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VN > V in Camuno: An alternative historical pathway to nasal loss

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Internal reconstruction as well as comparative evidence demonstrate that historical loss of coda nasals in some varieties of Camuno has occurred, and involves four phonetic or phonological variables: stress, cluster *vs* singleton coda, voicing of the following obstruent in NC clusters, and place of articulation of the nasal. While historical loss of coda nasals is evident in other Romance languages, the absence of vowel nasalization and the occurrence of historical word-final obstruent devoicing in Camuno (Cresci 2014) make this historical development of special interest. In this study I suggest phonetic factors that may explain differential loss of *n *vs* *m in word-final position of stressed syllables, the role of obstruent voicing, and absence of contrastive nasalized vowels in the history of Camuno. I argue that Camuno exemplifies an alternative historical pathway to nasal loss, one in which nasals are lost without a trace, leaving behind plain oral vowels. Ohala & Busà (1995) account for such pathway as the inverse of spontaneous nasalization.[*]

KEYWORDS: Nasal loss, Rhinoglottophilia, Nasalized vowels, Nasal Deletion, Camuno, Eastern Lombard, Dialects of Italy, Endangered languages.

1. Introduction

This study provides historical phonetic explanation for sound patterns in some varieties of Camuno, where /n/ and /m/ alternate with Ø. These patterns, which are synchronically analyzed as nasal deletion, are the result of historical nasal loss, and are found in a number of other Romance languages (Hajek 1997, Sampson 1999), where they are associated with the rise of contrastive nasalized vowels. In these varieties of Camuno, however, contrastive nasalized vowels are not attested, and, I argue, never evolved.

[*] This work would not have been possible without Juliette Blevins, who first encouraged me to start and pursue it, and the invaluable help of Giovanni Bonfadini, who greatly contributed to its final shape. In addition, I would like to thank the anonymous reviewer, whose comments and suggestions have significantly improved this study.

A common pathway – pathway A – to loss of a nasal consonant is presented in Beddor (2009). Anticipatory coarticulation of a nasal consonant in a sequence ṼN (Ṽ is phonetic) can result in misparsing of nasality as originating in Ṽ instead of N. The nasal consonant is perceived as a spurious element and eventually dropped. The final result is a contrastive nasalized vowel. This pathway is usually assumed for contrastive nasalized vowels in Romance languages like French and Portuguese, and in a few northern Italian vernaculars. Another pathway – pathway B – is presented in Ohala & Busà (1995). An aspirated nasalized rime can result in misparsing of nasality as aspiration. The nasal consonant is perceived as a spurious element and eventually dropped. In this case, the final result is a plain oral vowel. This is a perceptually-based sound change, a case of "hypercorrection" for Ohala (2012), and of "change" for Blevins (2004). Ohala & Busà (1995) claim that this sound change is the inverse of spontaneous nasalization. This symmetrical nature would make it of particular interest, since sound change is in principle asymmetrical (Garrett & Johnson 2013, Igartua 2015). The phrase "spontaneous nasalization" was first coined by Grierson (1922, cited in Ohala & Busà 1995) for cases in the Indo-Aryan languages where nasalization on a vowel or occasionally a nasal consonant itself appears in a word where historically there was no original nasal. Crucially, whenever this happens, it is very often in the environment of a segment characterized by high airflow: any voiceless fricative, especially [h], aspirated stops, and affricates.[1]

The hypothesis explored in this work is that the varieties of Camuno under investigation (henceforth simply indicated as 'Camuno') exemplify pathway B. The claim is that the nasal patterns are partly the result of the historical effects of a spread glottal gesture at phrase-final boundaries on a short nasal segment. This gesture is held responsible for devoicing of the nasals, their subsequent loss via misperception, and absence of contrastive nasalized vowels.

This study is organized as follows. §1 introduces the focus of the study; §2 supplies some basic information on the language; §3 introduces and analyzes Camuno nasal patterns; §4 explores the diachronic and phonetic origins of the nasal patterns; §5 investigates arguments supporting the evolution and loss of contrastive nasalized vowels in the area where Camuno is spoken in light of the facts of Camuno. In §6 exceptions to nasal deletion in clusters are accounted for. Conclusions are in §7.

In order to explore both the form and content of a speaker's grammar as well as questions regarding explanations for the form and content of Camuno nasal patterns, I will use a range of tools and concepts

developed over the years within Generative approaches to Phonology (cf. Chomsky & Halle 1968; Goldsmith 1976, 1990; McCarthy 1984; Clements 1977, 1984; Clements & Sezer 1982) without taking a stance whether the phonological categories and rules arise from Universal Grammar (UG), are learned, or some combination of the two. The basic assumptions that inform this work are: (i) that linguistic competence can be modeled as a combination of words, rules and exceptions to these rules (exceptions may be listed in the lexicon, or expressed in the rules themselves); (ii) surface forms are derived from underlying forms through ordered rules. The form of rules is not assumed to have psychological reality. They are simply a useful and precise way of representing relationships between surface forms and more abstract phonological representations.

2. Camuno

Camuno is a variety of Eastern Lombard spoken in Valcamonica, Italy, together with the local variety of Italian. Located in eastern Lombardy, Valcamonica – [alkaˈmɔnegɔ] in Camuno – is one of the largest valleys in the central Alps.

Though referred to as a dialect of Italy, Camuno – like almost all the (traditional) dialects of Italy, alternatively called Italian dialects or Italian vernaculars – is not a local variety of Italian, but a sister of Italian, a local divergent development of the Latin originally spoken in Italy (Maiden & Parry 1997: 2). Native speakers never refer to the language as Camuno. They simply call it [diaˈlɛt] 'dialect'. As a variety of Eastern Lombard, Camuno is quite different from Standard Italian, the official language of Italy, which derives from a Florentine variety of Tuscan. *Ethnologue* (Lewis, Simons & Fennig 2013) classifies Lombard [lmo] as a language of Italy, whose varieties are today spoken in Lombardy, and in Switzerland (Ticino and some valleys of the Grisons).

Camuno is a spoken language that lacks a writing system, and is severely endangered. Despite local attempts to collect and document cultural traditions and folklore, the language is understudied (Bonfadini 1995: 26). Cresci (2014) is, to date, the only synchronic description of the phonology of two varieties of the language.

Camuno exhibits remarkable phonetic, phonological and grammatical features, including a unique system of height harmony (Cresci 2015), a phonetically unique pattern of final obstruent devoicing, and patterns of nasals alternating with Ø, the subject of this work.

The sound inventory of the language is in (1) and (2).

(1)

p	b	t	d				k	g	
f	v		z/ð		(ʃ)				h
					ʧ	ʤ			
	m		n			ɲ			
			l	r					
						j		w	

(2)

i	y		u	
	e	ø		o
	ɛ			ɔ
		a		

Final obstruent devoicing in Camuno interacts with N alternating with Ø; for this reason, it is illustrated in (3) and (4). Camuno exhibits morphologically related pairs in which a medial voiced obstruent alternates with a final voiceless obstruent, as in (3), alongside morphologically related pairs in which such alternation is not observed, as in (4).

(3)	[koˈlombɔ]	‘pigeon.F’	[koˈlomp]	‘pigeon.M’
	[ˈhurdɔ]	‘deaf.F’	[ˈhurt]	‘deaf.M’
	[huriˈgi]	‘mouse.DIM’	[hoˈrɛk]	‘mouse’
	[kaiˈʤi]	‘twig.DIM’	[kaˈiʧ]	‘twig’
	[ˈiɔ] < *[ˈivɔ]	‘alive.F’	[ˈif]	‘alive.M’
	[ˈhpuzɔ]	‘bride’	[ˈhpuh]	‘groom’
(4)	[gruˈpi]	‘knot.DIM’	[ˈgrop]	‘knot’
	[ˈhytɔ]	‘not wet.F’	[ˈhyt]	‘not wet.M’
	[ˈhɛkɔ]	‘dry.F’	[ˈhɛk]	‘dry.M’
	[kuˈniʧɔ]	‘rabbit.F’	[kuˈniʧ]	‘rabbit.M’
	[ˈhtyfɔ]	‘tired.F’	[ˈhtyf]	‘tired.M’
	[ˈrohɔ]	‘red.F’	[ˈroh]	‘red.M’

Different pieces of evidence suggest that the analysis of final obstruent devoicing (not voicing) for Camuno is the correct one. Underlying voiced obstruents are thus posited for all alternating obstruents in (3). Underlying voiceless obstruents are posited for the non-alternating voiceless obstruents in (4). Spectrograms of voiceless and devoiced segments [t] are in Figure 1 and Figure 2 respectively. They represent [ˈpyt] /ˈpyt/ ‘bachelor’, and [ˈøt] /ˈød/ ‘empty’ as uttered in 2010 by a 75 year-old female native speaker of Camuno. Notice that final stops are released with sustained airflow.

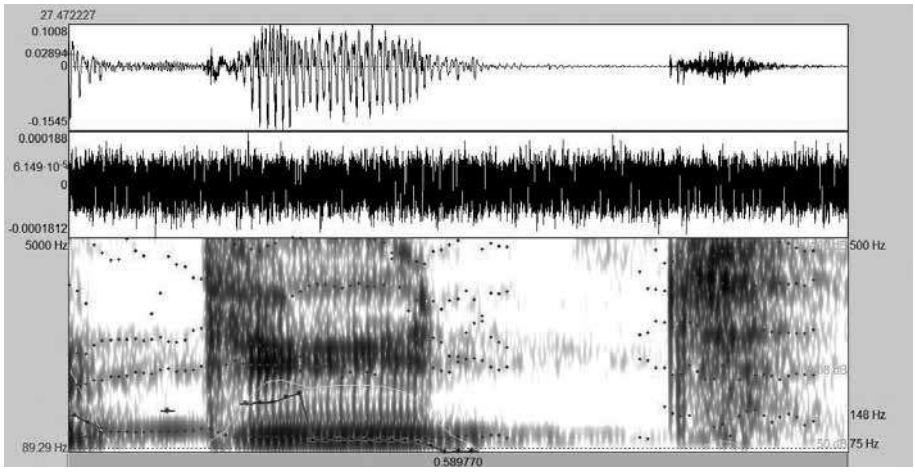


Figure 1. [ˈpyt] 'bachelor'

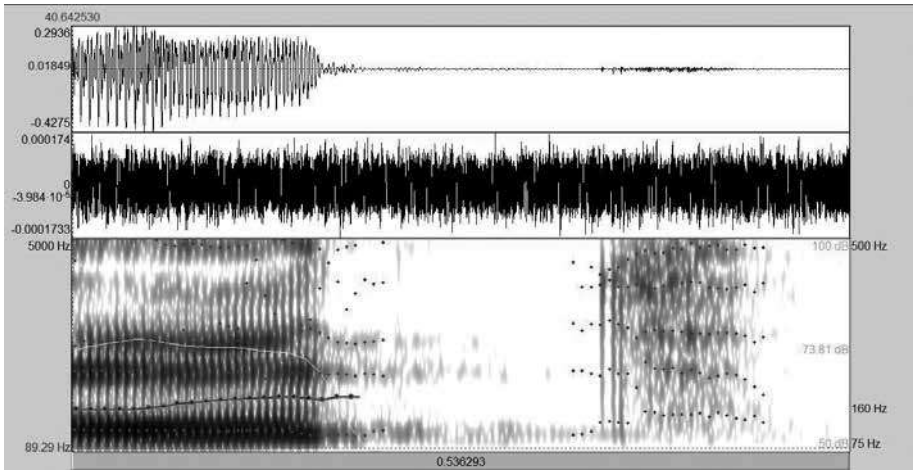


Figure 2. [ˈøt] 'empty'

In addition to that, historical voiceless segments are preaspirated with devoicing effects on the preceding sonorant as shown in Figure 3. The two spectrograms in Figure 3 and Figure 4 refer to [ˈhpɛrt] /ˈhpɛrt/ 'smart', and [ˈhurt] /ˈhurd/ 'deaf' as uttered in 2010 by a 65 year-old male native speaker of Camuno. As one can notice, while /r/ is totally devoiced in [ˈhpɛrt] 'smart', it is voiced in [ˈhurt] 'deaf'.

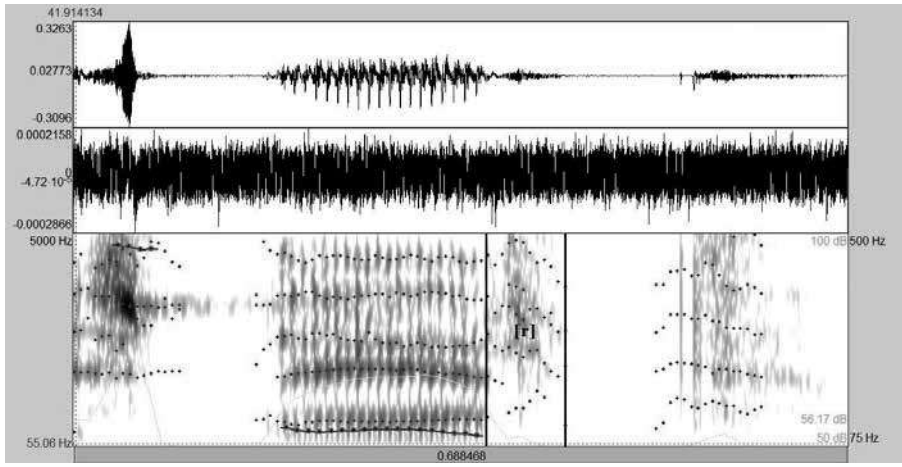


Figure 3. [ˈhpɛrt] 'smart'

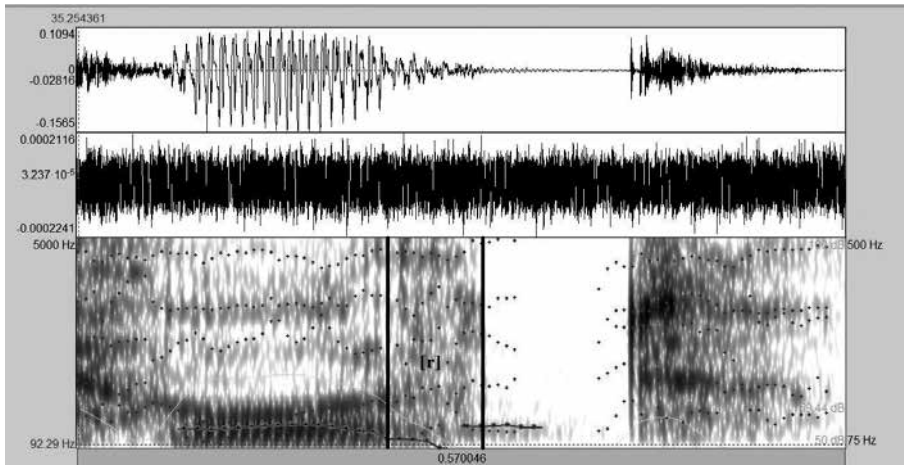


Figure 4. [ˈhurt] 'deaf'

This study of N alternating with Ø is based on two varieties of the language spoken in the upper part of the lower valley, namely in Bienno, Breno, Cogno, Darfo, Esine, Gorzone, Malegno, Piamborno and Prestine. They are mainly distinguished by the presence of /z/ in one variety (Camuno-z) and of /ð/ in the other (Camuno-ð). /z/ or /ð/ occur word-initially, medially between vowels, and after /r/, /n/ and /l/. Some examples are: [ˈzøk] or [ˈðøk] 'game', [ˈazɛn] or [ˈaðɛn] 'donkey',

[manˈzøl] or [manˈðøl] ‘two-year-old beef’ and [valˈzɛl] or [valˈðɛl] ‘stream.DIM’. Word-finally, both varieties exhibit an alternation with [h]. For example, both [ˈhpuzɔ] and [ˈhpuðɔ] ‘bride’ alternate with [ˈhpuh] ‘bridegroom’. Examples in this work are given in Camuno-z. Notice that one variety of Camuno-z has /o/ instead of /ɔ/ before /m/.

The data presented come from my knowledge of the language as a heritage speaker, and from the recordings and fieldnotes that I collected from over fifty native informants between 2010 and 2012 (cf. Cresci 2014).

3. Synchronic nasal patterns

Contrasting nasals in Camuno occur at three points of articulation: labial /m/, coronal /n/, and palatal /ɲ/. In word-initial, medial and final position, homorganic NC nasal clusters are observed, including non-contrastive labiodental and velar nasals as well. N alternating with Ø is observed for /n/ and /m/, but not for the palatal /ɲ/.

/n/ is observed word-initially ([ˈnaf] ‘ship’), medially ([ˈpanɔ] ‘cream’), finally ([ˈan] ‘year’), and in homorganic NC nasal clusters ([ˈntrek], ‘whole’, [kanˈtu] ‘corner’; [ˈtont] ‘round’). In stressed-syllable codas, either it alternates with /ɲ/ in singular *vs* plural paradigms ([ˈan] ~ [ˈaɲ] ‘year(s)’), or it is not realized, as in (5).

(5)	[ˈma]	‘hand’	[maˈninɔ]	‘hand.DIM’
	[ˈfe]	‘hay’	[feˈnah]	‘poor-quality hay’
	[ˈbu]	‘good.M’	[ˈbunɔ]	‘good.F’
	[ˈpi]	‘kid, child.M’	[ˈpinɔ]	‘child.F’

/n/ alternates with Ø only if it is preceded by a stressed vowel; if the vowel is unstressed, the final nasal is always pronounced. A few examples are in (6).

(6)	[ˈazɛn]	‘donkey’
	[maˈlyzɛn]	‘sorb’
	[ˈpɛtɛn]	‘comb’
	[ˈkorɛn]	‘cliff’
	[ˈfurɛn]	‘oven’
	[ˈhtefɛn]	‘Stephen’
	[ˈzuɛn]	‘young’

/n/ is observed after a stressed vowel in the singular members of

the small set of morphologically related pairs in (7) as well as in the words [ˈhɔn] ‘sleep’, and [(a)yˈtyn] ‘fall’.[2]

(7)	[ˈan]	‘year’	[ˈaɲ]	‘years’
	[ˈdan]	‘damage’	[ˈdaɲ]	‘damages’
	[ˈpan][3]	‘item of clothing’	[ˈpaɲ]	‘clothes’

The pairs in (7) are morphologically related. Final /n/ and /ɲ/ are in a singular *vs* plural morphological relationship, where palatalization expresses plurality. Palatalization as a marker of plurality is observed also in pairs as [ˈgat] ~ [ˈgaʧ] ‘cat(s)’, [ˈgal] ~ [ˈgaj] ‘rooster(s)’.

/m/ exhibits a behavior similar to /n/, but with a difference. Like /n/, /m/ is observed word-initially (e.g. [ˈmar] ‘sea’), medially (e.g. [ˈlamɔ] ‘blade’), and in homorganic NC (e.g. [ˈmpe] ‘standing’, [kampuˈli] ‘field.DIM’, [koˈlomp] ‘pigeon’). Unlike /n/, /m/ does not alternate with Ø word-finally, as shown in (8), while both /m/ and /n/ are observed to alternate with Ø in word-final clusters after a stressed vowel, as shown in (9).

(8)	[ˈpom]	‘apple’	[puˈmi] /poˈmi/[4]	‘apple.DIM’
	[ˈfam]	‘hunger’	[faˈmahɔ]	‘a lot of hunger’
	[ˈram]	‘branch’	[ramiˈli] /rameˈli/	‘branch.DIM’
	[ˈɔm]/[ˈom]	‘man’	[omaˈhi]	‘man.DIM’
	[haˈlam]	‘salami’	[halaˈmi]	‘salami.DIM’
	[ˈlym]	‘light’	[lyˈmi]	‘light.DIM’

(9)	[ˈdet]	‘tooth’	[dinˈti]	‘tooth.DIM’
	[ˈhik]	‘five’	[hiŋˈkwantɔ]	‘fifty’
	[ˈkap]	‘field’	[kampuˈli]	‘field.DIM’
	[ˈhʤuf]	‘swollen’	[hʤoŋˈfa]	‘to swell’
	[ˈkuh]	‘dressed’	[konˈhat][5]	‘dressed’

In environment (9), {n, m} alternating with Ø occurs only before lexically voiceless obstruents. Before lexically voiced obstruents, as in (10), nasals do not alternate even though these obstruents are final and phonetically devoiced.

(10)	[ˈgamp]	‘stem’	[gamˈbɛt]	‘short stem’
	[ˈtont]	‘round.M’	[ˈtondɔ]	‘round.F’
	[ˈloŋk]	‘long.M’	[ˈloŋgɔ]	‘long.F’
	[ˈfonh]	‘mushroom’	[fonzaˈti]	‘mushroom.DIM’
	[ˈpjanh]	‘s/he cries’	[pjanˈzi]	‘to cry’
	[ˈtɛnh]	‘s/he dyes’	[tinˈzi]	‘to dye’

A process of /o/ raising in conjunction with {n, m} alternating with Ø is also observed. /ˈu/ and /o/ alternations are shown in (11).

(11)				
	[ˈput]	'bridge'	[ponteˈzɛl]	'bridge.DIM.'
	[ˈut]	'greasy'	[onˈta]	'to grease'
	[ˈmut]	'mountain'	[muntiziˈli] /montezeˈli/	'mountain.DIM'
	[ˈruk]	a placename	[ronˈkej]	a placename

A comparison between (11) and (12) reveals that /o/ raising occurs when the stressed vowel is followed by a nasal which itself is followed by a lexically voiceless obstruent, and does not occur when the same obstruent is lexically voiced.

(12)				
	[ˈtont]	'round.M'	[ˈtondɔ]	'round.F'
	[ˈfont]	'deep.M'	[ˈfondɔ]	'deep.F'
	[ˈloŋk]	'long.M'	[ˈloŋgɔ]	'long.F'
	[ˈfonh]	'mushroom'	[fonzaˈti]	'mushroom.DIM'

Occurrence of NC preceded by a stressed vowel in the complementary, non-word-final environment is observed in words as [ˈintime] 'mattress cases', [ˈroŋkɔ] 's/he snores', [poˈlɛntɔ] 'cornmeal porridge', [ˈrampɔ] 'steep', [ˈhɛmpe] 'single', and [ˈpompɔ] 'pump'. This distribution shows that {n, m} alternating with Ø occurs only word-finally:[6] in absolute word-final position for /n/, and in final NC before a voiceless obstruent for /n/ and /m/.

3.1. Synchronic account

When a segment alternates with Ø, there are at least two straightforward analyses: the alternation may reflect regular insertion or regular deletion. A nasal insertion analysis for CV# words followed by a stressed vowel (cf. [ˈma] 'hand' ~ [maˈninɔ] 'hand.DIM') makes incorrect predictions for numerous CV# words, as shown in (13).

(13)	BASE		DERIVED		UNGRAMMATICAL
	[ˈma]	'hand'	[maˈninɔ]	'hand.DIM'	-
	[ˈka]	'house'	[kaˈzinɔ]	'house.DIM'	**[kaˈninɔ]
	[ˈko]	'head'	[kohaˈri]	'head.DIM'	**[koˈni]
	[ˈpɛ]	'foot'	[pehaˈti]	'foot.DIM'	**[peˈni]
	[ˈfra]	'friar'	[frataˈhi]	'friar.DIM'	**[fraˈni]

For NC# alternating with C#, a rule of N-epenthesis for words ending in /p, t, k/ followed by a stressed vowel also makes incorrect predictions, as shown in (14).

(14)	BASE		DERIVED		UNGRAMMATICAL
	[ˈdet]	'tooth'	[dinˈti]	'tooth.DIM'	-
	[ˈlat]	'milk'	[laˈti]	'buttermilk'	**[lanˈti]
	[ˈhɛt]	'seven'	[heˈtɛm]	'seventh'	**[henˈtɛm]
	[ˈok]	'goose'	[uˈki]	'goose.DIM'	**[uŋˈki]
	[ˈɲɔk]	'dumpling'	[ɲuˈki]	'dumpling.DIM'	**[ɲuŋˈki]
	[ˈgrop]	'knot'	[gruˈpi]	'knot.DIM'	**[grumˈpi]

It is quite clear that a nasal-insertion analysis is untenable in Camuno. For this reason, an analysis of nasal deletion is pursued in this work.

While nasal deletion occurs for both /n/ and /m/ in word-final NC after a stressed vowel before lexically voiceless obstruents (cf. examples in (9)), /n/ but not /m/ alternates with Ø in word-final position after a stressed vowel (cf. examples in (5) and (8)). To capture this asymmetry, two synchronic rules of nasal deletion are suggested. A rule that deletes the coronal nasal (15), and a rule that deletes any nasal when it is followed by a voiceless obstruent (16). Crucially, the environment is the same: word-final position, after a stressed vowel. The two processes are not ordered.

(15) FINAL CORONAL NASAL DELETION (N-DEL)
[+nas, +ant, COR] → Ø / ˈV_ #.

(16) FINAL PRE-VOICELESS OBSTRUENT NASAL DELETION (NT-DEL)
[+nas] → Ø / ˈV_ [-son, -voiced]#. Must precede final obstruent devoicing.

NT-DEL and final obstruent devoicing are in counterfeeding relationship. If final devoicing applied before NT-DEL, it would feed it by supplying a voiceless obstruent after the nasal. For this reason, NT-DEL is ordered before final obstruent devoicing. n-DEL targets /n/ in word-final position after a stressed vowel. NT-DEL targets both /n/ and /m/ in word-final position, after a stressed vowel, before a voiceless obstruent. Notice that the two processes share a similar environment. In both cases, a nasal is deleted after a stressed vowel in word-final position. A few exceptions to NT-DEL, such as [ˈbjaŋk] 'white', are observed; they will be discussed in §7.

A process of /o/ raising is observed in conjunction with nasal deletion in obstruent clusters (as in (11)). Here, the target is a stressed vowel. To capture this pattern, a rule of /o/ raising before a nasal followed by a lexically voiceless obstruent is suggested. For the process to occur, the syllable needs to be stressed, or strong in the foot. The rule is stated in (17).

(17) /o/ RAISING
[+syll, +back, -low, +tense, -high, +stressed] → [+high] /_ [+nas] [-son, -voiced]$_{\sigma}$

/o/ raising needs to apply before NT-DEL (counterbleeding order). If NT-DEL applied before /o/ raising it would delete /n/ before a voiceless obstruent; in this way it would bleed the environment for /o/ raising to apply. In addition, /o/ raising needs to apply before final obstruent devoicing (counterfeeding order). If final obstruent devoicing applied before /o/ raising it would feed it by supplying a voiceless obstruent after a nasal. n-DEL and /o/ raising can apply in any order with respect to one another. The same applies to n-DEL and NT-DEL.

Synchronic derivations for the attested forms [ˈpom] 'apple', [ˈbu] 'good', [ˈazɛn] 'donkey', [ˈintime] 'mattress cases', [ˈkap] 'field', [koˈlomp] 'pigeon', [ˈdet] 'tooth', [ˈut] 'greasy', [ˈtont] 'round', [ˈbjaŋk] 'white' and [ˈan] 'year' are in (18) and (19). For [ˈbu] 'good', [ˈkap] 'field', [koˈlomp] 'pigeon', [ˈdet] 'tooth', [ˈut] 'greasy', [ˈtont] 'round', the underlying forms are assumed to be /ˈbun/, /ˈkamp/, /koˈlomb/, /ˈdent/, /ˈont/, and /ˈtond/ respectively on the basis of /n/ alternating with Ø in [ˈbunɔ] ~ [ˈbu] 'good.F~M'; /m/ alternating with Ø in [kampuˈli] 'field.DIM' ~ [ˈkap] 'field'; /p/ alternating with /b/ in [koˈlomp] ~ [koˈlombɔ] 'pigeon.M~F'; /n/ alternating with Ø in [dinˈti] 'tooth.DIM' ~ [ˈdet] 'tooth'; /o/ alternating with /ˈu/, and /n/ alternating with Ø in [onˈta] 'to grease' ~ [ˈut] 'greasy'; /t/ alternating with /d/ in [ˈtont] ~ [ˈtondɔ] 'round.M~F'. The underlying representations are lexical forms after stress assignment and nasal place assimilation.

(18)	Underlying forms	/ˈpom/	/ˈbun/	/ˈazɛn/	/ˈintime/	/ˈkamp/	/ˈan/
	/o/ raising	-	-	-	-	-	-
	n-DEL	-	ˈbu	-	-	-	[-n-DEL]
	NT-DEL	-	-	-	-	ˈkap	-
	Final obstruent devoicing	-	-	-	-	-	-
	Attested forms	[ˈpom]	[ˈbu]	[ˈazɛn]	[ˈintime]	[ˈkap]	[ˈan]

(19)	Underlying forms	/koˈlomb/	/ˈdent/	/ˈont/	/ˈtond/	/ˈbjaŋk/
	/o/ raising	-	-	ˈunt	-	-
	n-DEL	-	-	-	-	-
	NT-DEL	-	ˈdet	ˈut	-	[-NT-DEL]
	Final obstruent devoicing	koˈlomp	-	-	ˈtont	-
	Attested forms	[koˈlomp]	[ˈdet]	[ˈut]	[ˈtont]	[ˈbjaŋk]

Under this account, exceptions to the n-DEL and NT-DEL rules are marked as [-n-DEL] and [-NT-DEL] respectively, and will not undergo the rules.

The plurals in (7), [ˈaɲ] 'years', [ˈpaɲ] 'clothes', and [ˈdaɲ] 'damages', will be accounted for by the morphological rule of overt plural marking. Three rules of plural marking are assumed, as shown in (20). R1 accounts for overt plural marking of masculine nouns ending in a [COR, -cont, +cons]. This includes nouns ending in /t, d, n, l/ whose plurals are realized as /ʧ, ʤ, ɲ, j/ respectively (e.g. [ˈgat] 'cat' ~ [ˈgaʧ] 'cats'). In other words, when a singular noun ends in /t, d, n, l/, the plural autosegment [+high, -back] associates with the final segment palatalizing it. R2 accounts for /ɔ/ and /e/ marking the singular and plural feminine respectively in nouns (e.g. [fonˈtanɔ] ~ [fonˈtane] 'fountain(s)'). R3 accounts for no overt plural marking of masculine nouns ending in [-COR] (e.g. [ˈhak] 'bag(s)'), and in [COR, +cont] (e.g. [ˈmar] 'sea(s)'). Rule R3 is the default rule, or the elsewhere case.

(20) R1 …C]$_{Nsg}$

[COR, +cons, -cont] [+high, -back]$_{Plural}$

R2 …ɔ]$_{Nsg}$ → …e]$_{Npl}$

R3 …Ø]$_{Nsg}$ → …Ø]$_{Npl}$

Rule R1 will yield palatalized laterals from lateral-final nouns like /gal/ 'rooster'. A phonological rule of delateralization taking a palatalized */lʲ/ to /j/ is needed to account for surface forms like [ˈgaj] 'roosters'. The rule is in (21).

(21) Delateralization
[+lateral, -syllabic, +high] → [-lateral] / _ #

Although nasals provide the most salient and consistent pattern of a consonant alternating with Ø in word-final stressed syllables, similar alternations are found sporadically for non-nasal consonants as well. Some examples are in (22).

(22)	[ˈka]	'house'	[kaˈzinɔ]	'house.DIM'
	[ˈpɛ]	'foot'	[pehaˈti]	'foot.DIM'
	[ˈko]	'head'	[kohaˈri]	'head.DIM'
	[ˈfra]	'friar'	[frataˈhi]	'friar.DIM'
	[ˈna] or [ˈnda]	'to go'	[andaˈri]	'kid-walker'

Whether these patterns of C alternating with Ø are synchronically productive is an open question.

4. Diachronic account

Historical evidence shows that *n, but not *m, was lost in word-final syllable codas, while both *n and *m were lost in word-final coda clusters, before a voiceless obstruent, after a stressed vowel, as illustrated in (23), (24), and (25) respectively.[7]

(23)	[ˈma]	<	MANU(M)	‘hand’
	[ˈbu]	<	BŎNU(M)	‘good’
	[ˈfe]	<	FĒNU(M)	‘hay’
	[ˈpa]	<	PANE(M)	‘bread’
	[ˈfi]	<	FĪNE(M)	‘good-quality’
(24)	[ˈpom]	<	PŌMU(M)	‘apple’
	[ˈfam]	<	FAMEN	‘hunger’
	[ˈram]	<	RAMU(M)	‘branch’
	[ˈɔm]/[ˈom]	<	HŎMO	‘man’
	[ˈlym]	<	LŪMEN	‘light’
(25)	[ˈdet]	<	DĔNTE(M)	‘tooth’
	[ˈhik]	<	CĪNQUE	‘five’
	[ˈkap]	<	CAMPU(M)	‘field’

I argue that these sound changes are phonetically motivated and follow directly from a number of preceding and interconnected sound changes. What follows is an account of how attested sound changes in the history of Romance languages, namely open-syllable lengthening, consonantal weakening, vowel coloring in the form of /o/ fronting, loss of word-final non-low vowels, and final obstruent devoicing contribute to explaining nasal loss and the subsequent evolution of the synchronic patterns of nasal deletion attested in Camuno. What is explored in this work is the phonetic sources of nasal loss, which, I argue, are: (i) aspiration due to a laryngeal spreading gesture at phrase boundaries; (ii) stress; and (iii) the intrinsic duration of the nasals. The relevance of these phonetic factors for nasal loss is discussed in §4.1 through §4.2.4.

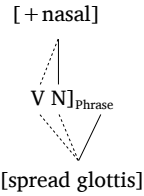
4.1. Effects of a laryngeal spreading gesture

The effects of a laryngeal spreading gesture that are under scrutiny in this study are inhibition of phonetic voicing, subsequent devoicing (Ohala 1997), and 'rhinoglottophilia' (Matisoff 1975), that is the perceptual confusion between nasality and aspiration. Blevins (2006: 138), following Ohala (1983) and Vaux & Samuels (2004), observes that laryngeal spreading gestures are used in many languages to mark phrase-boundaries. These gestures may result in phrase-final devoicing, often with aspiration. Blevins (2006: 138) argues that this is one of the sources of final obstruent devoicing. Since the end of a phrase is also the end of a word, [p t k] will occur word-finally at the phrase boundary. This gives rise to voiced and voiceless variants from which the pattern of final obstruent devoicing may evolve. The evolution of sound patterns from phrase-based to word-based domains is due to dominance effects of single-word utterances in early language acquisition. Interpreting phrase-final effects as word-based effects will result in word-final devoicing. Cresci (2014) provides phonological and phonetic evidence that Camuno exhibits final obstruent devoicing. The neutralized segments in (5) and (6) are characterized by audible release and lack of phonetic voicing. In addition, historically voiceless stops are preaspirated with devoicing effects on the preceding sonorant, as shown in Figure 3. Camuno phonetic facts, and studies on the effects of laryngeal spreading gestures suggest that the source of final obstruent devoicing in Camuno is very likely a laryngeal spreading gesture at phrase-boundaries. What is argued for in this work is that the same laryngeal spreading gesture which is assumed as the source of final obstruent devoicing in Camuno is also the source of nasal loss, with nasal loss preceding final obstruent devoicing. Under this analysis, a laryngeal spreading gesture devoiced first the coronal nasal codas, then the nasals in NT, paving the way to the synchronic nasal deletion patterns attested today.[8] Later, when more word-final codas had evolved, it devoiced final voiced obstruents giving rise to the pattern of final obstruent devoicing attested today.

The laryngeal spreading gesture affected Camuno nasals in two different ways. On the one hand, it inhibited phonetic voicing by preventing abduction of the vocal folds (Ohala 1997), thus devoicing the nasals and making them less audible; on the other hand, it muffled the very perception of nasality. There is a fair amount of evidence that aspiration and nasality can be confused (Matisoff 1975; Ohala 1975, 1980, 1987; Klatt & Klatt 1990; Blevins & Garrett 1993). If nasality is confused with aspiration, the speaker will treat nasality as a spurious element engen-

dered by aspiration, and discard it altogether. Consider a rime where nasality and aspiration are overlapping and coextensive as in (30), with [spread glottis] coming from a phrase-final laryngeal spreading gesture.

(30)



If a speaker attributes the nasal percept to aspiration and discounts it, nasality can be lost without a trace. Ohala & Busà (1995) provide cross-linguistic and experimental evidence that the environment where voiceless aspiration occurs can lead to nasal loss. First, they observe that nasals are lost or absent more often before a voiceless fricative than elsewhere. They account for the frequency of this pattern by observing that the production of segments characterized by voiceless aspiration require greater-than-normal glottal opening. This glottalic gesture may spread via assimilation to the margins of adjacent vowels where it creates acoustic effects that mimic nasalization. Listeners may misinterpret this nasalization as an effect of the fricative consonant rather than the nasal consonant. If this happens, the nasal consonant may be discarded as a spurious element engendered by aspiration. The perceptual experiment they ran supports this claim. American English and Italian speakers failed to detect a nasal consonant shorter than 30 ms before a voiceless fricative, but not before a voiceless stop. This result suggests that relatively short nasals in an environment characterized by aspiration are hard to perceive, easily confusable with aspiration, and therefore prone to loss.

An interesting claim in Ohala & Busà (1995) is that nasal effacement in the environment of aspiration is the inverse of spontaneous nasalization. In the case of spontaneous nasalization, the final outcome is either a nasalized vowel or a nasal segment; in the case of nasal effacement, the final outcome is a plain oral vowel. Ohala & Busà (1995) expect this pattern to exist, although they do not have evidence of languages where nasal effacement has resulted in plain oral vowels. My claim is that Camuno exemplifies this kind of language, namely that nasals were lost without a trace because they were short, and loss occurred in the environment of aspiration. Notice that what makes the difference in Ohala & Busà's (1995) experiment is the environment, fric-

atives *vs* stops, and the duration of the segment. American and Italian participants failed to detect a nasal consonant below the threshold level of 30 ms. What needs to be explored with respect to Camuno is (i) whether there are reasons to believe that the nasals that were eventually lost were short segments, shorter than the segments that were maintained; (ii) whether *n and *m exhibited differential duration, since one was lost and the other was maintained word-finally; lastly, (iii) whether this difference neutralizes to the shorter segment in NC clusters where they were both lost.

One of the sources of segment reduction is stress, whose role in nasal loss in Camuno is explored in §4.2.

4.2. Stress in nasal loss

Camuno /n/ is not observed in word-final stressed syllables (as in (5)), except for the few cases shown in (7), while it is observed in unstressed, word-final syllables (as in (6)), suggesting a role for stress in *n loss. Loporcaro (2011: 54-110) observes that major lengthening of stressed open syllables is attested for proto-Romance after the collapse of the Latin quantitative vowel system, around the early 5th century, when a new, stress-dependent phonetic vowel length distinction evolved.[9] Stressed vowels in open syllables were phonetically long and short elsewhere, suggesting that the main phonetic correlate of stress in Proto-Romance was duration (for a discussion of lengthening under stress cf. Blevins 2004: 173). This lengthening process, assumed for proto-Romance, is usually referred to as open-syllable lengthening. It was observed, with some variation, in the whole central-southern part of the Romance area, including the area where Valcamonica is located. As a result, a word like *ˈmanu < MANU(M) was phonetically *[ˈmaː.nu], while a word like *ˈannu < ANNU(M) was *[ˈan.nu].

Lengthening of a stressed vowel can have three consequences, among others: (i) lenition and/or reduction of the following unstressed syllable; (ii) vowel coloring, which, in the case of Camuno, provides useful insight into the intrinsic duration of *n and *m; and (iii) apocope. The effects of stressed vowel lengthening on nasal loss are explored in §4.2.1 through §4.2.4.

4.2.1. Lenition of post-tonic segments

Lenition of segments in ˈV_V is part of a wider process in the evolution of Romance languages which is usually referred to as consonantal weakening (Giannelli & Cravens 1997: 32-40). Loporcaro (2011: 154) argues that lenition in the form of voicing of intervocalic stops in ˈV_V is

sporadically attested in epigraphic documents from the whole territory of the western Empire since the 1st century (Weinrich 1960; Campanile 1971: 59f; Varvaro 1984, cited in Loporcaro 2011). It grows more frequent in Gaul from the 6th century, whereas Visigothic Spain and Langobardic Italy show considerable delay (Herman 1998: 13; Politzer 1953: 13, cited in Loporcaro 2011).

For some Romance languages including Camuno, one of the final outcomes of consonantal weakening was loss or spirantization of original voiced stops, the evolution a new series of voiced stops from originally voiceless ones, and degemination. In Camuno, the originally voiced stops were eventually lost, as shown in (27).

(27)	[ˈfaɔ]	<	FABA(M)	'horse bean'
	[ˈlaer]	<	LABIU(M)	'lip'
	[ˈkuɔ]	<	CŌDA(M)	'tail'
	[miˈølɔ]	<	MEDŬLLA(M)	'mallow'
	[ˈhtreɔ]	<	STRĬGA(M)	'witch'

In a few northern Italian dialects there is evidence for a weakening process of *n in intervocalic position. Loss of intervocalic *n is observed in Piemontese, Ticinese, and Ligurian, three Gallo-Italic varieties like Camuno, where *n is lost before the plural suffix /-i/ as in [ˈbui] 'good.M.PL' < BONI (data from Ormea, in the province of Cuneo), [ˈkai] 'dogs' < *CANI (Western Ligurian), and [ˈkai] 'dogs' < *CANI (Ticinese). In the Gallo-Italic dialect spoken in Novara di Sicilia, loss of intervocalic *n is observed with subsequent nasalization of the preceding vowel as in [ˈlũa] 'moon' < LŪNA(M), [kaˈdẽa] 'chain' < CATĒNA(M), [kãˈau] 'canal; pipe' < CANALE(M) (Rohlfs 1966: 312). A similar weakening process is visible in Gascon, Galician, Portuguese, among Romance languages. An interesting case of *n lenition is observed in Basque. Following Igartua (2015: 646), the old Basque lenis nasal *n was replaced by a nasalized glottal fricative at the onset of the second syllable of the word. The fortis correlate, usually represented as *N, retained its nasal character while leniting to /n/. The Basque case shows remarkable similarities to Camuno, for two reasons: (i) it shows a clear connection between nasality and aspiration; (ii) the change targeted the weaker nasal segment of a pair.

Although Camuno has maintained *n in intervocalic position, I argue that the coronal nasal that was eventually lost underwent lenition, which affected its duration, turning it into a shorter segment. Evidence that a lenited /n/ can be shorter than its non-lenited counterpart comes from the experimental realm. Skaer & Aniya (2008) show that in the North

American variety of English /n/ in $V_1\_V_2$, where V_2 is unstressed, lenites to an alveolar nasal tap whose duration is roughly half the duration of the alveolar nasal, without losing nasality.

There are thus reasons to believe that the coronal nasal that was eventually lost in Camuno in word-final post-tonic syllables was a reduced segment, as historical and experimental data suggest. Maintenance of *m in the same environment, on the other hand, suggests that this segment did not undergo reduction in the same way as *n did. The reason, as I argue in §4.2.2, is a durational differential between the two nasals, with *m being on average longer than a regular consonant, and *n shorter.

*4.2.2. Vowel coloring: an insight into the intrinsic duration of *n and *m*

Evidence that Camuno *n in word-final ˈV_V underwent lenition comes from the sound change that targeted Latin stressed ŏ in open syllables. Latin stressed ŏ in open syllables was affected in different ways in different Romance languages. In French (Western, Gallo-Romance) it went to /ø/ as early as the 6th century. In Florentine (Central, Italo-Romance) it diphthongized to /wɔ/ around late 6th to 7th century (Loporcaro 2011: 127). In central and southern Italo-Romance varieties, evolution of Latin stressed ŏ in open syllables is usually associated with diphthongization and metaphony. In northern Italy the situation is less clear (Loporcaro 2011: 120-124; Rohlfs 1969: 112-123, 139-150). Loporcaro (2011) believes that these processes provide further evidence for the effectiveness of open-syllable lengthening: the quality of a lengthened vowel is unstable and prone to change, as it happened in the history of Romance. In Camuno, Latin stressed ŏ in open syllables went to /ø/ everywhere except when followed by *n and *m, suggesting that, at the time of the sound change, the vowel before *m and *n, for some reason, did not meet the structural description for the sound change. The working hypothesis is that it was phonetically either longer or shorter than stressed ŏ before non-nasal consonants. Consider the reflexes of Latin ŏ and ō in stressed open syllables in (28).

(28)	MŎLA(M)	>	[ˈmølɔ]	‘grindstone’
	BŎNU(M)	>	[ˈbu]	‘good.M’
	NEPŌTE(M)	>	[neˈut]	‘nephew’
	CORŌNA(M)	>	[kuˈrunɔ] (/koˈrunɔ/)	‘crown; rosary’

The data reveal that before *n, stressed ŏ has evolved in the same way as stressed ō, namely as /u/. This suggests that stressed ŏ before *n

was categorized as ŏ, a long vowel, possibly because *n, in that environment, was shorter than the other consonants. This explains why the sound change that took stressed ŏ to /ø/ in open syllables did not occur before *n. Stressed ŏ in that environment was already too long to be categorized as ŏ.

While /u/ is observed before /n/ in Camuno, /o/ or /ɔ/ is observed as the reflex of stressed ŏ and ō before /m/, as in [ˈɔm] or [ˈom] 'man' < HŏMO, [ˈpom] 'apple' < PŌMU(M). Thus, before *m, stressed ŏ and ō in open syllables have evolved alike, suggesting that stressed ō before *m was categorized as a short vowel. In turn, this reveals that *m was a long consonant, possibly longer than the other consonants. This explains why the sound change that took stressed ŏ to /ø/ in open syllables did not occur before *m either. The duration of the target vowel was already different from regular stressed ŏ in open syllables. The hypothesis is that it was shorter than regular stressed ŏ because /m/ was possibly longer than a singleton consonant, long enough to close the preceding syllable and to act as an onset of the following one. This hypothesis finds support from the evolution of both stressed ŏ and ō in closed syllables where vowels tend to be shorter than elsewhere. In this environment, they have evolved as /ɔ/ and /o/, which is the way they have evolved before *m. Some examples are in (29).

(29)	CŎLLU(M)	>	[ˈkɔl]	'neck'
	HŎRTU(M)	>	[ˈort]	'vegetable garden'
	COGNŌSCIT	>	[koˈnɔhe]	's/he knows'
	*BŌRRA	>	[ˈborɔ]	'trunk'

These facts reveal that at the time of the sound change that took stressed ŏ to /ø/ in open syllables the intrinsic duration of the nasals was different from the other consonants; while *n was shorter than the other consonants, *m was longer (on duration differential between *n and *m in northern Italian dialects see also Hajek 1997: 173). Further evidence that *n was a short segment comes from *ɛ > [e] in [ˈdet] 'tooth' < *dɛnt where a lax vowel changes into a tense, an intrinsically longer vowel.

More Camuno data offer additional evidence that the coronal nasal was intrinsically shorter than its bilabial counterpart, and that these durational differences have persisted over time. The language exhibits exceptions to the /n/ deletion pattern in absolute word-final position, as showed in (7). These exceptions have a historical explanation. The source of the attested /n/ is different from the source of the lost

*n. Attested /n/ was originally either a geminate or a nasal cluster. In (7) [ˈan] is the reflex of ANNU(M) 'year', [ˈpan] of PANNU(M) 'an item of clothing', and [ˈdan] of DAMNU(M) 'damage'; [ˈhɔn] of SŏMNU(M) 'sleep', and [(a)yˈtyn] of AUTŭMNU(M) 'fall'. Thus, word-final nasal segments were affected in two ways: the lenited, short *n was lost, while geminates and clusters were reduced to coronal nasals. Notice that /m/ is maintained word-finally together with the reflexes of historical geminates and clusters; this provides compelling evidence of a durational difference between *n and *m, showing at the same time that *m patterned with clusters and geminates, whose length was possibly the same.

An intrinsic differential duration between /n/ and /m/ has been found by Mattei & Di Benedetto (2000). Italian /m/ and /n/ appear to have different duration in onset position after a stressed vowel, with /m/ being longer than /n/.[10] These findings support the hypotheses above, and are not unexpected since the tip of the tongue is a more agile articulator and has less inertia than the lips.

While *n was lost, and *m maintained word-finally, both *n and *m were lost in word-final NC clusters, suggesting that the differential duration discussed above neutralizes to the shorter segment in this environment. This point is discussed in §4.2.3.

4.2.3. The intrinsic duration of final NC

As illustrated in (30) and (31), there is historical evidence that *n and *m were both lost in word-final syllable clusters, before a voiceless obstruent (30), but maintained before a voiced obstruent (31).

(30)	[ˈkap]	<	CAMPU(M)	'field'
	[ˈdet]	<	DĔNTE(M)	'tooth'
	[ˈhik]	<	CĪNQUE	'five'
(31)	[koˈlomp]	<	COLŬMBU(M)	'pigeon'
	[ˈtont]	<	ROTŬNDU(M)	'round'
	[ˈloŋk]	<	LŎNGU(M)	'long'
	[ˈpjanh]	<	PLANGIT	's/he cries'

This sound change is very likely to be the result of the phonetic phenomenon of the 'vowel-length effect'. The vowel-length effect refers to durational trading relationships between voiced *vs* voiceless obstruents and preceding sonorant domains. In addition to vowel lengthening associated with word-final stress, vowels and other rime-internal sonorants may be phonetically longer when followed by voiced consonants

as opposed to voiceless ones. The general vowel-length effect, found in most of the world languages, shows longer vowels before voiced consonants than before voiceless ones (Kluender *et al.* 1988). Related studies show the same effect when the segment immediately preceding the voiced *vs* voiceless consonant is not a vowel but a (non-vocalic) sonorant. There is cross-linguistic typological and experimental evidence that a nasal is shorter in clusters with a voiceless obstruent (NT) than with a voiced obstruent (ND). Raphael *et al.* (1975) provide instrumental evidence that the entire sequence VN is longer before /d/ than /t/ in American English. Apparently, the vowel and nasal durations are affected differently by their voicing environments, with the increment of nasal duration being proportionally greater than that of vowel duration before /d/. This articulatory fact has perceptual consequences. Raphael *et al.* (1975) argue that the duration of the nasal is a relatively stronger cue than that of vowel duration to the voicing of the following segment. This would be clear from a comparison of the amount of variation in the duration of N *vs* V needed to change the listeners' judgments from /t/ to /d/. As it appears, there is less variation in the duration of N with respect to V. Thus, a relatively short N (preceded by a relatively long vowel) would cue voicelessness; a relatively long N (preceded by a relatively short vowel) would cue voicedness. Similar results are found in Fava & Magno Caldognetto (1976) for Italian ˈVNCV sequences. They found that in ˈVNCV – where N stands for either /n/ or /m/ – the nasal segment is shorter (and preceded by a longer vowel) when it is followed by a voiceless obstruent; when the following obstruent is voiced, the nasal segment is longer (and preceded by a shorter vowel). Apparently, the vowels preceding NT sequences have on average the same length as vowels in open syllables.

On the articulatory side, Beddor (2009) provides experimental evidence that the context of voicelessness promotes early velum lowering or shortening of consonantal constriction resulting in an inverse relation between duration of the nasal consonant and duration of anticipatory vowel nasalization. Hayes & Stivers (2000), on the other hand, argue that loss of a nasal before a voiceless segment would be an articulatorily natural process, complementary to post-nasal voicing.

Experimental data reveal two facts with respect to NC. Firstly, before a voiceless obstruent /n/ and /m/ are shorter than before a voiced obstruent; secondly, the intrinsic duration of the two nasals seems to neutralize to the short segment before a voiceless obstruent. These findings are in line with Camuno data. They explain why Camuno nasals were lost before a voiceless consonant but were maintained before a voiced one. Futhermore, they support the hypothesis that the

nasals that were eventually lost in Camuno were short segments, which explains why *m was lost in NC, but not word-finally. The source for nasal reduction is partly different, though: intervocalic lenition due to open syllable lengthening in the case of word-final *n; interaction between voicelessness and vowel length in the case of final NC. The common element is stress. The second finding is also consistent with Camuno. Let us consider, once more, the evolution of stressed ŏ. In syllables closed by *n followed by a voiceless obstruent, stressed ŏ has evolved as /u/ (e.g. [ˈmut] < MŎNTE(M) 'mountain') as it has in open syllables (e.g. [ˈbu] < BŏNU(M) 'good'). This is consistent with Fava & Magno Caldognetto's (1976) findings, namely that the length of ˈV in ˈVNCV is the same as the length of ˈV in open syllable, suggesting that the following /n/ and /m/ are equally short. In syllables closed by *m followed by voiced obstruent or sonorant, on the other hand, the same vowel has evolved as /ɔ/ and /o/ (e.g. [ˈhɔn] < SŏMNU(M) 'sleep'). Notice that the sound change that took stressed ŏ to /u/ before *n followed by a voiceless obstruent is the origin of the synchronic pattern of /o/ raising illustrated in (15).

In sum, the differential duration between *n and *m in ˈV_V, and the neutralization of this durational difference in ˈVNC are among the phonetic sources of word-final *n loss and *m maintenance, and of loss of both *n and *m in word-final NC clusters.

These sound changes, which will result in the synchronic patterns of nasal deletion, follow a major sound change in the history of Romance languages, apocope, whose consequences on nasal segments are explored in §4.2.4.

4.2.4. Apocope: the evolution of coda nasals

The only vowels attested word-finally in Camuno are /ɔ/ and /e/, which also function as morphemes, marking, for example, the singular feminine and plural respectively (Cresci 2014).

Loporcaro (2011: 65-69) argues that pre-literary Latin had already undergone vowel reduction processes. These were part of a conspiracy that eventually resulted in the loss of the vowel quantity contrast in unstressed position. This shortening of unstressed vowels gradually proceeded. Western Romance apocope appears as a differentiated process, which went through several intermediate steps and proceeded at a different pace in different varieties. Apocope, together with syncope, was carried out earliest and in its fullest form in northern Gallo-Romance; it was completed in Old French before its earliest documentation in the 9th century, possibly between the 7th and 8th centuries. Word-final vowels were lost in Camuno, with the exception of *a, which has undergone

reduction to /ɔ/, and /e/, which is usually a reflex of previous diphthongs (e.g. [ˈalbe] 'trough' < *alve < ALVEU(M), [ˈhɛmpe] 'single'< *sɛmpe < *sɛmpi < *sɛmpju < SĪMPLU(M)). Apocope, which naturally follows stressed open-syllable lengthening, paved the way for the evolution of coda nasals, thus setting the whole process of nasal loss into motion.

Further light on the evolution of coda nasals and the sound changes that affected the nasals in Camuno comes from a number of northern Italian dialects. Tuttle (1991) observes that in some northern Italian dialects apocope occurred only after /n/, and it did not occur after the palatal nasal, the final clusters, and /m/. In the Lombard varieties spoken in the triangle extending roughly between Varese, Novara and Milan, apocope is observed after /r, l, n/ but not after /m/ (Marinoni 1957, Sganzini 1993 as cited in Sanga 1997: 256). These facts lend themselves to two observations. Firstly, /m/ patterning with final clusters and not with singleton sonorants is further evidence that the duration of *m was possibly closer to (or the same as) the duration of a cluster, than the duration of a singleton sonorant, as observed in §4.2.2. Secondly, coda *n appears to have been the first to evolve. That coda *n was the first to evolve is not phonetically surprising. The word-final, post-tonic syllable onsetted by *n was possibly the shortest, thus perceptually the weakest; in addition to that, vowels following a nasal are less audible, thus more easily lost. Ohala (1983: 205-6) argues that nasalization affects the audible flow of air created by turbulence downstream. This reduction of audible airflow would make vowels more difficult to perceive after a nasal than elsewhere (Blevins 2004: 163).

Once evolved, one major threat that coda nasals had to face was an environment characterized by voiceless aspiration, as engendered by a laryngeal spreading gesture, whose origin and effects were discussed in §4.1. What remains to explore are some arguments supporting the evolution and subsequent loss of nasalized vowels in the area where Camuno is spoken. These arguments are not compelling and do not stand up against Camuno facts, as discussed in §5.

5. Pathways to nasal loss: evolution vs *non evolution of contrastive nasalized vowels*

Contrastive nasalized vowels are well-established in French and Portuguese; they are also attested in a number of non-standard Romance varieties, or vernaculars, such as those spoken in northern Italy, as well as in non-Romance European languages as Polish, Albanian, Irish/ Gaelic, and Breton.

Sampson (1999) provides a comprehensive survey with respect to vowel nasalization in Romance Languages. For the purpose of this work, I will focus on Sampson's (1999) observations that may shed some light on the history of vowel nasalization in Camuno.

On the basis of synchronic and historical data, Sampson (1999) claims that in northern Italian dialects high level nasalization has occurred widely; in some cases, nasal phonemes were created, more likely in those environments where the conditioning nasals were lost. In modern times, contrastive nasalized vowels are attested patchily in Piedmont, in Western and Central Lombardy and especially in Emilia-Romagna (Sampson 1999: 265).[11] At present, the trend is to downgrade nasality in vowels by elimination of contrastive nasalized vowels, and reduction of levels of nasality in allophonic nasalized vowels. This trend seems to be stronger in urban dialects than in rural ones (Sampson 1999: 269-70). Sampson (1999) argues that the two processes by which contrastive nasalized vowels are (being) eliminated are "vowel denasalization" and "restoration". Denasalization is observed systematically in central and eastern Lombardy, and in the dialects of western Veneto leaving behind long oral vowels, though shortening of [aː] > [a] in word-final position is observed in the vernaculars of Bagolino and Bergamo, two Eastern Lombard varieties (cf. [ˈpa] 'bread' *vs* [ˈbeː] 'well, good', [ˈbuː] 'good'); in the dialect of Bagolino [aː] is reported to have shortened before a word-final obstruent as well, as in [ˈkap] 'field' *vs* [ˈmuːt] 'mountain', [ˈteːp] 'weather, time', [ˈhiːk] 'five'.[12] Restoration has been much more widespread than vowel denasalization. In this case, the contrastive nasalized vowels are restructured into sequences of vowel plus nasal coda consonant making nasality allophonic. Sampson (1999) assumes restoration as an indicator that significant levels of vowel nasalization occurred historically. An additional indicator of vowel nasalization is a change in the quality of the target vowel. Sampson (1999: 267-8) notices that high nasal vowels have lowered to take on a mid point of articulation in a number of dialects of Emilia-Romagna and southern Lombardy. In Eastern Lombardy and Milanese the trend is apparently reversed. In Bergamasco, an Eastern Lombard variety, *o > [u] is observed in all the three environments Sampson (1999: 268) investigates, namely word-finally, before a voiceless obstruent and intervocalically: [ˈbuː] 'good', [ˈmuːt] 'mountain', [kuˈruːna] 'crown' < BŌNU(M), MŎNTE(M), CORŌNA(M); in Milanese it is not observed intervocalically, thus [kuˈrɔna] 'crown'.

With respect to Sampson's (1999) arguments discussed above, Camuno would make a good candidate for the historical evolution of contrastive nasalized vowels for two main reasons: (i) the conditioning

nasals were deleted word-finally and before historical voiceless obstruents; (ii) [o] alternating with [u] before historical nasals is attested. However, despite these observations, I believe that there is a different story behind, that needs to be explored.

First of all, although Camuno exhibits the same phonological patterns as northern Italian dialects where contrastive nasalized vowels are still attested (cf. the dialect of Meldola in Emilia-Romagna, in Sampson 1999: 274), some differences may turn out to be crucial. To begin with, the same PHONOLOGICAL environment does not necessarily imply the same PHONETIC environment. As shown in Figure 1 and Figure 2, Camuno final obstruents are characterized by absence of phonetic voicing, and presence of audible release; in addition, voiceless stops are preaspirated, as shown in Figure 3. Thus, in Camuno, nasals were lost in an environment characterized by high voiceless airflow.

Secondly, mid-vowel raising in the form of [o] alternating with [u] may not be a good indicator of strong nasalization as claimed by Sampson (1999: 268). In fact, strong nasalization would be expected to result in raising of low vowels and lowering of high vowels (Krakow & Goldstein 1986; Beddor 1999), as in French and in the dialects of Emilia-Romagna and southern Lombardy (Sampson 1999). As I argue in §4.2.2, in the area where Camuno is currently spoken, [o] alternating with [u] is the result of Latin stressed ŏ being categorized as stressed ō in late Latin, a LONG vowel, under stressed open syllable lengthening and subsequent intervocalic weakening of *n. This would explain why Latin stressed ŏ did not change to /ø/ before *n when the sound change that took ŏ to /ø/ in open syllable occurred. This fact suggests that it was either too long or already /u/. Thus, mid-vowel raising in the form of [o] alternating with [u] in Camuno predates apocope and the whole vowel nasalization process and it should not be taken as evidence of major vowel nasalization.

Finally, Camuno lacks two hallmarks of historical contrastive vowel nasalization, namely: (i) restoration, in the form of contrastive nasalized vowels being restructured into sequences of vowel + nasal coda consonant, which Sampson (1999: 263) assumes as an indicator of significant levels of historical vowel nasalization, and (ii) long vowels in the environment of a historical nasal segment. Unlike what Sampson (1999) claims for the Eastern Lombard varieties spoken in Bagolino and Bergamo and the Western Lombard variety of Milan, Camuno exhibits [ˈpa] ‘bread’, [ˈbe] ‘well’, [ˈbu] ‘good’, [ˈkap] ‘field’, [ˈmut] ‘mountain’, [ˈtep] ‘weather, time’, [ˈhik] ‘five’, and [kuˈruna] ‘crown; rosary’.

These observations are in keeping with the studies on Eastern Lombard in which nasalized vowels and long vowels in the environment

of historical nasal segments are not attested (for Bresciano, see Melchiori (1817) and Von Ettmayer's (1902) survey, which includes four points in Valcamonica; for Bergamasco, see Biondelli (1853), Tiraboschi (1873), and Von Ettmayer's (1903) survey; see also the surveys of *AIS* (1928-1940), and *ALD-I* (1998), which include seven points in Valcamonica).

It follows that Sampson's (1999) arguments for a stage of contrastive nasalized vowels and subsequent denasalization do not hold up against Camuno facts. There is no compelling evidence for a stage of contrastive nasalized vowels and subsequent denasalization for Camuno. Camuno facts are far more compatible with nasals being confused with aspiration and lost without a trace. There is quite a fair amount of evidence to assume that Camuno exemplifies the inverse of spontaneous nasalization. While in the latter nasality is associated to a vowel, or to a nasal segment that is epenthesized in the environment of high voiceless airflow, in the former a nasal segment and nasality more generally are deleted exactly in the same environment leaving behind plain oral vowels. Ultimately, Camuno may well be the language that Ohala & Busà (1995) predicted would exist.

6. Apparent exceptions to nasal deletion in clusters

Although several pieces of evidence suggest that /m/ was maintained word-finally because it was relatively longer than /n/, the fact that both /n/ and /m/ were lost in clusters before a voiceless obstruent suggests that in this environment nasals are short, regardless of their place of articulation. However, language internal evidence reveals that the duration differential between /n/ and /m/ observed in word-final position is maintained in certain types of clusters, and it affects the evolution of the nasals in this environment.

The experimental literature does not provide substantial information on the differential duration between /n/ and /m/ in this environment. Hayes & Stivers (2000: 29) suggests that in English /p/ and /b/ in ˈVMPV and ˈVMBV have the same duration and basically behave as prenasalized consonants. In Camuno, there is evidence that the durational difference between /n/ and /m/ observed word-finally is maintained in triconsonantal clusters, and that in this environment it has played a role in the evolution of the two nasals.

While pairs as [ˈkap] 'field' ~ [kampuˈli] 'field.DIM', [ˈtep] 'weather' ~ [tɛmˈpah] 'lousy weather' alongside [ˈdet] 'tooth' ~ [dinˈti] 'tooth. DIM' reveal that both *n and *m were lost when followed by a voiceless obstruent in word-final position, language-internal evidence suggests

that the length of the nasal played a role in its evolution in triconsonantal clusters. Consider the homophones [ˈput] < PŎNTE(M) 'bridge', and [ˈput] < PŬNCTU(M) 'point' *vs* [ˈpront] < PRŌMPTU(M) 'ready', and [ˈkynt] < CŎMP(U)TU(M) 'bill'. The evolution of PŎNTE(M) 'bridge', and PŬNCTU(M) 'point' as [ˈput] suggests that nasal loss in clusters was fed by cluster simplification, an attested phenomenon in proto-Romance (Loporcaro 2011). Under this analysis, PŬNCTU(M) 'point' > *puntu, while PRŌMPTU(M) 'ready' > *promtu. The fact that *n was lost in [ˈput] < PŬNCTU(M) 'point' while *m was reduced (and maintained) in [ˈpront] < PRŌMPTU(M) 'ready' is suggestive of the same length difference between /n/ and /m/ observed elsewhere. When the sound change occurred, the homorganic nasals were lost; the non-homorganic /m/ was maintained.

The exceptions [ˈpront] 'ready' and [ˈkynt] 'bill' find a phonetic explanation which is consistent with the intrinsic durational difference already observed between singleton /n/ and /m/, and which seems to hold in triconsonantal clusters as well. The same phonetic explanation would hold for [ˈgaŋf] 'numbness' < *CRAMPF/*RAMPF (whose original meaning was 'bent', as reported in Bianchini & Bracchi 2003). The evolution of *CRAMPF/*RAMPF as [ˈgaŋf] parallels the evolution of [ˈpront] < PRŌMPTU(M) 'ready', and [ˈkynt] < CŎMP(U)TU(M) 'bill' discussed above.

The pair [ˈhant] < SANCTU(M) 'saint, holy' and [ˈhat] < *SATTU(M) 'toad' could be analyzed as a case of homophony avoidance. Latin [ˈsaŋktus] 'saint, holy' is a word that often recurs in the Catholic mass, in the rosary, and in most prayers. It is possible that in a community of church-goers, where the praying of the rosary was a daily practice, homophony avoidance prevented [ˈhant] to turn into [ˈhat].

I do not have a good explanation for the exceptions [ˈmat maˈtɛnt] 'very crazy', [ˈbjaŋk] ~ [ˈbjaŋkɔ] 'white.M~F', [ˈfront] 'forehead', and [ˈhtiŋk] 'drunk; dead'. Tempini (1908) provides evidence that [ˈbjakɔ] 'white' was still attested at the beginning of the 20th century in a variety spoken 15 miles north of the area of interest. The expected [ˈfrut] < FRŎNTE(M) is still attested in other varieties of Camuno (Goldaniga 2001).

7. Conclusions

There is ample evidence that the two synchronic patterns of nasal deletion in Camuno have a common phonetic source. This source involves the conjoined effects of stress, vowel-length effect, duration differential between the nasals, and the acoustic consequences of a

phrase-final laryngeal spreading gesture. While stress and vowel-length effects can reduce the duration of a nasal, a laryngeal spreading gesture can devoice the same nasal, and make the percept of nasality confusable with aspiration itself. If this happens, the nasal may be discarded as a spurious element without a trace. Under this account, Camuno never went through a stage of contrastive nasalized vowels and subsequent denasalization. The lingering, allophonic nasality on vowels was probably discarded soon after the nasal was lost. The final result, plain oral vowels, are still attested today.

Notes

[1] Quite interestingly, the varieties of Camuno under investigation underwent *s > [h], a sound change that Ohala & Busà (1995) associate with spontaneous nasalization.

[2] [(a)yˈtyn] 'fall' might be a recent loan from Italian [auˈtuːo], since [ˈhtretɔ] for 'fall' is observed in a number of conservative speakers.

[3] [ˈpan] rarely occurs in the language; the singular form of [ˈpaŋ] 'clothes' would be in fact a specific item of clothing (a blouse, a shirt, etc.). It is observed in the compound [pandeˈma] 'kitchen towel' (< /pan-de-man/).

[4] Camuno is characterized by a complex system of height harmony (Cresci 2015).

[5] The environment of /h/ < *s is not as straightforward and would deserve more study since in this environment restoration has occurred over time. [ˈkuh] for 'dressed' is in fact a more conservative version of [konˈhat]; it occurs in the phrases [ˈrih ˈkuh] that is a rice dish, and [poˈlɛntɔ ˈkuhɔ], that is a kind of porridge made from coarsely ground cornmeal; both dishes are dressed with butter. Evidence of medial /n/ loss before historical /h/ is provided in Tempini (1908) for a variety of Camuno spoken 15 km north of the area investigated. [koˈha] < *COMPTIARE 'to dress; to season' and [peˈha] < PENSARE 'to think' were still attested at the beginning of the 20th century. Currently the language exhibits [konˈha] and [penˈha], suggesting /n/ restoration; see also [(v)ˈɛnh] 's/he wins', [(v)inˈhi] 'to win' where /n/ is observed before a voiceless segment, possibly the result of /n/ restoration. Notice, however, that the items are verbs, which suggests that some sort of paradigm leveling might have occurred.

[6] Giovanni Bonfadini (personal communication) makes me notice that there is one exception to this pattern, namely [ˈkutrɔ] 'against' ~ [konˈtrare] 'opposite' exhibiting /n/ alternating with Ø word-medially.

[7] There is some evidence that historically /n/ was also lost in medial position; some examples are [ˈvetɛr] < VĒNTRE(M), [ˈdetɛr] < DEĪNTRO. Apparently, the only alternation in this environment is the aforementioned [ˈkutrɔ] ~ [konˈtrare].

[8] Historical evidence supports the claim. Sampson (1999: 266) mentions a fourteenth-century glossary translating Latin words into Bergamasco providing evidence of items such as ‹vi› < VĪNUM 'wine', ‹fe› < FĒNU(M) 'hay', ‹pa› < PANE(M) 'bread', ‹carbo› < CARBŌNE(M) 'coal' with clear loss of final *n alongside ‹pan› < PANNU(M) 'clothing item', ‹lum› < LŪMEN 'light', ‹leng› < LĪGNU(M) 'wood', ‹zoven› < IŪVENE(M) 'young', ‹argent› < ARGĔNTU(M) 'silver', ‹bianch› < *BLANK 'white', ‹dent› < DĔNTE(M) 'tooth', ‹campo› < CAMPU(M) 'field'. Only from the sixteenth century

texts appear from Bergamo exhibiting forms as ‹cap› < CAMPU(M) ‘field’ and ‹tep› < TĒMPUS ‘weather’ with loss of the nasal segment before a voiceless obstruent. With respect to the glossary mentioned by Sampson, Giovanni Bonfadini (personal communication) points out that in fact it dates back to the fifteenth, not the fourteenth century.

[9] Blevins (2004: 54) observes that the evolution of a contrast, albeit phonetic, between short and long vowels in a language that had a distinctive quantitative vowel system is not unexpected: “In languages with pre-existing vowel-length contrasts, the listener is presented with unambiguous tokens of long and short vowels, and categorizes them accordingly. Where phonetically lengthened vowels occur, […] the learner is more likely to categorize these as long vowels for the simple fact that a category of long vowel may already be established. Priming effects may also take the form of heightened attention to vowel length, recognizing its constrastiveness elsewhere”.

[10] Below is the duration in milliseconds of syllable initial /m/ and /n/ in nonce words from Mattei & Di Benedetto (2000: 5)

	/m/		/n/
ama	86.7	ana	76.6
imi	96.9	ini	88
umu	102.7	unu	89.9

[11] Some of the information reported in Sampson (1999: 265) could be misinterpreted. Giovanni Bonfadini (personal communication) makes me notice that contrastive nasalized vowels are attested in the Piedmont and Aosta Valley regions, but in Franco-Provençal, not in Piemontese; they are attested at Rhemes-St-Georges (see *AIS*, pt. 121), and more rarely at Saint-Marcel (see *AIS*, pt. 122). These two towns, which are both in the province of Aosta, belong linguistically to the Franco-Provençal area. Thus, the barred area on the map in Sampson (1999: 357) should be located more to the north where Franco-Provençal is spoken. With respect to Lombard and Lombardy, Lombard is linguistically divided into Eastern Lombard and Western Lombard; central Lombardy and southern Lombardy are used to refer to the geography of the region but do not correspond to varieties of Lombard.

[12] It is not clear where these data come from, since they are not found in the sources that Sampson (1999) includes in his bibliography, namely Sanga (1987), and Bazzani & Melzani (1988). It is possible that they come from *AIS* like other data in the book; however, data from *AIS* are not to be taken as representative of a stable picture of a language at a given time, because of the purpose and way they were collected. For further discussion, see Bonfadini (2009).

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