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Complexity effects in nasal–continuant clusters

It is a phonological commonplace that nasal–stop clusters prefer to be homorganic. Indeed, this configuration seems to be rather unmarked, especially when compared to nasal–non-stop clusters. Generally viewed, the combination of a nasal and a continuant segment usually establishes a very unstable relation which often results in various "repair" strategies. It is conspicuous that — unlike in the case of nasal–stop clusters — in nasal–continuant clusters place assimilation is frequently avoided. The purpose of this paper is to investigate these strategies through syncronic and diacronic processes in various languages. An attempt is made to explain the reason for the instability and its resolution, making use of the notion of segmental complexity within a recent offspring of Government Phonology, the strict CV model.

1 Nasal–continuant clusters

One of the most widely attested processes concerning nasal–continuant clusters is the loss of the nasal in the sequence. Oftentimes, the nasal gesture is completely lost, but it may also be transferred to the preceding vowel. As a consequence of the disappearance of the nasal, the pre-cluster vowel lengthens, too (unless the vowel is long anyway, in which case no "superlong" vowel arises). This state of affairs is very common in Hungarian, as the data in (1).

(1) **Nasal deletion and vowel nasalization in Hungarian nasal–continuant clusters**

honfi	[hõːfi]	'patriot'	*avanzsál*	[ɔvõːʒaːl]	'promote'
honvágy	[hõːvaːɟ]	'homesickness'	*tonhal*	[tõːɦɔl]	'tuna'
tanszer	[tõːsɛr]	'teaching aid'	*kínlódik*	[kĩːloːdik]	'be in pain'
pénz	[pẽːz]	'money'	*tanrend*	[tõːrɛnd]	'timetable'
Hanság	[hõːʃaːg]	place name	*bűnjel*	[bỹːjɛl]	'corpus delicti'

The process is optional, although in the standard dialect this does seem to be the norm. Also, it is usually the dental nasal /n/ that is most likely to

be lost, neither the labial nor the palatal (the two other underlying nasal segments in Hungarian) is deleted: one needs to speak rapidly or very carelessly in order to produce *három fiú* ?[haːrõːfiuː] 'three boys', *támfal* ?[tãːfɔl] 'supporting wall' or *tényfeltáró* ?[tẽːfɛltaːroː] 'investigative'. We are going to see that /m/ before a fricative or approximant is preserved (no change occurs), while /ɲ/ lenites to [j̃], which makes /n/ the most, and /m/ the least prone to change. /ɲ/ displays a "middle-of-the-road" behaviour: it does not fully delete, and it is not fully kept either.[1]

The history of English also provides examples of nasal loss before fricatives. A fairly well-known Anglo-Frisian change is the loss of nasals before fricatives with compensatory lengthening of the preceding vowel. In all cases **n* and **m* were lost before **f*, **þ* and **s*. The preceding vowel was nasalized and then lengthened (the nasalization was lost at the beginning of the Old English period):[2]

(2) a. **i* > *ī*
**fimf* > OE *fīf* (E *five*; G *fünf*)
**linþj(a)*- > OE *līþ* (OHG *lindi*)
b. **u* > *ū*
**uns* > OE *ūs* (G *uns*)
**munþa*- > OE *mūþ* (G *Mund*)
c. **a* > *ō*
**gans* > OE *gōs* (G *Gans*)
**tanþ*- > OE *tōþ* (L *dens*, gen.sing. *dentis*)

The loss of [ŋ] before [x] is, however, common to Germanic languages: e.g., *[faŋxan] > *[fõːhan] > OE [foːn], Go [foːhan] 'catch'.

Some English dialects show the deletion of nasals before continuants, but with no compensatory lengthening: Southern American English:[3] *glance* [glɑ̃ɪs], *strength* [strĩθ], *constant* ['kɒ̃stə̃t], *consent* [kən'sɪ̃ə̃t]. The next two

[1] It is sometimes claimed that /m/ changes into a labiodental nasal [ɱ] before labiodental segments ([f], [v], [ʋ]). Most phonologists agree that this is not the product of a phonological assimilation, but that of PHONETIC COARTICULATION. On the dubious phonological status of [ɱ], see Kenstowicz 1994 : 29 and Pullum & Ladusaw 1986 : 96, among others. Consider, however, Ladefoged & Maddieson (1996 : 18) who report that in the Kukuya dialect of Teke the labiodental nasal contrasts with both the bilabial nasal and labiodental fricatives.

[2] See, for instance, Cser 1998.

[3] The examples are taken from Wells (1982 : 541ff).

examples show that deletion is active before coronal and velar stops too: *drink* [drĩk], *can't* [kæ̃ət]. Even labial /m/ is lost in some dialects: Kru Pidgin English (Liberia): *himself* [hĩsɛlf], *James* [ʤæ̃s], as well as *ants* [æ̃s]; African English:[4] *rooms* [rũːz], *parents* [ˈperɛ̃z]; Cockney: *something* [sʌ̃ðĩk], *long way* [lɒ̃ˈwæɪ], etc.

In other languages even the nasal gesture may be lost. This is the case in Lithuanian. Consider the behaviour of the prefix *saN-*: *sąskambis* [saːskambis] 'harmony', *sąšlavos* [saːʃlavos] 'sweepings', *sąžinė* [saːʒineː] 'conscience', *sąvoka* [saːvoka] 'idea'.

The palatal nasal in Hungarian is not prone to assimilate before stops in the standard dialect, but it may undergo vocalic lenition before continuants. The output of this process is a nasalized palatal approximant [j̃]:

(3) **Palatal Nasal Vocalization**

tényfeltáró	[teːj̃fɛltaːroː]	'investigative'
ponyva	[poj̃vɔ]	'glue'
kényszer	[keːj̃sɛr]	'compulsion'
kormányzat	[kormaːj̃zɔt]	'government'
reménység	[rɛmeːj̃ʃeːg]	'hope'
hány zseni	[haːj̃ʒɛni]	'how many geniuses'
enyhe	[ɛj̃ɦɛ]	'mild'
viszonylag	[visoj̃lɔg]	'relatively'
hány róka	[haːj̃roːkɔ]	'how many foxes'
vékony jég	[veːkoj̃jeːg]	'thin ice'

Polish exhibits a very similar pattern. Let us take a look at the data in (4).[5]

[4] Wells uses the term "African English" to refer to the English which is the official state language in an African country (Ghana, Nigeria, Zambia etc.) (1982 : 632).

[5] Taken from Kenstowicz (1994 : 486). I am using his transcription.

(4)	a.	*ząb*	[zomp]	'tooth'
		zęby	[zembɨ]	'teeth'
		ręce	[rence]	'hand-dat'
		węgiel	[veŋg'el]	'coal'
		mąż	[mo͡wš]	'husband'
		węch	[ve͡wx]	'smell'
		rzęsa	[že͡wsa]	'eyelash'
	b.	*kunszt*	[ku͡wšt]	'art'
		konflikt	[ko͡wflikt]	'conflict'
		on sę ce ńi	[o͡w śe͡w ce ńi]	'he values himself'
	b.	*klamka*	[klamka]	'doorknob'
		tramwaj	[tra͡wvay]	'tram'
		tam valą	[ta͡w valo͡w]	'they are hanging'
		chamski	[xamski]	'boorish'

In this language nasal place assimilation works as expected in nasal–stop clusters: the nasal surfaces as homorganic with the following stop. Before fricatives (and word-finally) what we can see are nasalized diphthongs (or rather nasalized (off-)glides). In fast speech, underlying /n/ itself undergoes the process, (4b). /m/ is — once again — the most reluctant to undergo assimilation or deletion, (4c): it only assimilates/vocalizes within its own place, that is before labials (compare *klamka, chamski* with *tramwaj, tam vala*).

Hungarian also shows gemination effects. Before /l/, /r/, or /j/, the nasal totally assimilates to the consonant following it, creating geminates [lː], [rː], and [jː]; the rule appears to only work in phrases and compounds: *Henrik*, a name, is [hɛ̃ːrik] and not *[hɛrːik], just as *kenjed* 'smear-2sg.imp.def.' is [kɛɲːɛd] rather than *[kɛjːɛd]. (5) exhibits examples for total nasal assimilation.

(5) **Total nasal assimilation**

olyan lusta	[ojɔlːuʃtɔ]	'so lazy'
olyan részeg	[ojɔrːeːsɛg]	'so drunk'
olyan jó	[ojɔjːoː]	'so good'

Latin provides another diachronic example for this process. Latin *in-* and *con-* had been originally retained unchanged before all consonants, but later totally assimilated to following *l* and *r*: *in+legalis* > *illegalis*, *in+rationalis* > *irrationalis*, etc. All these forms were degeminated later (in

Old French, for example); in Middle English, these words are found in the same form as in Old French, i.e., degeminated; cf. today's pronunciation: English *irrational* [ɪˈræʃənəl], French *irréel* [ireɛl] 'unreal'; in other cases, however, nasal deletion applies in French: *inlavable* [ɛ̃lavabl] 'unwashable').

When /n/ is followed by /j/, several things may happen to it in Hungarian. If the /j/ is a synthetic suffix (the imperative suffix or the person marker), there is place assimilation: /n/ → [ɲ] and full assimilation of /j/: [ɲ] → [ɲː]. Examples include: *tűnj* 'disappear-imp.' [tyːɲː], *bánja* 'feel sorry-3sg.pres.def.' [baːɲːɔ]. In case /n/ and /j/ are divided by an analytic morpheme boundary, the following options are possible, as shown in (6) — compare *bánja* 'feel sorry-3sg.pres.def.' with *bűn#jel* 'corpus delicti' (the chart is based on that of Siptár & Törkenczy's (2000 : 212)).

(6)	*bánja*	*bűnjel*	
a.	[baːɲːɔ]	—	nasal place assimilation and total assim. of [j]
b.	—	[bỹːjɛl]	nasal deletion/vowel nazalization
c.	—	[byːjːɛl]	total assimilation of [n]
d.	—	[byːɲjɛl]	nasal place assimilation
e.	—	[byːj̃jɛl]	nasal place assim. and palatal nasal vocalization
f.	—	[byːnjɛl]	nothing happens (slow/careful speech)

It is, however, nasal deletion/vowel nasalization (6b) that is most likely to apply in *n#j* clusters in Hungarian (cf. Siptár & Törkenczy 2000 : 208).

2 Epenthetic stops

Fortition processes in nasal clusters — that is, when an epenthetic (also called "intrusive") stop is inserted between a nasal and a following consonant (most typically before a fricative, but sometimes before a coronal stop too, cf. English *Sump*^{p}*ter*) seem to be frequent in languages; however, they are not so well understood, and interpretations of them are diverse.

In English (in RP at least), epenthetic stops appear mostly in a prominent foot, that is, when the nasal–fricative cluster is preceded by a syllable with either primary or secondary stress. Following unstressed syllables, and across word-boundaries, according to most writers, epenthesis is not likely to occur.[6] Also, RP appears to favour epenthesis before

[6] Cf. Harris 1994 : 227, for example.

voiceless fricatives:[7] *an^{t}swer, prin^{t}ce, ten^{t}th, an^{t}them, An^{t}thony, Corin^{t}th, in^{t}fant, in^{t}fomation*, etc.; *Am^{p}sterdam, ham^{p}ster, warm^{p}th, em^{p}phasis*, etc.; *leng^{k}th, young^{k}ster* etc. Although Clements (1987) mentions such a possibility, epenthesis is said not to appear before voiced fricatives: **?circum^{b}vent*, **?in^{d}voice*, **?en^{d}vy*. Often, it appears, the words *crimson, Ramsey* for example are pronounced as [ˈkrɪm^{b}zən], [ˈræm^{b}zɪ]. Although their occurrence may sound rather odd, epenthetic stops are said to show up after /l/ too: *?el^{t}se, ?pul^{t}se* — this indicates that nasals pattern with other noncontinuants (Harris 1994 : 227).[8] The picture is not so clear, however. Transcriptions vary by a great deal, and no systematic distribution of epenthetic stops arises from the data.[9]

In Hungarian, epenthesis apparently occurs mostly before *voiced* fricatives: *pén^{d}z* 'money', *ben^{d}zin* 'petrol', but there are not many examples of this. *Vonzó* 'attractive' is not normally pronounced as *?[von^{d}zoː]. Therefore, *pén^{d}z, ben^{d}zin* are best be regarded as lexical free variants. In some pronunciations, we hear *szom^{p}széd* 'neighbour', *Mün^{ty}chen* 'Munich', but it is doubtful that in other words, like *hon^{t}fi* 'patriot', *tám^{p}fal* 'supporting wall', there is stop epenthesis. It does seem that Hungarian prefers partial deletion of nasals (normally /n/) to fortition.

[7] Data are from Wells (1990).

[8] This then suggests that /l/ is to be treated as noncontinuant. But, as we saw above, /l/ seems also to pattern with continuants when it triggers partial deletion, as in *vén ló* [vẽːloː], for example. The status of /l/ remains an unsettled problem.

[9] For instance, Wells (1990) in most cases transcribes a superscript *t* or *d* in words where the nasal–fricative cluster is in a prominent foot: *infantry* [ˈm^{t}fəntrɪ], *influenza* [ˌɪn^{t}flʊˈenzə], *circumferential* [səˌkʌm^{p}fəˈren^{t}ʃəl], but gives no such symbols in: *infective* [mˈfektɪv], or in analytic affixation **un^{t}suitable*. However, he transcribes *infamy* as [ˈmfəmɪ], although *nf* is in a prominent foot; on the other hand, all occurrences of the suffixes *-a/ence, -a/ency, ship* have the intrusive stop in them in Wells (1990), even though they never immediately follow a stressed syllable: *abstinence* [ˈæbstɪmən^{t}s], for example (but consider *championship*, which is transcribed /ˈʧæmpiənʃɪp/ by Wells). The situation is similar to *con-*: *cónferen^{t}ce, cónfident, cónfine, cónflict vs. cón^{t}secrate, cón^{t}sequen^{t}ce, cón^{t}sonant, còn^{t}centrátion*. The situation seems to be currently under change, and the tendency appears to go towards favouring the epenthesis of stops in nasal–fricative clusters. It seems that English nasals are strong sounds, that is, stronger than fricatives: they either resist assimilation to fricatives, or even induce fortition upon them. It is indeed conspicuous that Wells (1990) transcribes almost all nasal–fricative clusters that are in a prominent foot with the epenthetic stop *t* or *p*, and never uses the symbol [ŋ], unlike earlier works (e.g., Jones 1956, Gimson 1970).

According to Steriade (1993 : 420), morpheme-initial nasal–fricative sequences in Bantu languages realize as nasal–stop–fricative clusters, for example /Nv/ becomes [mbv]; often, the fricative strengthens to a stop: /Nβ/ becoming [mb], or /Nɣ/ becoming [ŋg]. Not only fricatives, but other continuants also undergo this process: /Nl/ → [nd], /Nj/ → [nʤ]. She, therefore, prefers to name this process post-nasal hardening, or even: postnasal stopping. According to her, the epenthesis of a stop is a mechanism in which the postnasal continuant transforms into a complex stop–continuant segment, and the whole sequence constitutes an affricate.

Nasal–intrusive stop–fricative sequences can indeed be viewed as nasal–affricate clusters, since the nonnasal cluster in say *em*^{p}*phasis* consists of a bilabial stop phase followed by a labiodental fricative release phase: [ˈɛmp͡fəsɪz]. Normally, an affricate is defined as "a stop released into the homorganic fricative within one and the same syllable and one and the same morpheme" (Catford 1988 : 112). Therefore, treating intrusive [t]/[d]–[f]/[v] clusters (as, say, in *in*^{t}*fluence*) as affricates is somewhat controversial. Nonetheless, since these sequences also have a stop closure phase followed by a fricative release, they are very similar to homorganic stop closure–fricative release clusters, i.e., affricates, hence I will consider them "SECONDARY" AFFRICATES.[10]

3 Nasal–continuant processes: a complexity-based analysis

Summing up the results of the previous two sections, we can establish the following processes involving nasal–continuant clusters.

(7) **Nasal–continuant processes**

a. stop epenthesis ("post nasal stopping/nasal mutation"), e.g., English;
b. (partial) deletion of the nasal, resulting in vowel nazalization (plus vowel lengthening), vocalization or gemination (total assimilation), e.g., Hungarian;
c. no change occurs, typical only in careful and/or slow speech;
d. nasal place assimilation.[11]

[10] Since some of the clusters arising as a result of intrusive stop formation are indeed homorganic, this term seems to be justified. I thank László Varga for pointing this out.

[11] This is reported in Catalan for example: *so*[n] *sincers* 'they are sincere', *so*[n̪] *rics* 'they are rich', *so*[n̪ ʒ]*ermans* 'they are brothers', *so*[ɲ ʎ]*iures* 'they are free', *Jua*[ŋx]o (a name); see Kiparsky 1985 : 95 and Avery & Rice 1989 : 189.

The following questions arise, among others, thus: (i) why are nasal–continuant clusters not appreciated in some languages as opposed to nasal–stop clusters, and (ii) why is the dispreferred sequence resolved as it is?

I will approach these issues through the prosodic and segmental model of Government Phonology (GP). In particular, I will couch my arguments using two central notions of GP: SEGMENTAL COMPLEXITY and GOVERNMENT/LICENSING. Since space limitations restrict me, I will only summarize those aspects of the model which are relevant for the present discussion.

3.1 Complexity and Coda Mirror Plus

In standard Government Phonology government is defined as a binary asymmetrical relation holding between two skeletal positions (cf. Kaye et al. 1990 : 198). There are two types of condition on government. The formal constraint makes sure that this relation is STRICTLY LOCAL (heads and dependents are strictly adjacent) and STRICTLY DIRECTIONAL. Because of strict locality and strict directionality, in standard GP a syllabic constituent can be maximally binary branching (one consequence of which is the impossibility of "superheavy" rhymes since such a constituent contains at least three skeletal positions).

The substantial constraint regulates which segments can be governors and which can be governees. This is phrased in the following condition (Harris 1990 : 274).[12]

(8) **Complexity condition**

Let α and β be segments occupying the positions A and B respectively. Then, if A governs B, β must be no more complex than α.

[12] The idea of complexity originates in Kaye et al. 1990, where it was noted that segments that are usually governees can occasionally themselves govern (as in the case of English *rm, rn, rl* clusters). In their phrasing, the Complexity Condition declares that a charmless segment (one that is usually not found in governing positions) may govern if it has a complexity greater than its governee. Harris goes further and assumes a more general application of the condition: he extends its effect onto *all* segments ("charmed" as well as "charmless" ones), and at the same time he makes government possible for segments that have the same complexity gradient as their governees. This condition is what could be made responsible for the notion dubbed the "stop paradox" (cf. Dienes 2000 : 30f): stops will be represented to be the most complex, although — among consonants — these segments are the least marked universally.

Complexity is directly calculable in terms of the number of elements of which a segment is composed (i.e., a typical governor should not possess less elements than its governee). What is of great importance is thus that the governing capabilities of segments are directly encoded in their melodic representation.

I will assume a fairly conservative theory of elements.[13] A standard set of elements is displayed in (9).[14]

(9) **Elements**

		SALIENT PROPERTY	INDEP. MANIFESTATION
RESONANCE	**A**	uvular	[ɑ]/[ʁ]
	I	palatal	[i]/[j]
	U	labial	[u]/[w]
	R	coronal	[ɾ]/[ɜ]
	(**@**)	*none*	[ɯ]/[ɯ̩]
'MANNER'	**ʔ**	occluded	[ʔ]
	h	stridency	[s]
	N	nasal	[ɯ̃]/[ŋ]
LARYNGEAL	**H**	spread glottis, aspiration	[ˋ]/[h]
	L	slack vocal folds	[ˊ]/??

I will not assume a separate (neutral) element **@** to represent emptiness—emptiness will be represented by nothing. That is to say, segments whose head are supposed to be **@** are basically sounds without a head. (10) presents a few examples of what melodic representation some consonants are supposed to have. The head of a segment is underlined.

(10) a. [p] {**hU.<u>ʔ</u>**} [t] {**hR.<u>ʔ</u>**} [k] {**hʔ._**} [pʰ] {**HhU.<u>ʔ</u>**} [b] {**LhU.<u>ʔ</u>**} [f] {**U.<u>h</u>**} [s] {**R.<u>h</u>**} [ʧ] {**Iʔ.<u>h</u>**}

b. [m] {**UN.<u>ʔ</u>**} [n] {**NR.<u>ʔ</u>**} [ɲ] {**IN.<u>ʔ</u>**} [ŋ] {**ʔN._**}

[13] I acknowledge the various drawbacks of the element theory of standard Government Phonology (like the problem of universal interpretation, or that of coronals), but since it is the complexity asymmetry of segments that is of prime importance for my analysis, in this paper I will only the deal with the *number* of elements a segment possesses, and not the elements themselves. What crucially counts is that a stop is not to be less complex (have less elements and thus a be better governor) than a continuant.

[14] See, among others, Backley 1993, Harris 1990, Harris 1994, Harris & Lindsey 1995.

The prosodic model I will be assuming is that of "strict" CV phonology, in the sense of Lowenstamm (1996), according to whom, the phonological skeleton is made up of strictly alternating consonant–vowel units.[15] In particular, this paper will make good use of Dienes & Szigetvári's theory on lenition (Dienes & Szigetvári 1999), which is named "Coda Mirror Plus" (henceforth CMP) by Szigetvári (1999). The most crucial aspects of this theory are the following.

(11) **The inherent meaning of C and V**

a. V's are inherently loud and inherent governors and licensors.
b. C's are inherently mute.

There are two forces that may challenge the inherent properties of a C and a V: one is the lexical association of melody, the other is government. GOVERNMENT together with LICENSING are the two very basic primitives of GP. These two relations will be given the following interpretation in CMP:[16]

(12) **The interpretation of government and licensing**

a. Government spoils the inherent nature of its target.
b. Licensing comforts the segmental expression of its target.

(13) and (14) summarize the governing/licensing properties of a V and a C.

(13) **Licensing**

a. A full V licenses the preceding full C position. (universal)
b. A full V licenses the preceding full V position provided the intervening C position is empty and not licensed by the V. (language-specific)

[15] See also Scheer 1997, 1998a, 1998b, Ségéral & Scheer 1999, Polgárdi 1999, 2000, Rebrus 2000a, 2000b.

[16] Cf. Ségéral & Scheer 1999 : 20 for licensing, and Dienes & Szigetvári 1999 : 7 and Szigetvári 1999 : 66ff for government.

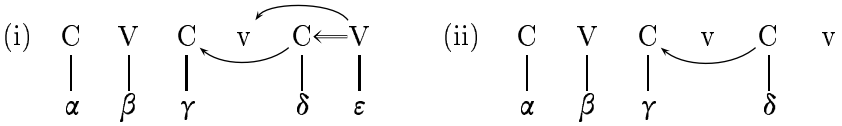
(14) **Government**

a. A full V governs the preceding empty V position. (universal)
b. A full V governs the preceding C position if the preceding V position is not empty. (universal)
c. A full C may govern a previous C position if the intervening V is empty, in which case the segment governed is never more complex than its governor. (language-specific)

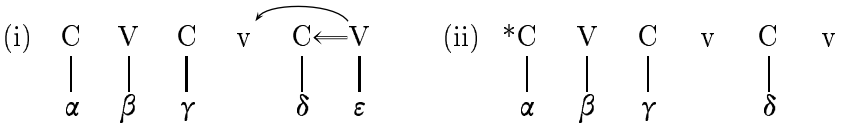
An empty V over which there is C-to-C government is defined to be BURIED, i.e., uninterpreted phonetically.

A CODA CLUSTER is thus defined as a governing relation between two C's, with the V buried between them (this makes word-final coda clusters grammatical word-finally as well, since the empty vowel within the cluster is taken care of by the C-to-C government). On the other hand BOGUS CLUSTERS are — by definiton — those sequences whose consonants do not contract any government between them (and thus these are predicted to be ungrammatical word-finally: nothing licenses the inter-consonantal empty vowel). These two cases are shown in (15) (the Greek letters indicate any kind of melodic material; an empty V position is depicted as "v" and an empty C position as "c"; government is shown by an arrow, licensing is represented by a double arrow).

(15) a. CC cluster 1: "coda cluster" (C-to-C government/burial; possible V-to-V government):



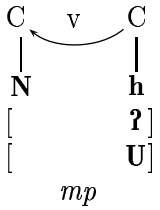
b. CC cluster 2: "bogus cluster" (V-to-V government):



According to (8), optimal government can only be established between two consonants if the governor is not less complex than its governee. Between

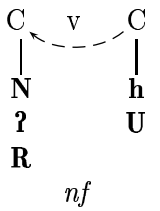
the members of a *mp* cluster, the government is optimal as the governor is more complex than its governee:[17]

(16)



If we follow this line of thinking, we can now gain a better understanding of the question why nasal–continuant clusters are so unstable. This is because the segment designated to be a governor is in fact a simplex segment melody-wise, thus the establishment of an optimal governing relation is problematic, as it violates the Complexity Condition. Let's look at the representation of an *nf* cluster:

(17)



Here, the government is not optimal since the governor is less complex. A non-optimal governing relation like that in (17) cannot be maintained, and languages seem to resolve the unfavourable situation through various means. Their common underlying denominator is the aim to make the segmental asymmetry maximal between the two members of the cluster. This can be achieved in one of two ways: (i) either the governee is weakened, or (ii) the governor is strengthened. Thus, we observe partial or total lenition of the governee nasal (this is case (i)), or we see the fortition of the governor continuant into an affricate (case (ii)). Some languages also choose to allow a continuant to govern a nasal, with or without place sharing: if this is so, this obviously makes the Complexity Condition a violable constraint.[18]

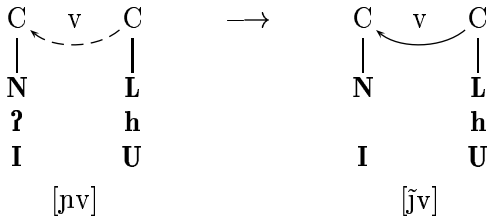
[17] Element sharing domains are represented by "[ ]". This is representational variant of what is spreading of an element in standard autosegmental phonology. It is also assumed that element sharing is only possible if the two segments in question stand in some sort of relation (e.g., C-to-C government); see, for example, Kiss 2001 : 21f.

[18] A point that calls for an Optimality Theoretic approach. Further research is needed to account for these facts satisfactorily in GP.

3.2 Nasal lenition

In this section I will be looking at the representation of the various cases of nasal lenition in nasal–continuant clusters. The first case, that of partial lenition (vocalization) of the palatal nasal, as in Hungarian *ponyva* [poɲvɔ] 'canvass', is shown in (18).

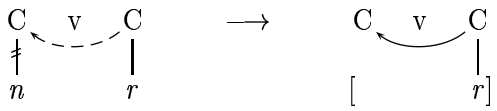
(18) **Palatal Nasal Vocalization**



In this particular case we see that even equal complexity is not tolerated (the complexity asymmetry is more apparent in cases like *ny+s*). The effect is the non-licensing of the occlusion element, thus an optimal governing relation complexity-wise. The same process is assumed in the Polish examples (see (4)): /m/ → [w̃], as in *tramwaj* 'tram'.

A further weakening effect can be seen in *n* plus *r, l, j* clusters in Hungarian. This time the complexity status quo is saved by getting rid of all melody in the governed C position and by spreading all the elements of the governor into this position. This total regressive assimilation is illustrated in (19), where the hypothetical example is *nr,* as in Hungarian *egyenruha* [ɛɟɛrːuɦɔ] 'uniform'.

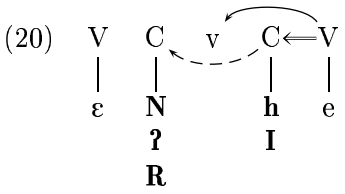
(19) **Total assimilation**



The total sharing of the elements of *r* is made possible by the governing relation creating the necessary sharing domain: place sharing is only assumed to exist under C-to-C government.

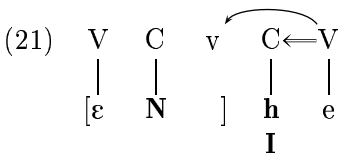
Let us now turn to the last group constituting our examples of nasal lenition. These involve cases like Hungarian *fenség* [fɛ̃ːʃeːg] 'majesty', where we see the deletion of the nasal, the nasalization plus the lengthening of the pre-nasal vowel.

The non-optimal configuration in a /nʃ/ cluster is shown below (to simplify matters, the second vowel is shown short):

(20)


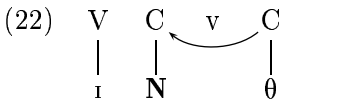
/ɛnʃe/

The effect of these circumstances is the withdrawal of licensing of all elements, except **N** in the first C. The optimal sequence is now this:

(21)


[ɛ̃ːʃe]

It must be stipulated at this point that the configuration of [V**N**v] is interpreted as a long nasalized vowel. An interesting question involves the fate of C-to-C government in (20). If there was such a relation contracted, no vowel lengthening would be be predicted to arise since the second vowel would be buried, hence inaccessible. Government would block the first vowel from contracting any relation with the second one: no element sharing domain could be established, unlike in (21). Is there such a case where C-to-C government is preserved then? The answer seems to be positive: this is the situation when nasal loss before a continuant is not compensated by vowel lengthening (the nasal gesture is still preserved though). We noted in §**1** that such a process exists in Southern American English, e.g., *strength* is [strĩθ]:

(22)


[strĩθ]

This structure is then interpreted as a short vowel + nasal gesture (i.e., a short nasalized vowel) followed by a consonant. This paper silently ignores the problem of what sort of relation we should posit in long vowels (especially those arising as a result of compensatory lengthening) in the strict CV models. What is assumed is, however, that lengthening must involve the expansion of the vowel's interpretation domain to the second (empty) V position. The only remaining relation left for vowels is V-to-V licensing.

The real problem concerns its direction. It is not trivial which vowel should license which in long vowels and diphthongs. For details of the problem and some ideas on how it could be solved, see Kiss 2001 : 54–57, for example.

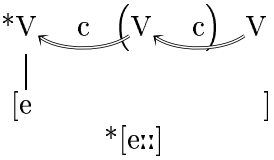
In case the vowel before the (underlying) CC cluster is long, there will be no lengthening, as that would create a "superlong" vowel, which is banned due to the following constraint (cf. Szigetvári 1999 : 73, for example):

(23) **The Burial Constraint**

Burial domains may not share a skeletal unit.

In superlong vowels, the middle VC unit is shared by both the preceding and the following VC units. Look at (24) where it is the parenthesized unit which violates the Burial Constraint:

(24)



Accordingly, the representation of nasal deletion/long vowel nasalization (as in the Hungarian word *vánszorog* 'crawl' [vã:sorog]) is displayed in (25):

(25)

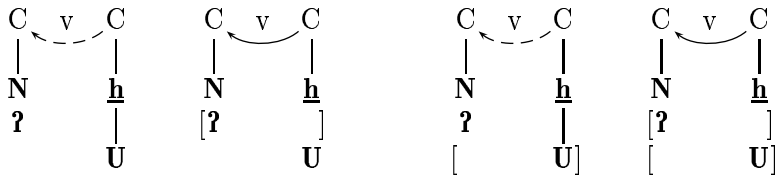
The Burial Constraint also makes C-to-C government impossible in this case, because two burial domains would follow each other, sharing a common VC unit.[19] All this also predicts that the only situation where a long vowel can be followed by a CC cluster is when there is no government between the two consonants. That is, when they are not coda clusters but bogus clusters. This is by and large supported by empirical data, usually coming under the term "closed syllable shortening". Notice that the underlying configurations, like in (25), also involve bogus clusters, provided that such sequences are defined as CvC clusters *without* C-to-C government. The fact that V**N**vC is interpreted as $\tilde{\text{V}}$C does not contradict this.

[19] The V-to-V licensing domain in (25) buries a consonant (marked "c"), while C-to-C government buries a vowel ("v").

3.3 Fortition in nasal–continuant clusters

The second option that is observable in nasal–continuant clusters in some languages is that an epenthetic stop appears between the two consonants. This stop intrusion in our analysis is seen as a strengthening effect on part of the governor: instead of choosing to weaken the governee, this time the governor is "fortified". The governor continuant segment can only grow more complex (hence stronger) than its governee if it gains more elements. The element that it absorbs from the governee is **ʔ**. I propose that a **ʔ**-sharing domain will be contracted between the governor and the governee. The examples below show a n^tf (as in English *influence*) and a m^pf cluster (English *emphasis*):

(26) a. *nf* → n^tf b. *mf* → m^pf



In this analysis this fortition process is monotonous: the existing melodic relations are preserved and no new skeletal slots have been created.[20]

In the representations in (26) the difference between n^tf and m^pf is preserved in the following way. In the latter sequence there are two element-sharing domains: both the stop and the labial element are shared, and so the complex cluster is interpreted as a labial nasal–labial stop–labial fricative unit. In the former case, the fact that the place is not shared in them, the cluster is interpreted as a non-homorganic unit: coronal nasal–coronal stop–labial fricative (since the nasal and the stop are placeless, they are interpreted as coronals). In those languages which allow nasal place assimilation as well as fortition in nasal–fricative clusters, *nf* clusters will be represented as sharing the labiality of the fricative too (hence *nf* → m^pf).

[20] Cf. the analysis of Clements & Hume (1995), who also represent "intrusive stop formation" as stopness and place (their "oral cavity node") being associated with the fricative, but they show this association with the *ad hoc* creation of a root-node for the stop. In Clements 1989 the splitting of a root-node into two homologues is dubbed "node fission".

Notice that the representation also assumes that affricates (and affricate-like segments, like ^{t}f) are represented as strident stops (headed by **h**).[21]

The representation in (26a) does not include the coronality element **R** (cf. (10a)); the main reason for this is that if *n* (and the intrusive *t*, too) contained it, the resulting sequence would still have equal complexity: both *n* and ^{t}f would have three elements (*n*: **N**, **ʔ**, **R**; ^{t}f: **h**, **ʔ**, **U**). This is perhaps another argument for ridding the melodic representation of a coronality prime.

4 Summary

The paper has investigated nasal–continuant clusters. It has been observed that such sequences are dispreferred and that the reason for that is that no optimal governing relation can be established between them because the governors are typically simplex segments. Various processes have been discussed, all of which aim to resolve the non-optimal complexity distribution. The following main options seem to be available:

(27) a. The simplex governor is strong enough to govern the nasal, plus it also spreads its place element to the preceding governee (e.g., Spanish *nara*[ŋx]*a* 'orange', Catalan, Sudanese Arabic, etc.).
b. The simplex governor is strong enough to govern the nasal, but no place assimilation takes place (e.g., slow/careful speech).
c. The simplex governor cannot govern the nasal: (partial) deletion, vocalization, or gemination (total assimilation) occurs (e.g., Hungarian, Polish, Lithuanian).
d. The more complex governee nasal passes its **ʔ** to the simplex governor to "fortify" it so that the maximal complexity asymmetry (or at least equal complexity) could be kept up: the result is nasal fortition through intrusive stop formation (e.g., English). In some cases fortition results in the fricative becoming a stop. The process may also be complemented by nasal place assimilation once the C-to-C governing domain is optimal complexity-wise.

[21] See, among others, Szigetvári 1997. The stance is not uncontroversial though. For example, in British English RP, /t/ cannot be preglottalized in intervocalic position, but /ʧ/ can be. It is as if the stop component of the affricate was followed by a consonant (/t/ can be preglottalized preconsonantally in this dialect); on the contour analysis of affricates, see, for example, Clements 1987 and Clements & Hume 1995.

In some cases the infelicitious cluster is resolved through metathesis. Pre-Classical Greek provides an example of this. Postconsonantal *j* always disappears from that position after sonorants for example: $VnjV \rightarrow VjnV$.[22] This is one of the extreme cases of resolving a nasal–continuant cluster: by changing positions, the optimal governing relation can now be established. Cases like this could well be expanded to other clusters where the complexity of the members does not satisfy the Complexity Condition.[23]

It is also interesting to note that the changes usually involve the coronal nasal: in lenition processes it fully lenites (leaving behind the nasal gesture); the palatal nasal usually lenites to a nasal approximant, while the labial nasal either does not lenite or only does so partially (to [$\tilde{\text{w}}$]). The reason for this appears to be that in many languages *m*–continuant sequences do not constitute coda clusters but bogus clusters, thus in which there is no governing between the C's, and so there is no pressure for *m* to weaken (or to strengthen the continuant): the Complexity Condition only refers to governing relations. This seems to be backed by the Hungarian data, for example, where we do not see changes like $VmsV \rightarrow {}^{*}\tilde{V}\text{:}sV$, and even the number of m^p–continuant clusters is really low (and so the emerging intrusive stop in the few sporadic cases may really be considered as a result of phonetic coarticulation). Further research into empirical data is needed to back these proposals and answer the remaining questions.

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[22] See Cser 1998 : 20.

[23] Consider, for example, the change occurring in *pj* clusters in the history of Greek: [pj] > [pc] > [pt] > [ft]. On other distributional effects that seem to be derivable from complexity asymmetries, see Kiss 2001.

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