Coda/Onset Asymmetries in Dhivehi

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ABSTRACT

The asymmetry between codas and onsets in neutralizations and assimilations is a challenge for classic OT, which operates only on output constraints and does not distinguish between VC_1C_1V and VC_2C_2V as the output of $/VC_1C_2V/$. Serial forms of OT capture the asymmetry by making coda neutralization a prerequisite for assimilation. Dhivehi offers evidence that neutralization does in fact precede assimilation, as neutralization of coronal /t/ leaves a coronal glide 'trace' that persists after assimilation of a coda to a following onset. However, onsets assimilate to preceding codas in certain morphological environments when the coda is retroflex and the onset is dental. This kind of assimilation cannot be captured by serially ordered neutralization and assimilation, and the analysis requires the use of either morphologically targeted constraints or the reranking of constraints between morphological levels.

1 Introduction

Cross-linguistically, coda consonants are weak. Depending on the language and the context, coda consonants may assimilate to a following onset, undergo place neutralization (debuccalization), or delete entirely. Onset consonants, by contrast, are stable (Wilson 2001, McCarthy 2007a, 2008). Both coda debuccalization and coda-to-onset assimilation are attested in Dhivehi [ISO 639-3: div], the national and only native language of the island nation of the Maldives. Dhivehi is an Indo-Aryan language whose closest relative is Sinhala, although it draws its high-register vocabulary from Arabic and Persian, rather than Pali and Sanskrit as Sinhala does. Dhivehi also displays perseveratory or progressive (onset-to-coda) assimilation of dentals to retroflexes in certain morphological contexts, suggesting that the comparative weakness of codas compared to onsets is not absolute, and requiring a constraint that specifically triggers assimilation (in line with Steriade 2001).[1]

Cross-linguistic tendencies with regard to weakness of onsets are captured schematically in (1).

(1)

Assimilation:	$VC_1C_2V \rightarrow$	VC_2C_2V,	$*VC_1C_1V$
Deletion:	$VC_1C_2V \rightarrow$	VC_2V,	$*VC_1V$
Debuccalization:	$VC\# \rightarrow$	V?#	

Coda/onset asymmetries are a problem for classic Optimality Theory (OT) as formulated by Prince & Smolensky (2004). In OT, the weakness of word-final codas is captured by CODA-COND, a cover constraint that assigns violations to codas that license their own Place nodes, formulated within OT in Ito & Mester (1994), and harking back to Ito (1988). However, while CODA-COND is satisfied by coda deletion or assimilation, it is equally satisfied by the deletion or assimilation of the second (onset) consonant in a cluster, as pointed out for the deletion case by Wilson (2001) and for the assimilation case by McCarthy (2007a, 2008). The failure of classic OT to distinguish coda-to-onset (regressive or anticipatory) assimilation from onset-to-coda (progressive or perseveratory) assimilation is shown schematically in Tableau 1, in which the

[1] Data in this paper come from Cain & Gair (2000), one of the few published works on Dhivehi grammar; Reynolds (2003), the most complete published Dhivehi-English dictionary; and my own fieldwork and language-learning experiences, the results of which are forthcoming in a grammar (Gnanadesikan in press). The forms cited here reflect the standard dialect.

intended winning output $VC_2.C_2V$ ties with an intended losing output $VC_1.C_1V$, in which the onset assimilates to the preceding coda.

/VC_1C_2V/	MAX	DEP	CODA-COND	HAVE-PLACE	IDENT-PLACE
$VC_1.C_2V$			*!		
☺ **$VC_2.C_2V$**					*
☹ **$VC_1.C_1V$**					*
V?.C_2V				*!	
V.C_2V	*!				
V.$C_1V.C_2V$		*!			

Tableau 1: Coda-onset assimilation in classic OT

Serial forms of OT, however, can derive the result that codas assimilate to onsets but not vice versa, as McCarthy (2007a) does with OT with Candidate Chains (OT-CC, McCarthy 2007b) and McCarthy (2008) does with Harmonic Serialism (HS). In serial versions of OT (and concentrating henceforth on Harmonic Serialism specifically), candidates are not only evaluated at the output of the grammar, but also step-by-step along the way as the candidates diverge from the input. Specifically, in HS (introduced as a possible variant of OT in Prince & Smolensky 2004, 6) candidates are evaluated after (at most) one change is made. Since delinking the underlying Place node from a coda and relinking the coda to the Place node of a following onset count as two changes, each of these two changes must be harmonically improving. The result is that an onset will not lose its Place node, since doing so has no effect on CODA-COND and is not harmonically improving. Thus onsets will not assimilate to codas, but codas will assimilate to onsets. The derivation of coda assimilation is shown in Tableau 2, in which the faithful parse is given first (labeled FP), and the winning candidate for each pass through the grammar is given next (labeled St 1 for Step 1, etc.). The candidate in which the onset loses its Place node loses at Step 1, because deleting the onset's Place does not satisfy CODA-COND.[2]

/VC_1C_2V/	MAX	DEP	CODA-COND	HAVE-PLACE	MAX-PLACE	NOLINK-PLACE
FP $VC_1.C_2V$			*!			
St1 V?.C_2V				*!	*	
St2 $VC_2.C_2V$						*

Tableau 2: Coda-onset assimilation in Harmonic Serialism

[2] As McCarthy (2007) points out, serial solutions to coda/onset asymmetries require using MAX(feature) constraints rather than the IDENT(feature) constraints more often used in classic OT, hence this difference between the constraints used in Tableau 1 and Tableau 2.

McCarthy (2007) sums up the serial approach to coda/onset asymmetry thus: "[D]eletion 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." (page, 2 in ROA version; emphasis added). In other words, debuccalization is necessarily ordered before deletion or assimilation. Thus the three processes (debuccalization, coda deletion, and anticipatory coda-to-onset assimilation) are related to each other within HS, and the asymmetry between codas and onsets is explained. However, McCarthy does not provide any theory-external evidence in support of the ordering of debuccalization before assimilation (or deletion). The facts of Dhivehi coda debuccalization and assimilation provide just such evidence. However, as will be returned to in Section 3, CODA-COND applied within HS cannot explain all the interactions between Dhivehi codas and onsets.

2. Dhivehi Debuccalization and Assimilation with the Coronal 'Trace'

Dhivehi obeys CODA-COND relatively strictly. The consonants found in word-final position are underlyingly /m/, /n/, /t/, /k/, /ṣ/, and /s/, as shown in (2).[3] Of these, the nasals neutralize in prepausal position to *ŋ*, and the obstruents neutralize to *ʔ*, as shown at the left in (2).[4] When a vowel-initial suffix is added, the neutralization does not occur, as shown at the right in (2). An exception to the neutralization is /s/, which surfaces unchanged as *s* in coda positions but becomes *h* intervocalically. The case of /s/ is included in the final line of (2) for the sake of completeness but is otherwise not discussed further in this paper.[5]

(2)	/nam/	naŋ	'name'	/nam + ek/	nameʔ	'a name'
	/fan/	faŋ	'palm leaf'	/fan + ek/	faneʔ	'a palm leaf'
	/ruk/	ruʔ	'palm tree'	/ruk + ek/	rukeʔ	'a palm tree'
	/raṣ/	raʔ	'island'	/raṣ + ek/	raṣeʔ	'an island'
	/fot/	**foʸʔ**	**'book'**	**/fot + ek/**	**foteʔ**	**'a book'**
	/bas/	bas	'language'	/bas + ek/	baheʔ	'a language'

As shown in the penultimate line of (2), the behavior of the coronal dental stop /t/ is unusual. Debuccalization to *ʔ* occurs, as with the other obstruents (other than /s/). However, the [Coronal] feature of /t/ surfaces as a coronal glide. The glide is apparently non-segmental, as it does not add further weight to the syllable (i.e. *foʸʔ* is a heavy, not a superheavy, syllable). Cain & Gair (2000, 11) describe it as an offglide of the vowel, but I analyze it as an onglide to *ʔ*, as it does not behave like the diphthong /ai/ (which monophthongizes to *æː* in the standard dialect). Thus the [Coronal] feature remains on the segment with which it is underlyingly associated, but shows up as a V-Place rather than a C-Place feature (assuming a theory of place features along the lines of Clements & Hume 1995).

When a coda consonant (other than /s/) is followed by a consonant other than /h/, either within or across words, the coda assimilates to form a geminate or partial geminate (i.e. a homorganic nasal-stop cluster) with the following onset. This is shown in (3), in which the words in (2) are repeated at the left, but are given a consonant-initial suffix at the right. As in (2), the coronal stop produces a coronal 'trace' onglide as in the bolded penultimate line in (3).

[3] Other word-final consonants do not occur, other than /l/, which surfaces as a back vowel in native words (e.g., /bol/ → *boo* 'head', cf. *bole?* 'a head'). In loanwords, other final consonants are made licit with the addition of an epenthetic *u*. Word internally, coda consonants also include the first element of a geminate or partial geminate.

[4] When a vowel- (or /h/-) initial word follows, the neutralizations are all to *ŋ*, with /t/ becoming *ʸŋ*, as in /fot ufeddum/ *foʸŋ ufedduŋ* 'book production'.

[5] It may be that the /s/ is protected from the effects of CODA-COND by higher ranking constraints preserving its [strident] feature; however, this feature is lost when a vowel-initial suffix is added, so it cannot be all that highly protected. The exceptional behavior of /s/ in Dhivehi is a matter for further work.

(3)	/nam/	naŋ	‘name’	/nam + tak/	nantaʔ	‘names’
	/fan/	faŋ	‘palm leaf’	/fan + tak/	fantaʔ	‘palm leaves’
	/ruk/	ruʔ	‘palm tree’	/ruk + tak/	ruttaʔ	‘palm trees’
	/raṣ/	raʔ	‘island’	/raṣ + tak/	rattaʔ	‘islands’
	/fot/	**foʸʔ**	**‘book’**	**/fot + tak/**	**foʸttaʔ**	**‘books’**
	/bas/	bas	‘language’	/bas + tak/	bastaʔ	‘languages’

While the assimilation in (3) happens before any consonant other than /h/, the case in which the following onset is /t/ is particularly interesting. The output of /fot + tak/, *foʸttaʔ* ‘books’, with the coronal glide, is *less* faithful to the input than a simple **fottaʔ* would be. Outputs such as *rattaʔ* ‘islands’ and *ruttaʔ* ‘palm trees’ (as well as monomorphemic forms such as *batti* ‘lamp’ and *datta* ‘older sister’) indicate that a geminate *tt* presents no difficulty in Dhivehi. The output *foʸttaʔ* ‘books’ is, however, *more* faithful to an intermediate debuccalized form **foʸʔtaʔ* (ungrammatical as an output, but not ungrammatical as an intermediate form), suggesting that the debuccalized form is indeed created before the assimilated form. If the assimilation could occur in one step, there would be no need for the coronal trace, at least in the case where the following consonant is /t/.

The behavior of Dhivehi’s coronal trace can be easily analyzed in an HS framework. The retention of [Coronal] in the form of the coronal onglide trace must satisfy some faithfulness constraint. This can be assumed to be MAX-Coronal, which in Dhivehi outranks other MAX-Place constraints. However, the coronal trace must violate some other constraint by showing up in the output as a vocalic rather than a consonantal place. This constraint may be called IDENT-Tier. It must be assumed that switching tiers from C-Place to V-Place (or vice versa) is a one-step process, whereas the delinking and spreading that occurs in assimilation is a two-step process. The constraints and ranking of relevant constraints required for deriving the coronal trace in the assimilation case are shown in Tableau 3. In the case of prepausal neutralization, the derivation stops at Step 1, since there is no following onset to assimilate to. In either case, a coronal trace is derived from an underlying /t/.[6]

/fot + tak/	MAX-COR	CODA-COND	IDENT-TIER	HAVE-CPLACE	NOLINK-PLACE
FP fo[t_1.t_2]ak		*!			
St1 fo[ʸʔ.t]ak			*!	*	
St2 fo[ʸt_2.t_2]ak					*

Tableau 3: Coronal Trace in Harmonic Serialism

The coronal trace could also be derived without serialism by using Output-Output constraints (as proposed by Benua 1997) that require faithfulness of the inflected /fot + tak/ *foʸttaʔ* ‘books’ to the uninflected /fot/ *foʸʔ* ‘book’. Such a parallel O-O analysis gives the uninflected form *logical* priority (as something to be faithful to) but not *temporal* priority. Some sort of priority of the debuccalization (that occurs in the uninflected form) over assimilation (that occurs in the inflected form) holds in either an O-O or an HS analysis, however. Yet HS has the additional benefit of providing an analysis of both the coronal trace and coda/onset asymmetry in general. Output-Output faithfulness, on the other hand, has nothing particular to say about the general problem of coda/onset asymmetry.

[6] /t/ is not the only coda coronal. The retroflex /ṣ/ also occurs word finally but leaves no coronal trace. This is presumably because the [retroflex] dependent of [Coronal] has no glide equivalent and is not permitted on the V-Place tier.

3. Retroflex Assimilation and Morphological Levels

In most cases the asymmetry between codas and onsets in Dhivehi is as expected based on cross-linguistic norms, with codas being weak and onsets being strong. However, in certain morphological environments, onsets assimilate to preceding codas. Specifically, retroflexion spreads to a coronal onset that begins a derivational morpheme, the second half of compound, or a clitic postposition, as in (4).[7]

In other environments—in inflectional morphology or across words in phrases—codas assimilate straightforwardly to onsets, losing any retroflexion in the coda but retaining the rare cases of retroflexion in the onset. This is shown in (5).

(4)	/avaṣ + teri/	'neighborhood + ADJ'	avaṭṭeri	'neighboring'
	/aṣ # diha/	'eight # ten'	aḍḍiha	'eighty'
	/kurumaṣ=taka/	'doing.DAT=BEN'	kurumaṭṭaka	'for the sake of doing'

(5)	/raṣ + tak/	rattaʔ	'islands'	(*raṭṭaʔ)
	/varaṣ# #duruga(i)/	varadduga(i)	'very far'	(*varaḍḍurugai)
	/ek# #ṭaviyani/	eṭṭaviyani	'one [letter] "taviyani"'	

Considering first the cases in (4), while onset-to-coda assimilation is rare in general, perseveratory retroflex assimilation (in languages that have retroflexes) is actually normal cross-linguistically. As Steriade (2001) points out, retroflexion is more easily perceived *after* a vowel than before. This fact leads Steriade to propose a fixed ranking that favors the retention of retroflexion after a vowel over its retention before a vowel, as in the following slightly abridged version.[8]

(6) IDENT [retroflex]/ V__ >> IDENT [retroflex]/ __V (adapted from Steriade 2001)

The ranking in (6) is consistent with the fact that retroflexes generally do not start words or lexical morphemes in Dhivehi except in loanwords. The IDENT [retroflex] constraints cannot be the whole story, however. For one thing, the behavior of coda retroflexes is variable, as demonstrated by the difference between the forms in (4) and (5).

For another thing, a trigger is needed for the rightward spreading of [retroflex]. Unlike in the case of leftward spreading from onset to coda, CODA-COND cannot be the trigger for spreading [retroflex] rightward from coda to onset. If rightward spreading of [retroflex] satisfied CODA-COND, then we would expect it to happen whenever a retroflex coda is followed by a dental onset, but in fact it does not. Something else must be the trigger.

The HS account of the normal coda/onset asymmetry has the satisfying aspect of not requiring a constraint that specifically drives assimilation. Rather, the assimilation derives from the interaction of other constraints in the presence of CODA-COND, and assimilation belongs to a family of responses to CODA-COND that also includes debuccalization and deletion. A similar account for onset-to-coda retroflex assimilation would be theoretically satisfying. However, such an account does not seem to be available. A constraint ruling out [retroflex] in onsets (similar to CODA-COND ruling out Place in codas) would simply prohibit retroflex onsets without forcing assimilation, since there is no "HAVE-[retroflex]" constraint

[7] The latter case, that of the clitic postposition, may be frozen in the language. The only context in which it occurs is the benefactive postposition, which begins with a coronal stop and always occurs in the assimilation environment, following the dative case ending /-aṣ/. With no alternations, the benefactive postposition is considered by speakers to begin with a retroflex /ṭ/, which is almost unheard of in native Dhivehi lexical morphemes. The other cases of retroflex assimilation (derivational and compounding morphology) appear to be productive, though my consultant reports some optionality of the assimilation in nonce forms, which may be related to slow vs. fast speech contrasts or to uncertainty over the compound status of such words.

[8] I avoid here the issue of what featural configuration causes retroflexion and designate it simply as [retroflex]. I have also generalized from Steriade's statements about apical consonants to include the Dhivehi dental stops, which are phonetically laminal but do not contrast with apical alveolar stops and may be considered the unmarked coronal series in Dhivehi.

analogous to the HAVE-PLACE constraint of Tableau 2. Instead, a constraint that actively drives assimilation is apparently needed; it must furthermore not be vacuously satisfiable by debuccalization, or coda retroflexes could simply lose their place to avoid violating the constraint, especially given that debuccalization is an option in the language. Thus an analysis parallel to that of coda assimilation is not available, and a constraint like Steriade's (2001) AGREE constraint is needed. Therefore, I use AGREE-[retroflex] as an assimilation constraint that prohibits clusters with two different values of [retroflex].

However, a single ranking of AGREE-[retroflex] will not suffice to derive both the outputs in (4) and those in (5). Whether coda retroflexion will spread to a following onset depends on the morphological context in which it occurs. Coda retroflexion *spreads rightward* in derivational morphology, compounds, and lexical clitics, as in (4), but *disappears* in inflectional morphology or across words in phrases, as in (5). The rare cases of onset retroflexion actually spread the retroflexion leftward to preceding codas across words in phrases, as when the retroflex that starts the word *ṭaviyani* (the name of the letter that spells /ṭ/) spreads leftward in /ek ṭaviyani/ *eṭṭaviyani* 'one "taviyani"' in (5). Thus there is a difference between derivational and lexical morphology (what we can call Level 1 morphology) on the one hand, and inflectional and phrasal morphology (what we can call Level 2 morphology) on the other. To capture this distinction the constraints must either be morphologically targeted or have different rankings at the two different morphological levels.

Different rankings for different morphological levels is the solution pursued by theories of Stratal OT (e.g., Kiparksy 2000, Ito & Mester 2003). Although Stratal OT has been criticized (e.g., McCarthy 2007b) for being too powerful, some reference to morphological environment must be made here. Either the constraints themselves must come in sets, each member of which makes reference to a particular type of morphology, or the constraints must be allowed to be reranked between Level 1 and Level 2. In either case there is the theoretical possibility of an explosion of the grammar.

A single instance of constraint reranking between Level 1 and Level 2 (or a single split in ranking between a Level 1- and a Level 2-targeted constraint) serves to derive the facts of [retroflex] assimilation in HS as laid out in Tableau 4 and Tableau 5, which show the derivation of *avaṭṭeri* 'neighboring' from /avaṣ + teri/. At Level 1 the assimilation-triggering AGREE-[retroflex] constraint, shown in bold Tableaux 4 and 5, outranks CODA-COND, while at Level 2 it ranks below CODA-COND.

/avaṣ + teri/	**AGREE-[retro]**	CODA-COND	HAVE-CPLACE	IDENT-[retro]/V__	IDENT-[retro] /__V
FP a.vaṣ.te.ri	***!**	*			
St1 a.vaṣ.ṭe.ri		*			*

Tableau 4: Level 1 morphophonology

a.vaṣ.ṭe.ri	CODA-COND	**AGREE-[retro]**	HAVE-CPLACE	IDENT-[retro]/V__	IDENT-[retro]/V__
FP a.vaṣ.ṭe.ri	*!				
St1 a.vaʔ.ṭe.ri		***!**	*	*	
St2 a.vaṭ.ṭe.ri				*	

Tableau 5: Level 2 morphophonology

The output of Tableau 4 does not show the final output, merely the output of Level 1 morphophonology. It serves as the input to Tableau 5; the output of Tableau 5 is the final output. The forms in (5), such as *ratta?* 'islands' from /raṣ + tak/, do not partake in the derivation in Tableau 4, having no Level 1 morphology, and simply undergo the assimilation driven by the high-ranked CODA-COND in Tableau 5.

By the analysis laid out in Tableaux 4 and 5, the retroflexion spreads rightward from the coda to the following onset, then the coda loses its place (including its retroflexion), and then the features of the onset (including the retroflexion) spread leftward from the onset to the coda. In other words, the retroflexion spreads rightward, is lost from the coda, and then spreads leftward again. While this may seem unnecessarily roundabout, it is consistent with the fact that only retroflexion spreads rightward from the coda to the onset while almost all features of the onset spread leftward to the preceding coda. In other words, retroflexion is the only feature that spreads rightward but is a subset of the features that spread leftward.

4. Conclusion

As is typical cross-linguistically, Dhivehi codas are generally weak as compared to onsets, and both debuccalization and assimilation occur, suggesting high ranking of CODA-COND. Unusually, however, coda /t/ leaves a coronal 'trace' onglide in both the debuccalization and assimilation cases, a fact that actually leads to lower faithfulness to the input in cases where the assimilation is to a /t/. The coronal trace is evidence that the debuccalization occurs before the assimilation, so that the relevant faithfulness in the assimilation case is actually to the debuccalized form, as is predicted by HS. Thus coda weakness and the coronal trace in Dhivehi are both neatly captured by an HS analysis without the need for O-O constraints. However, although coda-to-onset assimilation can be captured without any constraints that specifically force assimilation or refer to the specifics of the morphology, the facts of Dhivehi retroflex assimilation, which is sensitive to morphological level, indicate the need for AGREE-type constraints that specifically drive assimilation and for morphologically specific rankings (or morphologically specific constraints). While reranking at different morphological levels (or the breakdown of constraints into sets of morphologically targeted constraints) appears to add unwanted power to the grammar, it does appear to be necessary to capture the full range of coda-onset behaviors in Dhivehi. The reranking required in the Dhivehi case is of a single constraint, moved with respect to one other constraint, suggesting that the reranking of constraints between levels is in fact highly constrained.

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