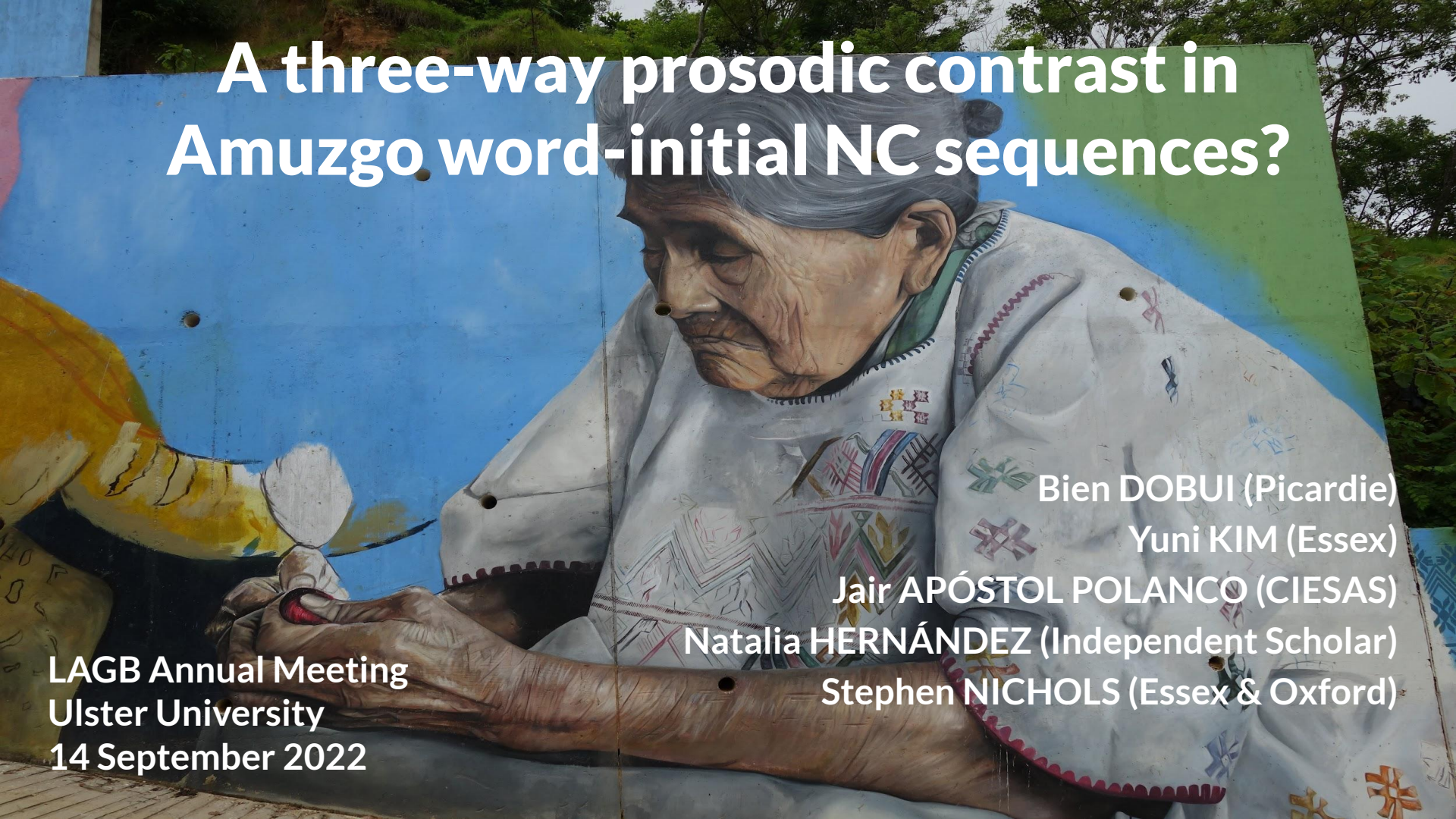


A three-way prosodic contrast in Amuzgo word-initial NC sequences?

Bien DOBUI (Picardie)
Yuni KIM (Essex)
Jair APÓSTOL POLANCO (CIESAS)
Natalia HERNÁNDEZ (Independent Scholar)
Stephen NICHOLS (Essex & Oxford)

LAGB Annual Meeting
Ulster University
14 September 2022

The phonological representation of NC sequences

Browman & Goldstein 1986, Herbert 1986, Maddieson 1989, Maddieson & Ladefoged 1993, Iverson & Salmons 1996, Downing 2005, Durvasula 2009, Riehl & Cohn 2011, Stanton 2017

Unary (Monosegmental)

Prenasalized stops	^{n}d	
Postoralized nasals	n^{d}	

Cluster (Bisegmental)

Tautosyllabic cluster	.nd–	–nd.
Heterosyllabic cluster	n.d	
Syllabic nasal + Onset	n̩.d	

- No attested /^{n}d/ ~ /n^{d}/ contrast language-internally (Cohn & Riehl 2008)

Riehl (2008) on unary /^{n}d/ vs cluster /nd/ contrasts:

- **Nasal duration** is the main cue
- Prediction: Unary & bisegmental NC can only contrast in languages with **phonemic length**, which permits speakers to produce and perceive the nasal duration contrast

Amuzgo: An introduction

- A branch of Oto-Manguean, closest to Mixtecan
- 30-40,000 speakers in Guerrero and Oaxaca, southern Mexico
- 4 or more distinct varieties

Our research compares 2 varieties:

- Xochistlahuaca (Guerrero)
- San Pedro Amuzgos (Oaxaca)

Approximate location of Amuzgo in Mexico

Amuzgo: A phonological profile

Historically *CVCV (Longacre & Millon 1961)

Strong monosyllabic tendency: (N)(C_2)V(^{n})(ʔ) with reduction of pretonic syllable (iambic stress in the root)

CCC is maximal initial where C_1 is a nasal, C_3 usually a glide

Nuclear contrasts

- Tonally complex (XA: 3 level & 3 contour tones; SPA: up to 5 level & 3 contour tones)
- Nasal vowels
- Diphthongs
- Three-way phonation: modal, laryngealized, “breathy”

A three-way NC contrast?

- Previous sources vary widely in their characterizations of NC sequences (Bauernschmidt 1965: 476-480, Smith-Stark & Tapia García 1984: 208, Buck 2000, Herrera Zendejas 2009: 154, Buck 2018, Hernández 2019, Dobui 2021, Kim & Hernández 2021).

However, they imply a three-way phonological contrast:

N^C “Shielded” nasal, an allophone of /$n^{(j)}$/ before an oral vowel
(1) /**n**ia^H/ [**n^d**ia^H] ‘clothes’

NC Cluster of nasal + obstruent
(2) /**n**-**t**ĩõ^M/ [**nd**ĩõ^M] ‘corral’, pl. (cf. /tĩõ^M/ ‘corral’, sg.)

N̩.C Syllabic nasal + obstruent onset
(3) /**n̩**^{H}-**t**ũã^M/ [**n̩**^{H}.**d**ũã^M] ‘wash’, 3pl. fut.

Data from the variety of San Pedro Amuzgos, Oaxaca (SPA)

Outline and preview

- Morphophonological definitions of the 3 categories of NC
- Acoustic phonetic study: is the three-way distinction just a morphophonological abstraction (cf. Ladefoged & Maddieson 1986), or is it also detectable on the phonetic level?
- Preview: It’s messy
  - In SPA, difficult to tell NC categories apart based on duration
  - In XA, the phonetic distinctions are more robust, but they don’t go in expected directions
- Consideration of implications for the phonological interpretation of NC

1. Morphophonological status

Morphophonological status

- NC sequences are common in both Xochistlahuaca (XA) and San Pedro Amuzgos (SPA)
  - Occurs **monomorphemically** in roots (a)
  - And **multimorphemically** because segmentally homophonic {n} prefixes for both the nominal plural (b) and the future marker (c)

4)	Word Gloss	Phonological type		Variety
a.	ɲ^{dj}o^{H} ‘mouth’	N^{C}	Shielded nasal	XA
b.	t^{j}uɛʔ^{L} → nd^{j}uɛʔ^{L} ‘hills’, pl.	NC	Nasal + obstruent cluster	SPA/XA
c.	n^{H}-t^{j}e^{HL} ‘wash oneself’, fut.	N̩.C	Syllabic nasal + simple onset	SPA

Morphophonological s

NB: Stop voicing is non-contrastive Before diphthongs; post-nasal stops are automatically voiced

- NC sequences are comm A) and San Pedro Amuzgos (SPA)
  - Occurs **monomorphemically** in roots (a)
  - And **multimorphemically** because segmentally homophonic {n} prefixes for both the nominal plural (b) and the future marker (c)

4)	Word Gloss	Phonological type		Variety
a.	ɲ^{dj}o^{H} ‘mouth’	N^{C}	Shielded nasal	XA
b.	t^{j}uɛʔ^{L} → nd^{j}uɛʔ^{L} ‘hills’, pl.	NC	Nasal + obstruent cluster	SPA/XA
c.	n^{H}-t^{j}e^{HL} ‘wash oneself’, fut.	N̩.C	Syllabic nasal + simple onset	SPA

Evidence for shielding /n/ → [n^{d}]

- Active morphophonological alternations between [n] and [n^{d}] based on nasality/orality of following vowel (Dobui 2021, Kim & Hernández 2021)
  - 5) In XA, a shielded nasal “deoralizes” when marked by a nasal 3sg possessive marker: **ɲn^{dj}o^{H} ‘mouth’ → ɲõ^{H} mouth.3SGPOSS**
  - 6) In SPA noun plurals, certain initial consonants (e.g., *ts*) are replaced by either [n] before nasal vowels, or [nd] before oral vowels:

    a. tsĩõ^{MH} → nĩõ^{MH} ‘smoke’, PL.

    b. tsio^{MH} → n^{d}io^{MH} ‘bottles’, PL.

Morphophonological status

- NC sequences are more widely distributed in SPA than in XA given slightly different morphophonological strategies for nasal blocking
- SPA prefers [nd/t] shielding where XA has a diversity of surface forms: (7) a non-nasal allomorph [l] in plural marking and (8) allomorphs [nl] in future marking

Compare:

gloss	variety	form	phonological type
7) 'bottles', pl.	in SPA:	**n^{d}io^{MH}**	N^{C} Shielded nasal
	in XA:	**lio^{HL}**	
8) fut-eat	in SPA:	**n̩^{H}-tkwaʔ^{M}**	N̩.C Syllabic nasal
	in XA:	**n̩^{H}l-kwaʔ^{M}**	

2. Phonetic nature of the contrast: Previous work and hypotheses

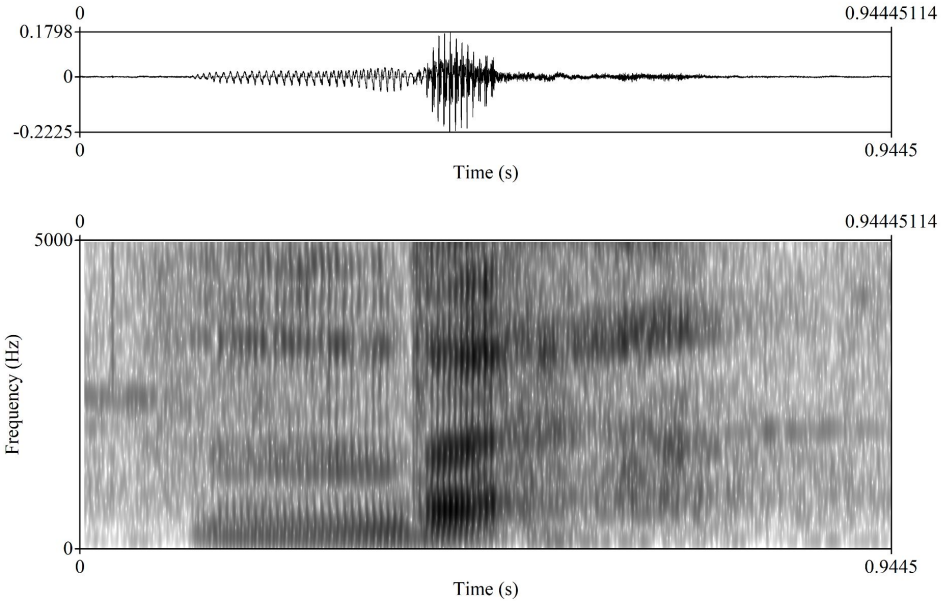
Phonetics of [n^{d}] vs [nt] in Amuzgo

Kim & Hernández (2021) claim that **plosive** duration distinguishes shielded from cluster NC

Speaker: renowned native-speaker linguist Fermín Tapia García (b. 1936)

Shielded [n^{d}]: very short plosive duration

[^{d}ɛʔ^{HL}] ‘graneros de maíz’



Phonetics of [n^{d}] vs [nt] in Amuzgo

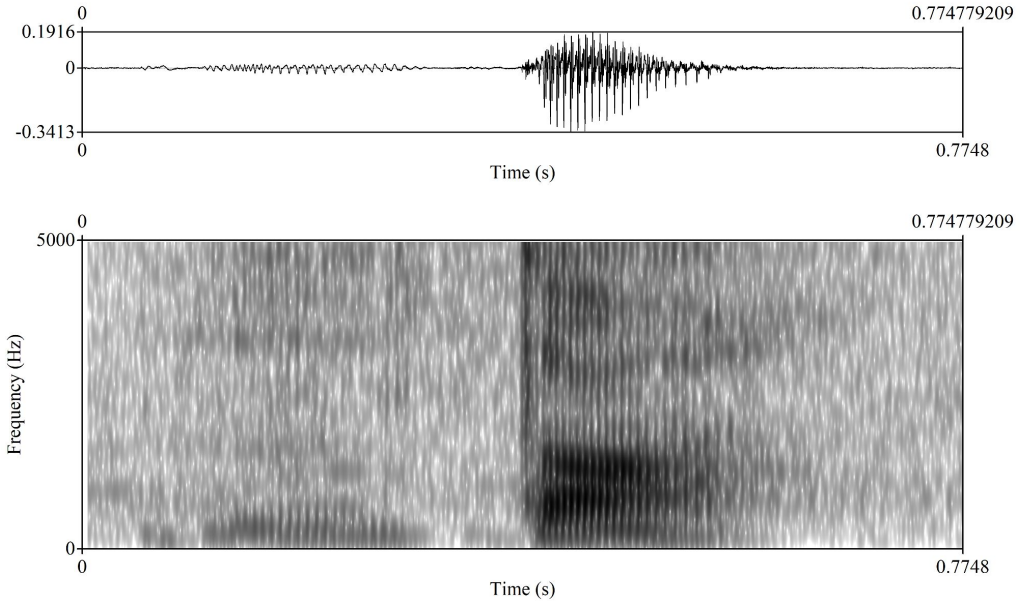
Cluster: longer plosive phase; voiceless

E.g. [nta^{HL}] ‘wedding’

BUT!

Is the durational difference just due to voiceless [t] vs voiced [d], which we’d expect anyway?

& Riehl 2012)



Phonetics of NC **voicing** contrasts cross-linguistically

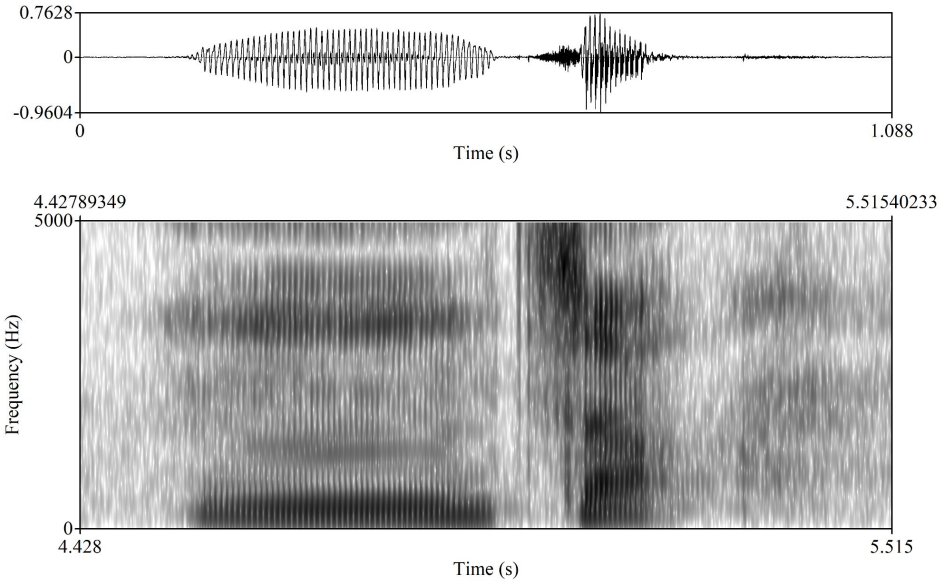
- **Durational cues** help preserve ND vs NT contrasts, given the pressures on voicing post-nasally (Cohn 1990; Solé 2012; Beddor 2007, 2009; Cohn & Riehl 2012)
  - **Absolute** and **relative** duration can both matter
  - Downing & Hamann (2021): Aspiration is a key cue to NT in Tumbuka
- /d/ is NOT phonemic in Amuzgo but arises, exclusively in N_ position:
  - through shielding: /n/ → [n^{d}]
  - through **pre-diphthongal** postnasal voicing in clusters
    - Non-syllabic n: n_{plural} + $ti\tilde{o}^{M}$ ‘corral’→ [$ndi\tilde{o}^{M}$]
    - Syllabic n: n^{H}_{future} + tiu^{MH} ‘se romperá’→ [$n̩^{H}.diu^{MH}$]
- This paper: ***when controlling for voicing***, what are the phonetic cues to the 3-way prosodic contrast in NC?

Phonetics of syllabic nasals

Nasal duration of 300-400ms, as compared with ~200ms for non-syllabic NC clusters

E.g. [n̩^{H}-tsaʔ^{HM}] ‘do, 2sg. fut’

Hypothesis: **Syllabic nasals will have longer duration** than non-syllabic nasals



2.1. SPA data and results

Wordlist and recording

- 63yo female recorded in SPA in August 2022
- Controlled for phonation and PoA; tones varied
- Total of 293 tokens

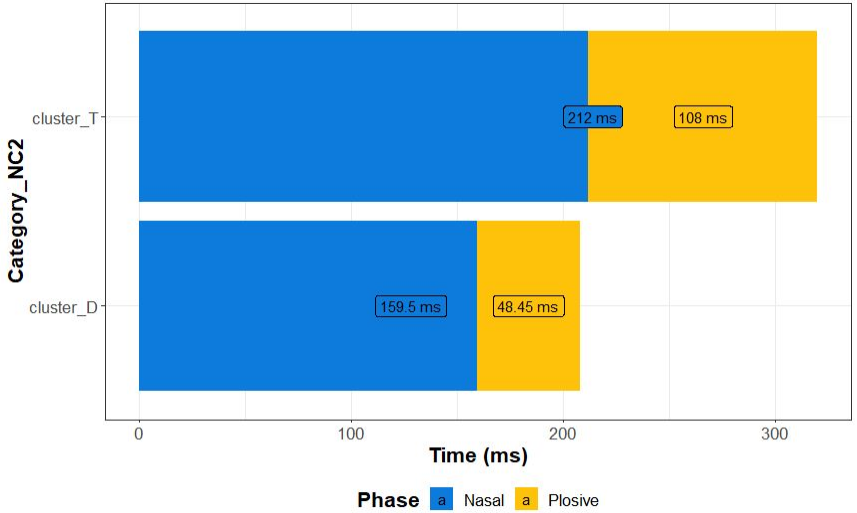
	[n^{C}]	[nC]	[n̩.C]
[nd]	82	20	37
[nt]	–	33	29

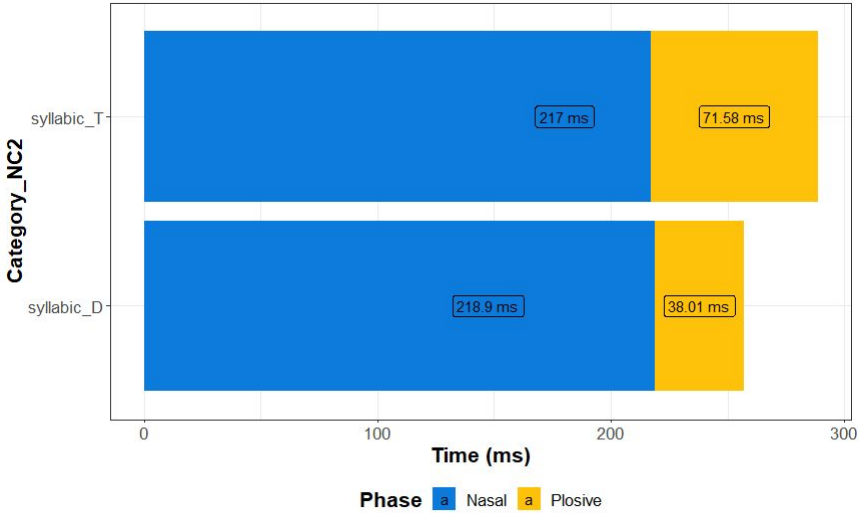
Plain nasals as controls: 32 NV (non-syllabic); 35 syllabic N̩.NV (some N̩.V?)

BONUS: 25 tokens of [n̩.n^{d}] (double nasal: syllabic + postoralized)

Cues to voicing in bisegmental sequences: plosive duration

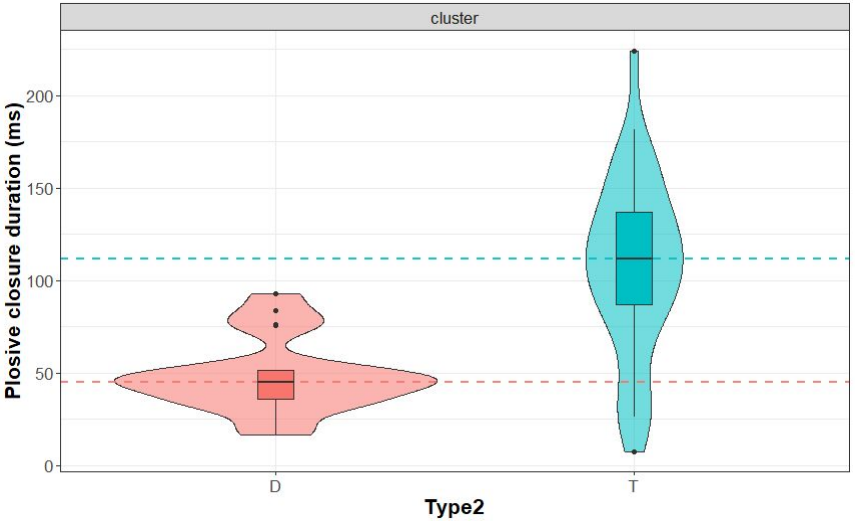
- As expected, D is **shorter** than T, for both NC and N.C
- But in the voiceless condition, both [n] and the [t] are longer than in [n(.)d]!
  - Nasal duration *positively* rather than inversely correlated; no enhancement of relative duration



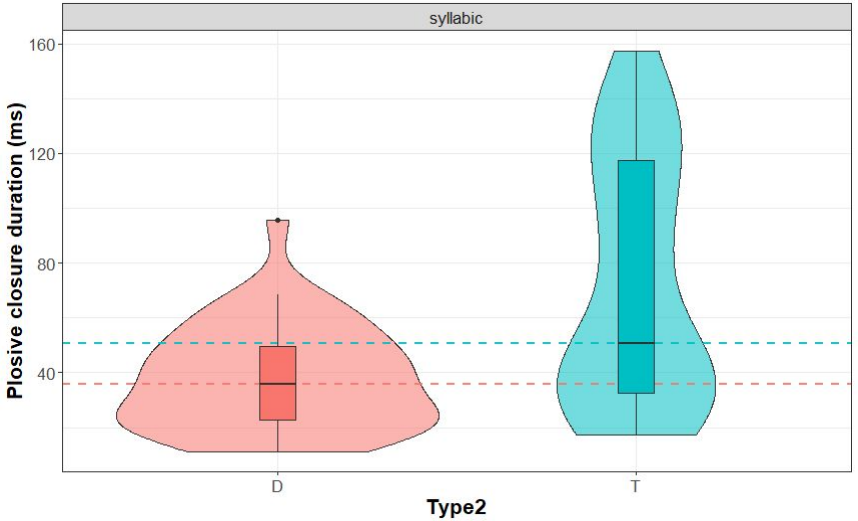


Plosive-phase durations (San Pedro Amuzgos)

Cluster-D vs cluster-T

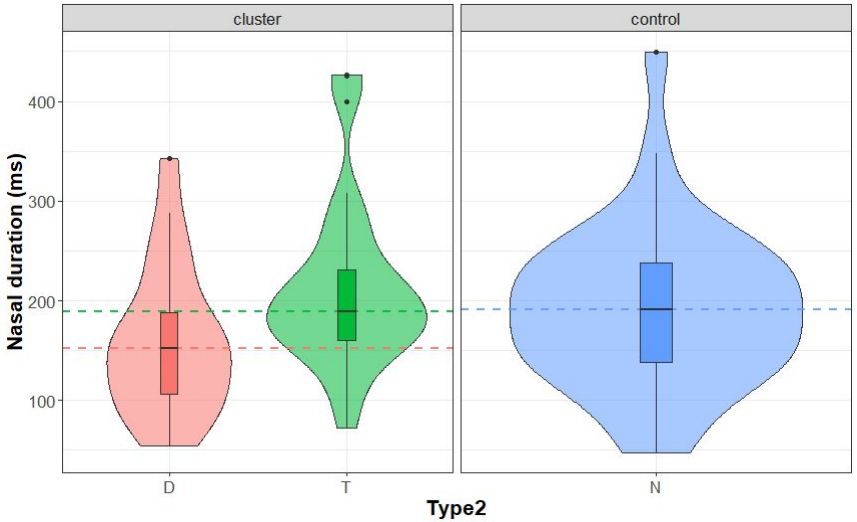


Syllabic-D vs syllabic-T

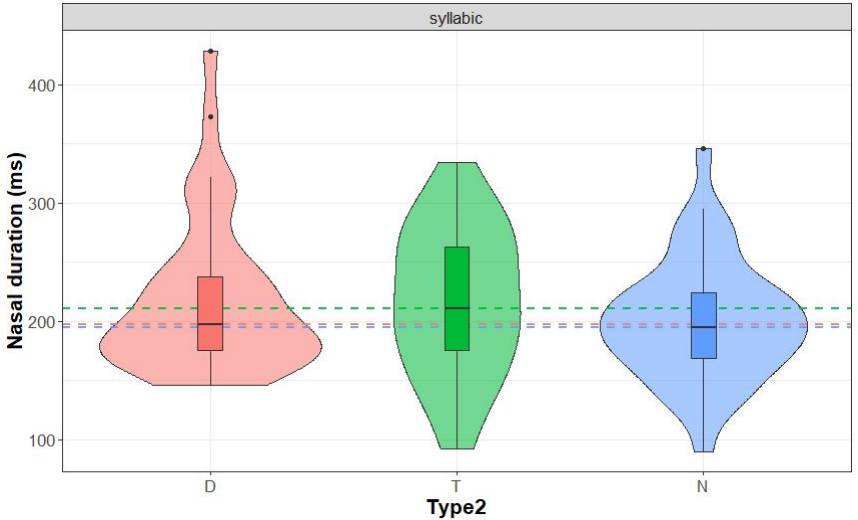


Nasal durations: very similar to plain, single onset N

Non-syllabic nasals in NC clusters. The similarity to NV sequences is unsurprising.



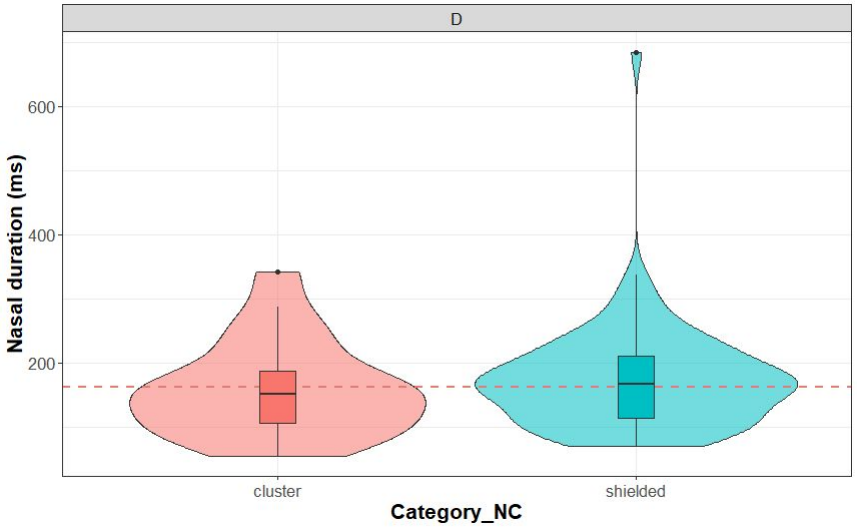
Even the putative syllabic nasals are very similar to singleton onset N!



Lack of durational cues to cluster [nC] vs unary [n^{C}] status

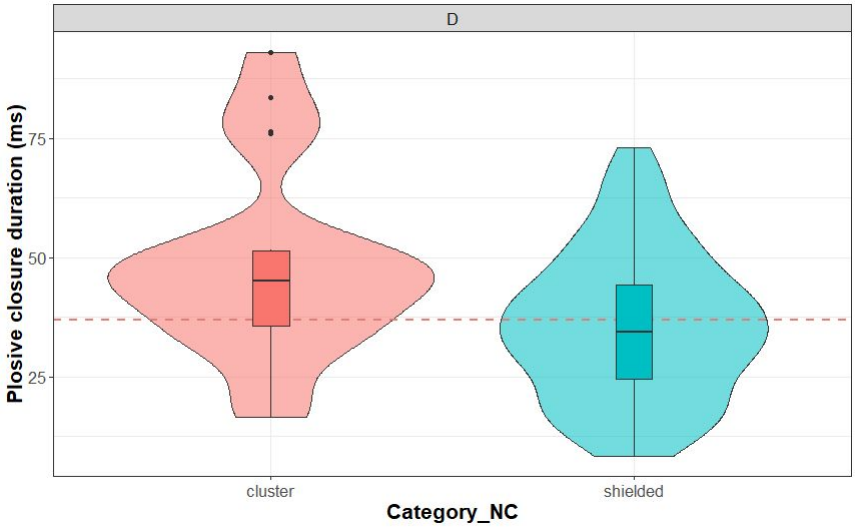
Nasal duration, cluster [nd] vs unary [n^{d}]

Similarity not entirely surprising, given that both are /n/ segments



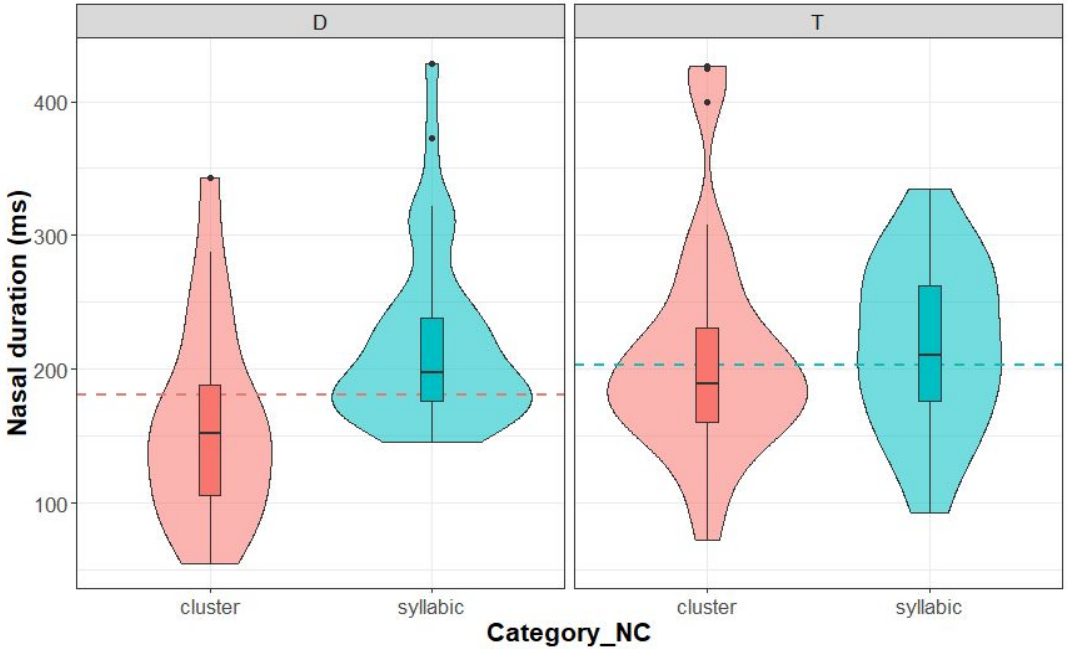
Plosive duration, cluster [nd] vs unary [n^{d}]

Only slightly longer in the cluster context; lots of overlap



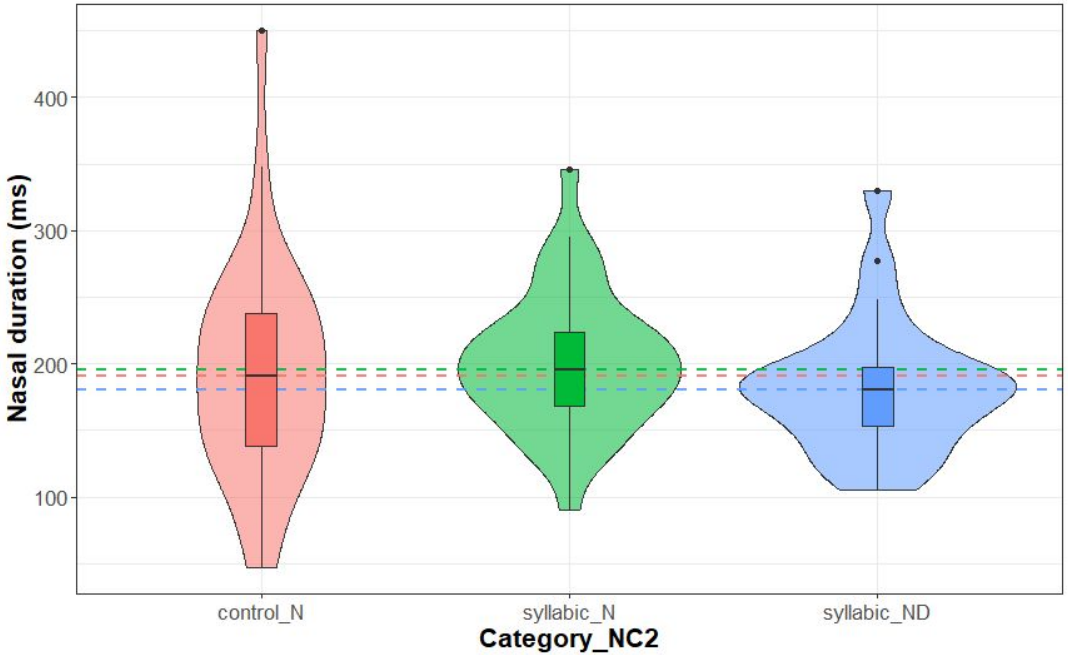
Are syllabic nasals longer in duration than non-syllabics?

Not by much. More so in the voiced ND context (left) than with voiceless NT (right)



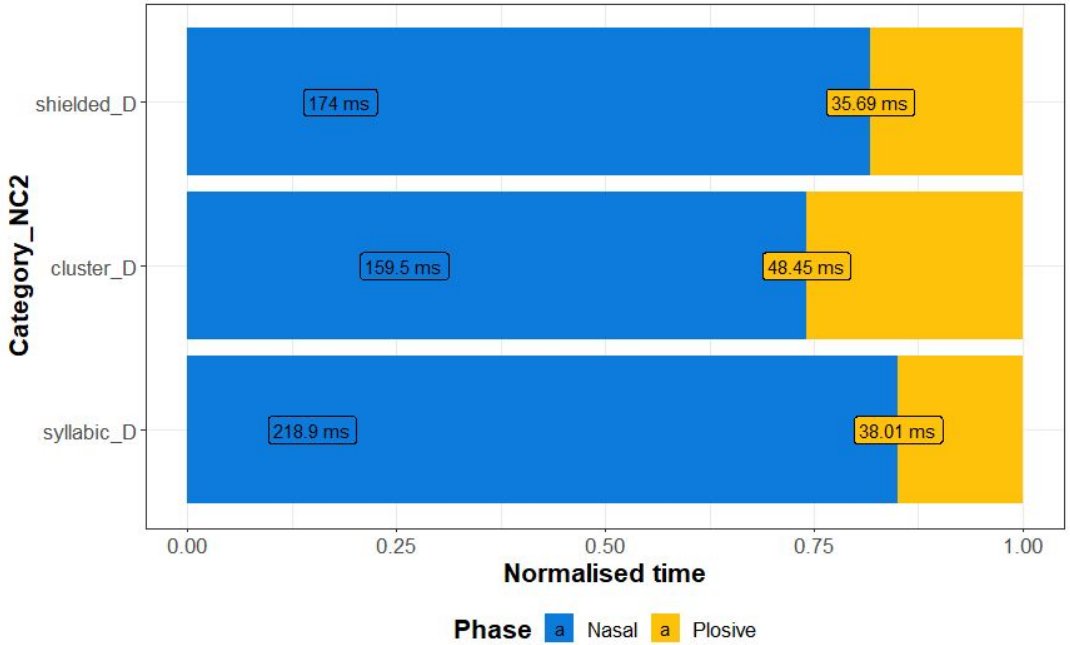
Lack of durational cues to putative double nasals

L to R: single NV onset; syllabic nasal in N.C; syllabic *plus* shielded N.N^{C}



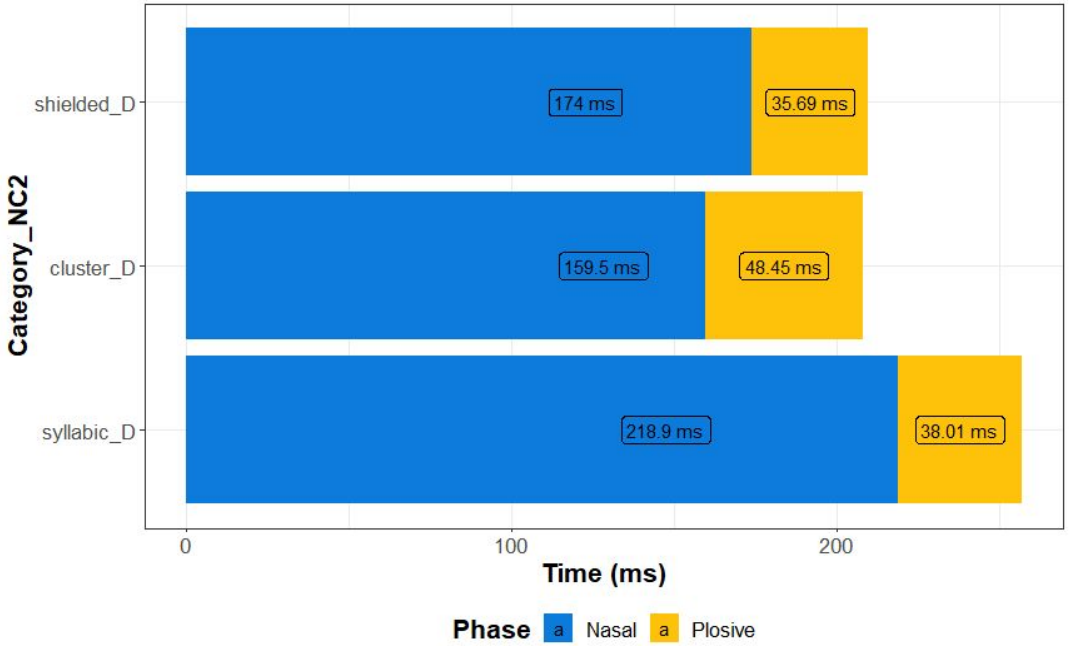
Is there really a 3-way NC distinction?

In the voiced condition, we can make a direct 3-way comparison. No drastic differences in relative duration:



Is there really a 3-way NC distinction?

- Absolute duration: syllabic distinct, but unary & cluster NC very similar



2.2. XA data and results

Wordlist and recording

- 58 yo female recorded in Xochistlahuaca in May 2022
- Controlled for phonation and PoA; tones varied
- Total of 226 tokens

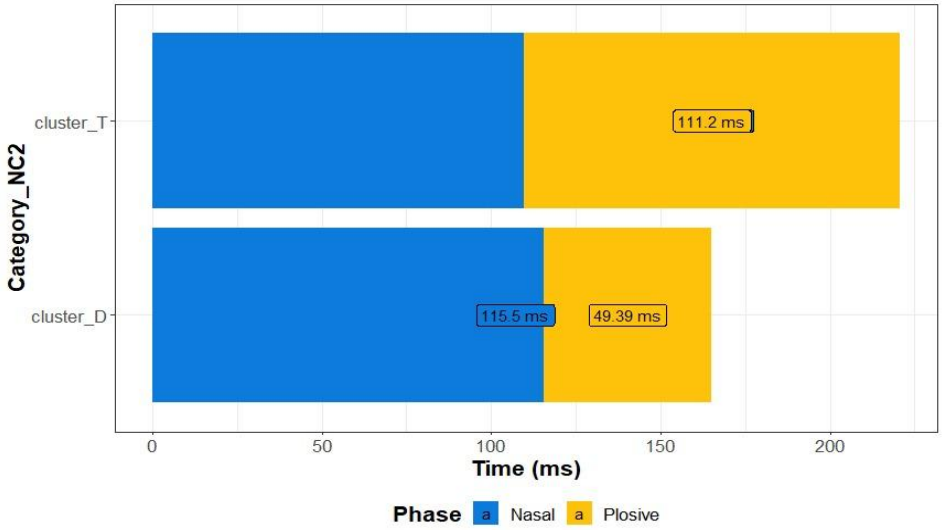
	[n^{C}]	[nC]	[n̩.C]
[nd]	16	39	12
[nt]	19	24	40

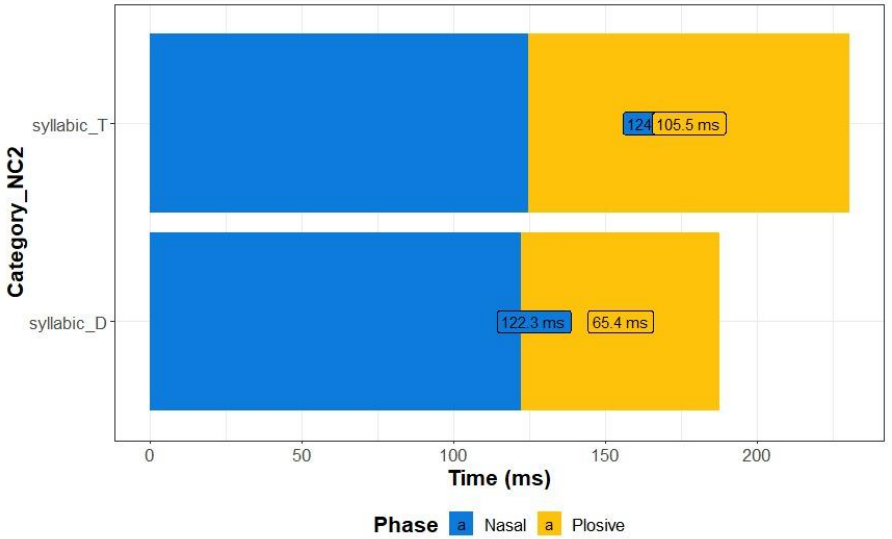
Plain nasals as controls: 30 NV (non-syllabic onset), 46 (N̩.NV) syllabic + onset N

Cues to voicing

- **Like SPA:** XA has similar cues with SPA : shorter D than T and not inversely correlated with nasal duration

Absolute durations of confounded D and T for clusters and syllabics

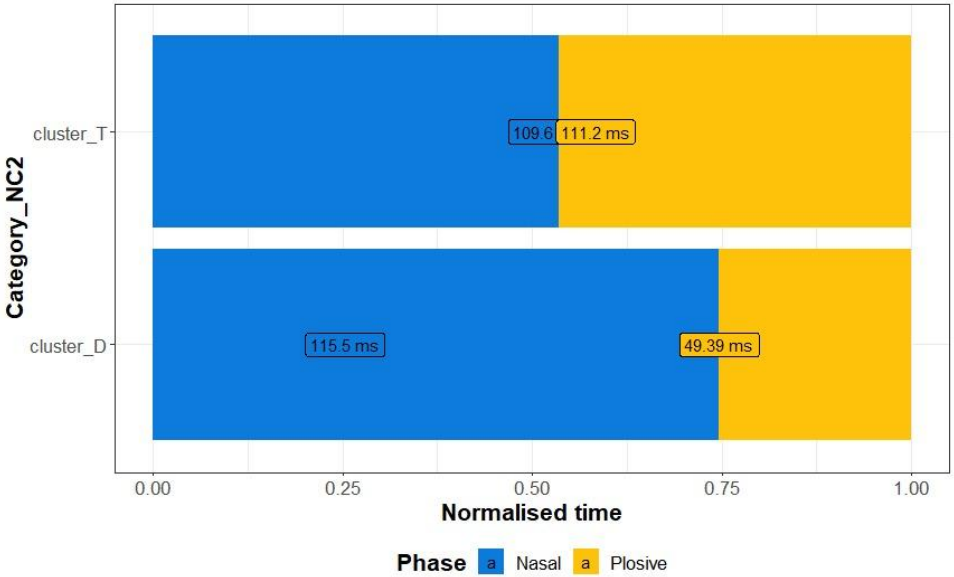




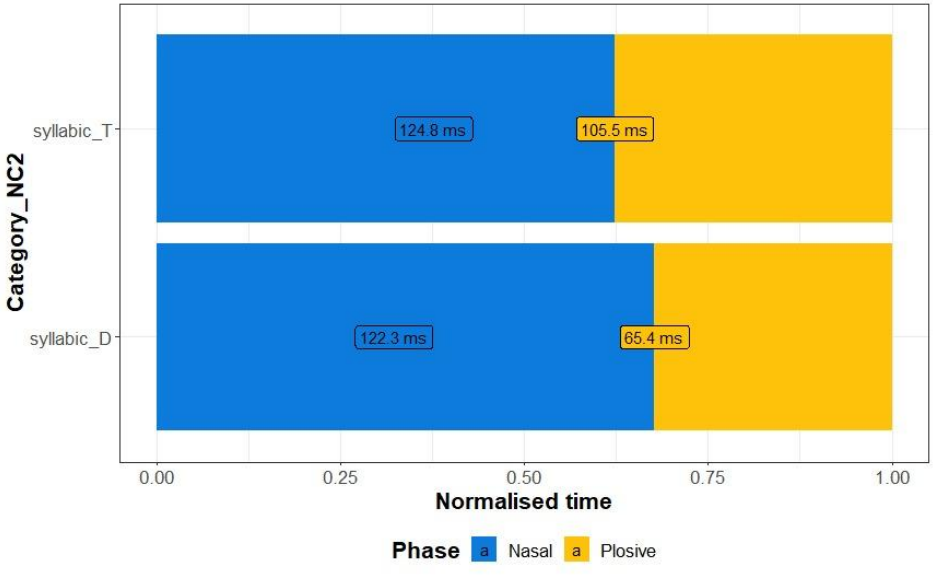
Relative durations serve as cues for D and T

- **Difference between SPA and XA**: relative durations show cues for voicing of plosive, esp. in clusters

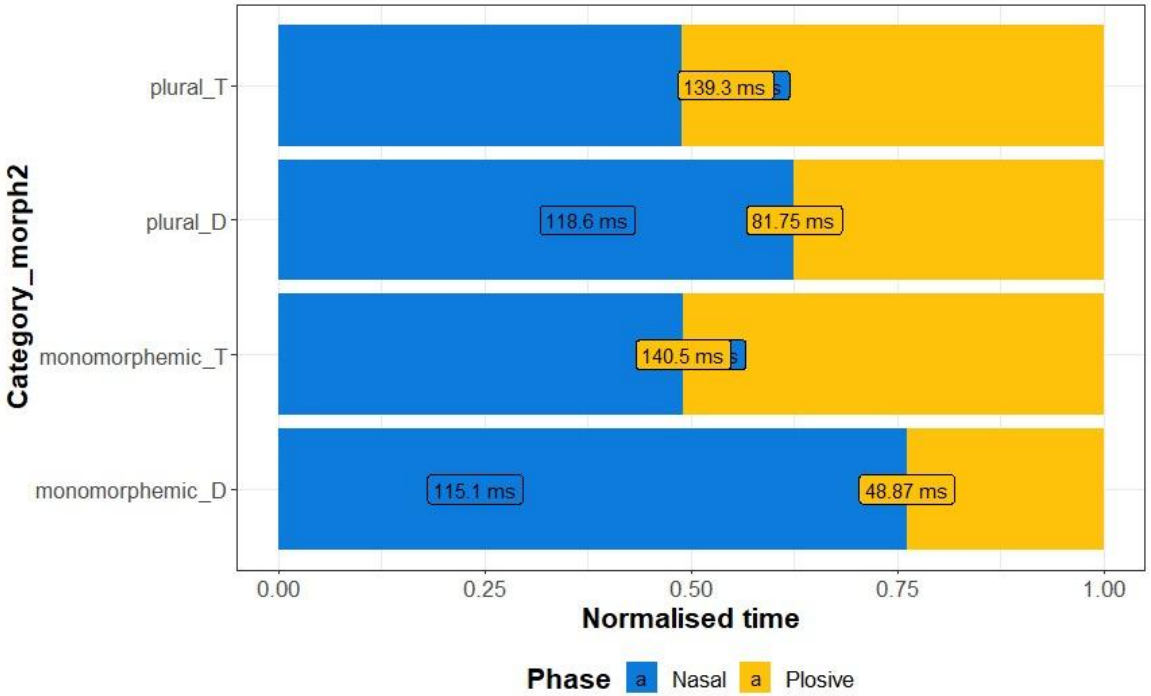
In cluster



After syllabic N



Durations by category



- Categories D and T opened up into morphological and prosodic categories
- Cues across morphological categories:
  - Relative measurements show durational cues in monomorphemic tokens between D and T
  - And similarly but less so in multimorphemic (plural marked) words

Durations by category

- *Cues across prosodic categories show absolute durational cues*
- Again nasal duration doesn't positively correlate with plosure in D, and in T is trivial
- Another way of saying: bisegmental NC/N.C display differences in absolute durational cue in T but not in D
- Surprisingly unary N^c (i.e. shielded N and esp. n^d) have longer plosure durations than fully segmental binary sequences

Absolute durations of plosive closure

n^d >	**n.d >**	**nd**
95ms	50ms	40ms
n^t >	**nt >**	**n.t**
175ms	155ms	120ms

Absolute durations of nasal closure

n^d =	**n.d =**	**nd**	~ 125ms
n^t >	**n.t >**	**nt**	
140ms	130ms	110ms	

Durations by category

- *Cues across prosodic categories show relative durational cues*
- Relative differences in closure cues positively correlate
- Unary N^c seems to be cued also in relative durations, though differences are less notable (esp in nt vs n^t)
- Same with binary sequences NC and N.C

Relative durations of plosive closure

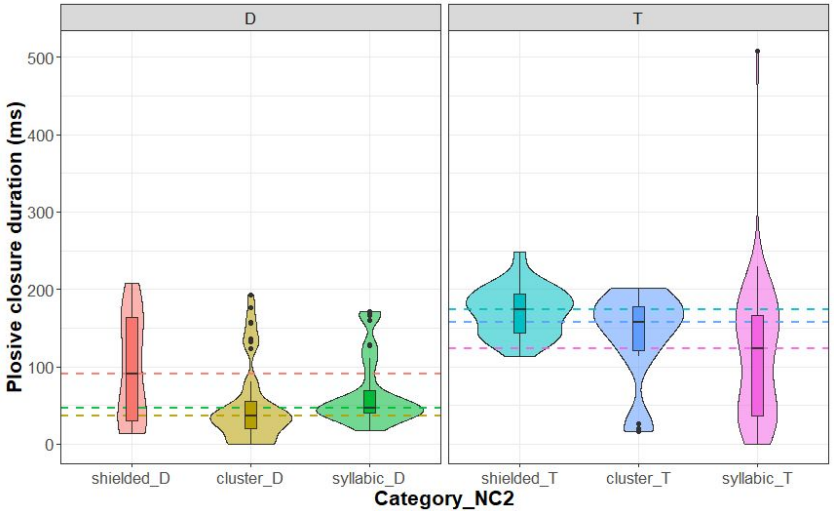
n^d >	**n.d >**	**nd**
~.38	~.29	~.22
n^t =	**nt >**	**n.t**
~.55		~.45

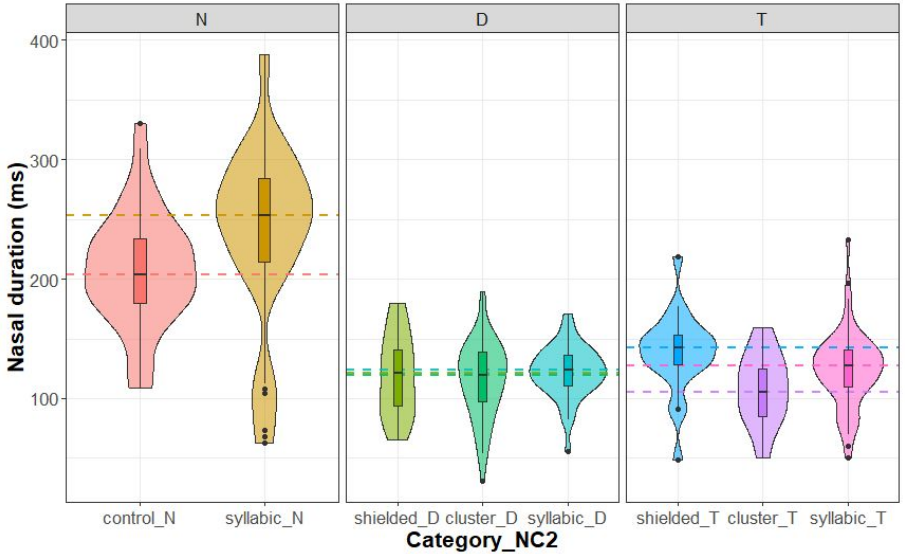
Relative durations of nasal closure

nd >	**n.d >**	**n^d**
.77	.7	.62
n.t>	**nt =**	**n^t**
~.6	~.42	

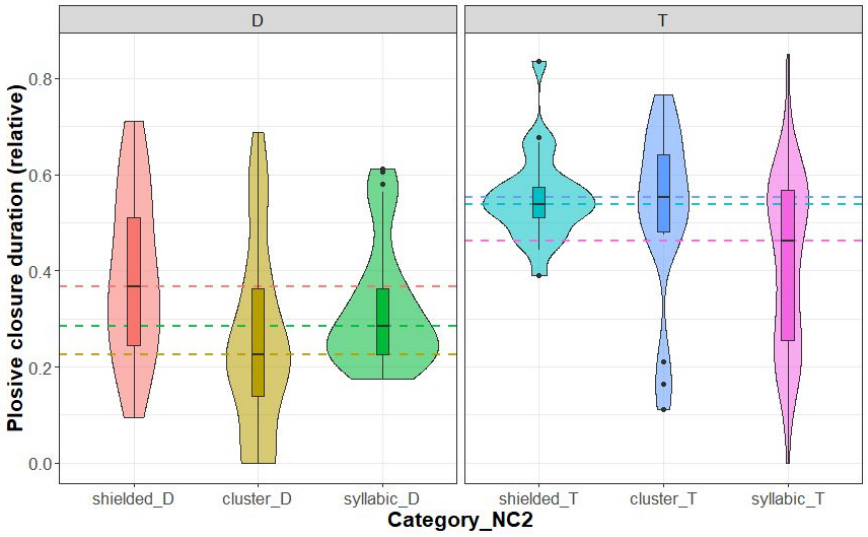
Absolute nasal and plosive closure durations by category

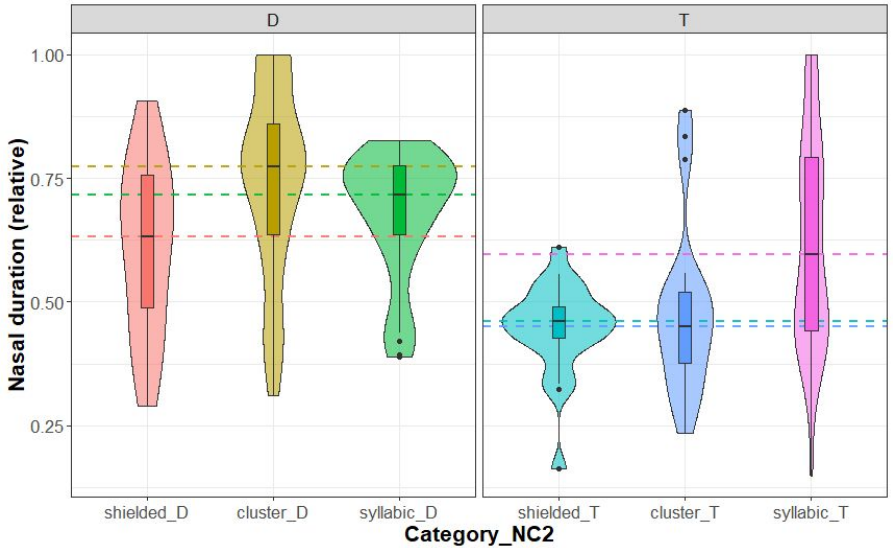
Opening up the D and T into the different prosodic types + control nasal durations





Relative durations in form of boîte à moustache





Takeaways from XA data

- Relative durational cues for voicing are found
  - The main cue is plosure
  - Nasal closure is stable in absolute confounded D and T, but relative measurements find closure duration does cue voicing
- Plosure duration cues for unary N^c vs bisegmental NC/N.C are found in absolute + both plosive and nasal closure cues in relative measurements
- Durational cues between NC and N.C are lacking in relative measurements, but pitch on future marking syllabic N may bear some of that burden
- Three-way contrast for unary N^c vs NC vs N.C is not only morphophonological but also phonetic

3. Summary and conclusions

Challenges posed by XA's threeway contrast

Going back to previous work

- Riehl (2008) on unary /^{n}d/ vs cluster /nd/ contrasts:
  - **Nasal duration** is the main cue
  - Prediction: Unary & bisegmental NC can only contrast in languages with **phonemic length**, which permits speakers to produce and perceive the nasal duration contrast

Compared to XA where:

- Primary cue between unary and cluster in XA is both plosive closure and relative duration.
- Phonemic length is not contrastive in XA

Additionally,

- A threeway contrast isn't predicted but is observed here, though durational cues between N.C vs NC are less robust (perhaps carried by lexical tone)
- Unary N^{c} forms durational cues surprisingly carried by plosure; longest across three types > could this be a data issue?

Why did we find so little difference in SPA?

- Next step: Investigate possible **tonal cues** for putative syllabic (TBU) [n]
  - Duration may not be the only cue

- [n^{d}] vs [nd]: given that both have a ‘full’ nasal segment, there are physical constraints on how much the duration of [d] can vary
  - Mirror image of Riehl’s work on [^{n}d] vs [nd], where nasal duration can be varied more easily to cue peripheral vs. ‘core’ segmental status

- Possible implications for orthography: OK not to differentiate NC types?

Phonological analysis

- Lack of cues differentiating unary shielded N and binary sequences in SPA could be related to the status of shielded N in the language
  - In XA shielded N can be uncovered (or unshielded) by morphology allowing a positive ID of the allophone
  - Not the case in SPA
- Consonants recruited to shield nasal assimilation are posited to be only those which are non-contrastive in the language (Stanton 2018, Wetzels & Nevins 2018)
  - Voiced plosives are non-contrastive in Amuzgo, but status of putatively shielded N in SPA may indicate the development of D towards phonemic status, albeit very restricted in distribution
  - Also voicing of plosive in SPA appears more predictable than in XA

Acknowledgments

- Fermín Tapia García, for recording and sharing the lexical and grammatical knowledge to which this study owes a great debt
- Community members in San Pedro Amuzgos and Xochistlahuaca who have been supportive of our research
- Audiences at the 3rd Workshop on Sound Systems of Latin America, 28th MFM, and 19th RFP
- Silke Hamann, for encouraging us to take a more critical approach to the voicing dimension in this project
- Bert Botma, Florian Breit, Faith Chiu, Nancy Kula & Kuniya Nasukawa for stimulating discussions about nasality in Amuzgo

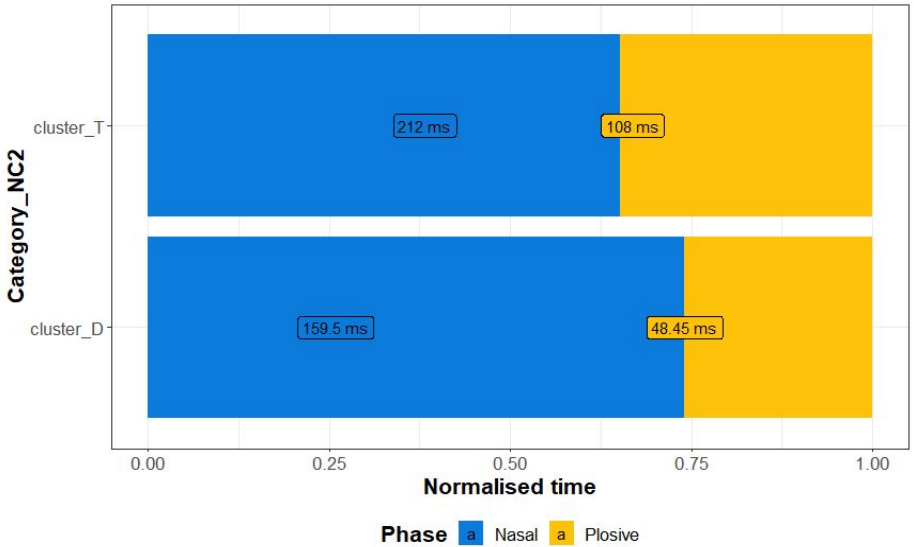
Thank you

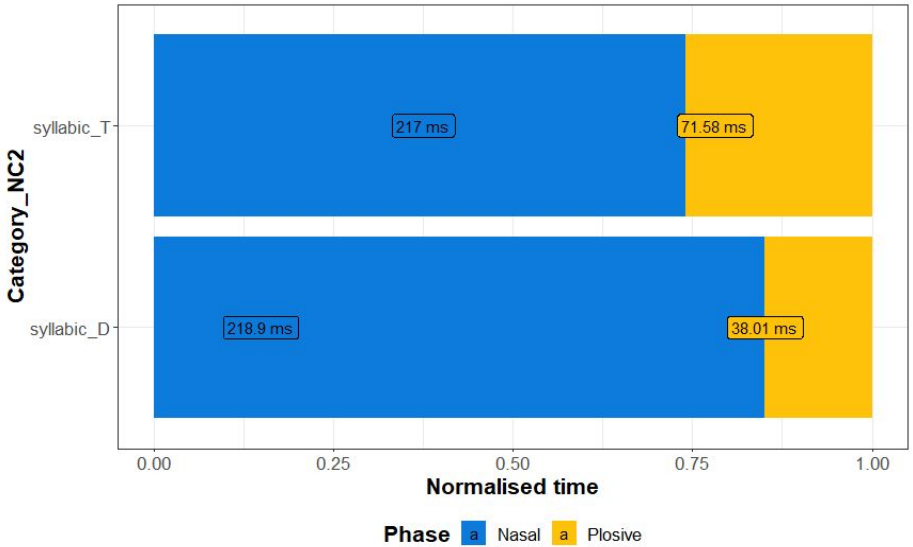
Go raibh maith agaibh

Nkya yà ‘u’

Appendices

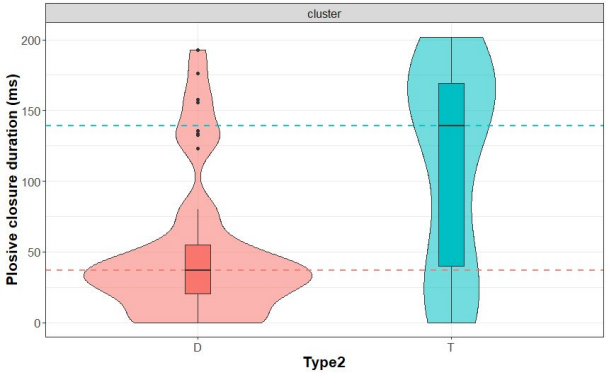
SPA cues to voicing: relative duration in normalised time

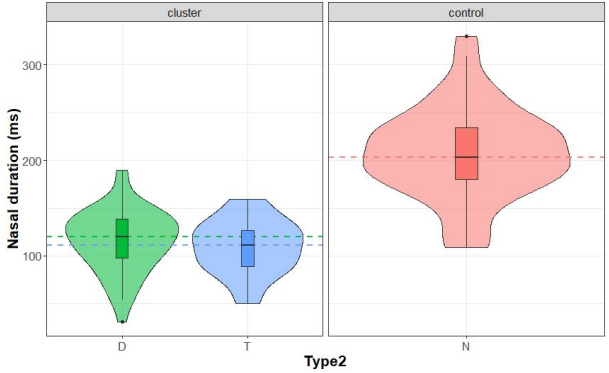




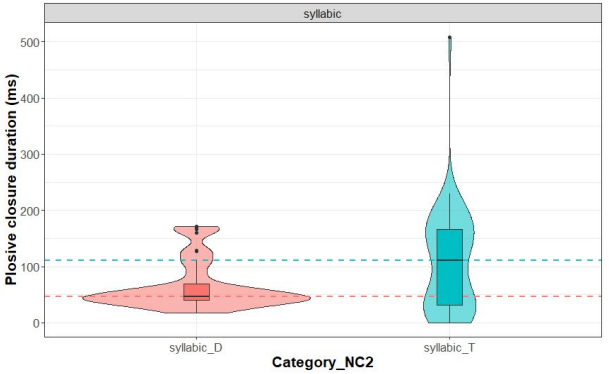
XA/ Confounded D and T categories: Absolute durations

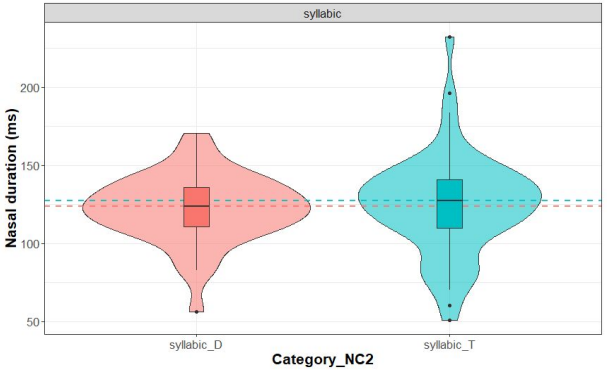
Absolute durations for clusters





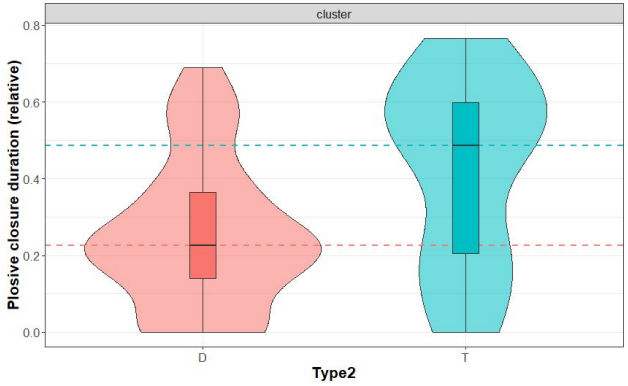
Absolute durations for syllabic sequences

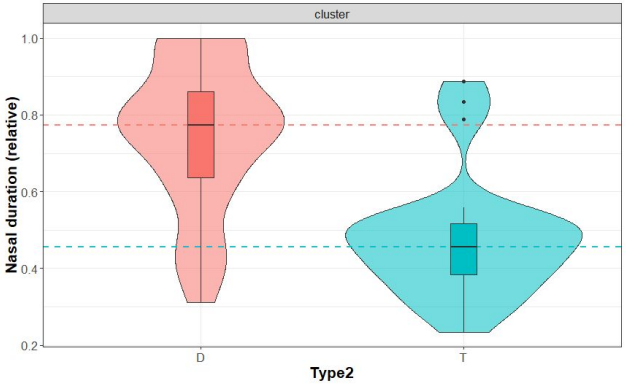




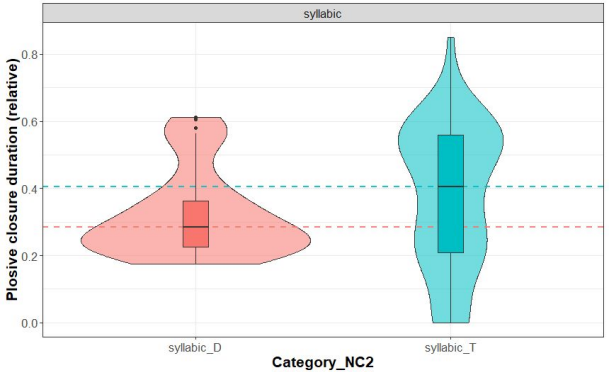
XA/ Confounded D and T categories: Relative durations

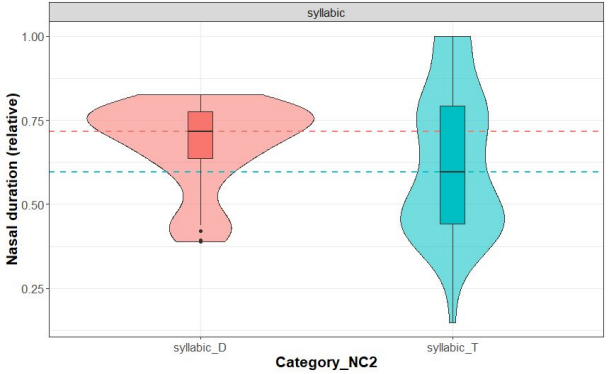
Relative durations in clusters



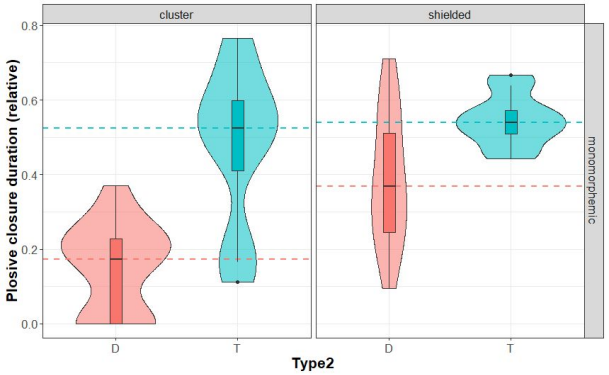


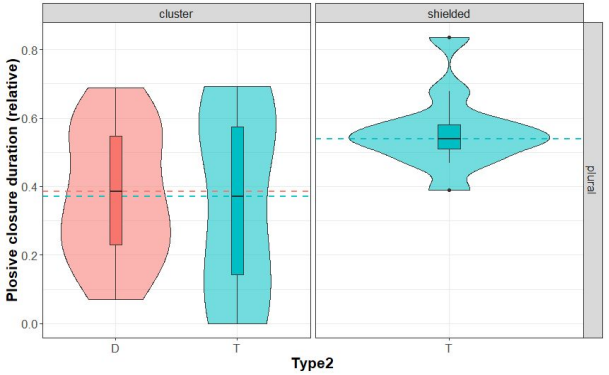
Relative durations in syllabic sequences

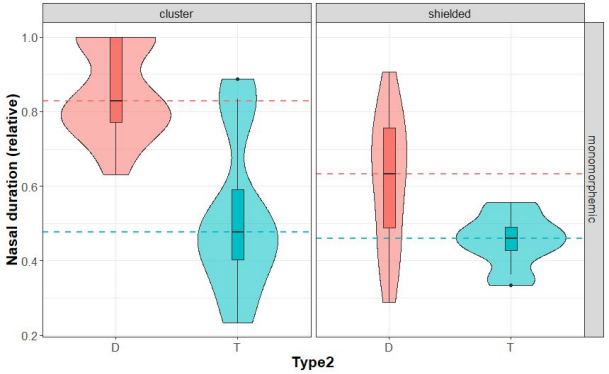


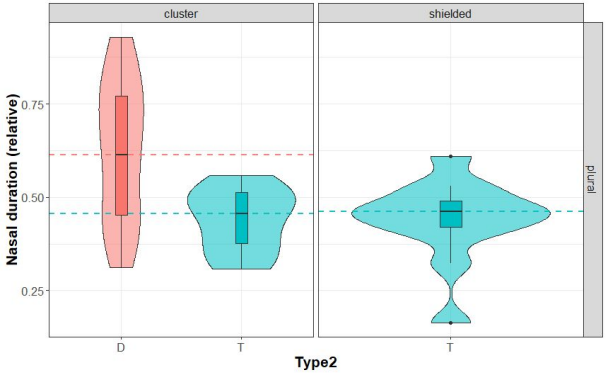


XA/ Durations by morphological and phonological categories









Morphophonological status

- The phonological constructions **N^{C}** and **NC** are both found in both mono and multimorphemic words

5)

	N^{C}	**NC**
Monomorphemic	hndɛ^{MH} ‘sell’ (ma-hnɛ̃^{MH} ’s/he is selling’) [XA]	ntiʔ^{H} ’excrement’ ntõ^{M} ‘black’
Multimorphemic	n^{d}-ɛ^{L} arches, pl.	n-tɛ^{L} ’fruit, pl.’ (tɛ^{L} ’fruit, sg.)

Morphophonological status

- The phonological construction **N̩.C** corresponds to future marked verb stems where the future marker is a lexically high tone {n^{H}}

  - Before diphthongs, post-nasal stops are automatically voiced

6)

	N.C	**gloss**	**Variety**
Multimorphemic	n^{H}-$t^{j}e^{HL}$	fut-wash.oneself	SPA/XA
	$ɳ^{H}$-$d^{j}io^{M}$	fut-put	SPA