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Nasal allophony and nasalization in Xochistlahuaca Amuzgo

RESEARCH

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Abstract

This paper proposes an account of nasalization phenomena in Xochistlahuaca Amuzgo (XA), a variety of Guerrero Amuzgo, using insight from the phonology-morphology interface within the context of constraints due to monosyllabic lexical roots. Previous assumptions are clarified to show that while nasal consonants and vowels exist phonemically, complex nasal-stop segments do not; and nasalization remains limited to root morphology and a set of inflectional markers and does not occur across syllable boundaries, in contrast with Mixtecan languages. These insights are illustrated by the third-person singular human enclitic (3SGHUM), a nasal autosegment. Alternations triggered by 3SGHUM show that complex nasal-stop segments are shown to be allophones of simple nasals that are post-oralized before an oral vowel to protect and enhance nasal-oral contrast in vowels, an example of the phenomenon known as shielding. A reduplicative allophone of 3SGHUM further displays nasalization that appears exceptional when compared with other nasalization phenomena in plural and pronominal inflection, as well as derivation. These challenges are met from a strict CVCV approach, enabled by the assumption that the Proto-Amuzgo-Mixtecan *CVCV lexical root survives today in XA as CCVV(?), the maximal lexical root. The monosyllabic economy that sets XA apart from its sister languages influences strategies that block against morphophonological change triggered by inflection, or that enhance contrast against loss of identity. Enhancing strategies like shielding then bring XA into a typological relationship with unrelated languages (Jê, Tupí-Guarani, among others).

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1. Introduction

Nasal segments and phonological processes of nasalization are common in Otomanguean languages.[1] In addition, analyses of Amuzgo and Mixtecan languages, and Jalapa Mazatec establish prenasalized stops or complex nasals as phonemic.[2] The phonemic system of the Amuzgo spoken in the town of Xochistlahuaca (Guerrero State, southwest Mexico) has thus been reported to contrast both nasals /N/ and complex nasals /ND/.[3] In this account and contrary to previous accounts of Xochistlahuaca Amuzgo (hereafter XA), I show that complex nasal segments of a nasal and a voiced stop, e.g. [nd], are only realized in surface alternations that result in the prevention of nasalization of oral vowels in lexical roots and should be phonologically represented as e.g. /n/. This alternation is revealed by nasalization on the morphemic level from the third-person human marker (hereafter 3SGHUM). Suarez's (1983: 39) survey of Mesoamerican languages notes that while prenasalized stops are found in Amuzgo, these may not have phonemic status. This study proposes to provide evidence for Suarez's intuition, namely that this is a case typical of what Herbert (1986) calls 'environmental shielding' in which oral-nasal contrast in vowels is enhanced through the use of a non-contrastive feature (in this case voiced plosives) to punctuate a nasal-to-oral sequence and prevent nasalization of an oral environment.

Further, this account allows for a better understanding of nasalization in a language displaying monosyllabic lexical roots, namely nasalization is morphemic and not only segmental; morphemes alternate according to nasal/oral contexts; and while nasal spread exists, nasalization cannot be said to cross morphemic boundaries (criteria from Clements & Osu 2003), which in this monosyllabic language correspond as well to syllabic boundaries. Further data from 3SGHUM marking in XA appear to be exceptional cases of cross morphemic nasalization but are accounted for using a CVCV approach (Lowenstamm 1996; Scheer 2004, 2012) and the relation of correspondence (Kitto & de Lacy 1999, Kawahara 2004).

Together these observations help to: i) formalize the status of the 3SGHUM marker as autosegmental using a CVCV framework and the relation of correspondence; ii) characterize larger nasalization phenomena on the segmental and the morphemic levels within the monosyllabic economy of XA; and iii) better situate XA in relation to languages that are genetically related (i.e. Mixtec, another Otomanguean language that displays nasal harmony (Marlett 1992, Walker 2000)) and typologically connected (i.e. Jê languages spoken in Brazil (Anderson 1976, Lapierre, forthcoming), Tupí-Guarani languages (Dietrich 1986, Lapierre & Michael 2018), etc. which also display oralized alternations of nasal consonants).

In (1)a, the verb stem for 'frolic' is marked by 3SGHUM in the form of nasalization that is realized on the right edge of the stem.[4] This autosegmental nasalization is the reduced form of /õ̰[1]·/ the full form of 3SGHUM that is used optionally in addition to the autosegmental form or for focus and topicalization. In (1)b, a stem that is phonologically similar given its nasal-stop sequence, is also marked for 3SGHUM. However, where in the uninflected stem an [nd] sequence is observed, in the inflected form only [n] is observed. In (1)c, an already nasal root does not show any surface change after 3SGHUM marking.

1 All languages have at least one nasal consonant; many have nasal vowels (Suarez, 1983: 38) and nasalization across syllabic or morphemic domains (Suarez, 1983: 47).

2 The term prenasalized stops should be taken to refer to complex segments like /m^{b}/, analyzed by Daly (1973) for Santa Maria Peñoles Mixtec. Phonemic prenasalized stops have been analyzed in the Mixtecs of Chalcatongo (Macaulay, 1996) and Santa Maria Peñoles (Daly, 1973) among others; in the Mazatec of Jalapa (Silverman, *et al.* 1995); in the Amuzgo variety of San Pedro Amuzgos in Oaxaca State (Smith Stark & Tapia García 1984; Cuevas 1985), etc. For XA, Longacre (1966), Cuevas (1996), Herrera Zendejas (2000), Zeferino (2003), Apostól (2014) have followed the characterization of phonemic prenasalized stops found in Bauernschmidt (1965).

3 The notation for abstract use is the following: C signifies consonants, T voiceless plosives, D voiced plosives, G glides, V is a vowel, Ṽ is a nasal vowel, N is a nasal sonorant and L a non-nasal sonorant.

4 In the bracketed phonetic transcriptions, classic IPA is employed: ◌̃ for nasality; superscript tones are 1 for high, 2 for mid, 3 for low. Non-modal phonation is noted as ◌̤ (breathiness) or ◌̰ (creakiness) on vowels and sonorants. A syllable final dot (CV·) denotes a 'ballistic' syllable. In its absence, a syllable is considered 'controlled'. See footnote 9 for a description of this rare feature.

(1) (Zeferino, 2003: annexes)

a.	[ɲ.cn̥^{2}·]	[ma^{2}-ɲ.cn̥^{2}·]
	‘frolic’	PROG.SG-frolic.3SGHUM
		‘s/he is frolicking’
b.	[tsei^{1} + n̥dɔ^{2}·]	[ma^{2}-tsei^{1} + n̥ɔ̃^{2}]
	‘carry, bring’	PROG.SG-bring.3SGHUM
		‘s/he is bringing’[5]
c.	[wa + ɲ.tõ·]	[ma^{2}- wa + ɲ.tõ·]
	be + harvest	PROG.SG-be + harvest.3SGHUM
	‘win’	‘s/he is winning’

The nasal-stop sequence occurring stem initially in (1)a undergoes no change after nasalization of the oral vowel; is realized as a simple nasal after nasalization of the oral vowel in (1)b, and again undergoes no change after vacuous nasalization in (1)c. I will show that the nasal-stop sequence [nd] is actually a surface realization of an underlying simple nasal /n/ (as seen in the inflected form) and that realization of the nasal-stop sequence is conditioned by oral nucleus, otherwise written as /N/ → [ND]/____V. In XA, this allophonic alternation is revealed by the morphology of 3SGHUM, which forces nasalization of the oral vowel in stems of [NDV] surface type, giving derived [NṼ]. This implies an underlying representation of a simple nasal, given abstractly as /N/.

These observations seem to imply nasalization of the stem by a right-attaching nasal autosegment. In the case of post-glottalized stems like in (2)a, the autosegment appears to cross morphemic boundaries. This pattern would fit at least partially with the characterization of nasal harmony from Clements & Osu (2003), viz. that nasalization occurs across syllable boundaries, countering nasalization phenomena observed elsewhere in this language, namely: nasality is not shared across morphemes or syllables (as in (2)b); nasalization also occurs from left to right so neither *[LṼ] nor *[NV][6] ever appear in a lexical root; and further, as in (2)c, stem-initial nasals show sensitivity to oral contexts (here the plural prefix /n-/ denasalizes or triggers consonant mutation before an oral context).

(2) a. (Zeferino, 2003: annexes)

[k^{w}aʔ·]	[ma^{2}-k^{w}ãʔ· = ã]
‘eat’	PROG.SG-eat.3SGHUM = 3SGHUM
	‘s/he is eating’

b. [ma^{2}-wa^{2} + ɲə̃m̥^{3}·][7]
PROG.SG-be + upright.3SGHUM
‘s/he is standing’

c. ELA (02012011)

[wa̱^{1}]	[la̱^{1}] *or* [n̥^{2}.ta̱^{1}]
‘house’	PL.house
	‘houses’

In order to account for this apparent exception, I use the representational theory referred to as CVCV phonology, or strict CV. This approach is an offspring of Government Phonology (Kaye *et al.* 1985, 1990). A CVCV account assumes a lateral rather than dependent or constituent relationship on a strict CV skeleton. A key supposition asserts that CV is the only skeletal unit. This implies that two phonetically adjacent consonants are separated on the skeletal tier by a V slot and in following, two adjacent vowels are similarly separated by a C slot.

Importantly for this paper, CVCV assumes that no word ends with a consonant. In treating post-glottalized or ‘checked’ stems (CVʔ), CVCV assumes that these are re-syllabified, meaning

5 Translations are for illustrative purposes and should not be understood as grammatical phrases given that some transitive verbs require an object.

6 [NV] appears in two known grammatical morphemes, such as *ma-* the progressive singular marker and *me* + the preverb for ‘be’ while [NṼ] surfaces elsewhere, i.e. lexical words. In the case of the progressive singular marker, and possibly for the latter example as well, cognates exist in other Otomanguean languages like the perfective in Lealao Chinantec *ma-tuú*^{4}*-y* PRF-spill.something-1SG (Palancar 2015).

7 Rounded, nasal back vowel /õ/ surfaces as labialized [əm̥], as in /tsõ/ [tsəm̥^{1}] ‘heart’.

a glottal coda becomes a glottal onset.[8] 3SGHUM nasalizes the stem vowel as it does on a CV stem, but a lexical requirement to align on the right motivates copying of the stem vowel. This gives rise to inflected forms like in (2)a. Under this reading 3SGHUM inflection is not a case of nasality spreading across morphemes, but as a copying of nasalized material in the stem to fulfill obligatory CVCV syllabification. The copied vowel is in a relation of *correspondence* with the base, an aspect of reduplication in which some feature identity is maintained from the copy of features from one node to another (McCarthy & Prince 1995, Kitto & de Lacy 1999). This contrasts with more local operations like epenthesis in which features spread from a shared node and affect intervening segments (Kawahara 2004), a set of circumstances that is unattested in 3SGHUM marking of checked syllables. These data and others prove crucial to understanding nasalization in XA.

While roots mostly conform to a tight frame of a maximal CCVV(ʔ) syllable (where prevocalic C is often a glide), word-building through compounding, prefixation, and cliticization tends to result in multisyllabic words. This monosyllabic root has undergone diachronic syllable reduction from the proto-Amuzgo-Mixtecan *CVCV lexical root (for proto-Amuzgo-Mixtecan, see Longacre & Mak (1960), Longacre & Millon (1961); for an overview of Mixtecan syllables, see Suarez 1983: 38–39), resulting in vowel neutralization and consonant compacting and giving onsets of up to two consonants, with a handful of CCG onsets, where G is a glide. This monosyllable differentiates Amuzgo from its Mixtecan sister languages where reduction did not occur and the *CVCV lexical root has mostly been maintained, giving synchronic simple onsets. Thus, despite the synchronic monosyllabic root in XA, the CVCV model remains a useful framework given the historical *CVCV root, synchronic shapes like CVʔ, and roots with complex onsets.

This difference in syllable structure is important to observing nasalization phenomena in XA as compared to Mixtec. Synchronically, the Mixtecan couplet displays nasal harmony where nasality attaches to the right and spreads iteratively across syllables in the absence of opaque segments (Marlett 1992, Walker 2000), while in XA reduction makes such observations impossible given its monosyllabic morpheme. For this reason, any nasal harmony found in XA would necessarily be cross-morphemic.

This type of syllable economy typologically results in a diversity of secondary articulation in the contrastive phonological inventories as is the case here with Amuzgo: mid-sized phonemic inventories are further expanded by eleven tonal values, nasalization, laryngealization, and a syllabic-level contrast known as 'controlled-ballistic' syllables.[9]

With a wide variety of secondary contrasts put to different uses, the phonological complexity of this language can give the appearance of irregularity in surface forms. But a phonological analysis can be proposed that shows morphophonological alternations to be productive and regular processes. This paper focuses on the phonology-morphology interface, a zone that

8 As mentioned in the previous footnote, nasal back vowel /õ/ is realized as [ə̰m̰]. Given the fact that the labialized closure is an extension of the rounding of this back vowel, arguably the labialized closure does not bear phonological status as the glottal stop does. In addition, no immediate data shows a re-syllabification of the final labial in a following syllable, of the type *Cə̰m̰ = V (unlike glottal-final syllables). As such, I tentatively do not consider Cə̰m̰ syllables to be true CVC syllables, but rather a surface realization and consequence of nasalization.

If Cə̰m̰ were considered to be a phonological occurrence of CVC, lexical roots of the type Cə̰mʔ (see: [tse^{1}-ə̰m̰ʔ^{21}] 'compare') would require admitting the syllable shape CVCC, posing further challenges to the CVCV approach. Additional study to determine the phonologic status of the labialized closure would help account for these apparent CVC and CVCC syllable types.

9 The terms describing this contrast give a fair description of the audible difference between the two. The term 'ballistic' originally comes from Pike (1955) and is taken up thereafter in Otomanguean studies for Chinantec (e.g. Merrifield 1963), Triqui (e.g. Hollenbach 1984), Amuzgo (e.g. Bauernschmidt 1965), and the Mazatec of Jalapa (Silverman *et al.,* though tentatively). Mugele (1982, 1984) gives a phonetic account of the syllabic contrast in Chinantec as an "initial surge and rapid decay of intensity, with a resulting fortis articulation of the consonantal onset". A more contemporary acoustic examination proposes that ballistic syllables of XA display characteristics typical to glottal abduction (Herrera 2000) that could be diachronically analyzed as a remnant of breathiness or final -h. The examples below from XA show controlled syllables in the left-hand column and ballistic syllables in the right-hand. The contrast is both lexical, differentiating lexical roots (i), and morphological in derivation (ii) (albeit irregularly) and inflection of animacy in adjectives (iii):

(i)	[we^{2}] 'red'	[we$^{3\cdot}$] 'two'
(ii)	[seʔ^{2}] 'flesh, muscle, body'	[seʔ$^{2\cdot}$] 'meat (to be eaten)'
(iii)	[ka^{1} = ʧi$^{1\cdot}$ ka$^{2\cdot}$ = ã̰^{2}]	[lja^{1} ka$^{2\cdot}$ = ã̰$^{2\cdot}$]
	CLASS = eagle CLASS = yellow.AN	dress CLASS = yellow.IN
	'yellow eagle'	'yellow dress'

remains underexplored in Amuzgo (save Kim 2011, 2016, 2018 on the Amuzgo of San Pedro Amuzgos), with existing accounts tending to focus on one over the other.

After briefly providing typological context for this language in §1.1, §1.2 gives a review of some literature on the concept of shielding and nasalization in related languages. §2 provides an overview of relevant phonology of XA. In §3 nasals and nasalization are examined in light of phonological and morphological phenomena and compared with nasalization in Mixtec as well as other genetically unrelated languages. In §4, other inflectional phenomena will be drawn on (§4.1) toward a formalization of 3SGHUM using CVCV and the relation of correspondence (§4.2) in order to finally qualify nasalization phenomena in XA. In §5 a conclusion discusses the paper's findings and implications.

1.1. About the language

The Amuzgo of Xochistlahuaca (XA), known endonymically as *ñomndaa* (literally 'word of water') is spoken in the southwest of Guerrero State, Mexico by about 4,000 people. This town is the administrative center of Guerrero Amuzgos and home to the variety most commonly understood in the region. The *Ethnologue* classification of 'Guerrero Amuzgo' includes the Xochistlahuaca variety, as well as all but one other variety of this state, with a total estimation of 49,500 speakers. This count has not yet benefited from dialectal work.[10]

The Otomanguean phylum is in the linguistic area known as 'Mesoamerica' and counts a large variety of languages (177 according to *Ethnologue*) making it the most widely spread and diversified in Mesoamerica (Campbell *et al.* 1986). A majority of these languages is to be found in Oaxaca State, Mexico, with some spread into Guerrero, Puebla and Mexico States, among others. The typological traits defining the Mesoamerican *sprachbund* that are also found in Otomanguean languages are: the presence of tone, simple or absent codas, complex verbal morphology, suffixal or enclitic subject marking, and very often endocentric (or VSO/VOS) canonical phrase order.

The term 'Amuzgo' applies to a separate group of languages rather than languages of the Mixtecan variety (as described in Longacre 1961, opposed in a later analysis in Campbell 1997). Currently, the Xochistlahuaca variety of Amuzgo is classified as 5 'developing' in the *Ethnologue* scale of vitality, while other varieties with fewer speakers and in more vulnerable circumstances have been designated as 6 (threatened) or 7 (shifting). Beyond these qualifications, the socio-political situation of almost every indigenous group of Mexico remains vulnerable on multiple levels that constitute key structural factors to language survival (cf. Escárcega & Varese 2004).

The data used in this paper come from first- and second-hand sources. First-hand sources result from elicitation work in Xochistlahuaca in collaboration with Jair Apostól (cited as first names and dates) or with the Endangered Language Alliance (ELA) in New York City (noted as 'ELA' followed by date or internal code) with a member of the Amuzgo diaspora. Work cited as 'ELA (2010–2011)' can be attributed to the work of Daniel Kaufman, Violeta Maldonaldo and Lluvia Cervantes, among other researchers at ELA. Second-hand sources are the 2014 version of an unpublished dictionary from Amy Bauernschmidt of the Summer Institute of Linguistics based on data from 1960s missionary work and the master's theses of two Amuzgo linguists, Moisés Zeferino de Jesús García (2003), and Jair Apostól (2014). Second-hand data are adapted from sources and thus all representations are mine.

1.2. About nasals and complex nasals

I will briefly mention some pertinent literature on similar phenomena in nasals and complex nasals. Insight from these studies are helpful for qualifying the observations made so far by providing typological and historical perspective.

10 The recent classification of Huixtepec Amuzgo by Nazario *et al.* (2009) marks a start to the remaining work to be done. At least the Guerrero varieties of Huehuetonoc, Guadalupe Victoria and Cozoyoapan (despite sharing a street with the city of Xochistlahuaca) demonstrate enough variation for Xochistlahuacan Amuzgos to notice, as reported during fieldwork undertaken in 2016. Limited wordlists of the first two also show notable variation. On the other side of the state border, Oaxacan varieties (Santa María Ipalapa and San Pedro Amuzgos) have enjoyed more inquiry in part thanks to the works of native Amuzgo speaking linguist Fermín Tapia García (with Thomas Smith Stark 1984, 1986, and as sole author 1999, among others).

Using data from UPSID-92 (Maddieson & Precoda, 1990), Clements & Osu (2003) note the presence of simple nasal consonants and/or nasal vowels as phonemes in four possible logical configurations across languages. The most common type of configuration (found in 345 languages of the 451 represented in UPSID-92) are those languages with nasal consonants but no nasal vowels (i.e. English, Arabic). The second most likely (97/451) are those languages with both nasal consonants and nasal vowels (i.e. French, Portuguese). The other two types count a handful each. Languages with complex nasals (listed as 'prenasalized') are numbered at 54 in this same database, including Amuzgo, which is noted as having the segments [mb, nd, ndj, ng] with the possibility of these complex nasals being allophonic. Data is not available on nasality as a suprasegmental feature. This database of course gives a partial vision of phenomena like nasals and nasalization in the world's languages, which come in segmental and autosegmental forms with varying statuses in the phonology.

Given the distribution of nasals and allophonic reflexes of the nasal sonorants observed in §3, XA is of the second type (like French and Portuguese), with both phonemic nasal consonants and vowels. While the distribution of nasal sonorants is unable to confirm phonemic status, allophonic alternation of simple nasals to post-stopped nasals in front of an oral vowel (/N/ → [ND]/____V) demonstrates the phonemic status of simple nasal sonorants.

Similar nasal phonemes with complex nasal allophones arising in oral environments are attested in the Austronesian languages of Acehnese (Durie 1985) and Jambi Malay (though only in coda positions according to Durvasula 2010); Jê languages of the Brazilian Amazon like Kaingang (Anderson 1976) or Panará (Lapierre, forthcoming); Harakmbut (an isolate of Peru; Van Linden forthcoming); Tupí-Guarani languages like Chiriguano (Dietrich 1986, Lapierre & Michael 2018), and Kaiwa (Bridgeman 1961). A survey of data is found in Stanton (2018) and review of similar phenomena is found in Wetzels & Nevins (2018). These accounts follow Haudricourt (1970), Hyman (1975), Herbert (1986), Michaud et al. (2012) and others, to characterize these allophonic alternations as a form of protection of oral-nasal vowel contrast. The term 'environmental shielding' (Herbert, 1986) describes this synchronic, perceptually motivated alternation that employs non-contrastive features in order to effectively safeguard and enhance nasal-oral contrasts in a segmental sequence (Wetzels & Nevins, 2018: 2).

The diachronic development of nasal-stop segments like $\widehat{\text{ND}}$ has been posited as a way to maintain NV vs. N$\tilde{\text{V}}$ contrast (Haudricourt 1970, Michaud *et al.* 2012). Where in NV, nasality from N may transfer to V, and rather than losing N vs. L contrast and to maintain oral V, the language develops $\widehat{\text{ND}}$. This is a pattern consistent with systems lacking obstruent voice distinction, giving surface contrasts of [N$\tilde{\text{V}}$]-[NDV]-[(N)TV/$\tilde{\text{V}}$] (drawing from Henton, *et al.* 1992: 71, and as cited in Iverson & Salmons 1996: 172). In some languages voiced stops may even develop from this process: N > $\widehat{\text{ND}}$ > D (Michaud *et al.* 2012). This bears directly on XA, which lacks a voicing contrast in plosives.

From a synchronic perspective, and under Durvasula's (2010) account, a simple distinction of nasal and non-nasal sonorants (like that available from the typological database UPSID-92) provides only a partial depiction of the facts. When put into a larger context of the language inventory, nasals can be further distinguished by formalizing the varied nasal-stop segments, or 'partially nasalized stops' attested in the world's languages, and proposing two types: nasal based, and voice based. The first is typical of inventories with a two-way contrast of voiceless versus nasal segments (i.e. /p/ vs. /m/) and without laryngeal contrast on obstruents. The second type is typical of inventories where a voice contrast is present in the inventory (i.e. /p/ vs. /b/ vs. /m/) and where partially nasalized stops are phonemic. The previously cited Jê languages and XA would thus be of the first type, i.e. nasal-based. The lack of contrastive voicing typical of Durvasula's first type is recruited to enhance oral-nasal contrast by shielding (Stanton 2018, Wetzels & Nevins 2018).

While in previous work it has been proposed that XA features phonemic prenasalized stops (see footnote 2), evidence from alternations show allophonic reflexes in XA that are atypical in the local group of related languages, like the Mixtecs of Chalcotongo (Macaulay 1996, Iverson & Salmons 1996) and Santa Maria Peñoles (Daly, 1973) or the Mazatec of Jalapa (Silverman, *et al.* 1995) where this is not reported to occur. Marlett's (1992) account proposes a possible alternation of nasals to post-oralized complex nasals before oral environments in Mixtec, though as a generalization and without further detail. In XA itself however, surface [$\widehat{\text{NDV}}$] forms are

quite common and constitute about 13/443 pages in Bauernschmidt's (ms, 2014) dictionary. Across genetically and areally unrelated languages, nasal-based stops are attested and their development inevitable given a set of features.

2. XA Phonology

Segmental inventories are given according to the distinctive features that are relevant in XA. Consonants do not exhibit contrastive voicing but are rather [±sonorant]: non-sonorant consonants (plosives: /p, t, c, k, k^w, ʔ/; stridents: (/β, s, ʃ, ʦ, ʧ/) contrast with sonorant consonants (/m, n, ɲ, l, j, w, r, ɾ/).[11] Labials are marginal, attested mainly in functional words (/m, w/) and loan words (/p, β/), noted below in parentheses; rhotics are the apical trill /r/ and tap /ɾ/, both of which are mostly restricted to expressive words, sound symbols and loan words. Vowels are oral /i, e, ɛ, u, o, ɔ, a/ and nasal /ẽ, ɛ̃, õ, ɔ̃, ã/. No high nasal vowels are found. Three basic tones (high V^1, mid V^2, low V^3) and three contour tones (V^{13}, V^{21}, V^{32}) exist. In addition, the controlled-ballistic distinction (see footnote 9) occurs, doubling the number of possible surface tonal values. One possible contour tone (V^{23}) is not observed, giving in total, eleven surface tonal values. ***Table 1*** shows the phonemic inventory of XA, with allophones in square brackets and rare phonemes in parentheses.

Table 1 Phonemic inventory of XA.

	Bilabial	Alveolar	Alveolo-palatal	Velar	Glottal
Stop	(p)	t	c	k k^w	ʔ
Affricate		ʦ	ʧ		
Fricative	(β)	s	ʃ		
Nasal		n [n̤, ɲ̤, ŋ̤, n^{dj}]	ɲ [$ɲ^{dj}$, ɲ̤]		
Trill		r			
Tap		ɾ			
Approximant	m w [m]	l [l̤]	j		

In ***Table 2***, examples of contrastive segments are given.

Table 2 Examples of consonants – adapted from Bauernschmidt (ms, 2014).

[-sonorant]			[+sonorant]		
/p/	/paʧõ/ [paʧə̃m̥^{13}]	'hairy; idle' (from Mx Span. *pachón*)	/l/	/la/ [la^2]	'DEM.PROX'
/t/	/tɛ·/ [tɛ^{3}·]	'fruit; sour'	/n/	/nã·/ [nã^{2}·]	'corn husk wrapping' (Mx Span. *totomostle*)
/c/	/cã/ [cã^1]	'clumsy; a clumsy person'	/ɲ/	/ɲãʔ/ [ɲãʔ^3]	'palate'
/k/	/kǫ̱ʔ/ [kǫ̱ʔ^{12}]	'exceptional'	/m/	/ma/ [ma^2]	singular, progressive marker
/k^w/	/k^weʔ/ [k^weʔ^{13}]	'little'	/w/	/wiʔ·/ [wiʔ^{3}·]	'painfully'
/β/	/βi̱ǫ̱/ [βʔio^3]	'hell'	/j/	/ja·/ [ja^{1}·]	'well (adv); good (noun)'
/s/	/sa·/ [sa^{3}·]	'man; pile (of things)'	/r/	/ka·=ru/ [ka^{1}·=ru^2]	'whirring sound'
/ʃ/	/ʃẽʔ/ [ʃẽʔ^2]	'parent-in-law'	/ɾ/	/ɾa·/ [ɾa^{3}·]	'3SG.MALE.HONORIFIC'
/ʦ/	/ʦa·/ [ʦa^{2}·]	'immature corn' (Mx Span. *jilote*)			
/ʧ/	/ʧĩʔ·/ [ʧĩʔ^{2}·]	'moon'			

11 This division reflects internal behavior in the language wherein segments group together phonologically based on a division of sonority. As such, I will call glides and semi-vowels 'sonorants' in this paper.

Nasal sonorant phonemes exist, as attested by the distribution seen in (3). In (3)a, a nasal sonorant before a nasal vowel is found in 'hot', while in (3)b–c, the nasal sonorant occurs tautomorphemically with oral vowels and sonorants. In both latter cases, the nasal sonorant is extrasyllabic. This extrasyllabicity proves to further distinguish [NDV] and [NTV] as discussed in §3.

(3) (ELA, 2013)

a.	/nã/	b.	/nlw̰a/	c.	/nteʔ/
	[nã^{1}]		[nl^{2}.w̰a$^{2\cdot}$]		[n̥^{2}.teʔ^{1}]
	'hot'		'money'		'excrement'

Nasal sonorants have a number of allophones due to assimilation, as in (4)a–d. Before stops, nasal sonorants are thus not contrastive for place.[12] While the labial nasal /m/ exists marginally in function words like *ma-* 'PROG.SG', a labial nasal surfaces most often as a nasalized realization of /w/, never appearing except before a nasal vowel, as in (4)e–f. This [w]~[m] reflex is common in Otomanguean languages, and is reconstructed in Proto-Amuzgo-Mixtecan (Longacre & Mak (1960), Longacre & Millon (1961)) and synchronically, for example in Chalcatongo Mixtec (Iverson & Salmons 1996).

(4) (Bauernschmidt, ms, 2014)

a.	/ntsi·/	b.	/ka·=ntʃiuʔ/	c.	/ntõʔ·/
	[n̥.tsi$^{3\cdot}$]		[ka$^{1\cdot}$=n̥.tʃiuʔ^{1}]		[n̥.tə̰m̰ʔ$^{1\cdot}$]
	'sugarcane juice'		CLASS=hairy.caterpillar		'oven'
			'hairy caterpillar'		
d.	/nkę̰·/	e.	/ka=tʃwẽ/	f.	/tʃw̰ẽ/
	[n̥.kę̰$^{3\cdot}$]		[ka^{2}=tʃmẽ^{1}]		[tʃm̰ẽ^{1}]
	'why'		CLASS=agile		'cat'
			'thief'		

Nasal vowels, like nasal sonorants, are phonemic. In ***Table 3***, examples of vowels are given. The low-mid oral vowels are rarer than the more cardinal vowels. Their nasal counterparts are also rarer than the other nasals.

Table 3 Examples of vowels – ELA (2013).

Oral vowels:			**Nasal vowels:**		
/i/	/tsiʔ/ [tseiʔ^{3}]	'egg/bone'			
/e/	/ʧe·/ [ʧe$^{3\cdot}$]	'nagua (a clothing style)'	/ẽ/	/ʧẽ/ [ʧẽ^{1}]	'fragile'
/ɛ/	/ʃɛ̰/ [ʃɛ̰^{2}]	'foot.3SGPOSS'	/ɛ̃/	/wa+cɛ̃/ [wa+cɛ̃^{1}]	'be sitting'
/a/	/ta·/ [ta$^{3\cdot}$]	'hill'	/ã/	/tã/ [tã^{13}]	'offensive'
/u/	/katsku/ [ka^{2}tsku^{3}]	'pig'			
/o/	/tso̰/ [tso̰^{1}]	'dead person'	/õ/	/tsõ·/ [tsə̰m̰$^{1\cdot}$]	'heart'
/ɔ/	/kʷɔ·/ [kʷɔ$^{2\cdot}$]	'mountain'	/ɔ̃/	kʷi-kɔ̃ [kʷi-kɔ̃^{13}]	'PROG.become.dry'

3. Nasals and nasalization in XA

With the above facts taken into consideration, the distribution of sonorants and nasal vowels in lexical roots can be summarized as the following: [LV], [NṼ], and the rare cases of [NLV] (like in (3)b, which is likely a fossilized form inflected for the plural by the prefix *n-*). In addition, *[LṼ] and *[NV] do not occur on the surface. Other surface forms observed are [LTṼ] ([l.kẽ^{1}] 'rice', likely another fossilized plural) and [NTṼ] ((4)c above, and in derived form, like [n̥-tə̰m̰^{1}] PL-knot), as well as [LTV] ([l.koʔ^{2}] 'son-in-law') and [NTV] (as in (4)a, b, d above and in derived form, like [n̥-tɛ^{3}] 'PL-fruit').

12 Non-nasal sonorant /l/ appears rarely before stops and even then, only in formerly motivated inflected forms before /k/, as in /lkẽ/ 'rice' and /lkẽʔ/ 'grains, seeds'. These are likely fossilizations of the plurally inflected form, their most common derivation. The non-nasal sonorant /w/ (like the other semi-vowel /j/) never appears before a stop.

Marlett's (1992) account of Mixtec nasalization notes the absence of [LṼ] as an indication of phonotactic blocking of nasal spread from right to left. While XA exhibits only monosyllabic roots, Mixtec typically has maintained the Proto-Amuzgo-Mixtecan couplet or CVCV. Thus, in a monomorphemic lexical root, T/NṼNṼ, L/TVTṼ occur but *CVLṼ, for example cannot without nasalization spreading across syllable boundaries to L and V_1. Marlett claims that nasalization is thus predictable and morphemic, attaching as an autosegment on the right and spreading iteratively to the left, nasalizing sonorants but not obstruents, which block nasalization. All nasalization patterns not following this logic are unattested e.g. *TṼTV, *TṼTṼ, *LṼTṼ, *TṼLṼ, etc. Monomorphemic nasal harmony is thus attested in Mixtec where in XA it cannot be observed, given the monosyllabic frame.

Another surface form, [NDV], proves crucial to understanding nasal phenomena. This form shows contrastive voicing of plosives (i.e. versus [NTV]), which is not noted elsewhere. Below in (5)a–c [NDV] stems are marked for 3SGHUM, the nasal autosegment that attaches to the right of the stem and nasalizes the vowel. Where before 3SGHUM marking of the [NDV] stem there is a nasal with a homorganic post-occlusion before an oral vowel, after, the occlusion is no longer observed, leaving a simple nasal before a nasalized vowel. Additionally, from the phonotactics of lexical roots, minimal pairs of [NṼ] and [NDV] are observed as in (5)d.

(5) a. (Zeferino, 2003: annexes)

/n̤ɛ/	/ma-n̤ɛ̃/
[n̤͡dɛ^{21}]	[ma^{2}-n̤ɛ̃^{21}]
'sell'	PROG.SG-sell.3SGHUM
	's/he is selling'

b. (Apostól, 2014)

/=ɲe·/	/=ɲẽ·/
[=ɲ͡ɟe^{1}]	[ɲẽ^{1}·]
=ET[13]	= ET.3SGHUM

c. (Herrera, 2000)

/ɲo/	/ɲõ/
[ɲ͡ɟə̰m̰^{11}]	[ɲə̰m̰^{1}]
mouth.3SGPOSS	mouth.3SGHUM.POSS
'someone's mouth'	'his/her mouth'

d. (ELA, 2013)

na	nã
[n͡da^{3}]	[nã^{1}]
'water'	'hot'

These facts and those observed in (3) show that nasal consonants are phonemic and cannot be ruled out as exclusively belonging to surface realizations due to nasal vowels, despite the fact that *[NV] and *[LṼ] do not occur on the surface. The allophonic alternation of (what can now be considered as a single complex segment) /N/ → [N͡D] /_V attests to this fact. This also shows that while sonorants do not contrast before nasal vowels, they do contrast before oral vowels and are thus phonemic. Contrary to other systems where nasal sonorants only surface in nasal environments (i.e. Ikwerre, Ewe both Niger-Congo languages, see Clements & Osu 2003), in XA nasal sonorants have phonemic distribution before nasal and oral vowels.

In addition to phonotactic evidence, this morphological evidence reveals a set of conditioned nasal allophones that prevents nasalization of nucleic oral vowels. Completely nasal forms surface in the case where the nucleic vowel is nasalized by a nasal autosegmental morpheme, e.g. /N/ → [N͡D] /_V. The environment for [N͡D] being before an oral vowel, the underlying representation of surface form [N͡DV] can be represented as /NV/ and in the case of surface form [NṼ], /NṼ/, as in (5).

13 ET stands for 'extended theme' from the Spanish *tema extendido*, the annotation given in Apostól's (2014) master's thesis. According to this source and Dobui (2018), this enclitic is likely a demotivated object marker [=ɲ͡ɟe^{1}] 'ET' that takes subject marking suffixes (e.g. [=ɲ͡ɟu?·] 'ET.2SG') in a class of verbs that once were stative, though synchronically mostly demotivated.

Each allophone is a nasal with post-occlusion whose place of articulation is homorganic to and dependent on that of the nasal: the alveolar /n/ → [n͡d] (as in (5)a and d, and the palatal /ɲ/ → [ɲ͡ɟ] (in (5)b–c). The remaining nasal, the bilabial /m/ is rare, as noted in §2, and mostly attested in function words. In Bauernschmidt's (ms, 2014) dictionary, only two instances of the parallel sequence (bilabial nasal-bilabial stop, [mp]) are found in lexical roots: [mpa^{13} = ɲ͡ɟe^{1}] be.friends = ET 'be friends' and [mpẽĩ$^{13\cdot}$] 'taut, tense'. In the former case, nasalization of the verb from 3SGHUM nasalizes not the verb stem, but the enclitic ET (see footnote 13) giving [mpa^{13} = ɲẽ$^{1\cdot}$] be.friends = ET.3SGHUM. This unfortunately reveals nothing in terms of the allophonic alternation at hand. The second example is a case of the [NTṼ] type and thus irrelevant here.

The voiced occlusion oralizes part of the nasal without loss of nasal identity, protecting the adjacent oral vowel and thereby enhancing oral-nasal contrast in vowels. This is an example of shielding whereby a noncontrastive feature, in this case voicing in plosives, is employed for perceptual enhancement.

Nasalization by 3SGHUM also delineates two underlying forms from surface forms [N͡DV] and [NTV]: the former (as in (5)) where the stop is allophonic and part of a single complex nasal; and in the latter (as in (6)) where the occlusion is phonemic and the sequence is biphonemic /NT/. After this latter onset, V can be nasalized without any change to the onset.

(6) (Zeferino, 2003: annexes)

a.	/ɲ.cn̥·/	/ma-ɲ.cñ̥·/
	[ɲ^{2}.cn̥$^{2\cdot}$]	[ma^{2}-ɲ^{2}.cñ̥$^{2\cdot}$]
	'to frolic'	PROG.SG-frolic.3SGHUM
		's/he is frolicking'
b.	/me + ɲ.cɛ̰ʔ/	/ma-me + ɲ.cɛ̰̃ʔ/
	[me^{2} + ɲ^{2}.cɛ̰ʔ^{2}]	[ma^{2}-me^{2} + ɲ^{2}.cɛ̰̃ʔ^{2} = ẽ]
	be + on	PROG.SG-be + on.3SGHUM = 3SGHUM
	'stand'	's/he is standing'

Surface voice contrast of the plosive in [N͡DV] is actually a feature of nasal sonorants rather than the plosives themselves, an example of how noncontrastive features, here plosive voicing, can be employed to augment contrast of nasality-orality (Stanton 2018, Wetzels & Nevins 2018), as previously discussed. Thus, [N͡DV] can only come from /NV/, and [NTV] from /NTV/. Likewise, *[NDṼ] does not occur, while [NTṼ] does. This /NTV/Ṽ/ form corresponds to the 'sesquisyllable' meaning one-and-a-half syllable (Matisoff's term from 1973: 86, but also see Butler 2010, 2014 for a more recent examination) wherein N is extrasyllabic, a plausible reason for why, in terms of articulation, the intervocalic stop remains unvoiced. In the case of [N͡DV], the complex nasal carries voicing over from the nasal sonorant to the oralized part. Under this consideration, complex nasal allophones stand as tautosyllabic onsets and not part of the sesquisyllabe type.

On the one hand, sonorant-initial lexical stems may have any of the following surface forms: [LV, NṼ, N͡DV, NTV, NTṼ]. On the other hand, derived words can reveal other surface possibilities as 3SGHUM reveals underlying /NV/ and its relationship to [N͡DV]. In the case of 3SGHUM marking of [LV], surface forms [LṼ] are realized without change on the non-nasal sonorant as in (7). As such, in (7)a expected *mẽ = ẽ does not occur despite /w/ → [m]/__Ṽ as in /tʃw̰ẽ/ [tʃm̰ẽ^{1}] 'cat' from (4)f.

(7) (Zeferino, 2003: annexes)

a.	/wiʔ/	/wĩʔ/
	[wiʔ^{3}]	[wẽʔ^{3} = ẽ$^{2\cdot}$]
	'fall ill'	fall.ill.3SGHUM = 3SGHUM
		's/he falls ill'
b.	/lṵɛ̰·/	/ma-lṵ̃ɛ̰̃·/
	[lṵɛ̰$^{2\cdot}$]	[ma^{2}-lṵ̃ɛ̰̃$^{2\cdot}$]
	'search'	PROG.SG-search.3SGHUM
		's/he is searching'

It is impossible to know if a surface [NṼ] were not underlyingly /LṼ/ without some *hypothetical* morpheme that denasalizes stems (as an opposite of the 3SGHUM). This stands to reason given arguments that nasalization is a privative feature, so that orality is not expected to spread as the default or unmarked feature (Trigo 1993, Rice 1993, Steriade 1993, Botma 2004, Walker 2011). However, given forms in (7), non-nasal sonorants can be found to the left of nasal vowels in derived words, but not in lexical roots.

4. Formalizing nasalization in XA

In §3, alternations result from the attachment of the 3SGHUM morpheme, an autosegmental nasal feature that reveals an underlying nasal allophone and confirms phonemic nasal sonorants. However, in order to formalize this morpheme, in §4.1 stems presenting different phonological environments are examined and compared to morphophonological consequences of another nasal morpheme, though a mostly segmental one, the plural prefix, as well as facts from first-person singular inflection. Together these observations help to: i) formalize the status of 3SGHUM as autosegmental (§4.2); and ii) characterize larger nasalization phenomena in XA (§5). In terms of the latter, nasalization is prevented from occurring progressively from left to right, but this is limited to the domain of the morpheme and consequently there is no long-distance nasalization across syllable boundaries. These observations amount to nasal spread but not nasal harmony according to criteria proposed by Clements & Osu (2003).

4.1. Other inflectional facts to consider

Explored below are 3SGHUM, substantive plural, and first-person inflections as shown on different stems, e.g. sonorant initial stems and checked stems. In the facts observed, nasalization is kept from spreading, but only from left to right; and nasalization resulting from 3SGHUM marking affects only immediately adjacent vowels uniteratively, going through glottal stops where these are found.

In (8), nasality does not spread across morphemic boundaries despite adjacent sonorants of differing nasal values as with the verbalizing morpheme [wa^{2}] or the root for 'move' /le/ [lei^{2}], which remains non-nasal despite being in a nasal environment at both its left and right edges. 3SGHUM marking does not trigger nasalization beyond the adjacent vowel, even when it applies vacuously, as it does below. This shows that lexical nasality does not spread across adjacent morphemes and nasality from 3SGHUM inflection applies (even vacuously) only to an adjacent vowel.

(8) (Bauernschmidt, ms, 2014)

a.	/waɲõ·/	/mawaɲõ·/
	[wa^{2} + ɲə̃m̥^{3}·]	[ma^{2}-wa^{2} + ɲə̃m̥^{3}·]
	be + upright	PROG.SG-be + upright.3SGHUM
	'be together/upright'	's/he is standing'
b.	/lenõ/	/malenõ/
	[lei^{2} + nə̃m̥^{2}]	[ma^{2}-lei^{2} + nə̃m̥^{2}]
	move + walk	PROG.SG-move + walk.3SGHUM
	'run'	's/he is running'

It was noted above in example (7), that non-nasal sonorants do not undergo right-to-left nasalization triggered by 3SGHUM. This leads one to think that non-nasal sonorants do not undergo nasalization. Noun pluralization, accomplished by the prefixation of a segmental nasal morpheme /n-/, shows however that non-nasal sonorants are in fact sensitive to nasalization.[14] In this case, nasalization is prevented from spreading left to right.

14 See Dobui's (2013) master's thesis on noun pluralization in XA for further data and rule-based analysis.

Shown in (9)a is the general pattern in which the plural prefix attaches to stop-initial stems without change. In (9)b, the nasal prefix attaches to a changed stem giving [n̥^{2}-ta̰^{1}] 'houses'.[15] An equally possible realization shows the loss of the initial consonant and the surfacing of a non-nasal allomorph as in [la̰^{1}].

(9) a. (ELA, amuzgot2f)

[tɛ^{3}·]	[n̥^{2}-tɛ^{3}·]
'fruit'	PL-fruit
	'fruits'

b. ELA (02012011)

[wa̰^{1}]	[n̥^{2}-ta̰^{1}] *or* [la̰^{1}]
'house'	PL-house *or* PL.house
	'houses'

Two plural allomorphs are shown in (9): a nasal and a non-nasal. Change is also seen in the stem in (9)b [n̥^{2}-ta̰^{1}] if the stem is now taken to be [-ta̰^{1}]. The distribution of the different allomorphs of the plural prefix and the aforementioned change to the stem can be understood if it is assumed that non-nasal sonorants are sensitive to nasalization, and also recalling from §3 that oral vowels must be protected from nasalization.

This analysis implies that nasals morphologically introduced at the left edge of the morpheme must be prevented from spreading nasality rightward to the root to which they attach. In (9)a the nasal attaches without change, presumably because the initial stop prevents nasal spread. In the first pluralized form in (9)b the non-nasal sonorant of the stem shows sensitivity to nasalization, fortifying to [t] to prevent nasalization from spreading and confirming that non-nasal sonorants are sensitive to nasalization. The second pluralized form displays allomorphy that prevents nasalization of either the non-nasal sonorant (it is lost) or the oral stem vowel, which is thus protected from nasalization.

Sensitivity to left-to-right nasalization is further seen in (10) where nasality of the stem motivates allomorphy. In (10)a, the stem-initial consonant is lost and [n-] attaches without further change on a nasal stem.[16] The nasal prefix surfaces with a nasal stem without fear of losing lexical identity. The non-nasal allomorph of the plural prefix appears in (10)b as the only possible pluralized form (contrary to (9b), and also after loss of the initial consonant on an oral stem. Here, an oral stem is protected against nasalization by the selection of the non-nasal allomorph.

(10) a. ELA (amuzgo19122010)

[tsã̰^{1}·]	[nã̰^{1}·]
'person'	PL.person
	'persons'

15 In this case, both forms of the plural are possible, though this is not always so elsewhere with phonologically similar stems. Only a single example could be found to exemplify default e.g. [n-] plural marking on a sonorant-initial stem.

As the plural allomorph [l] exists, many l-initial stems are in fact fossilized plural forms, as in:

(i) [la̰^{1}ʔ] 'flower'
(ii) [l̥^{2}.kɛ̃^{1}] 'rice'

as noted earlier in footnote 12.

Other non-nasal sonorants, [j] and [w] are rarely found in substantives and the few that are pluralize irregularly, as in:

(Bauernschmidt, ms, 2014)

(i)	[yu^{2}·=sku^{3}·] CLASS=woman 'woman'	[yo·=l̥^{2}ku^{3}·] PL.CLASS=PL.woman 'women'
(ii)	[we^{1}·lo^{3}ʔ·] 'grandfather' from Spanish *abuelo*	[we^{1}·lo^{3}·] 'grandfathers'

16 Sonorant-strident sequences are phonotactically avoided, with different alternations triggered when the plural prefix attaches to a strident initial stem. For ts-initial nasal stems, the stem-initial consonant is lost in the inflected form as with (9)b. In ts-initial oral stems, the strident can be fortified, as in:

(i) [ka^{2}=tsu^{21}] CLASS=snake 'snake'
(ii) [ka^{2}=n̥^{2}tu^{21}] CLASS=PL.snake 'snakes'

b. Bauernschmidt (ms, 2014)

[tsio^{2}]	[lio^{2}]
'bottle'	PL.bottle
	'bottles

To summarize, sensitivity to the presence and absence of nasality is noted in monomorphemic environments, i.e. in lexical roots where *LṼ is never found and in the /N/→[N͡D]/__V allomorphic alternation where the oral vowel is protected from nasalization through oralization of the nasal onset. It is also observed at the left edge in the above noted alternations in plural morphophonology where non-nasal sonorants and orality of stem vowels provoke consonant mutation and/or allomorphy to prevent nasalization. Environments in which sensitivity is unattested, i.e. from right to left in (7) where non-nasal sonorants remain so despite an adjacent vowel nasalized for 3SGHUM; and in neither direction across morphemic boundaries in (8) where nasalization does not occur between adjacent morphemes. This clarifies that 3SGHUM only affects adjacent vowels, as specific to the morpheme rather than as part of the general phonology.

In the case of checked stems, nasalization occurs through the glottal stop and a copy of the vowel surfaces nasalized as in (7)a above and (11) below. The copied nasal vowel appears to the right of the stem and is lexically ballistic, realized as such regardless of the stem syllable's ballistic-controlled quality. Comparing these forms to unchecked stems in (5), it appears that a final glottal stop triggers the realization of 3SGHUM as a segmental morpheme in the form of a vowel copied from the stem.

(11) Zeferino (2003: annexes)

a.	[me^{2} + n.ce̤i̤ʔ^{2}]	[ma^{2}-me^{2} + n.cẽ̤ĩ̤ʔ^{2} = ẽĩ$^{2\cdot}$]
	be + on	PROG.SG-be + on.3SGHUM = 3SGHUM
	'stand'	's/he is standing'
b.	[kaʔ$^{3\cdot}$]	[ma^{2}-kãʔ$^{3\cdot}$ = ã$^{2\cdot}$]
	'ask'	PROG.SG-ask.3SGHUM = 3SGHUM
		's/he is asking'
c.	[wa^{2} + ɲə̰m̰ʔ$^{1\cdot}$]	[ma^{2}-wa^{2} + ɲə̰m̰ʔ$^{1\cdot}$ = ə̰m̰$^{2\cdot}$]
	be + for	PROG.SG-be + for.3SGHUM = 3SGHUM
	'defend/protect'	's/he is defending/protecting'

Glottal stops are transparent to nasalization. In the copied vowel, the prosodic features (ballisticity and tone) are specific to 3SGHUM and can be attributed lexically to the morpheme.

Subject marking is done with enclitics, though independent full forms also exist, as seen in ***Table 4***, mostly for focus or topicalization.[17] Some observations from first-person marking help to further characterize nasalization triggered by 3SGHUM and in general.[18] Like the 3SGHUM, realization of singular and plural first-person marking also depends on the presence of a glottal stop. Where the stem is unchecked, as in the verb for 'cut' [cę̤^{21}] in ***Table 4***, glide-initial allomorphs (=ja) surface. In the case of a checked stem, as in [k^{w}aʔ$^{2\cdot}$] 'eat', only the vowel (=a) surfaces. While prosodic and segmental identity of the first-person morpheme is maintained after attaching to the radical (*contra* 3SGHUM, see e.g. [ma^{2}-kɔʔ^{1} = a^{2}] 'I am stopping'), allomorphy depends on the stem coda (similar to 3SGHUM).

17 Subject versus possessive pronouns are undistinguished, marked by the same set of enclitics as in the columns labeled 'eat' and 'cut' in ***Table 4***. These are analyzed as enclitics for reasons cited in Spencer & Luis (2012), i.e. pronouns originate from independent forms, a relationship that is still visible in the column labeled 'Independent'; and for the most part, the phonology of these function words depends at least partially on stem phonology. This latter characteristic of clitics has been observed for 3SGHUM where realization of a copied nasal vowel, or simply the nasalization of the stem depends on the stem's phonology i.e. the presence of a glottal stop finally. Second-person marking – generally a glottal stop with possible prosodic alternations (tone and ballisticity) – also depends on whether the stem is a checked syllable. In some cases, tradeoffs may occur with prosodic features when a stem is glottal-final, preventing overt second-person marking. In this case, prosodic features mark inflection. First-person marking also triggers ATR assimilation of the stem vowel, but beyond an autosegmental status similar to 3SGHUM, is irrelevant to the current study.

18 Tonal change has been noted to occur on stems marked for 1PL, but this will be left aside for the current discussion.

	Independent	'eat'	'cut'
1SG	[ạ²·]	[ma²-kʷaʔ¹·=a²·]	[ma²-cɛ̰¹·=ja²·]
		PROG.SG-eat.1SG=1SG	PROG.SG-cut.1SG=1SG
2SG	[u̯²·]	[ma²-kʷaʔ¹³·]	[ma²-cɐ̰ʔ²¹]
		PROG.SG-eat.2SG	PROG.SG-cut.2SG
3SG (overt subject)	∅	[ma²-kʷaʔ²·]	[ma²-cɐ̰²¹]
		PROG.SG-eat.3SG	PROG.SG-cut.3SG
3SG.HUM	[o̰¹·]	[ma²-kʷãʔ²=ã²·]	[ma²-cɐ̰̃¹³]
		PROG.SG-eat.3SGHUM=3SGHUM	PROG.SG-cut.3SGHUM
1PL.INCL	[ạ¹]	[kʷi²-kʷaʔ²=a¹]	[kʷi²-cɛ̰³=ja¹]
		PROG.PL-eat.1PL=1PL.INCL	PROG.PL-cut.1PL=1PL.INCL
1PL.EXCL	[ạ¹³˙]	[kʷi²-kʷaʔ²=a¹³·]	[kʷi-cɛ̰³=ja¹³·]
		PROG.PL-eat.1PL=1PL.EXCL	PROG.PL-cut.1PL=1PL.EXCL
2PL	[o̰²·]	[kʷi²-kʷaʔ²·=joʔ²·]	[kʷi-cɐ̰ʔ³·=joʔ²·]
		PROG.PL-eat.2PL=2PL	PROG.PL-cut.2PL=2PL
3PL.HUM	[o̰¹=nã¹]	[kʷi²-kʷaʔ³·=nã¹·]	[kʷi-cɐ̰³·=nã¹]·
		PROG.PL-eat.3PL=3PL.HUM	PROG.PL-cut.3PL=3PL.HUM
	Apostól (2014)	Zeferino (2003: 240)	Zeferino (2003:467)

Table 4 XA subject pronoun marking.[19]

In the examples of first-person marking below, the singular is used as representative of the phenomena since alternations are regular and can be generalized to the plural pronouns. In stems containing phonemically nasal vowels as in (12) and (13), the first-person marker does not undergo nasalization despite being adjacent to a nasal syllable. The same situation holds for stems without nasal consonants, i.e. phonemically nasal nuclei, as in (13).

(12) Zeferino (2003: annexes)

a. [ma²-mẽĩʔ²¹ = a²·]
PROG.SG-fight.1SG = 1SG
'I am fighting'

b. [ma²-wa² + n̰ãʔ¹ = a²·]
PROG.SG-identify/recognize.1SG = 1SG
'I am identifying'

(13)

a. [ma²-tɔ̃ʔ³· = a²·]
PROG.SG-break.1SG = 1SG
'I am breaking'

b. [ma²-tãʔ³ = a²·]
PROG.SG-leave.1SG = 1SG
'I am leaving'

If (12) and (13) are compared to (14) and (15) where the same stems are marked for 3SGHUM, the forms are nearly syncretic, contrasting at times almost solely in nasality of the final vowel, as with (14)b and (15)b compared to (12)b and (13)b.

(14) Zeferino (2003: annexes)

a. [ma²-mẽĩʔ²¹ = ẽĩ²·]
PROG.SG-fight.3SG = 3SG
's/he is fighting'

b. [ma²-wa² + n̰ãʔ¹ = ã²·]
PROG.SG-identify/recognize.3SGHUM = 3SGHUM
's/he is identifying/recognizing'

(15)

a. [ma²-tɔ̃ʔ³· = ɔ̃²·]
PROG.SG-break.3SGHUM = 3SGHUM
's/he is breaking'

b. [ma²-tãʔ³ = ã²·]
PROG.SG-leave.3SGHUM = 3SGHUM
's/he is leaving.'

Consequences of 3SGHUM and first-person marking further show that nasalization of the vowel appearing at the right edge of the root (but of no additional phonological material) is specific

19 Singular and plural pronouns for animal and inanimate nouns are omitted here as they do not bear on the present discussion.

and lexical to the 3SGHUM autosegmental morpheme. In a linear reading, it appears that 3SGHUM nasalizes the right-most vowel, then spreads across to a copied vowel.

To summarize: (i) substantive pluralization allomorphy shows that nasalization is prevented from spreading left to right within a morpheme; (ii) nasalization by 3SGHUM does not spread from right to left beyond the nucleic vowel within a given unchecked morpheme; (iii) nasalization by 3SGHUM of a checked syllable is realized with a nasalized copy vowel word-finally. However, on the surface, the latter appears to present a case of nasal spread across morpheme boundaries, which would be the only instance of long-distance spread (meaning harmony) so far attested in XA. Different formal interpretations of 3SGHUM allow this surface analysis to be discarded.

4.2. Formalizing 3SGHUM

With these details in mind, a formalization of 3SGHUM can be proposed. Two realizations of 3SGHUM have been noted that can be schematized as the following: $C\tilde{V}$ or $C\tilde{V}ʔ = \tilde{V}^{2\cdot}$ in the case of a checked stem. Given these surface realizations, 3SGHUM is a right-aligning nasal autosegment. In this iteration, the autosegment is satisfied with attaching to one possible adjacent slot, without further spread for example to a non-nasal sonorant onset, as with [ma²-lṵḛ²·] 's/he is searching'. ***Figure 1*** is a formalization of 3SGHUM as a nasal autosegment as it attaches to the right-most vowel of the verb [kɔ³·] 'clean the house'.

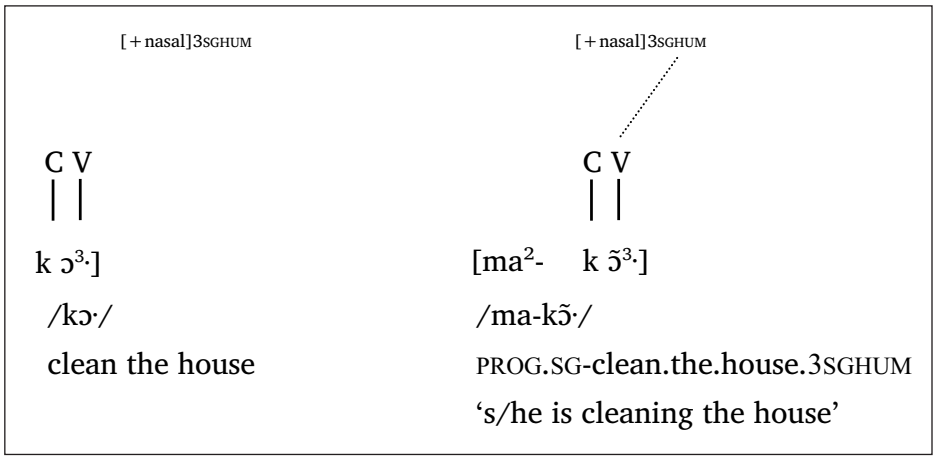

Figure 1 Derivation of 3SGHUM marking as a nasal autosegment.

Drawing in data from checked stems however, calls for a formalization of the 3SGHUM morpheme that would not contradict facts from nasalization seen earlier, namely that nasalization on checked stems appears to spread across morpheme boundaries from a copied nasalized vowel.

Two proposals for formalization can be made with different implications. First, the 3SGHUM autosegmental morpheme has a segmental allomorph, e.g. $=\tilde{V}_1$ where feature identity is indexed to correspond to the nucleic vowel. The allomorph attaches to checked syllables and nasality then spreads from right to left across the glottal stop, as in: $CV_1ʔ = \tilde{V}_1 \rightarrow C\tilde{V}_1ʔ = \tilde{V}_1$. The additional final vowel slot would be accounted for without recourse to vowel copying. However, this analysis has the disadvantages of requiring an explanation of exceptional spread across a morpheme boundary, in addition to adding an allomorph to the inventory. The same concerns arise if the allomorph were assumed to be the autosegment and the morpheme the segmental form. Reducing the allomorphic inventory only to the segmental form (and doing away with the autosegmental form) is also a possibility: when the morpheme attaches to the stem, an anti-gemination rule (present elsewhere in the phonology) would reduce *VV to V as in: $CV_1 = \tilde{V}_1 \rightarrow C\tilde{V}_1 = \tilde{V}_1 \rightarrow C\tilde{V}$. However, this version does not take care of accounting for nasalization across a morpheme boundary.

In a second proposal, the morpheme is *only* an autosegment and the copied vowel is reduplicative.[20] From a rule-based approach, there are two possible orders of events. In the first scenario, the autosegment attaches to the root vowel and reduplicates a nasalized copied

20 I use Kawahara's (2004) distinction between epenthesis (local, driven by phonotactics) and reduplication (longer distance, driven by morphology).

vowel, as triggered by the glottal stop. This is an attractive proposal as it nullifies the need to account for spreading nasality across morpheme boundaries and maintains a minimal morpheme inventory. This account considers the additional vowel slot to be reduplicative but fails to find a motivation for reduplication given that CV? words surface elsewhere, meaning there is no apparent phonological reason for 3SGHUM to trigger reduplication on checked syllables.

The assumption used to analyze CV stems, namely that the morpheme for 3SGHUM must be right aligned, helps explain reduplication. In the case of CV? syllables, as the glottal stop cannot be nasalized, nasalization attaches to the nearest candidate, the stem vowel. Requirement for right-edge alignment results in the now nasalized stem vowel being copied to the right, giving the second type $C\tilde{V}? = \tilde{V}^{2\cdot}$. In a CVCV account driven by syllable well-formedness, the final glottal stop re-aligns as a syllable onset and permits a segmental realization (i.e. the reduplicated vowel) of 3SGHUM that remains formally autosegmental, as in the inflection of unchecked CV stems. Rather than nasality spreading from one point to another linearly, the CVCV formalization in ***Figure 2*** assumes two non-linear operations: nasalization occurs on the stem and the vowel is then copied to satisfy right-edge alignment. In considering the copied vowel to be a case of reduplication, near identity between the root vowel and the copied vowel is accounted for by correspondence. As a faithfulness constraint, correspondence requires some level of identity between the copied item and its base, the two being separate strings, as is the case here where only tone and ballisticity are specific to 3SGHUM.

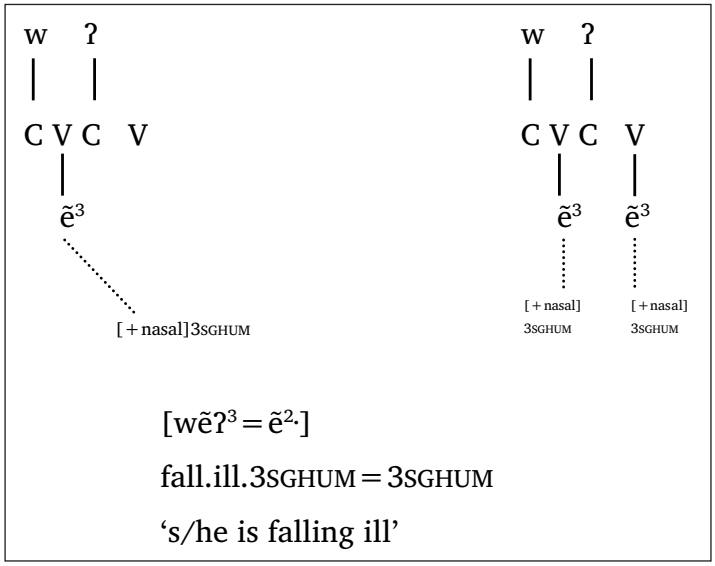

Figure 2 Correspondence after 3SGHUM inflection on a checked syllable.

The assumptions allowed by correspondence and the CVCV approach help avoid an analysis of nasalization across boundaries as in ***Figure 3***, where nasal spread from V-place is shared between the two vowel slots. In Kawahara's (2004) association of reduplication and correspondence, he also associates epenthesis to feature spreading. Analyzing the copied vowel as a reduplication rather than as epenthetic follows Kawahara's definition (see footnote 20), allowing an analysis that does not assume nasal spread across boundaries.

The account illustrated by ***Figure 2*** has several advantages. First, apparent nasal spread across syllable and morphemic boundaries is ruled out. Second, apparent right-to-left spread is also ruled out. This would otherwise have been the only case of regressive nasalization across boundaries and would have stood as an exception. Third, rather than proposing two allomorphs for 3SGHUM, meaning an autosegment in the case of CV and a segmental allomorph in the case of CV?, only one account is needed. Finally, this account also fits nicely with phenomena seen in first-person marking where on an unchecked stem, (a generalized) *=ja* surfaces, while on checked stems, *=a* surfaces. This is another example of syllable re-alignment on a CVCV skeleton.

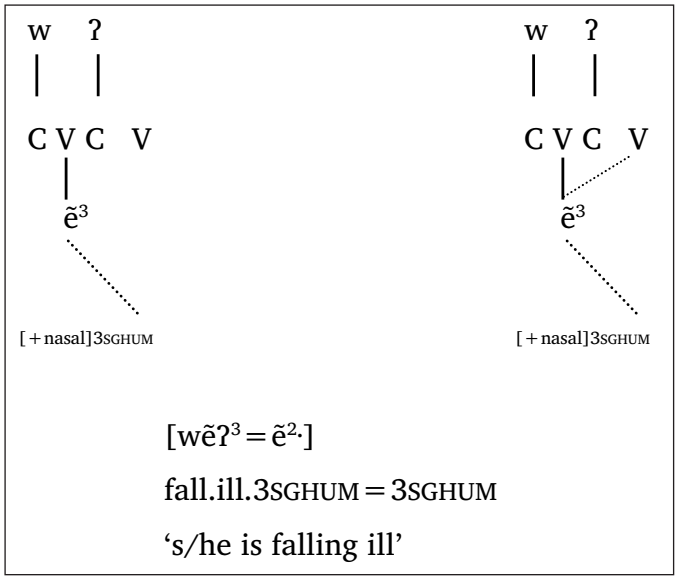

Figure 3 Dispreferred analysis of nasalization across morpheme boundaries.

5. Discussion

Investigation into the interface between phonology and morphology allows for a better understanding of nasalization in XA, previously considered to bear an inventory of complex nasal segments. Much of what appears on the surface in this language, even in underived stems like those seen in this study, risks misinterpretation without insight from morphologically driven alternations. Thus, surface forms have a strong tendency to appear unpredictable without an interpretation of facts from other parts of the grammar.

Part of this surface lexicality can be linked to the parsimonious syllable economy of XA where any change may majorly affect surface identity. Analysis of XA is well served by the CVCV model applied here thanks to a historical understanding of XA as a *CVCV language now reduced to a tight monosyllable of C(C)V, or near monosyllables (i.e. sesquisyllables) like C.CV, only partially mentioned here. Synchronically speaking, CVCV provides a way to account for phenomena like 3SGHUM where morphologically driven change depends on phonology, in this case the CVʔ syllable.

In turn, characterization of larger nasalization phenomena in XA is possible, namely i) the existence of nasal consonantal and vocalic phonemes; ii) the prevention of nasalization from left to right in the phonotactics (i.e. *[LV]) and in the morphophonology (i.e. pluralization); and iii) lack of iterative nasalization from right to left (i.e. as seen in cases like (7)) and across morphemes (i.e. nasalization from 3SGHUM). The allophonic alternation of /N/ → [N͡D] /_V is revealed in part thanks to 3SGHUM. This helps relate XA typologically to Jê and Tupí-Guarani languages (among others), which also display this kind of shielding. Studies on languages related to XA, like Mixtecan languages, do not note this alternation (except cursorily in Marlett 1992), though this warrants closer examination. Further, as lexical roots are monosyllabic in XA, nasalization cannot be noted as spreading across syllable boundaries within a single morpheme, typical of morphemic nasalization. This is in synchronic contrast with data from Mixtec that display nasal harmony across syllables in the CVCV couplet. Multimorphemic words in XA (and Mixtec, see Marlett, 1992) do not undergo nasalization, either as a result of derivation or inflection.

With this study, facts from this lesser studied language are reconsidered in light of fine-grained data and formalized approaches. In so doing, this paper allows greater insight into the language and phenomena in question, and also serves to draw XA into larger discussions in the science.

Abbreviations

AN	animate
CLASS	noun marker
DEM.PROX	proximal demonstrative
ET	extended theme

EXCL	exclusive
HONORIFIC	honorific pronoun
HUM	human
IN	inanimate
INCL	inclusive
PL	plural
POSS	possessive
PROG	progressive aspect
SG	singular

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Competing interests

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