

# Slouching Towards Optimality: Coda Reduction in OT-CC\*

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**Abstract.** There is a well-established asymmetry in the behavior of medial consonant clusters: the first consonant in the cluster can undergo assimilation or deletion, but the second consonant in the cluster cannot. This article presents an explanation for that asymmetry based on a version of Optimality Theory with candidate chains (McCarthy 2006a). The key idea is that a consonant can only assimilate or delete if it first loses its place features by debuccalizing, and debuccalization is only possible in coda position.

**Keywords:** OT, coda, assimilation, candidate chain.

## 1. Introduction

Medial consonant clusters are often simplified or assimilated: /patka/ → [paka], /pamka/ → [paŋka]. There is an interesting asymmetry in these processes: they always target the first member of the cluster for deletion or assimilation. In general, processes that target the second member of the cluster for deletion or assimilation do not occur: /patka/ → \*[pata], /pamka/ → \*[pampa].<sup>1</sup> I will refer to this observation as the *coda/onset asymmetry*.

Simplification or assimilation of medial clusters is usually attributed to the constraint CODA-COND, which says that syllable coda position does not license place of articulation specifications (Goldsmith 1990, Ito 1989). Deletion, as in /patka/ → [paka], satisfies CODA-COND *tout court*. Assimilation, as in /pamka/ → [paŋka], satisfies CODA-COND because a single place specification is shared by both coda [ŋ] and onset [k], and the association of this place specification with an onset segment licenses place for the preceding coda as well.

The coda/onset asymmetry is problematic because CODA-COND could just as well be satisfied by deleting the *second* consonant in the cluster or assimilating *progressively*: /patka/ → \*[pata], /pamka/ → \*[pampa]. The goal of this article is to explain why this asymmetry exists. The explanation is couched within OT-CC, which stands for OT with candidate chains (McCarthy 2006a). OT-CC is a modification of classic OT (Prince and Smolensky 2004) that posits candidates consisting of sequences of forms (“chains”) that link input to output.<sup>2</sup> OT-CC was originally developed as a theory of phonological opacity, but it is also relevant to other matters, including the topic of this article.

OT-CC posits two main conditions on the validity of candidate chains: *gradualness* and *harmonic improvement*. The gradualness requirement limits chains to making one change at a time. For example, in a language with both postconsonantal epenthesis and intervocalic voicing, the mapping /pap/ → [pabə] requires a chain with two steps: <pap, papə, pabə>. The putative chain \*\*<pap, pabə> is

excluded from the candidate set by the gradualness requirement and so it never has a chance to compete for optimality. (Double asterisks are used for chains that are invalid, reserving single asterisks for those that are merely ungrammatical.) There are various ways of formalizing the one-change-at-a-time requirement; see section 2 and McCarthy (2006a) for discussion.

The harmonic improvement requirement says that the successive forms in a chain must increase in harmony relative to the constraint hierarchy of the language in question. In the hypothetical language just described, \*\* <pap, pab, pabə> is not a valid chain if, as seems likely, nothing in the ranking favors voicing of final consonants. Formally, the link [pab] is not more harmonic than [pap] according to this language's constraint hierarchy.

In this article, I will show how gradualness and harmonic improvement explain the coda/onset asymmetry. The key idea is that deletion or assimilation of a consonant is possible only if that consonant first loses its place specification, and loss of a place specification is harmonically improving under CODA-COND only when coda consonants are affected. The quasi-derivational candidate chains and the independently necessary conditions on their validity are essential elements of this explanation.

## 2. Gradualness and Deletion or Assimilation Processes

There are two views of distinctive features, and the difference between these views has consequences in correspondence theory and in the effect of the gradualness requirement on chain well-formedness.

If features are thought of as *attributes* of segments, as in Chomsky and Halle (1968), then IDENT(feature) constraints are the appropriate means of expressing faithfulness to them. IDENT(feature) constraints, as defined in McCarthy and Prince (1995, 1999), are vacuously satisfied by segmental deletion processes. For example, the mapping /patka/ → [paka] obeys IDENT(place), since the deleted /t/ has no output correspondent to be featurally faithful to.

If features are thought of as independent *entities*, as in autosegmental phonology (Goldsmith 1976), then MAX(feature) constraints are the appropriate means of expressing faithfulness to them. Segmental deletion processes violate not only segmental MAX but also MAX(feature) constraints. For instance, the mapping /patka/ → [paka] violates MAX(place), since the place feature [coronal] has deleted along with the rest of the /t/. In general, violation of MAX entails violation of some MAX(feature) constraints unless the underlying segment already lacks the relevant feature or the feature is allowed to remain floating or link to another segment.

The gradualness requirement says that chains can only make one change at a time. There are several ways of expressing the one-change-at-a-time intuition formally; in McCarthy (2006a), a single change is the addition of a single violation of a basic faithfulness constraint. "Basic" is a term of art referring to certain constraints of maximal generality; the basic faithfulness constraints are taken to be

segmental DEP and MAX, IDENT(feature), and perhaps LINEARITY. In a features-as-entities framework with MAX(feature) constraints, it is reasonable to suppose that at least some MAX(feature) constraints are also basic.

If MAX(place) is a basic faithfulness constraint, then deletion of a segment that bears a place feature cannot be accomplished in a single step of a properly gradual chain. The putative chains \*\* <patka, paka> and \*\* <patka, pata> are therefore invalid — deletion of /t/ or /k/ violates both MAX and MAX(place), introducing two basic faithfulness constraint violations at once. Because of the gradualness requirement, deletion of either of these segments must proceed by way of prior deletion of their place features. The putative chains <patka, paʔka, paka> and <patka, patʔa, pata>, for instance, fulfill the demands of gradualness because they remove the oral place feature and the rest of the segment in separate steps. Whether or not these putative chains are valid also depends on whether they are harmonically improving, an issue addressed in the next two sections.

Similar reasoning can be applied to place assimilation. If autosegmental spreading also violates a basic faithfulness constraint, then the putative chains \*\* <pamka, paŋka> and \*\* <pamka, pampa> are also invalid since they introduce violations of two basic faithfulness constraints, MAX(place) and NO-SPREAD(place), in a single step. On the other hand, the putative chains <pamka, paNka, paŋka> and <pamka, pamʔa, pampa> are properly gradual because they separate deletion of one place feature from spreading of another place feature. (The symbol [N] is used for the placeless nasal glide that is found, e.g., word-finally in Japanese.) Whether or not these putative chains are valid also depends on whether they are harmonically improving.

This view of place assimilation is similar to a theory of assimilation that is common in the literature of autosegmental phonology. A mapping like /pamka/ → [paŋka] is a case of feature-changing assimilation, and it was often proposed that all apparent feature-changing assimilation rules should be analyzed as a combination of a feature-deleting neutralization rule and a feature-filling assimilation rule, applied in that order (Cho 1990, Kiparsky 1993, Mascaró 1987, Poser 1982). With OT-CC and the assumptions about faithfulness made here, the gradualness requirement on chains entails this same decomposition of feature-changing assimilation into neutralization plus spreading, though through the agency of an OT grammar rather than a sequence of rules.

### 3. Harmonic Improvement and Debuccalization

Deletion of oral place features from consonants is called *debuccalization*, because loss of place is loss of the constriction in the oral cavity. (*Bucca* is Latin for ‘cheek’.) What’s left after debuccalization depends on what was there before. In the case of obstruents, debuccalization typically leaves [h] or [ʔ] behind. When nasals debuccalize, the result is usually [N].

Coda debuccalization is a well-attested process. In the Cariban languages, for

example, obstruent codas are reduced to [h] or [ʔ] (Gildea 1995), and in Kagoshima Japanese coda stops and nasals are debuccalized to [ʔ] and [N], respectively (Kaneko and Kawahara 2002). Coda debuccalization may be related to the weakness of consonantal place cues in this position, particularly when the coda consonant unreleased (Jun 1995, 1996, Steriade 2001a). My concern here, however, is not so much with understanding the *why* of coda debuccalization as exploiting the *fact* of it.

If CODA-COND dominates the faithfulness constraint MAX(place) and the markedness constraint HAVE-PLACE (for which see Padgett 1995, Parker 2001, Smith 2002), then [paʔka] will be more harmonic than faithful [patka], and the chain <patka, paʔka> will be valid. The same goes for the chain <pamka, paNka> from input /pamka/.

(1) Harmonic improvement in debuccalization

	/patka/ /pamka/	CODA-COND	MAX(place)	HAVE-PLACE
a. →	paʔka paNka		*	*
b.	patka pamka	*!		

#### 4. Debuccalization, Deletion, and Assimilation

A debuccalized segment may go on to delete or assimilate. Whether the final outcome is debuccalization, deletion, or assimilation depends on the ranking of three constraints: HAVE-PLACE, NO-SPREAD(place), and MAX. HAVE-PLACE is, as we have seen, a markedness constraint that disfavors consonants that lack an oral constriction, principally [ʔ], [h], and [N]. NO-SPREAD(place) is a faithfulness constraint that militates against autosegmental spreading. Segmental MAX is violated whenever a segmental root-node is deleted.

Debuccalization is the final outcome if the ranking conditions in (1) are met and if, in addition, NO-SPREAD(place) and MAX dominate HAVE-PLACE. As (2) shows, a constraint hierarchy with all of these properties ensures that the chains <patka, paʔka> and <pamka, paNka> cannot undergo any further harmonic improvement. To see this, compare the debuccalized winners in (a) with the two possible chain continuations, deletion in (c)<sup>3</sup> and assimilation in (d).

## (2) Debuccalization as final result

	/patka/ /pamka/	CODA-COND	NO-SPREAD(place)	MAX	MAX(place)	HAVE-PLACE
a. →	paʔka paNka				*	*
b.	patka pamka	*!				
c.	paka paka			*!	*	
d.	pakka paŋka		*!		*	

For deletion to be the final outcome, the chains <patka, paʔka, paka> and <pamka, paNka, paka> must be valid. They are properly gradual, since the debuccalization step is separated from the segmental deletion step, as hypothesized in section 2. Chain validity also requires harmonic improvement, and harmonic improvement in the first, debuccalizing step requires the ranking conditions in (1) to be met. Harmonic improvement in the second, root-node-deleting step requires NO-SPREAD(place) and HAVE-PLACE to dominate MAX, as shown in (3).

## (3) Deletion as final result

	/patka/ /pamka/	CODA-COND	NO-SPREAD(place)	MAX(place)	HAVE-PLACE	MAX
a. →	paka paka			*		*
b.	patka pamka	*!				
c.	paʔka paNka			*	*!	
d.	pakka paŋka		*!	*		

For assimilation to be the final result, the chains <patka, paʔka, pakka> and <pamka, paNka, paŋka> must be valid. These chains are properly gradual because the debuccalizing step and the place-spreading step are separate. For the chains to be harmonically improving as well, the ranking conditions in (1) must be met and, additionally, MAX and HAVE-PLACE must dominate the faithfulness constraint NO-SPREAD(place), as (4) shows. (Recall from section 1 that the outputs of the chains <patka, paʔka, pakka> and <pamka, paNka, paŋka> satisfy CODA-COND because the single shared token of the place feature [dorsal] is licensed by its association

with an onset consonant (Goldsmith 1990, Ito 1989).)

(4) Assimilation as final result

	/patka/ /pamka/	CODA-COND	MAX	MAX(place)	HAVE-PLACE	NO-SPREAD(place)
a. →	pakka paŋka			*		*
b.	patka pamka	*!				
c.	paʔka paNka			*	*!	
d.	paka paka		*!	*		

### 5. Explaining the Coda/Onset Asymmetry

We now have the tools needed to explain the coda/onset asymmetry. Because of the gradualness requirement on chains, neither  $C_1$  nor  $C_2$  of a medial cluster  $C_1C_2$  can delete or assimilate unless it first debuccalizes. Because of the harmonic improvement requirement on chains, it is not enough for just deletion or just assimilation to be harmonically improving; the debuccalization step must also be harmonically improving. Debuccalization of codas is harmonically improving if CODA-COND dominates MAX(place) and HAVE-PLACE, as shown in (1). But debuccalization of onsets does not improve performance on CODA-COND. The reason for the coda/onset asymmetry, in short, is that deletion or assimilation require prior debuccalization, and CODA-COND imposes an inherent asymmetry in where debuccalization occurs.  $C_1$  is in a position where debuccalization better satisfies CODA-COND, but  $C_2$  is not. Chains beginning with  $\langle$ patka, paʔka, ... $\rangle$  or  $\langle$ pamka, paNka, ... $\rangle$  are harmonically improving under the ranking in (1), but chains beginning with  $**\langle$ patka, patʔa, ... $\rangle$  or  $**\langle$ pamka, pamʔa, ... $\rangle$  are not. In general, CODA-COND cannot be the motive for cluster simplification by deleting or assimilating  $C_2$ , given OT-CC and the specific assumptions about faithfulness and gradualness in section 2.

Although we have discussed only underlying clusters so far, these explanations apply with equal force when a consonant cluster is derived by syncope. Wilson (2001) shows that the first consonant is targeted for deletion even when the cluster is derived by syncope, and the same goes for assimilation. For example, Gildea (1995) describes various coda reduction and deletion processes in the Cariban languages that affect consonants that have become codas by syncope: derivationally, /sena:pi-sa/ → [sena:psa] → [sena:sa] ‘I eat it’ in Carib. Clearly, CODA-COND is not relevant until the candidate chain has progressed to the point of syncope:  $\langle$ sena:pisa, sena:psa, ... $\rangle$ . At that point, the situation is exactly the same

as it is in the /patka/ example: CODA-COND favors debuccalization of /p/ but not /s/, and debuccalization is a necessary step on the way toward deletion: <senɑ:pisɑ, senɑ:psɑ, senɑ:ʔsɑ, senɑ:sɑ >.

## 6. Further Consequences

This proposal makes a number of further predictions that go beyond the bare bones of the coda/onset asymmetry. As far as I have been able to determine, these predictions are correct.

First, this proposal predicts that the coda/onset asymmetry should not hold when C<sub>2</sub> is [ʔ], [h], or any other segment that lacks oral place in underlying representation. The reason: debuccalization is not a necessary precondition for deletion or assimilation when the affected segment already lacks oral place. This prediction is correct, as the examples in (5)-(8) show.

- (5) Onset /h/ deletion in Chitimacha (fed by apocope)<sup>4</sup> (Swadesh 1946: 315-316)
- |                 |            |                |
|-----------------|------------|----------------|
| /keʔe:b hup/    | ke:bup     | ‘to bed’       |
| /waʃta hetʃʔin/ | waʃtetʃʔin | ‘Sunday, week’ |
| /giti hujgi/    | gitujgi    | ‘parched’      |
- (6) Onset /h/ deletion in Tonkawa<sup>5</sup> (Hoijer 1946: 292)
- |                    |            |                           |
|--------------------|------------|---------------------------|
| /nes-he-tsane-oʔs/ | nesetsnoʔs | ‘I cause him to lie down’ |
| /nes-ha-na-kapa-/  | nesankapa- | ‘to cause to be stuck’    |
- (7) Bidirectional /h/ assimilation in Afar<sup>6</sup> (Bliese 1981: 240-241)
- |                      |                    |                   |
|----------------------|--------------------|-------------------|
| /si'do:x haj'to/     | si'do:x xaj'to     | ‘third’           |
| /'tamahih sabba'tah/ | 'tamahis sabba'tah | ‘because of this’ |
- (8) Onset /h/ assimilation in Arbore<sup>7</sup> (Hayward 1984: 66-67)
- |              |          |            |
|--------------|----------|------------|
| /mín-h-áw/   | mínnav   | ‘my house’ |
| /ʔabás-h-áw/ | ʔabássaw | ‘my stew’  |

Second, this proposal predicts that the coda/onset asymmetry should not hold when C<sub>2</sub> is epenthetic, since epenthetic segments have no underlying place specification to be faithful to. Example (9) shows that this prediction is also correct: a coda consonant can determine the place of articulation of a following epenthetic onset consonant.

- (9) Epenthetic onset assimilation in Lardil<sup>8</sup> (Hale 1973)
- |       |       |          |
|-------|-------|----------|
| /maɾ/ | maɾɬa | ‘hand’   |
| /ɾil/ | ɾilta | ‘neck’   |
| /kaŋ/ | kaŋka | ‘speech’ |

Third, this proposal predicts that deletion will not occur when codas are marked for reasons other than CODA-COND or some similar place restriction. The reason for this prediction is that debuccalization is a necessary precondition for deletion, and debuccalization is harmonically improving only under CODA-COND. This prediction also seems to be correct. For example, CV:C syllables are marked because they contain too much material in the rhyme (Sherer 1994 and others), and

not because the coda has place. Languages eliminate such syllables by vowel shortening (/xal-na/ → [xalna] ‘our maternal uncle’ in Cairene Arabic) or epenthesis (/xal-na/ → [xalana] in Mekkan Arabic (Abu-Mansour 1987)). No language known to me eliminates CV:C syllables by deleting the coda consonant.

Finally, because debuccalization is a step along the way toward assimilation or deletion, this proposal predicts that debuccalization and assimilation or deletion should sometimes occur together in a single language, with other constraints determining which outcome is chosen when. The correctness of this prediction is illustrated by the data in (10)-(13), which come from Carib of Surinam (Gildea 1995, Hoff 1968) and Arbore (Hayward 1984). In Carib, coda nasals assimilate in place to a following stop, but they debuccalize to [ʔ] before another nasal. Assimilation is blocked before nasals because the language has no geminates. In Arbore, plain stops in coda position assimilate, but glottalized stops debuccalize. The differential treatment of glottalized stops is perhaps an effect of faithfulness to their underlying [constricted glottis] specification.

- |      |   |  |                     |
|------|---|--|---------------------|
| (10) | Coda assimilation in Carib                            |  |                     |
|      | /eka:numi-poti/                                       | eka:numboti  | ‘to run repeatedly’ |
|      | /kin-eka:numi-taŋ/                                    | kine:ka:nundaŋ                                       | ‘he will run’       |
|      | /aj-eka:numi-ko/                                      | aje:ka:nunŋo   | ‘run!’              |
| (11) | Coda debuccalization in Carib                         |  |                     |
|      | /eka:numi-no/   | eka:nuʔno  | ‘running’           |
| (12) | Assimilation in Arbore                                |  |                     |
|      | /harrag-mé/   | [harrammé]   | ‘bead necklaces’    |
|      | /d <sup>2</sup> ek <sup>2</sup> k <sup>2</sup> at-mé/ | [d <sup>2</sup> ek <sup>2</sup> k <sup>2</sup> ammé] | ‘grindstones’       |
|      | /kut-n-e/   | [kúnne]  | ‘we cut (it)’       |
| (13) | Debuccalization in Arbore                             |  |                     |
|      | /be:k <sup>2</sup> -t-aw/                             | [be:ʔtáw]  | ‘my wound’          |
|      | /d <sup>2</sup> i:k <sup>2</sup> -t-e/                | [d <sup>2</sup> í:ʔte]                               | ‘she bled’          |

In general, this proposal establishes a connection between the contexts where segments neutralize with respect to place and the contexts where they undergo assimilation in place, since underlying place-specified segments cannot assimilate in place until they have neutralized in place. Positional faithfulness theory makes the same connection (Tessier 2006, citing a personal communication from Joe Pater): for example, codas could be the preferred targets of both debuccalization and place assimilation if onsets are protected by IDENT<sub>Onset</sub>(place). But positional faithfulness theory cannot explain why codas are also the preferred targets of deletion processes, since MAX<sub>Onset</sub> is meaningless — a deleted segment is obviously not in the surface onset position, so it cannot be subject to this constraint (Wilson 2001: 179ff.).

## 7. Progressive Assimilation?

The theory proposed here explains why place assimilation is normally regressive: place assimilation is contingent on prior debuccalization, and



debuccalization is a fate of codas but not onsets. I am therefore obliged to examine all known cases of progressive place assimilation, in order to determine whether they can be reconciled with this theory.

The best-known case of progressive place assimilation is probably German (see (14)). Syllabic [n] assimilates in place to a preceding stop (obligatorily) or fricative (optionally). Syllabic [m] does not assimilate; in fact, it triggers assimilation of a preceding [n]: [ajnəm] ~ [ajm̩m̩] ‘a, one (masculine singular dative)’.

(14) German (Wiese 1996)

/ge:b-ən/	ge:bən ~ ge:b̩m̩	‘to give’
/tra:g-ən/	tra:gən ~ tra:g̩ŋ	‘to carry’
/raʊf-ən/	raʊfən ~ raʊf̩ŋ ~ raʊf̩ŋ̩	‘to pluck’

It does not seem unreasonable to assume that syllabic [n] may be subject to debuccalization, like coda [n]: <ge:bn, ge:b̩N, ge:bm̩>. If codas debuccalize because they are not released (Jun 1995, 1996, Steriade 2001a), then debuccalization of syllabic consonants, which are also unreleased, is to be expected. This view is confirmed by the observation that syllabic nasals can also assimilate regressively when they are in preconsonantal position. An example is Denya<sup>9</sup> (Mbuagbaw 1996: 38-39): /N-pí/ → [m̩pí] ‘cl. + nail’, /N-ga/ → [ŋgà] ‘cl. + knife’.

Jun (1995) has assembled several examples where a suffix-initial onset consonant assimilates in place to a preceding root-final consonant. In Dutch, the diminutive suffix has several forms, among which are [-pjə] after a short vowel + [m] (example (c) in (15)) and [-kjə] after a short vowel + [ŋ] (example (d)).

(15) Dutch diminutive (Trommelen 1983, van der Hulst 1984, and others)

- a. [-jə] after an obstruent
 

bus-je	‘bus (dim.)’
--------	--------------
- b. [-ətjə] after short vowel + sonorant consonant
 

ball-etje	‘ball (dim.)’
-----------	---------------
- c. [-pjə] after short vowel + [m]
 

raam-pje	‘window (dim.)’
----------	-----------------
- d. [-kjə] after short vowel + [ŋ]
 

konin-kje	‘king (dim.)’
-----------	---------------
- e. [-tjə] otherwise
 

laan-tje	‘avenue (dim.)’
zee-tje	‘sea (dim.)’

If the underlying form of the diminutive suffix is /-tjə/, with a /t/, then this is an example of progressive feature-changing place assimilation. Van de Weijer (2002) presents an OT analysis along these lines, relying on the distinction between root and affix faithfulness (McCarthy and Prince 1995) to account for the direction of assimilation. His analysis is given in (16).

(16) Progressive assimilation according to van de Weijer (2002: 203)

/bo:m/ + /tjə/	NASALPLACEAGREEMENT	FAITH(ROOT)	FAITH(AFFIX)
a. → bo:mpjə			*
b. bo:ntjə		*!	
c. bo:mtjə	*!		

An analysis like (16) is not compatible with my proposal, however. It would require a candidate chain like \*\* <bo:mtjə, bo:mʔjə, bo:mpjə>, but this putative chain is invalid since it is not harmonically improving in its first step. Debuccalization of onset /t/ does not offer improved performance on CODA-COND or any similar markedness constraint. The FAITH(ROOT)/FAITH(AFFIX) ranking is irrelevant, since no markedness constraint favors debuccalizing /t/.

Van de Weijer notes, however, that (16) is not the only possible account of this phenomenon. He points out that progressive place assimilation does not affect other suffixal /t/s in Dutch, such as the distributive *geboomte*, \**geboompe* ‘foliage’ or the third singular and past tense suffixes. He goes on to say:

In the diminutive, however, as we have seen, the [t] does alternate. It might therefore be underlyingly underspecified for Place. We would then have to stipulate in the grammar that nasal assimilation only applies in a ‘feature-filling’ manner, i.e. that existing Place specifications are respected, and that only underspecified representations can be affected. In this way, the initial consonant of the diminutive is always available for assimilation, and the initial consonant of the distributive suffix never is. (van de Weijer (2002), p. 203)

In this approach, the [t] that appears in postvocalic contexts is the result of default fill-in of the least marked place feature when place cannot be obtained by spreading from an adjacent consonant. Other analyses of the Dutch diminutive along these general lines include Lahiri and Evers (1991), van der Hulst (1984: 127), and van Oostendorp (1997: 234ff.). In general, these analyses are compatible with the theory presented here; since the suffixal consonant has no underlying specification for place, it is a legitimate target for place assimilation without prior debuccalization, just like the placeless onset consonants in (5)-(9).

A similar phenomenon can be found in Kambaata (17).<sup>10</sup> This language has a monoconsonantal suffix that marks some person/number/gender combinations in verbal subject agreement. This suffix surfaces as [t] after root-final sonorants (a, b), and even triggers regressive place assimilation of /m/ (b), but it shows up as gemination of a preceding root-final obstruent (c). The similarity with Dutch is clear, and an analysis along the same general lines seems reasonable (cf. Hudson 1980: 107ff.). Interestingly, Kambaata also has an agreement suffix that causes gemination of root-final sonorants as well as obstruents: [marro] ‘he went’. These

two agreement suffixes can be distinguished by their degree of underspecification: the suffix that shows up as [t] after a sonorant and as gemination otherwise is derived from an archisegment that is specified as [-sonorant], while the suffix that always shows up as gemination derives from an archisegment that lacks even that much specification.

(17) Kambaata (Hudson 1980, Jun 1995, Sim 1985, 1988)

a.	/mar-t-o:ʔi/	marto:ʔi	‘she went’
	/wai-l-t-o:ʔi/	wai:lto:ʔi	‘she came’
	/fan-t-e:ʔi/	fante:ʔi	‘she opened’
b.	/tum-t-o:ʔi/	tunto:ʔi	‘she tossed’
c.	/ub-t-o:ʔi/	ubbo:ʔi	‘she fell’
	/t <sup>2</sup> uf-t-o:ʔi/	tuffo:ʔi	‘she closed’
	/dag-t-onti/	daggonti	‘you (sg.) knew’

The Dutch and Kambaata examples tend to support the view that feature-changing place assimilation can never target  $C_2$ , even when  $C_1$  is a root consonant and  $C_2$  is a suffix consonant. This view is consistent with my proposal, which cannot accommodate progressive feature-changing place assimilation even with the aid of the root/affix faithfulness asymmetry.

The same goes for deletion of  $C_2$ . When  $C_2$  has an underlying place specification, it cannot delete unless it first debuccalizes, but onset debuccalization is not harmonically improving under CODA-COND. Positing a distinction between high-ranking MAX(ROOT) and low-ranking MAX(AFFIX) does not make debuccalization of  $C_2$  harmonically improving without a markedness constraint that favors onset debuccalization. Therefore, the theory proposed here predicts that there should not be a language whose suffixes participate in a regular phonological alternation between -V after a consonant and -CV after a vowel, unless the C is epenthetic.<sup>11</sup> Sporadic examples that look like this would have to be analyzed as cases of listed allomorphy (Mascaró 1996, Mester 1994, Tranel 1996, and many others) or as ghost segments (Zoll 1993, 1996). For instance, the Ibibio example cited by Wilson (2001) is clearly not a regular phonological alternation, since two otherwise identical suffixes, the negative and the reversive, behave differently in the relevant respect (Akinlabi and Urua 2002).

Though it would be preferable to end this section on a high note, I will instead mention the only example known to me of progressive place assimilation that challenges the theory proposed here. Musey<sup>12</sup> has four different suffixes that are subject to progressive place assimilation (Jun 1995, Shryock 1993). Since these suffixes show up as /-na/, /-ra/, /-dī/, and /-gǐjō/ in nonassimilating environments, an analysis in the style of Dutch does not seem plausible. Musey, then, constitutes somewhat of a unique challenge to the theory, and it is likely to remain so because further relevant information about this language is not available.

## 8. Conclusion

In this article, I have argued that OT with candidate chains offers a novel account of the generalization that simplification and assimilation of medial consonant clusters targets the would-be coda and not the would-be onset. The elements of OT-CC that are essential to the explanation are the gradualness and harmonic improvement restrictions on chains — restrictions that are independently required in the OT-CC account of phonological opacity (McCarthy 2006a). When combined with certain assumptions about faithfulness and autosegmentalism, OT-CC requires consonant deletion or place assimilation to go by way of consonant debuccalization. Because debuccalization is harmonically improving in codas but not in onsets, only would-be codas can undergo deletion or assimilation

This proposal raises many questions for further research. Does segmental deletion involve an even more gradual process of attrition than loss of place? For instance, must the laryngeal features delete in a separate step: <pad.ma, pat.ma, pah.ma, pa.ma>? This seems like a reasonable possibility, but evidence for this chain and against <pad.ma, paf.ma, pa.ma> might be hard to come by. Does vowel deletion also involve gradual attrition? An obvious move is to require reduction as a prerequisite for deletion: <ka.ta.bat, ka.tə.bat, kat.bat>. There are certainly connections to be made between reduction and syncope processes, and this might be the right way to do it.

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## Notes

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<sup>1</sup> For documentation of the deletion asymmetry, see Steriade (2001b) and Wilson (2000, 2001). For the assimilation asymmetry, see Jun (1995), Ohala (1990), Steriade (2001a), and Webb (1982).

<sup>2</sup> OT-CC is based in part on harmonic serialism (McCarthy 2000, Prince and Smolensky 2004). On the similarities and differences, see McCarthy (2006a, 2006b).

<sup>3</sup> In (2), candidate (c)'s violation of MAX(place) exemplifies a point made in section 2: deleting a segment that has underlying place, such as the /t/ of /patka/, violates not only segmental MAX but also MAX(feature) constraints for all of /t/'s features. This is the main difference between the Max(feature) approach to featural

faithfulness and the IDENT(feature) approach. The mapping /patka/ → [paka] does not violate IDENT(place) because /t/ has no output correspondent.

<sup>4</sup> Chitimacha is an extinct Gulf language of Louisiana.

<sup>5</sup> Tonkawa is an extinct Coahuiltecan language of Oklahoma.

<sup>6</sup> Afar is a Lowland East Cushitic (Afroasiatic) language of Ethiopia.

<sup>7</sup> Arbore is an East Cushitic (Afroasiatic) language of Ethiopia.

<sup>8</sup> Lardil is a Pama-Nyungan language of Australia.

<sup>9</sup> Denya is a Niger-Congo language of Cameroon.

<sup>10</sup> Kambaata is a Highland East Cushitic (Afroasiatic) language of Ethiopia.

<sup>11</sup> Hideki Zamma points out that the Japanese is relevant to this claim. Japanese has various suffixes that begin with –V after a consonant and –rV after a vowel: [kak-u] ‘write’ vs. [mi-ru] ‘see’, [kak-eba] vs. [mi-reba]. Although earlier work in generative phonology regards the [r] as underlying, more recent research takes it to be epenthetic (De Chene 1985, Labrune 2006, Mester and Ito 1989).

<sup>12</sup> Musey is a Chadic (Afroasiatic) language of Chad. I am extremely grateful to Jongho Jun for providing me with a copy of Shryock (1993).

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