat

'write'

**grum**adwet ~ **gum**radwet

'graduate'

**prum**eno ~ **pum**reno

'brake'

# The onset as a target: reduplication

Samoan (Spencer 1991: 151, Lieber 2016: 93): CV-Redup. (determined by stress).

Yoruba (Spencer 1991: 151): reduplicate the first consonant (+vowel /i/)

<i>SG</i>	<i>PL</i>	
tóa	totoá	'brave'
má:	mamá:	'ashamed'
alófa	a:lolófa	'love'
galúe	ga:lulúe	'work'
maʔalili	maʔalilili	'(feel) cold'

<i>Verb</i>		<i>Adj or Noun</i>
lo	'go'	lilo
dum	'be tasty'	dídun
ta	'sell'	tita
je	'eat'	jije
mu	'drink'	mimu

# The onset as a target

		C1	C2	Condition
<b>Gemination</b>	Tashlhiyt	✓	✓	if syllabified as an onset
	Alabama	✓	✓	if penultimate
	Keleyi		✓	if 1 <sup>st</sup> $\sigma$ open
	Other Berber varieties		✓	-
	Arabic		✓	-
	Hausa		✓	-
<b>Infixation</b>	Tagalog	✓		-
<b>Reduplication</b>	Yoruba	✓		-
	Samoan	✓	✓	if C belongs to the stressed $\sigma$

# The onset as a target

- The choice of geminated consonant may rely on stress placement or syllable types.
- Infixation and reduplication target word-initial C (except for Samoan).
- Tashlhiyt is unique in that gemination targets the initial or medial consonant because syllabified as an onset.
- The analysis therefore predicts that any CCC verb with a consonant in the onset position must resort to gemination in the imperfective.

# Geminate the onset

	<i>Aorist</i>		<i>Imperfective</i>	
a.	bzg	*bbzg	tzbzag	‘enflate’
	bdg	*bbdg	tzbdag	‘be wet’
	k <sup>w</sup> f <sub>ɪ</sub> s	*kk <sup>w</sup> fs	ttk <sup>w</sup> fas	‘sow’
b.	r <sub>ɪ</sub> kz <sub>ɪ</sub>	*rkkz	ttrkaz	‘dance’
	r <sub>ɪ</sub> qs <sub>ɪ</sub>	*rqqqs	ttrqas	‘jump’
	n <sub>ɪ</sub> gs <sub>ɪ</sub>	*ngggs	ttn gas	‘jostle’

- Syllable-based analyses fail to explain why these verbs resist gemination.
- Either they are entirely made of obstruents or the only sonorant they contain appears in the initial position.

# Geminate the head

- Syllable structure is not relevant in determining the verbs candidate to gemination in the imperfective.
- For any verb to undergo gemination, it must contain an obstruent-sonorant sequence.
- The obstruent functions as the head of the root, the sonorant its complement.
- The consonant that is geminated is the one that acts as the head of the root.

*Lahrouchi (2009, 2010)*

# Geminate the head

*Aorist*

mgr

md<sup>ɣ</sup>l

ɸbr

bsr

gzm

ntl

*Imperfective*

mggr

mdd<sup>ɣ</sup>l

ɸbbr

bssr

gzzm

nttl

‘harvest’

‘burry’

‘disappear’

‘spread’

‘cut’

‘hide’



# Geminate the head

*Aorist*

smd

krz

frn

frg

χrb

ħlb

*Imperfective*

ssmd

kkrz

ffrn

ffrg

χχrb

ħħlb

‘add’

‘plough’

‘sort’

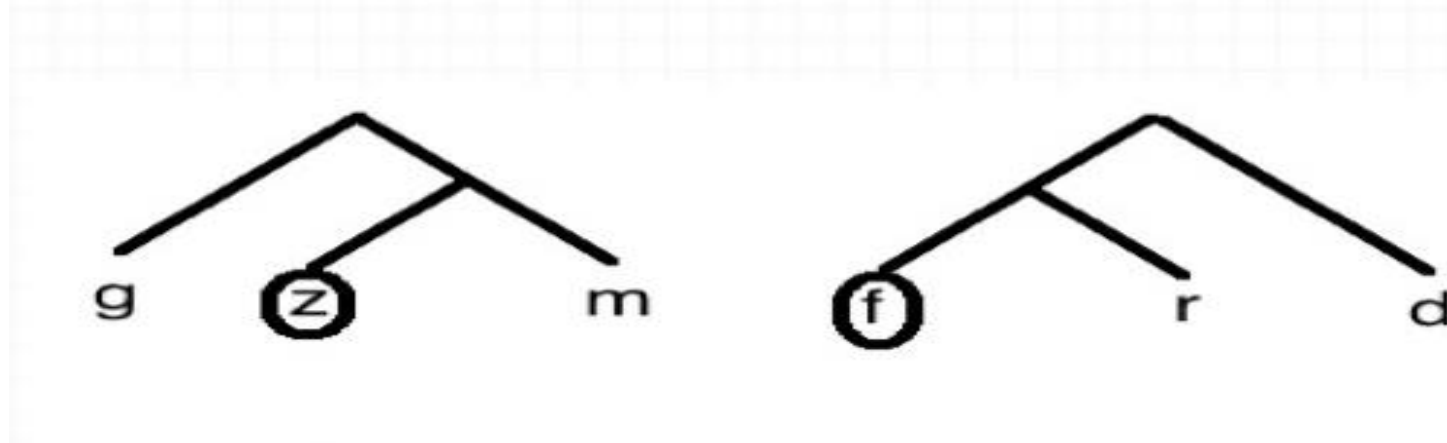
‘enclose’

‘scratch’

‘eat (liquid food)’

# Geminate the head

- The obstruent is the head of the root, the sonorant its complement.
- The segment that is geminated is the one that appears in the head position.



# Add a mora

- Lombardi and McCarthy (1990) posit a purely prosodic affix made of an empty mora.
- Gemination emerges when this affix is inserted in a base and filled by one of the nearby segments.
- Samek Lodovici (1992: 2) decomposes morphological gemination into two modules:
  - a. Affixation module:** freely add the moraic morpheme to the original base and freely alter the original base's prosodic configuration.
  - b. Selection module:** select the optimal derivation, i.e. that derivation whose phonological configuration fits best the constraints of the language.

# Add a mora

- Lombardi and McCarthy (1990) posit a purely prosodic affix made of an empty mora.
- Gemination emerges when this affix is inserted in a base and filled by one of the nearby segments.
- Samek Lodovici (1992: 2) decomposes morphological gemination into two modules:

**a. Affixation module:** freely add the moraic morpheme to the original base and freely alter the original base's prosodic configuration.

**b. Selection module:** select the optimal derivation, i.e. that derivation whose phonological configuration fits best the constraints of the language.

Morphology

Phonology

# Add a mora

- Bensoukas (2001: 122) claims that “[I]mperfective formation in Tashlhiyt consists in affixing a consonantal mora to the verb root”.
- *tt-* prefixation and gemination are variant realizations of this underlying empty consonantal mora.
- The choice of either realization relies on the interaction of specific well-formedness constraints, including:
  - (i) a bimoraicity constraint that is responsible for the choice between gemination and *tt-* prefixation.
  - (ii) a sonority contour constraint that determines which consonant geminates in the verb.

# Sonority again: loanword adaptation

- Tashlhiyt speakers interpret the French uvular fricative as a coronal tap.

<i>French</i>	<i>Tash. Berber</i>	
tχ̃ɛ	træn	'train'
tχavopyblik	traboblik	'public works'
fχ̃ɑs	frænsa	'France'
la bβik	labrik	'the brick'
kuβwa	kr <sup>ʰ</sup> wɑ	'timing belt'
bβuwɛt	br <sup>ʰ</sup> wɛt <sup>ʰ</sup>	'wheelbarrow'
agβemã	gɾima	'taxi license'

*Lahrouchi (2020)*

# Sonority again: loanword adaptation

- The Obstruent-Sonorant (Head-Complement) structure helps the Tash. speakers to interpret complex onsets in French as containing a sonorant preceded by an obstruent.
- Any rhotic preceded by an obstruent is thus interpreted as a sonorant, regardless of its phonetic nature (even if realized as a uvular fricative).

# Evidence from perception

Zellou, Lahrouchi & Bensoukas (2022)

- Tashlhiyt Berber listeners are able to better discriminate word pairs beginning with a rising-sonority cluster than those that begin a non-rising sonority.
- Why? Because they are active in the phonology of Tash (at the root structure).
- Naive (English) listeners also perceive rising-sonority clusters better than other types of clusters.



# Evidence from perception

Zellou, Lahrouchi & Bensoukas (2024)

- Test the perception of vowelless words in Tashlhiyt Berber, as opposed to vowelised words.
- Examine the effect of clear speech, a type of intelligibility-enhancing mode of speaking, on the discrimination of these contrasts, compared to casual speech.
- Does the sonority profile of consonant clusters affect the perception of vowelless words?

- Cross-linguistically, consonant clusters tend to be constrained – Why?
  - Perceptual explanation:
    - It is harder to identify a consonant when it appears in a cluster (Ohala 1993, Blevins 2004).
    - A stop produced before another stop will result in fewer and less robust acoustic cues.
    - Consonants harder to identify even in languages with genuine complex onsets (Cutler et al., 1987): e.g. /b/ in *band* vs. *brand*.

- Crosslinguistic dispreference of non-rising sonority profiles (Berent et al. 2007).
- Speakers from various language backgrounds prefer rising sonority profiles:
  - e.g. English blik > bnik > bdik > lbik
  - **blik** is an accidental gap.
  - \***bnik**: English has a structural constraint that prevents its morphemes from beginning with a labial C followed by a nasal C (Booij 2011).

# Perception of vowelless words

Zellou, Lahrouchi & Bensoukas (2024)

- 150 words (48 CVC et 98 CCC)
- Classified with regard to the sonority profile of  $C_1C_2$ :
  - OSC – rising sonority(28)
  - SOC – falling sonority (24)
  - OOC – plateau (46)
  - SSC – (4) *rwl* ‘run away’  
*mlk* ‘own’  
*wrt* ‘inherit’  
*mnʕ* ‘prohibit’

# Paired Discrimination task

*Which pair contains different words?*

CVC  
trials

f a n f a n

*pair 1*

f a n f i n

*pair 2*



# Paired Discrimination task

*Which pair contains different words?*

CVC  
trials

f a n    f a n

*pair 1*

f a n    f i n

*pair 2*

 CCC  
trials

ʌ b r    ʌ b r

ʌ b r    ʌ d r

*+ white noise (0 dB SNR)*

<b>Discrimination Trial types</b>	<b>Diff Pair (e.g.)</b>	<b>Same Pair (e.g.)</b>
Non-minimal pairs	<i>sir – r<sup>ɹ</sup>uħ</i>	<i>r<sup>ɹ</sup>uħ – r<sup>ɹ</sup>uħ</i>
CVC v. CVC	<i>fan – fin</i>	<i>fin – fin</i>
CVC v. CCC [rising sonority]	<i>tuf – tlf</i>	<i>tlf – tlf</i>
CVC v. CCC [falling sonority]	<i>r<sup>ɹ</sup>uħ – rbħ</i>	<i>rbħ – rbħ</i>
CVC v. CCC [plateauing sonority]	<i>kar – kdr</i>	<i>kdr – kdr</i>
CCC [rising] v. CCC [plateau]	<i>fr<sup>ɹ</sup>ħ – fth</i>	<i>fth – fth</i>
CCC [plateau] v. CCC [plateau]	<i>fkt – fst</i>	<i>fst – fst</i>
CCC [falling] v. CCC [falling]	<i>nkr – ngr</i>	<i>ngr – ngr</i>

# Native and naive Listeners

## 28 Tash. speakers

- mean age: 40 years old
- 11 female, 17 male
- Agadir (n = 16), Marrakech (n = 2), Essaouira (n = 1), smaller villages (n = 9).
- recruited through email flyers.
- reported that Tashlhiyt was their first language and that both parents speak Tashlhiyt.
- The experiment was conducted online using Qualtrics.

## 28 English speakers

- mean age = 20 years old
- 14 female, 2 non-binary, 12 male
- recruited from the UC Davis subjects' pool.
- native speakers of American English. Four participants reported that they speak a language other than English in the home (Swahili, n = 1; Estonian, n = 1; Vietnamese, n = 1; Punjabi, n = 1).
- Non of them spoke or had studied Tashlhiyt or any of the languages of North Africa.



# Clear speech

- “*speak the words clearly to someone who is having a hard time understanding you.*”

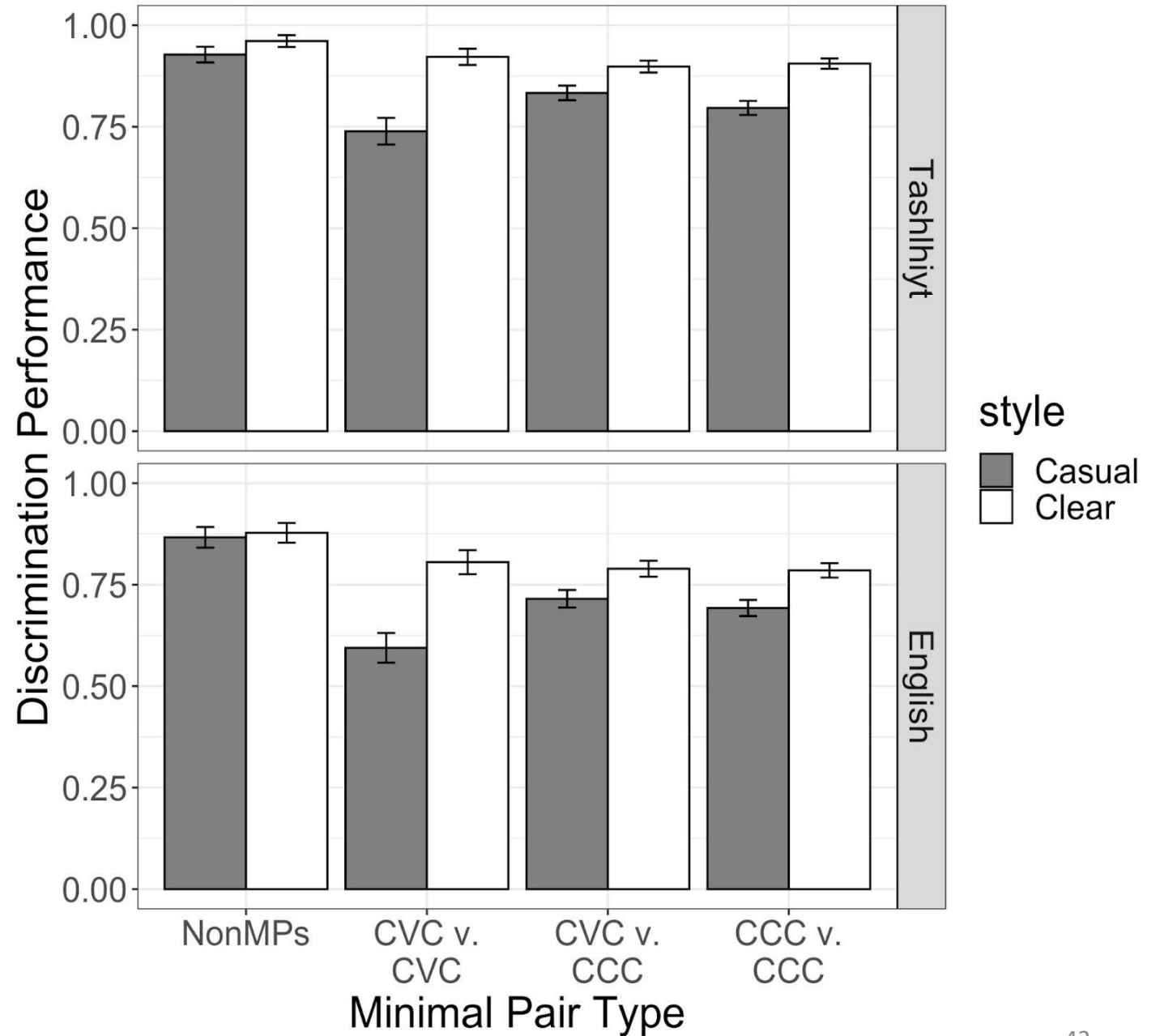
# Casual speech

- “*now, speak the list as if you are talking to a friend or family member you have known for a long time who has no trouble understanding you*”.

<i>inna daB ___ baħra</i>	"he said X again"
<i>ini ___ yat tklit</i>	"say X once"

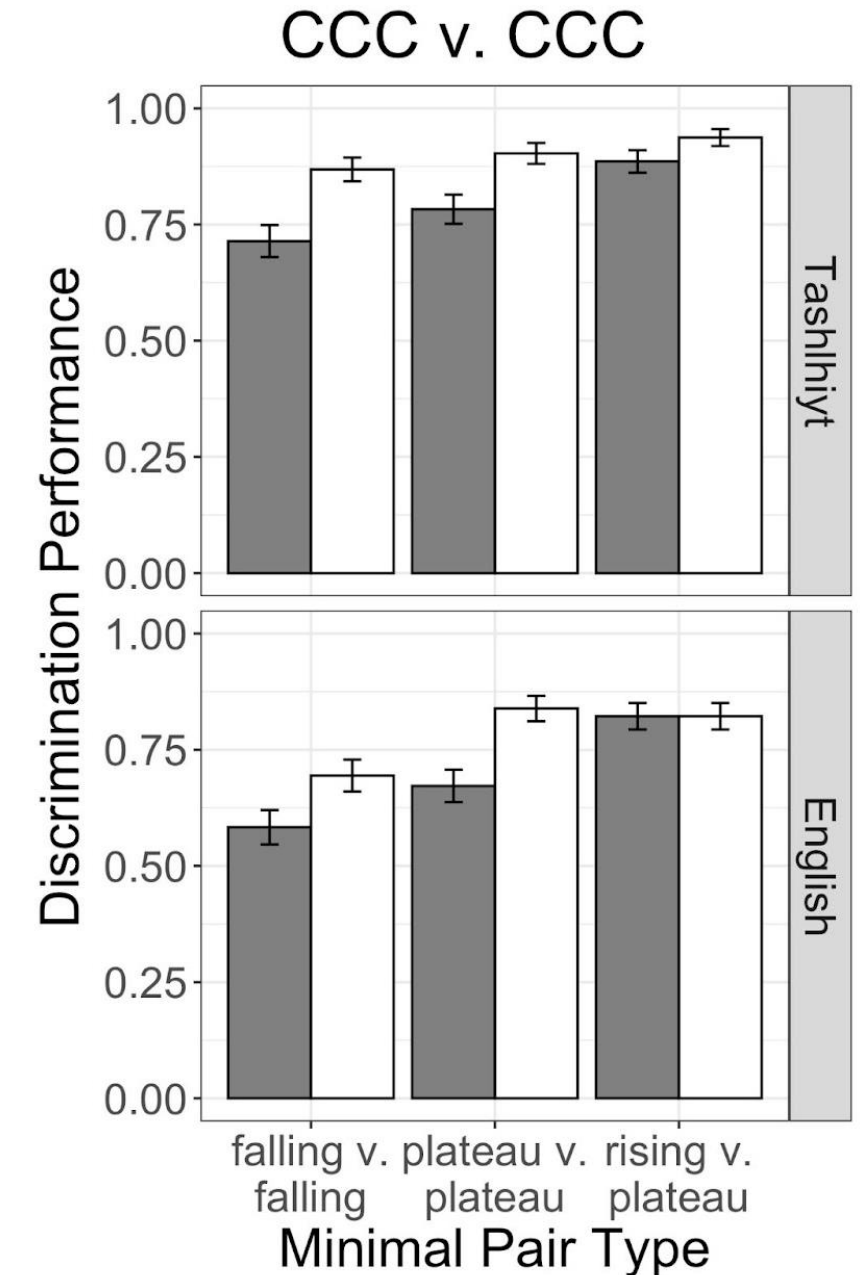
# Results

CVC v. CVC	<i>fan - fin</i>	<i>fin - fin</i>
CVC v. CCC	<i>tuf - tlf</i>	<i>tlf - tlf</i>
CCC v. CCC	<i>frh - fth</i>	<i>fth - fth</i>



# Vowelless words

CCC [rising] v. CCC [plateau]	<i>frħ - fth</i>
CCC [plateau] v. CCC [plateau]	<i>fkt - fst</i>
CCC [falling] v. CCC [falling]	<i>nkr - ngr</i>



# Rhyme prime

- Within Dell & Elmedlaoui's syllabification procedure, words that display the same number of consonants may have different syllabic structures:

**smd (1 $\sigma$ ) vs. lmd (2 $\sigma$ )**

- Any evidence from perception?
- I here report the preliminary results of an experiment that examines phonological priming to probe relatedness between Tashlhiyt words.
- The goal is to establish a baseline of phonological priming between Tashlhiyt words that will serve as a foundation for finer-grained studies of the syllable structure of Tash., asking whether the phonological priming of vowelless words involves any syllabic information of the type proposed by D&E.

*Lahrouchi, Benz, Guan, Tamminga & Embick (in progress)*

# Rhyme prime

- *Rhyme prime* refers to an effect produced by prime/target pairs sharing word-final overlapping phoneme sequences, typically words that share a syllable nucleus and coda (e.g. *cat* and *hat*).
- Rhyme prime produces a facilitatory effect, particularly in real (monosyllabic) words in French and English (cf. Radeau et al. 1995, Slowiaczek et al. 2000, Spinelli et al 2001, Bacovcin et al. 2017, Dufour et al. 2021).
- To what extent rhyme prime effects reflect syllabic structure or shared phonemes?
- Slowiaczek et al. (2000) found greater and more robust facilitation for pairs of the form *rank/bank* than for *honked/banked*.
- 3 phonemes are shared in both pairs, the greater facilitation in *rank/bank* can be attributed to the shared syllabic structure (i.e. the rhyme).

# Rhyme prime

- The experiment reported here focuses on monomorphemic words with identical final two consonants (e.g. **smd** ‘add’, **lmd** ‘learn’).
- We use a rhyme prime paradigm to probe phonological relatedness between words.
- We hypothesize that this paradigm can provide additional evidence for the syllabification of Berber words.
- Here we report a first step towards this goal, testing whether the processing of  $C_1C_2C_3$  targets can be facilitated with primes that share  $C_2C_3$ .

# Experiment

- Participants, stimuli & procedure
  - 80 native speakers (39 female, 41 male), mean age: 26, students at the University of Agadir.
  - 36 target items: primarily CCC words, with a subset CVC words ( $n = 8$ ).
  - Each target had two prime conditions: phonologically related ('Rhyme'), and control (unrelated).
  - Each participant heard all 36 targets, half in each condition (Rhyme vs Unrelated).
  - 2 lists were set so that each item appeared as a prime (in list 1) and as a target (in list 2).
  - Each list consisted of a total of 360 items: 180 words, and 180 pseudo-words.

- Illustration of list structure (critical items)

<b>List 1</b>		<b>List 2</b>	
PRIME	TARGET	PRIME	TARGET
smd	hmd	nkr	hmd
nkr	lmd	smd	lmd
f <sub>l</sub> m	s <sub>l</sub> m	χ <sub>r</sub> b	s <sub>l</sub> m
χ <sub>r</sub> b	z <sub>l</sub> m	f <sub>l</sub> m	z <sub>l</sub> m
m <sub>g</sub> r	l <sub>g</sub> r	s <sub>l</sub> χ	l <sub>g</sub> r
s <sub>l</sub> χ	z <sub>g</sub> r	m <sub>g</sub> r	z <sub>g</sub> r
		⋮	



- Participants were assigned to one of the two list groups at random, each participant heard each target only once during the course of the experiment.
- They performed a continuous lexical decision task, in which responses were obtained for every word or pseudo-word presented.
- They were asked to indicate as quickly and as accurately as possible whether each soundfile they heard was a word of Tashlhiyt.
- Words were presented at an ISI that varied between 600–800ms.
- Response time (RT) was measured from the onset of stimulus presentation.
- The experiment was run on a laptop using the Psychopy program (Peirce, 2007).

# Results

- **Mean RT**

Item type	Accuracy	Mean RT	N
Critical	78.6%	891 msec	5669
Filler	90.1%	902 msec	8511
Non-word	74.1%	1008 msec	14194

- Responses with an RT of less than 250 msec and greater than 3000 msec were excluded.
- We fit a series of linear mixed-effects regressions in R (v4.2.2, (2016)) using the lmerTest package (v3.1-3, Kuznetsova et al. (2015)) to calculate p-values.

# Results

- We found priming effects for targets preceded by phonologically related primes relative to phonologically unrelated controls, indicating that the method is effective in detecting phonological relatedness.
- The priming effects for targets preceded by phonologically related primes provides an important proof of concept for the use of the paradigm in the study of Tashlhiyt phonology.
- A first step towards an in-depth study of the syllabic structure of Tashlhiyt, e.g. the potentially distinct syllabification of different CCC words (mono- vs disyllabic).
- A study that requires an extensive list of phonologically related words. A hard task since disyllabic vowelless words (e.g. *lmd*) are less frequent than monosyllabic ones (e.g. *smd*).

# Concluding remarks

- *Sonority* has always been linked to the syllable, since the end of the 19th century (Sievers 1881), beginning of the 20th (Jespersen 1904, Saussure 1916).
- Hooper (1976) proposed *strength* as an inverse restatement of sonority, which refers to inherent properties of segment (typically consonants) that determine their behavior in certain phonological processes, such as lenition (see also complexity in Element Theory)
- Studies have shown "a tendency among speakers of many languages to prefer unfamiliar sequences with a typologically more natural sonority profile (like word-initial /kl/) over clusters whose slope is more marked (/lk/)." (Parker 2017: 3).
- Speakers of Tashlhiyt and English perceive rising sonority clusters better than falling-sonority or plateau clusters.
- The preference for rising-sonority clusters could be universal, part of humans' early, experience-independent, linguistic knowledge that shapes language perception and acquisition (Gomez, Berent et al. 2014).

## Selected references

- Dell, F. & M. Elmedlaoui (2002). *Syllables in Tashlhiyt Berber and in Moroccan Arabic*. Dordrecht: Kluwer Academic Publishers.
- Gómez, M., Berent, I., Benavides\_varela, S., Bion, R., Cattarossi, L., Nespor, M. & Mehler, J. (2014). Language universals at birth. *The Proceedings of the National Academy of Sciences (PNAS)* 111(16): 5837-5841.
- Lahrouchi, M. (2010). On the internal structure of Tashlhiyt Berber triconsonantal roots. *Linguistic Inquiry* 41(2): 255-285.
- Lahrouchi, M. (2020). Not as you R: Adapting the French rhotic into Berber. *Glossa: a journal of general linguistics* 51(1): 1-17.
- Ridouane, R., Hermes, A. & Hallé, P. (2014). Tashlhiyt's ban of complex syllable onsets: Phonetic and perceptual evidence. *Language Typology and Universals* 67(1): 7-20.
- Zellou, G., Lahrouchi, M. & Bensoukas, K. (2022). Clear Speech in Tashlhiyt Berber: The perception of typologically uncommon word-initial contrasts by native and naive listeners. *The Journal of the Acoustical Society of America* 152(6): 3429-3443.
- Zellou, G., Lahrouchi, M. & Bensoukas, K. (2024). The perception of vowelless words in Tashlhiyt. *Glossa: a journal of general linguistics* 8(1): 1-41.