Catalan Cluster Simplification and Nasal Place Assimilation

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This paper is set in the theoretical framework of Correspondence Theory (McCarthy and Prince 1995) and provides an Optimality Theoretic (OT, Prince and Smolensky 1993) account of the interaction of Cluster Simplification (CS) and Nasal Place Assimilation (NPA) in Catalan. The interaction of these two phenomena shown in (1) below results in a surface form which is both half-transparent and half-opaque. Accounting for such a form presents a challenge to any phonological theory, but the problem becomes especially interesting for a strictly parallel non-serial theory of phonology such as OT.

The usual suspects of Cyclicity (Mascaró 1978) and Underspecification of Coronals (see Paradis and Prunet 1991 and the references therein) are either unavailable or extremely problematic in OT. Underspecification of Coronals leads to problems with respect to Richness of the Base (Prince and Smolensky 1993, Smolensky 1993), and Cyclicity, at least in the form described by Mascaró, cannot be adopted because it is a derivational process (not possible in OT by definition).

One of the interesting aspects of this analysis is that it accounts for the data without appealing to Output-Output constraints (Benua 1995) or Sympathy (McCarthy 1997). Previous incarnations of this paper have found Sympathy to be inappropriate for the problem,[1] and even if this is shown to be a lack of imagination on my part, Sympathy has recently been criticized as a theory of opacity (Ito and Mester 1999). Additionally, if one were to adopt an Output-Output analysis, it would still have to be superimposed on top of an analysis such as the one presented here.[2]

The core problem is summarized in (1) below.

(1)   Underlying Representation: /tin+k bint   bota+s/
         Attested Output: [tíŋ   bím   bótəs]
         English Gloss: 'I have twenty wineskins.'

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[1] I was unable to arrive at a working Sympathy analysis for the following reasons: i) the sympathy candidate for certain forms would select itself incorrectly as the winner, ii) other rankings were only able to be established as a result of the Sympathy analysis.

[2] See Herrick 1999 for a discussion of how this could be done.

Looking at the output we see that the first word [tíŋ] is surface-opaque since it has failed to assimilate to the adjacent segment (the labial [b]) while presumably assimilating to the input-adjacent segment (the dorsal stop [k]) which has failed to be realized in the output. The second word [bím], on the other hand, is surface-transparent since the nasal has assimilated to the surface-adjacent segment (the labial [b]) instead of the input-adjacent segment (the coronal [t] which fails to surface). The problem for the theory is to explain how we can have both the surface-transparent [bím] and the surface-opaque [tíŋ] in the same OT grammar.

The analysis depends on the following theoretical tools: 1) MAX(FEATURE) (Lombardi 1998), instantiated here as MAX(PLACE), 2) the decomposition of MAX(PLACE) into MAX(COR), MAX(DOR) and MAX(LAB), 3) SPREAD(PLACE) (Padgett 1995) and the assumption of Feature Class Theory (FCT, Padgett 1995) which SPREAD entails and 4) a reformulation of Positional Faithfulness (Beckman 1997, Lombardi 1998) where availability of acoustic cues (Steriade 1997) is the relevant factor.

Crucially, it is the interaction of the constraint SPREAD with the individuated MAX(PLACE) constraints which does the majority of the work for us. By ranking MAX(COR) below SPREAD, the weakness of coronal segments is forced, and an underlying form such as /bint/ will always satisfy the spreading constraint; thus, /bint/ surfaces as [bím] in (1) above. Furthermore, by ranking the MAX(DOR) and MAX(LAB) constraints above the spreading constraint, underlying non-coronal segments will have to surface in the output, and their violations of SPREAD will be tolerated; thus, the output correspondent of /tin+k/ must contain a dorsal feature (from the [k]) in the output, and therefore it surfaces as [tíŋ] in (1).[3]

The organization of the paper will be as follows; section 1 will present an account of Cluster Simplification, section 2 will give an account for Nasal Place Assimilation, and section 3 will cover the interaction of CS and NPA. Section 2 will also contain a proposal for rethinking Positional Faithfulness in a more phonetic form.

1 Cluster Simplification

In a process referred to as Cluster Simplification homorganic consonant clusters ending in voiceless stops surface without the word final obstruents when syllabified in the coda – /mp/→[m], /nt/→[n], /lt/→[l], /rt/→[r], /st/→[s], /ŋk/→[ŋ] (Mascaró 1976, Wheeler 1979, Kiparsky 1985). In the following data (from Mascaró 1976) the left-hand column provides evidence that there is an underlying consonant cluster, and the second column shows that the cluster is 'simplified' (i.e. the final stop is not realized) in the output.

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[3] Nathan Sanders (p.c.) has suggested that the surface opacity of [tíŋ] could be attributed to a REALIZE MORPHEME constraint. However, while this is true of a large number of examples, REALIZE MORPHEME cannot account for the non-morphologically derived forms such as /bank/→[báŋ] 'bank' (see 2c above), and therefore I do not pursue such an analysis here.

1.1 Catalan CS – The Data

(2) Cluster Simplification:

	Word Internal Cluster (diminutive)	Word Final CS (base)			
a.	[ka<u>mp</u>ɛ́t]	[ká<u>m</u>]	from /kamp/	'field'
b.	[pu<u>nt</u>ɛ́t]	[pú<u>n</u>]	from /punt/	'point'
c.	[bə<u>ŋk</u>ɛ́t]	[bá<u>ŋ</u>]	from /bank/	'bank'

(3) No Cluster Simplification in Non-Homorganic Clusters[4]

a.	[se<u>rp</u>ɛ́t]	[sérp]	from /serp/	'snake'
b.	[di<u>sk</u>ɛ́t]	[dísk]	from /disk/	'disk'

1.2 Catalan CS – An OT Account

In this paper, I assume that CS effects are accounted for by the interaction of MAX(PLACE), *COMPLEXCODA and MAXIO as defined in (4-6) below. The MAX(PLACE) analysis of Cluster Simplification offers the following explanation for why word final obstruents delete; CS occurs in homorganic clusters because the loss of a segment does not result in the loss of place. If we adopt the MAX(PLACE) analysis, then we must assume the following ranking: MAX(PLACE) >> *COMPLEXCODA >> MAXIO.

(4) MAX(PLACE)   MAX(PLACE)
      Every input place feature has an output correspondent. (Lombardi 1998)

(5) MAX SEGMENT INPUT-OUTPUT   MAXIO
      Every segment of the input has a correspondent in the output. 'No phonological deletion.' (McCarthy and Prince 1995)

(6) *COMPLEXCODA   Abbreviated as *COMPLEX
      Syllables must not have complex codas. (Prince andSmolensky 93)

        To ensure that simplification occurs, *COMPLEXCODA must be ranked over MAXIO. This ranking, on its own, makes invalid predictions because it requires the final consonant of *any* word-final cluster to delete. The situation is easily remedied if we assume that MAX(PLACE) outranks *COMPLEXCODA as shown in (7) below. The ranking in (7) successfully blocks CS in cases where the word final cluster is not homorganic. In these cases, the deletion of a segment will give rise to a MAX(PLACE) violation while in homorganic clusters, the final consonant can delete because its place feature will still have an output correspondent. This is shown in (8) below.

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[4] Those familiar with this data know that there is no simplification in /l+k/ clusters. Herrick (1999) proposes that the output [ɫk] clusters are crucially *not homorganic* and therefore do not meet the condition for CS. This follows if all Catalan laterals are specified for the coronal feature (Palmada and Serra 1991).

(7) Ranking Argument: MAX(PLACE)>> * COMPLEXCODA

/disk/	MAX(PLACE)	* COMPLEXCODA	MAXIO
a. dís	*!		*
☞ b. dísk		*	

I assume that CONTIGUITY is highly ranked, and therefore candidates such as [káp] (where the stop surfaces rather than the nasal) will be ruled out. Additionally, a candidate which fails to parse both of the coda consonants (e.g. [ká]) will lose out due to excessive MAXIO violations.

(8) Cluster Simplification

/ kam p/ [lab]	MAX(PLACE)	*COMPLEXCODA	MAXIO
☞ a. kam | [lab]			*
b. kam p [lab]		*!	

2 Nasal Place Assimilation

In Catalan, coronal nasals assimilate in place to adjacent consonants except when the following consonant is palatal. Additionally, labial nasals only assimilate to other labials, and velar and palatal nasals do not show any NPA effects. The relevant data is shown in (9-11) below.

(9) NPA in Coronal Nasals: [son]   'they are'
     a. so[m]#pocs   'they are few'
     b. so[ɱ]#feliços   'they are happy'
     c. so[n]#sincers   'they are sincere'
     d. so[n̠]#[ž]ermans   'they are brothers'
     e. so[n̠]#[ʎ]iures   'they are free'[5]
     f. so[ŋ]#grans   'they are big'

(10) NPA in Labial Nasals: [som]   'we are'
     a. so[m]#pocs   'we are few'
     b. so[ɱ]#feliços   'we are happy'   ✓ Assimilation of [+distr.]
     c. so[m]#dos   'we are two'
     d. so[m]#grans   'we are great'

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[5] Full assimilation to lamino-palatals, but assimilation is only partial to palatals.

(11) NO NPA in Velar and Palatal Nasals:
    a. a[ɲ]#feliç   'a happy year'
    b. ti[ŋ]#pa[6]   'I have bread'

2.1 Nasal Place Assimilation – An OT Account

In this paper, I adopt the Padgett (1995) SPREAD(PLACE) constraint defined in (12) below, and I propose a Positional Faithfulness (Beckman 1997, Lombardi 1998) account of NPA. The major difference between my account and Padgett's (or Beckman's) is that I am proposing a reanalysis of positional faithfulness constraints in terms of availability of acoustic cues[7]. A generic version of the proposed 'Perceptual Faithfulness' constraints is defined in (13), and a specific instantiation of the constraint is defined in (14). A more detailed explanation follows in section 2.2 below.

(12)   SPREAD(X): $\forall_{x,y}$ x(y)(in some domain)   e.g. SPREAD(PLACE)
        Every feature is linked to every segment (in some domain), with x ranging over features and y over segments. (Padgett 1995) (Assess one violation mark for each feature which fails to link to each segment.) [8]

(13)   IDENT(PLACE) *N* CUES   Proposed constraint[9]
        Output correspondents (with at least *n* available acoustic cues) of an input [γPLACE] segment are also [γPLACE].

(14)   IDENT(PLACE) 1 CUE   IDENT 1 CUE
        Output correspondents (with at least 1 available acoustic cue) of an input [γPLACE] segment are also [γPLACE].

        The constraint in (13) allows us to form several faithfulness constraints along the line of (14); IDENT(PLACE) 1 CUE, IDENT(PLACE) 2 CUES, IDENT(PLACE) 3 CUES, etc. Before examining the data, I will develop the notion of 'Perceptual Faithfulness.' In order to use a faithfulness system like this, we will have to know how many cues are available to a segment in a give context. Section 2.2 will attempt to do just this.

2.2 Perceptual Faithfulness

Steriade (1997) proposes that we replace the notion of *positional prominence* with that of *perceptual prominence*. The basic idea is that neutralization will occur in contexts with a low number of perceptual cues. Steriade uses the cues for voicing – voice onset time

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[6] This is not crucial, but [ŋ] is not an underlying segment in Catalan (Hualde 1992).

[7] This is similar but distinct from Padgett's MAX RELEASE(PLACE):   Let S be a [+release] output segment. Then every place feature in the input correspondent of S has an output correspondent in S.

[8] Throughout this paper, I will be counting SPREAD violations in shorthand – I will assess one violation mark for an unassimilated cluster. In a few tableau, it will be necessary to make a more fine-grained distinction, and in those cases I will be more precise in assessing violation marks.

[9] Compare this constraint with the McCarthy (1995) version of IDENTIO(F):   Output correspondents of an input [γF] segment are also [γF].

(VOT), C-V andV-C formant transitions, and *burst* to develop a cue-based account of Positional Markedness. I have taken similar steps to develop a cue-based analysis for place which I have framed in terms of positional faithfulness rather than positional markedness.

Additionally, Steriade (1997) pits perceptual faithfulness against prosodic faithfulness which is something I disagree with – there is no reason to believe that *both* these conceptions of faithfulness are not relevant to Positional Faithfulness.

2.2.1 Cues to Place

The section below examines the availability of cues to place for (a) fricatives, (b) stops, (c) laterals and (d) nasals. I consider the following contexts; intervocalic position (15i), word-initial (or post-consonantal) position (15ii), and word-final (or pre-consonantal) position (15iii). For the purpose of this paper, I refer to 'burst' as 'noise' by which I mean aperiodic noise. I then equate frication with noise. Thus, the only difference between the frication of a fricative and the burst from a stop is that of duration. Therefore, I assume that fricatives have an additional cue of 'duration.' In looking at (15) below, the number on the left is equal to the number of available acoustic cues.

(15) Cues for place depending on context[10]
  i. intervocalic position: V_V   {where V = vowel}
  4   Fricatives: Noise, Duration, Vowel Onset Transition, Vowel Offset Transition
  3   Stops: Noise, Vowel Onset Transition, Vowel Offset Transition
  3   Laterals: [lat] implies [cor], Vowel Onset Transition, Vowel Offset Transition
  2   Nasals: Vowel Onset Transition, Vowel Offset Transition

  ii. In an utterance initial context: #_V or C_V   {where C = consonant}
  3   Fricatives: Noise, Duration, Onset Transition
  2   Stops: Noise, Vowel Onset Transition
  2   Laterals: [lat] implies [cor], Vowel Onset Transition
  1   Nasals: Vowel Onset Transition

  iii. In an utterance-final or pre-obstruent context: V_# or V_C
  3   Fricatives: Noise, Duration, Offset Transition
  2   Stops: Noise, Vowel Offset Transition
  2   Laterals: [lat] implies [cor], Vowel Offset Transition
  1   Nasals: Vowel Offset Transition

The result of developing a cue-based system of faithfulness that we can use this with the IDENT constraint in (13) above to create the faithfulness hierarchy in (16) below.

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[10] A crucial difference between laterals and nasals is that laterals get a special laterality cue while nasals don't get any nasality cue. This is due to the fact that typically, all laterals have a coronal place of articulation while we often see at least three distinct places of articulation for nasals. In Catalan, all laterals are [coronal] (there is a velarized lateral, but not a velar lateral), while there are five distinct places of articulation for nasals (counting by surface forms; 3 if we count UR's). Therefore, nasality is not seen as a cue to place while laterality is.

If we interleave a markedness constraint such as SPREAD(PLACE) between these faithfulness constraints, the result will be a factorial typology.

(16)   IDENT(PLACE) for a segment with at least 4 Available Cues
                         |
         IDENT(PLACE) for a segment with at least 3 Available Cues
                         |
         IDENT(PLACE) for a segment with at least 2 Available Cues
                         |
         IDENT(PLACE) for a segment with at least 1 Available Cue

         The case of Catalan appears to be one in which SPREAD(PLACE) is ranked between IDENT(PLACE) 1 CUE and IDENT(PLACE) 2 CUES. The constraint IDENT(PLACE) 4 CUES does not play a crucial role in the tableaux which follow, so it will be left out. IDENT(PLACE) 3 CUES has been left out of most tableaux for the same reason (though (17) shows its effect).
         The purpose of developing this acoustic account of positional faithfulness is twofold; first, it explains the directionality of spreading, and second, it accounts for assimilation in word final clusters. If we compare this with the prosodic accounts of positional faithfulness (c.f. IDENTONS(PLACE)), we see that they both fare equally well on the first point – i.e. elevating the status of onsets also accounts for the directionality effects; however, the accounts diverge with respect to the second point. That is, a prosodic account of positional faithfulness which refers to the onset as the relevant prominent position is not capable of making a prediction about the directionality of spreading in a word final cluster, and yet it is clear that (in Catalan at least) the spreading here is of the same direction as in other contexts. This is captured in the cue-based account presented here (see also Padgett (1995's MAX$_{REL}$(PLACE)) but not in the prosodic account.

2.3 Labial, Palatal and Velar Non-Assimilation

Recall from (9-11) that labial nasals assimilate only to other labial consonants and that palatal nasals do not assimilate to any segments. These facts can be accounted for if we decompose MAX(PLACE) into MAX(LAB), MAX(PAL), MAX(DOR) (which I will hereafter refer to with the cover term MAX(NONCOR)), and MAX(COR). Once we do this, we can rank MAX(NONCOR) above the spreading constraint while leaving MAX(COR) below it[11]. This will have the effect of requiring non-coronal nasals to be faithful to their input place even at the expense of violating the SPREAD constraint. Since SPREAD(PLACE) will be ranked above MAX(COR), coronal nasals will be forced to satisfy the spreading constraint at the expense of faithfulness. In a sense, this is similar to the underspecification of coronals, but it will not entail Richness of the Base problems as underspecification does.

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[11] It should be noted that decomposing faithfulness to place has been criticized by a number of researchers because it allows for rankings which predict unattested typologies; e.g. ranking MAX(LAB) above and MAX(COR) below NOCODA would produce a language with labial, but not coronal, codas. I hold that the individuated MAX(PLACE) constraints are problematic but necessary. Finding a way to appropriately restrict these constraints is outside the scope of this paper.

2.4 NPA Tableaux and Discussion

We are now ready to examine a series of tableaux to see how this analysis explains Catalan NPA. Tableau (17) shows coronal assimilation to a labial segment, tableau (18) shows that non-coronals will not assimilate place unless, as (19) shows, the adjacent segments are both labial.

(17) Coronal – Labial Assimilation

son#poks 'they are few'	IDENT 3 CUES	IDENT 2 CUES	MAX (NONCOR)	SPREAD (PLACE)	IDENT 1 CUE	MAX (COR)
☞ a. sómpóks				*(ks)	*(n)	*(n)
b. sónpóks				**!(ks,np)		
c. sóntóks		*!	*(p)	*(ks)	*(n)	*(n)
d. fómpóks	*! (s)	*(s)		*(ks)	**(n, s)	**(n, s)

In (17), the totally faithful candidate (b) loses because of its SPREAD(PLACE) violation. Candidate (c) loses because the assimilation has been progressive rather than regressive, and this results in both a MAX(NONCOR) violation as well as an IDENT 2 CUES violation. Candidate (d) has been unfaithful to a word-initial fricative, and it violates IDENT 3 CUES. Therefore, candidate (a) emerges as the winner despite its IDENT 1 CUE violation – the other competing candidate all have higher ranking violations.

(18) Labial – Coronal Non-Assimilation

som#dos	IDENT 2 CUES	MAX (NONCOR)	SPREAD (PLACE)	IDENT 1 CUE	MAX (COR)
☞ a. sómdós			* (md)		
b. sóndós		*! (m)		* (m)	
c. sómpós	*! (d)			* (d)	* (d)

In tableau (18), the faithful candidate (a) surfaces as the winner despite its spreading violation. This is because the spreading candidates (b) and (c) are both eliminated by higher ranking violations. Candidate (b) violates MAX(NONCOR), and candidate (c) violates IDENT(PLACE) 2 CUES because the segment which is not featurally identical in the output (the [p]) is in a position with at least 2 cues available to it (e.g. [+son]__V).[12]

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[12] I assume that a candidate such as [somos] in which the coronal [d] deletes is eliminated by a MAX WORD-INITIAL SEG constraint which punishes the deletion of the [d].

(19) Labial – Labial

som#felisus	IDENT 2 CUES	MAX (NONCOR)	SPREAD (PLACE)	IDENT 1 CUE	MAX (COR)	
☞ a. sómɱfelísus				* (m)		
b. sómfelísus			*!			[distr] has failed to spread
c. sómɸelísus	*!			*		

Tableau (19) is interesting because it is the only case where we see non-coronal segments satisfying the spreading constraint. This happens because both of the consonants involved are labials, and spreading does not violate the MAX(LAB) constraint. The totally faithful candidate (b) is eliminated by a spreading violation, and candidate (c) is eliminated by IDENT 2 CUES since the spreading has occurred to a more prominent segment.

3 Interaction of CS and NPA

Morphologically derived environments which show an interaction of Nasal Place Assimilation and Cluster Simplification are scarce, but they can be found. In Catalan, the first person singular suffix for a subset of verbs is /k/, and when the verb stem ends in a coronal nasal, the nasal assimilates to the place of the /k/, even though the /k/ fails to emerge in the output. This is shown in (20) below. The verbs following (b) give evidence for the underlying /k/ morpheme.

(20) Derivational Environment showing interaction of NPA and CS

	stem+/íə/		stem+/s/		stem+/k/
a. 'to have'	[teníə]	2 sg.	[tέns]	1 sg.	[tíŋ]
b. 'to cost'	[bəlíə]	2 sg.	[báls]	1 sg.	[báɫk]

The verbs in (20a) end in a coronal nasal (shown by the stem+/íə/ forms), and they exhibit an opacity effect due to the CS and NPA interaction in the first person singular forms. The appearance of a stem final velar nasal in the third column of (20a) is surprising since the /k/ is not present in the output form. (20b) shows evidence for an underlying /k/ morpheme.

The constraint SPREAD will not enforce the spreading of features unless there are adjacent consonants in the output. Since (20a) does not contain any output consonant clusters, SPREAD cannot be relevant. The question that arises, then, is this: if SPREAD is not responsible for the change from input /n/ to output [ŋ], then what is? As is usual in OT, the answer is not a single constraint, but a ranking of various constraints.

Under the current analysis, the IDENT *N* CUE CONSTRAINTS serve to account for the directionality of spreading and the weakness of nasals. Furthermore, while SPREAD cannot be relevant for the *winning* output since the output forms contain no consonant

clusters[13] it does do some work for us by eliminating candidates with clusters which do *not* assimilate. The relevant constraints, therefore, must be MAX(NONCOR), SPREAD(PLACE), and *COMPLEX. CONTIGUITY also plays a role.

Since MAX(NONCOR) is given a high ranking, all input non-coronal features will have correspondents in the output. However, *COMPLEX will punish complex codas, and therefore outputs which simplify the word-final clusters will be preferred. The constraint CONTIGUITY will ensure that codas will simplify by failing to parse the word-edge segments rather than word-internal ones, and finally, the candidates which remain faithful to non-homorganic clusters will violate SPREAD.

3.1 Interaction of CS and NPA – the Tableaux

The first task is to check that this ranking makes the correct prediction for the cases in (20a) above, and the next task will be to show that the ranking works for multiple-word inputs which show the so-called 'cyclic' effects (such as (1)).

(21) Interaction of CS and NPA

/ben+k/	IDENT 2 CUES	MAX (NONCOR)	SPREAD (PLACE)	IDENT 1 CUE	MAX (COR)	*COMPLEX CODA	MAXIO
☞ a. bɛ́ŋ				*	*		*
b. bɛ́ŋk				*	*	*!	
c. bɛ́nk			*!			*	
d. bɛ́n		*! (k)					*
e. bɛ́nt	*!	* (t)		*	*	*	

The winner, candidate (a), violates IDENT 1 CUE and MAX(COR), neither of which can be crucially ranked with respect to each other[14]. Going through the candidates one by one, we see that candidate (b), which satisfies SPREAD, poses the greatest challenge to the winner, but it ultimately loses out due to a *COMPLEX violation. The totally faithful candidate (c) loses due to a spreading violation. Candidate (d) loses because of MAX(NONCOR), and candidate (e) loses because of MAX(NONCOR) and IDENT 2 CUES violations. The next tableau considers the input from (1), /tin+k bint bota+s/ → [tiŋbimbotəs] 'I have 20 wineskins.'

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[13] SPREAD will become relevant when we consider inputs with more than one word such as that in (22). because that input gives rise to an output form which contains consonant clusters.

[14] The question of whether we still need MAX(PLACE) after decomposing it into the more specific constraints is an interesting one which falls outside the scope of this paper. Adam Ussishkin (Sherman) (p.c.) has claimed that MAX(PLACE) is necessary in some languages; however, in the present analysis of Catalan, MAX(PLACE) is not needed, so I have not included it in any tableaux.
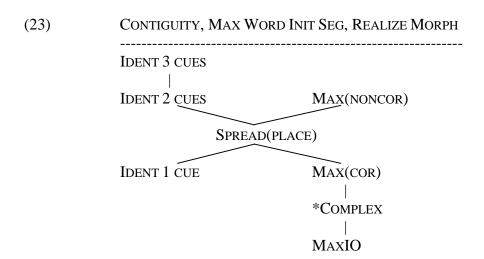
(22) Interaction of CS and NPA – No need for the cycle

/tin+k#bint#bota+s/ 'I have 20 wineskins'	IDENT 2 CUES	MAX (NONCOR)	SPREAD (PLACE)	IDENT 1 CUE	MAX (COR)	*COMP	MAXIO
☞ a. tíŋ bím bótəs			*(ŋb)	**	**	*	**
b. tíŋk bínt bótəs			*(kb) *!(tb)	*	*	***	
c. tím bím bótəs		*!(k)		**	**	*	**
d. tíŋ bín bótəs			*(ŋb) *!(nb)	*	*	*	**

In this tableau, the crucial role of SPREAD(PLACE) comes to light. Candidate (b) which is faithful to all segments incurs spreading violations at all the word boundaries, and thus, it loses to candidate (a). Candidate (c) satisfies SPREAD(PLACE) perfectly, but in doing so, it violates the higher ranking MAX(NONCOR) constraint. Candidate (d) represents the output we would expect in a non-cyclic derivational system which ordered NPA before CS. This candidate, too, is eliminated by excessive SPREAD(PLACE) violations. The result is that the optimal candidate is candidate (a) – the attested output. Surprisingly, this result has been accomplished without appealing to the theoretical tools of Cyclicity, Output-Output, or Sympathy. Even more surprising is the fact that the most responsible constraints appear to be SPREAD(PLACE) and MAX(NONCOR) constraints which are independently necessary for the NPA analysis.

4 Conclusion

This constraint-based analysis of Catalan NPA and CS interaction accounts for the data without the necessity of appealing to the cycle, Sympathy, Constraint Conjunction or Output-Output constraints. Its success is due primarily to the decomposition of MAX(PLACE) along with the conception of SPREAD(PLACE) as a gradiently violable constraint which affects *all* consonant clusters. The conception of positional faithfulness as a consequence of acoustic cues is also essential in predicting the direction of spreading as well as stopping spreading to candidates in positions with more cues available to them. The final ranking of all the constraints mentioned is given in (23) below.

(23)   CONTIGUITY, MAX WORD INIT SEG, REALIZE MORPH

IDENT 3 CUES
      |
IDENT 2 CUES   MAX(NONCOR)

             SPREAD(PLACE)

IDENT 1 CUE   MAX(COR)
                       |
                  *COMPLEX
                       |
                   MAXIO

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