1. Introduction

The Acehnese language has been discussed descriptively by a number of authors including Asyik (1972, 1978), Sulaiman (1977), and Durie (1985), but no work on the theoretical aspects of Acehnese phonology has been done. In this paper we propose to account for the restriction that Acehnese enforces on segments that can appear at the right edge of the syllable using the framework of Optimality Theory (henceforth OT) (Prince and Smolensky 1993/2000, McCarthy and Prince 1993a & b). We will show that although Acehnese may have simple codas, there is a constraint in the language, which restricts the type of consonant that can occupy the syllable-final position. This syllable structure condition is referred to as the Coda Condition (henceforth CODA-COND) (Itô 1986, 1989, Steriade 1982, Yip 199, Itô and Mester 1994, 1999).

We will show that the data can help us settle an open question regarding the choice among different approaches that employ restrictions on codas to derive the distribution of intervocalic clusters found in languages that allow codas. These approaches face both empirical and theoretical problems; an optimality-theoretic alignment approach (Itô and Mester 1994, 1999), for instance, fails to offer an adequate characterization of the Achenese data. It also fails to capture the generalization that onset place features are preserved and spread in assimilation contexts. To ensure onset-to-coda assimilation one should appeal to an additional stipulation such as the *Linking Condition* (Hayes 1986) or *Harmonic Ranking*: Faith [Place] Obstruent » faith (Place) Nasals (Pulleyblank 1997). The material covered is weighted in favor of an analysis whose most interesting aspects are the interaction among positional faithfulness constraints and various markedness constraints.

The purpose of the present paper, then, is to show that Positional Faithfulness, a radically different approach to CODA-COND, fares better than recent proposals couched within OT in handling the restriction observed in coda position.

The rest of the paper is organized as follows. It begins with some background information about the language in section 2. The body of the paper is in section 3, where we first present the coda conditions which have been formulated in the literature in order to account for coda effects. After pointing out the inadequacy of these, we introduce a positional-faithfulness-based analysis of coda/onset asymmetries in Acehnese. Section 4 concludes the discussion.

2. Acehnese

Acehnese is an Austronsian language spoken by three and a half million people in the Province of Aceh, the northern part of Sumatra, Indonesia. [See Asyik (1972), (1978) and Durie (1985) for more information on different aspects of Acehnese grammar].

The data on Acehnese presented here come from the Pidie dialect and have been elicited from three Acehnese speakers; (i) Muhammad Yusran Hadi from Lemteh, Banda Aceh, currently College of Shari'a 'Islamic Law' at Islamic University in Medina, (ii) Biktiyar a teacher of social sciences in an Indonesian school in Jidda, and (iii) Sulayman Ashi, currently an employee of Umm Al-Qura University in Makkah.

There are three points to review about Acehnese in this background section: the phoneme inventory; syllable inventory and syllable structure constraints; and pre-consonantal nasal place assimilation.

2.1 Acehnese segment inventories

The consonant and vowel inventories of Acehnese are given in (1) and (2) respectively.

(1) Acehnese consonant phonemes

	bilabial	alveolar	palatal	velar	glottal
Stops	p	t	c	k	ʔ
	b	d	ɟ	g	

Fricatives		s	ʃ		h
Nasals	m	n	ɲ		ŋ
Trill		r			
Lateral		l			
Glides	w		j		

Notes: All transcriptions are given in IPA. /s/ is a special IPA symbol used here for a laminal alveodental fricative.

(2) Acehnese vowel phonemes

Monophthongs

Oral

i	ɨ		u
e	ə		o
ɛ		ʌ	ɔ
	a		

Nasal

ĩ	ɨ̃		ũ
ɛ̃		ʌ̃	ɔ̃
	ã		

Diphthongs

Oral

iᵊ	ɨᵊ	uᵊ
ɛᵊ		ɔᵊ

Nasal

ĩᵊ	ɨ̃ᵊ	ũᵊ
ɛ̃ᵊ		ɔ̃ᵊ

2.2 Syllable structure

The overall structure of Acehnese syllable structure is C(C)V(V)(C), which is to say the onset may consist of a consonant optionally followed by another consonant (see Al-Ahmadi Al-Harbi (2002) for a complete list and discussion of onset clusters), and the rhyme may consist of a vowel alone, a vowel with a consonant, a diphthong alone, or a diphthong with a consonant. The set of syllable shapes that are well formed in Acehnese are given in (3).

(3) Acehnese syllables

a.	CV	ro	'to spill'
b.	CVV	ʔiᵊ	'water'
c.	CVC	baʔ	'tree'
d.	CVVC	piᵊp	'to suck'
e.	CCV	bri	'to give'
f.	CCVV	blɔᵊ	'to buy'
g.	CCVC	grah	'thirsty'
h.	CCVVC	pluᵊŋ	'to run'

It can be seen in (3) above that no syllable ends in a sequence of consonants, but a syllable can begin with a sequence of consonants; an obligatory branching onset and an optional non-branchig coda. Because complex constituents are allowed in the onset and not in the coda, we must split *COMPLEX into *COMPLEX^{ONS} which prohibits any cluster in the syllable onset and *COMPLEX^{COD} which militates against complex clusters in the syllable coda. The other syllable structure constraints that are needed to account for Acehnese syllabification are ONSET, NO-CODA and *COMPLEX^{NUC}. Consequently, five syllable structure constraints, namely ONSET, NO-CODA, *COMPLEX^{ONS}, *COMPLEX^{COD}, and *COMPLEX^{NUC} are involved in the process of syllabification in this language. These constraints are defined as follows:

(4) Syllable structure constraints (Prince and Smolensky 1993, Kager 1999)

a. **ONSET**
*[$_\sigma$ V ("Syllables must have onsets.")

b. **NO-CODA**
*C]$_\sigma$ ("Syllables are open.")

c. ***COMPLEX^{ONS}**
*[$_\sigma$ CC ("Onsets are simple")

d. ***COMPLEX^{COD}**
*CC]$_\sigma$ ("Codas are simple")

e. ***COMPLEX^{NUC}**
No more than one segment may associate to the nucleus

The avoidance of epenthesis and deletion in Acehnese motivates the faithfulness constraints in (5).

(5) Faithfulness constraints (Kager 1999)

a. **DEP-IO**
Output segments must have input correspondents. ("No epenthesis")

b. **MAX-IO**
Input segments must have output correspondents. ("No deletion")

Because syllables with complex onsets are allowed as in (3e, f, g, and h) *COMPLEX^{ONS} must be a dominated constraint, ranked lower in the hierarchy. Hence if there is a cluster, which consists of three consonants word-medially, the first member of the cluster is syllabified in the coda of the preceding syllable and the second and the third consonants are syllabified in the onset of the following syllable, thus creating a complex onset. This shows that complex codas are completely disallowed in Acehnese. Therefore the constraint that rules out complex codas is undominated in Acehnese. The ranking *COMPLEX^{COD} » *COMPLEX^{ONS} is shown in the tableau below.

(6) Input: /mɨntrɔᵊ/ 'vizier'	*COMPLEX^{COD}	*COMPLEX^{ONS}
a. mɨnt.rɔᵊ	*!	
b. ☞ mɨn.trɔᵊ		*

Knowing that syllables with a coda are allowed in Acehnese suggests that NO-CODA is dominated by the faithfulness constraints in (5). Let us now examine how NO-CODA is ranked in this language. Consider the form [cɨdra] 'to have a defect'. This form surfaces as [cɨ.dra] rather than *[cɨd.ra] because NO-CODA is minimally violated in domain-medial position. The only licit coda elements are the laryngeals (/ʔ/ and /h/) and homorganic nasals. Consequently the first segment of the cluster is syllabified in the onset of the following syllable. The choice of [cɨ.dra] as optimal candidate leads us to conclude that NO-CODA dominates *COMPLEX^{ONS}. Tableau (7) shows how NO-CODA outranks *COMPLEX^{ONS}:

(7) Input: /cɨdra/ 'to have a defect'	NO-CODA	*COMPLEX^{ONS}
a. cɨd.ra	*!	
b. ☞ cɨ.dra		*

Next consider the possibility of a strategy that might have been employed to avoid *COMPLEX^{ONS}: the deletion of /d/. This might have resulted in *[cɨ.ra], a candidate which satisfies NO-CODA but violates the faithfulness constraint MAX-IO. Since this candidate is not selected, MAX-IO must outrank NO-CODA. This interaction is shown in the tableau in (8) below:

(8) Input: /cɨdra/ ‘to have a defect’	MAX-IO	NO-CODA
a. cɨ<d>.ra	*!	
b. ☞ cɨ.dra		

Another possible output form that should be considered is *[cɨ.di.ra]. It is another potential candidate that avoids *COMPLEX^{ONS}. It satisfies both *COMPLEX^{ONS} and NO-CODA. But this leads to a violation of DEP-IO. This candidate loses the competition because DEP-IO is ranked higher than NO-CODA. The tableau below shows the interaction between these two constraints.

(9) Input: /cɨdra/ ‘to have a defect’	DEP-IO	NO-CODA
a. cɨ.di.ra	*!	
b. ☞ cɨ.dra		

Combining our conclusions, we arrive at the following total ranking:

(10) Preliminary ranking for Acehnese

MAX-IO, DEP-IO » NO-CODA »*COMPLEX^{ONS}

This ranking is illustrated by the following tableau, which contains candidates of the preceding tableaux:

(11) Input: /cɨdra/ ‘to have a defect’	MAX-IO	DEP-IO	NO-CODA	*COMPLEX^{ONS}
a. cɨ<d>.ra	*!			
b. cɨ.di.ra		*!		
c. cɨd.ra			*!	
d. ☞ cɨ.dra				*

Note that each candidate incurs a violation of one constraint. The optimal output (11d) violates the lowest ranking constraint, here *COMPLEX^{ONS}. In other words *COMPLEX^{ONS} is violated in order to avoid violations of higher-ranking constraints, MAX-IO, DEP-IO and NO-CODA.

Let us now turn to ONSET and *COMPLEX^{COD}. In tableau (11), NO-CODA is lower ranked compared to the faithfulness constraints. NO-CODA is violated in Acehnese therefore it is dominated. Similarly because this language does not allow onsetless syllables, ONSET is not vioable and because *COMPLEX^{COD} is undominated, it allows no complex codas. Therefore, we rank both constraints at the top of the hierarchy, which now takes its final form:

(12) Final ranking for Acehnese

ONSET, *COMPLEX^{COD} » MAX-IO, DEP-IO » NO-CODA » *COMPLEX^{ONS}

2.3 Nasal Place Assimilation

The process of nasal place assimilation is one of the commonest sound patterns cross-linguistically. In Acehnese a word-medial nasal surfaces place-assimilated in preconsonantal position. (We assume a fully specified input. So the nasal in this position

has coronal place).

(13) Acehnese nasal-stop clusters

Input	Output
/gun.pa/	[gum.pa] 'earthquake'
/lun.ba/	[lum.ba] 'to pass'
/ʔun.ta/	[ʔun.ta] 'camel'
/can.du/	[can.du] 'opium'
/run.ka/	[ruŋ.ka] 'skeleton'
/nan.grɔᵊ/	[naŋ.grɔᵊ] 'country'

The input-output pairings motivated above can all be treated readily in terms of OT. The feature [Place] is not licensed for nasals in coda position and hence it will be delinked. We must account though for the fact that the nasal not only loses its own place specification but also gains that of the following stop. We employ the constraint SPREAD-PLACE to force onset-place specifications to spread to fill the place of a nasal that would otherwise be placeless.

(14) SPREAD-PLACE
In nasal-plus-stop sequence, spread the place specifications of post-nasal consonant to the nasal

This obviously is in direct conflict with IDENT-IO [PLACE] which requires input/output identity with respect to place of articulation features.

(15) IDENT-IO [PLACE]

Corresponding input and output segments do not differ in [Place]

Ranking SPREAD-PLACE above faithfulness ensures that the optimal output for a nasal-plus-stop cluster in the input is a cluster in which one place specification is shared between the two consonants.

(16) Acehnese: Ranking of place agreement over faithfulness

SPREAD-PLACE » IDENT-IO [PLACE]

The tableau below shows the outcome of this ranking.

(17) Input: /gunpa/ 'earthquake'	SPREAD-PLACE	IDENT-IO [PLACE]
a. gun.pa	*!	
b. ☞ gum.pa		*

In (17) above, the fully faithful candidate (17a) violates the dominant constraint [SPREAD-PLACE]. Candidate (17b) is declared the winner because it violates IDENT-IO [PLACE] which is ranked lower in the hierarchy.

Now compare the way in which a palatal stop spreads its place of articulation to the nasal.

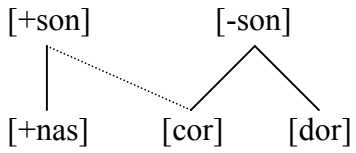
(18) Acehnese nasal-palatal stop clusters

Input	Output
/ban.ci/	*[baɲ.ci] [ban.ci] 'hate'
/han.co/	*[haɲ.co][han.co] 'broken'
/pan.cu.ri/	*[paɲ.cu.ri][pan.cu.ri]'thief'
/gun.ci/	*[guɲ.ci] [gun.ci] 'key'

Here nasal place assimilation when occurring before palatal [c], results not in [] an identically specified for place phoneme of the language but as an alveolar nasal [n]. To account for the asymmetric pattern of palatal consonant spreading of place features, we contend that the Acehnese palatal stop must

be viewed as a double [cor] [dor] articulation, a widely held view due to Keating (1988). We hypothesize that spreading is implemented as operation on terminal nodes in the feature tree [cf. Halle et al's. (2000) *Revised Articulator Theory*] and that it succeeds in causing linkage of only [cor] articulator feature. Following the insight of Padgett (1995), this partial assimilation to palatals can be depicted in (19).

(19) Assimilation to palatal stop in Acehnese



Given the asymmetric pattern of spreading of place for the palatal in the case at hand, we can provide a principled explanation of why only the [cor] articulation spreads its place. Nasal place assimilation to a palatal stop threatens to create a complex segment in the coda. To avoid this undesirable output assimilation is partial. Place assimilation to complex segments is partial in the sense that only one articulator of the complex segment spreads and it is due to the workings of top-ranked constraint *COMPLEX^{COD}.

To capture the asymmetric pattern of palatal consonant spreading, then, we must find ways of reformulating SPREAD-PLACE in such a way as to allow linkage of only the primary articulation in the featural make-up of palatal segments, such a move is well beyond the scope of this paper, however.

3. Acehnese CODA-COND

Acehnese, like many other languages [Japanese, Diola Fogny, Ponapean, Axininca Campa, and Burmese, to cite a few], exhibits some restrictions on its internal consonant clusters: coda consonants must share the place of articulation with the immediately following onset consonant. Internal sequences of two adjacent consonants are common, and if three consonants occur in sequence the first will always be a nasal that takes its place specifications from the succeeding onset, as illustrated in (20)

(20) Acehnese word-medial triconsonantal clusters

cam.pli	'pepper'
sin .thuᵊ	'slippery'
mɨn.trɔᵊ	'vizier'
ʔɨŋ.khɔᵊ	'to beat severely'
naŋ.grɔᵊ	'country'

As (20) shows a word-medial triconsonantal cluster always consists of a coda consonant and a complex onset. This coda consonant is a nasal preceding a homorganic stop.

Let us now move on to describe previous alternatives of OT formulation of CODA-COND like that in Acehnese, which bars segments specified for place from occupying the coda of a syllable.

3.1 Optimality accounts

Coda conditions have been formalized in various ways in the brief history of OT, though all versions have similar effects; they regulate the segments that can appear at the right edge of the syllable.

In Traditional OT, for example, CODA-COND is defined in prose.

(21) Traditional OT formulations of CODA-COND (altered to fit the Acehnese data)

a. McCarthy and Prince (1993a:29)
A coda consonant is a nasal homorganic to a following stop

b. Prince and Smolensky (2002:109)
A coda consonant can have place shared with another consonant

In Itô (1989) such a condition is expressed as a nonlinear filter referring to the syllable-final position and the melody:

(22) **CODA-COND**
*Place]$_{\sigma}$

This filter does not apply to linked structures. Thus homorganic nasal+stop clusters are permitted. In OT terms, of course, this filter has to be interpreted as a constraint on outputs, requiring that nasals be doubly linked. That is, in order for the data in (20) to obey the CODA-COND it is necessary that a consonant place is granted dual membership of neighboring syllables. Consider McCarthy's (1993:180) remarks in (23) about how CODA-COND in (22) is satisfied with an ambisyllabic r:

> (23) There are at least two principled ways to incorporate this refinement into the enforcement of CODA-COND. First, if enforcement is subject to the Linking Convention...any *r*, which is linked to both coda, and onset position is immune to this constraint. Second if CODA-COND is reformulated as a positive condition licensing *r* only in onsets...the fact that ambisyllabic *r* is also in a coda will not affect it. Either of these alternatives is fully satisfactory on all counts. (McCarthy 1993:180)

Likewise, CODA-COND (22) is satisfied with homorganic nasals. Indeed, there are two readings for this constraint. First it is violated by any nasal when it is in the coda position and not also in the onset. Shared place of articulation between the coda and the following onset is therefore not in violation of the CODA-COND because of Hayes' (1986) *Linking Condition* which predicts that CODA-COND will be violated only if the nasal is uniquely linked to the syllable-final C-slot. Viewed in that way, configurations containing more association lines are immune to this constraint. Second, this constraint can be interpreted as licensing place features for nasals only in syllable onset position. That is licensing permits place-assimilated nasals to be viewed as licit codas because their place features are simultaneously associated with a following onset position.

In the formulation of Itô and Mester (1994:27) linked structures have special status, exempting them from CODA-COND.

(24) CODA-COND as linking

Codas are disallowed unless linked to a following onset (Itô and Mester 1994:27)

This constraint says that nasal+stop clusters must be linked sequence. This formulation and the version, which appeals to the Linking Condition, are potentially equivalent.

Another account of these facts in terms of OT invokes alignment constraint.

(25) CODA-COND as alignment
ALIGN-LEFT (CPlace, σ)

(Itô and Mester 1994:34) (Itô and Mester 1999:205)

It requires consonantal place to be left-aligned with a syllable. In order for this alignment scheme to work the notion of alignment has to be refined. Since the formal definition of ALIGNMENT offered in McCarthy and Prince (1993b) rests on sharp edge requirement and interprets cross-linkage as misalignment, the strict *is-a* relation has been extended to cover multiply linked CPlace. Their definition is as follows:

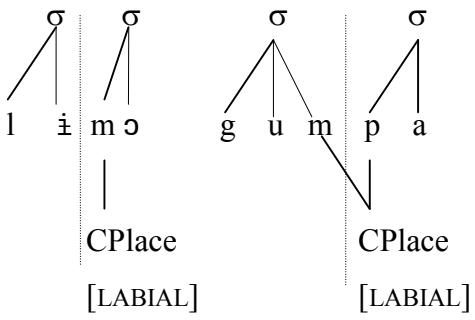
(26) NON-CRISP ALIGNMENT

a. Dfn. Let A be a terminal (sub)string in a phonological representation, C a category of type Pcat, and A *be-the-content-of* C. Then C is *crisp* (or: *has crisp edges*) if and only if A *is-a* Pcat

b. CrispEdge[*PCat*]: *PCat* is crisp (Itô and Mester 1994:38)

The replacement of the upwards-tracing relation *is-a* by the downwards-tracing *be-the-content-of* is crucial: if we assume that terminal substring can refer to place node associations then this string can be *be-the-content-of* a prosodic category (σ) even if some element of (σ) is also linked to some node outside of the string in question. Consider the examples in (27).

(27) a.[lɨmɔ] 'cow' b. [gumpa] 'earthquake'



Let A = the CPlace node [LABIAL] in (27b), this is the terminal substring of the phonological representation of this segment; let PCat C = σ_2. Tracing downwards from the prosodic category, the content of σ_2 is [pa] and the CPlace node to which it is associated. Tracing upwards from this CPlace node however does not converge on a single node labeled σ_2. Thus the coda-onset boundary is non-crisp (non-discrete). But the place node of the coda consonant fall at the start of the following syllable, alignment is fulfilled in spite of the additional link to the preceding syllable just as it is fulfilled in crisp alignment in (27a). It is important to note though that such non-crisp alignment needs further adjustment to ensure that the terminal substring can refer to sub-components of place-structure specifications, as the evidence in (18) suggests nasal plus palatal stop assimilation in Acehnese is partial.

To conclude this section, it has been shown that work in OT has established different more or less equivalent formulations of CODA-COND that appear to align remarkably well with restrictions on the type of consonants that can occupy the syllable-final position. The question, then, is how to choose among these competing approaches. In the present context the choice will have to be arbitrary.

In the next section, we focus on clusters consisting of two consonants. We will show that the data present crucial testing grounds for the various versions of CODA-COND and provide us with a very simple way of choosing among them.

3.2 Extending the Acehnese data: the laryngeal consonants ʔ and h

We have already discussed triconsonantal sequences; all sound straightforward and hardly worth mentioning when viewed from the perspective of different approaches that employ restrictions on codas to derive the distribution of intervocalic clusters. In contrast, different CC clusters give rise to word-internal syllables that can be closed not only by a consonant homorganic to a following stop but also by a laryngeal consonant. It is this latter set of data that distinguishes the OT formulations of CODA-COND repeated for convenience in (29).

(28) Acehnese word-medial two-consonant clusters

a. (i) Illicit codas (giving rise to complex onsets that satisfy the SSP)

su.kla	'very black'
gu.bhɔ	'hanging loosely'
ku.ɟri	'mixture of brown and white rice'

(ii) Illicit codas (giving rise to complex onsets that violate the SSP)

hi.lha	'to pull (with force)'
mɨ.rha	'to dissolve'

b. Licit codas

(i) Nasals homorganic to a following onset

Input	Output	
/tan.pa/	[tam.pa]	'to hit'
/ gɨ.lun.pɔᵊ/	[gɨ.lum.pɔᵊ]	'a dream'
/lin.to/	[lin.to]	'bridegroom'
/can.di/	[can.di]	'temple'
/lin.ka/	[liŋ.ka]	'around'
/lun.kɛ/	[luŋ.kɛ]	'horn'

(ii) Laryngeals

sɛʔ.sa	'punishment'
soʔ.moʔ	'bewildered'

ʃah.du	'passionately in love with someone'
ʔɔ̃h.nɔᵊ	'finishing line'

(29) OT formulations of CODA-COND

a. A coda consonant is a nasal homorganic to a following stop
b. A coda consonant can have place shared with another consonant
c. Codas are disallowed unless linked to a following onset
d. *Place]$_{\sigma}$
e. ALIGN-LEFT (CPlace, σ)

As seen above Acehnese tends to follow the Onset Maximization Principle in (28a). Clusters in medial position are syllabified as tautosyllabic onset clusters if the first member in the cluster is not an acceptable coda consonant. Notice that in medial position the clusters are syllabified as [.CC] even if the sonority value of the second segment of the cluster is lower than that of the first one as in (28aii). This indicates that in Acehnese the principle, which prohibits sonority from decreasing as we proceed from the onset to the peak known as the Sonority Sequencing Principle (SSP), is a dominated constraint. We will incorporate this principle directly into the constraint system and on the basis of a universal sonority scale such as the one in Clements (1990) O<N<L<G state its particular instantiation that applies to onset as follows:

(30) Sonority Sequencing Principle (SSP)
Within complex onsets sonority must fall from one segment to the next

Given that in Acehnese deletion and epenthesis are not possible options, clusters that violate the SSP are syllabified as tautosyllabic onset clusters. Therefore the ranking between *COMPLEX^{ONS} and SSP must be *COMPLEX^{ONS} » SSP. If the first member in a cluster were to qualify as a coda, however, as shown in (28b), the clusters are syllabified heterosyllabically.

On the analysis that we are proposing, then, the Acehnese CODA-COND restricts the type of consonant that can occupy the syllable-final position. Only multiply linked nasals and laryngeal consonants are allowed in the coda position.

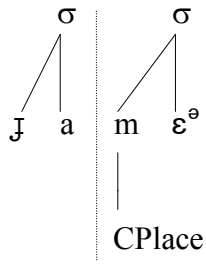
We note in passing that at present there exists a difference of opinion regarding how properly to represent the laryngeal consonants [ʔ and h]. One view is that they must be represented as root nodes because they permit total assimilation of one vowel to another (transparency to spreading) They are also assumed to be placeless based on apparent place delinking (debuccalization) a process by which stops or fricatives lose their place structure and become [ʔ] and [h] respectively (Steriade 1987, Stemberger 1993). Another view (McCarthy 1994) is that both [ʔ and h] have pharyngeal place. Rose (1996) forces the conclusion that different languages differ in their representation of the laryngeals: they are specified as pharyngeal only when pharyngeal and uvular consonants are also present; otherwise they are placeless. It is clear that the Acehnese data uniquely support the interpretation that they lack place specification altogether. They pattern with nasals in occupying the coda position.

Returning to our point of interest, how the different formulations in (29) fare with the data in (28), it is important to note that the equivalence of the first three versions (29a,b, and c) is not problematical; they seem to be saying simply that coda consonants are homorganic nasals. Of course they fail to account for the data in (28bii). The next step is to consider the last two versions (29d) and (29e). These are potentially equivalent formulations that restrict place features from appearing in coda position. The only difference is that the constraint in (29d) is negative while the constraint in (29e) is positive. Both versions try to exempt multiply linked CPlace (linked to both coda and onset) from violating CODA-COND. On one interpretation of the negative CODA-COND a place feature which is linked to both coda and onset is exempted from the constraint by virtue of Hayes' Linking

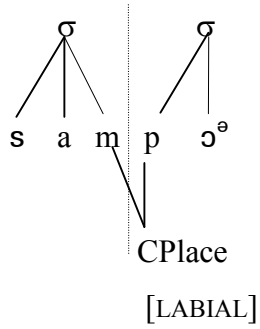
Condition. Since the CODA-COND is formulated with a single association line, structures in which CPlace is multiply linked will not constitute a violation. Only segments with place features that are exhaustively linked to a coda will incur a violation of the CODA-COND. On another interpretation, a coda cannot license place features. On this view we can say that the feature [place] is licensed for nasals in coda position and hence it will be delinked in that position. That is a coda can contain place features only when they are being linked to the onset position. The positively formulated CODA-COND derives the Linking Condition effect of exempting doubly linked place features from violating the constraint by left aligning the place nodes of the coda consonants with an onset consonant, which leftmost in a syllable. Thus CODA-COND is satisfied by shared CPlace features between a coda and a following onset because alignment need not be crisp.

Once again, in spite of the formal differences between the negative formulation of the CODA-COND and the positive statement of it, the core notion in both formulations is the same: in order for the CODA-COND to be satisfied, place features need only be simultaneously associated with a syllable position outside the coda, such as the second syllable's onset. These two versions are not cost-free, however. First CODA-COND alone cannot characterize the strong tendency for onset-to-coda spreading in place assimilation. Second, it is impossible just by examining these formulations to know what constitutes a licit coda in a particular language. Furthermore, the data constitute a severe problem for the optimality-theoretic alignment approach. The crucial analytical move in this version consists in identifying the coda consonant with its place node. It is legitimate to ask what happens when linkage does not exist. That is what happens when the coda consonant does not have its own place, but also does not come to share place with the following consonant. Consider the diagrammatic representations in (31).

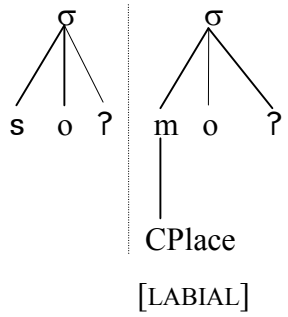
(31) a. [ɟamɛᵊ] 'guest'



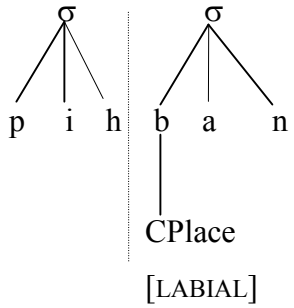
b. [sampɔᵊ] 'arrive'



c. [soʔmoʔ] 'bewildered'



d. [pihban] 'a moment ago'



All the examples in (31) obey the CODA-COND. In (31a) it is met vacuously because there is no coda to consider; in (31b) the coda consonant [m] shares the place of the following onset; in (31c) and (31d) the coda consonant does not have a place node and enters the coda freely. This obviously throws a spanner in the works of the alignment analysis. It is impossible in (31c) and (31d) to derive CODA-COND effects by simply aligning CPlace left. Hence the crucial test case for this approach is the difference in behaviors between (31b) and (31c) on one hand and (31b) and (31d) on the other, for together they show that CODA-COND is not uniquely satisfied. We therefore conclude that while an optimality-theoretic alignment approach is attractive and often highly insightful, it is not always feasible. It readily appears, then, that the only alternative to the statement of a satisfactory CODA-COND in Acehnese resides in a traditional formulation in prose as in (32).

(32) **Acehnese CODA-COND**

> A coda consonant can either be placeless or have place shared with another stop

With this formulation, it is now possible to address the fact that the CODA-COND is vioable in Acehnese in specific context: the final consonant of the word, a coda itself.

3.3 Violation of CODA-COND in Acehnese

So far we have seen that Acehnese syllables must end in one of the following two ways. First, syllables may end in a homorganic nasal. Second, syllables may end in a laryngeal consonant. The argument made on the basis of this pattern is that a CODA-COND is in force in Acehnese. It militates against codas having independent place of articulation. Like other constraints, this positional markedness constraint is in principle vioable. It is violated at the right word edge. Consider the inventory of word-final consonants in Acehnese depicted in (33) and exemplified in (34).

(33) Acehnese word-final consonants

	bilabial	alveolar	velar	glottal
Stops	p	t		ʔ
Fricatives				h
Nasals	m	n	ŋ	

(34) Acehnese word-final codas

a.

tam.pɔʔ	‘dome’
ʔɨ̃n.trɨʔ	‘later’
caŋ.klaʔ	‘arrogant’
ɟaʔ.coʔ	‘to take’
si.paʔ	‘to kick’
sum.pah	‘oath’
rɨn.tɔh	‘destroyed’
laŋ.kah	‘stride’
na.leh	‘dry measure (approximately 29Kg)’

b.

si.krop	‘scoop’
ʔa.sap	‘smoke’
mɨ.rhuᵊp	‘to collect money’
sum.prũt	‘to fall (of trousers)’
gɨn.tɨt	‘to break wind’
ʔuŋ.ket	‘search’
ʃah.wat	‘(sexual) desire’
ba.lot	‘to wrap’
mam.plam	‘mango’
tiŋ.grom	‘to push using foot’
ʔɨn.dram	‘to soak’
maʔ.sum	‘disreputable’
pɨ.gɔm	‘to put something facing downward’
tim.phan	‘a kind of Acehnese cake’
san.tan	‘coconut milk’
pih.ban	‘a moment ago’
la.wan	‘enemy’
gam.poŋ	‘village’
ʔun.toŋ	‘fortune’

raŋ.kaŋ	'part of a cottage where Qur'an is learnt'
ʔɨ̃ᵊʔ.doŋ	'nasal mucus'
klah.toŋ	'clamp'
na.lɨᵊŋ	'grass'

Coda consonant type (34a) reflects a pattern that ends in a laryngeal consonant. Since such a consonant is phonologically placeless, it enters the coda freely and does not incur a violation of CODA-COND. In contrast, type (34b) exhibits coda behavior that is in conflict with this constraint. The rightmost consonantal segment in the word has independent place of articulation. Although CODA-COND is violated in the examples in (34b), these examples still preserve their word-final consonant. This property is stated in constraint format in (35).

(35) **ANCHORING-IO** (McCarthy & Prince 1995a)
Any segment at the right edge of the output has a correspondent at the right edge of the input.

ANCHORING-IO is a correspondence constraint that militates against deletion or epenthesis at the right edge of a word. It actually inspects the correspondence relation between the right-most segment in the output and the input. Consider the diagrams in (36).

(36) a. Input: m a n d u **m** 'all'
| | | | | |
Output: m a n d u **m**

b. Input: m a n d u **m**
| | | | |
Output: m a n d u

c. Input: m a n d u **m i**
| | | | | |
Output: m a n d u m

The right-most segment [m] of the output in (36a) matches the rightmost segment of the input and the constraint is satisfied. In the remaining diagrams (36b) and (36c) ANCHORING-IO is violated. In (36b) the segment [m], which stands at the right edge of the input, does not have a correspondent at the right edge of the output. Similarly, the constraint is not satisfied in (36c) because a word-final epenthetic vowel [i] breaks coincidence with the right edge of the output. It readily appears that the core of the analysis must be a domination of ANCHORING-IO over CODA-COND. This ranking is demonstrated by the following tableau. It contains two candidates, which differ only in the presence versus absence of correspondence of segments in the input and output at the right edge of a word.

(37) Input: /ʔa.sap/ 'smoke'	ANCHORING-IO	CODA-COND
a. ☞ ʔa.sap		*
b. ʔa.sa.pi	*!	

To summarize the discussion so far: we have seen that the challenge posed for Traditional version of OT by Acehnese data can be successfully met in an analysis incorporating CODA-COND (32) which is ranked lower than ANCHORING-IO. If this type of analysis were the only possible account, it would form a strong case in favor of Traditional OT. However, it is possible to reanalyze the data without making use of coda-specific constraint (32). The next subsection elaborates on a positional-faithfulness-based analysis that employs universal constraint subhierarchies in which onsets are held to higher standards of faithfulness than are codas. Unlike the proposal considered above, it handles the Acehnese facts without appeal to an

additional stipulation such as the *Linking Condition* (Hayes 1986) or *Harmonic Ranking*: Faith [Place] Obstruent » faith (Place) Nasals (Pulleyblank 1997). A second problem with the Traditional OT account is that it misses the key generalization concerning consonantal assimilation patterns: onsets spread place features onto adjacent coda consonants. We, thus dismiss the Traditional approach here.

3.4 Positional Faithfulness

An alternative to the preceding analysis appeals to the notion of positional faithfulness (Selkirk 1994, Lombardi, Beckman 1997). On this account, faithfulness constraints such as IDENT are factored into those that refer to onset positions and those that do not.

(38) Faithfulness Constraints (Beckman 1997:99)

a. **Ident ^{Ons} (Place)**
A segment in the onset of a syllable and its input correspondent must have identical place specifications.

b. **Ident (Place)**
Correspondent segments have identical place specifications.

Observing that, cross-linguistically, it is always the coda consonant, rather than the onset which is unfaithful, the universal ranking in (39) is posited.

(39) IDENT ^{ONS}(Place) » IDENT (Place)

The features of the onset must take precedence over the features of the coda.

We now turn to an analysis of coda asymmetries. There are two basic properties of Acehnese syllable structure. In word-final syllables, all place features are permissible in coda position. In word-medial position, all place features are prohibited. This dual division between word-final syllables versus word-medial ones is captured by the interaction of positional faithfulness constraints in (38) with the following context-free markedness constraints:

(40) Place markedness (Prince and Smolensky 2002)

*DORSAL, *LABIAL » *CORONAL

The restriction on nonfinal codas results from the ranking in (41); no place of articulation is permitted in the coda:

(41) Ranking for Acehnese word-medial codas

IDENT ^{ONS}(Place) » *DORSAL, *LABIAL » *CORONAL » IDENT (Place)

As the data in (34) demonstrate consonants in non-final syllables may not appear in a syllable coda position unless they are either placeless or linked to a following onset. Thus coda consonants assimilate to the place of a following onset consonant because of the domination of place markedness constraints over IDENT (Place). By contrast onsets trigger spreading because of the ranking IDENT^{ONS} (Place) » *DORSAL, *LABIAL » *CORONAL. Consider the candidates in tableau (42) below.

(42) Input: /lunba / 'to pass'	*DORSAL	*LABIAL	*CORONAL	IDENT (Place)
a. ☞ lum.ba		*		*
b. lun.ba		*	*!	

The independent coronal place of articulation of the coda consonant in the fully faithful candidate (42b) incurs a fatal violation of *CORONAL. The place assimilation in (42a)

avoids this violation by reducing the [CORONAL] [LABIAL] sequence input /n+b/ to a single output [LABIAL] specification. The IDENT (Place) violation, which results from place assimilation, is irrelevant, since the optimal output (42a) violates the lowest ranking condition. Under this analysis then, the reason we get assimilation is that markedness constraints are better satisfied with fewer feature specifications. The unassimilated candidate (42b) violates both *LABIAL and *CORONAL, whereas the optimal candidate in (42a) only violates *LABIAL. In other words place-linked nasal+stop cluster such as [mb] incurs only one violation of *LABIAL.

As (42) shows the ranking *DORSAL, *LABIAL » *CORONAL » IDENT (Place) favors place assimilation rather than a strictly faithful output. However this ranking is unable to predict which consonant in the cluster must lose its place features. The labial stop could be replaced by a coronal stop giving two coronals (n+t). Thus the ranking is satisfied by regressive and progressive assimilation. In order to ensure that onset features are preserved, positional faithfulness must outrank the markedness constraints. This ranking is illustrated by the following tableau in (43):

(43) Input: /lunba / 'to pass'	IDENT ^{ONS} (Place)	*DOR	*LAB	*COR	IDENT (Place)
a. ☞ lum.ba			*		*
b. lun.ta	*!			**	*

High-ranked IDENT^{ONS} (Place) prevents coda-to-onset assimilation of place of articulation in (43b). As a result only coda segments may undergo assimilation.

Recall that the laryngeals are placeless. This can be attributed to high-ranking feature constraint. In Acehnese as in most languages of the world, segments such as laryngeal consonants [ʔ and h] that start out and remain fully placeless on the surface are permitted. This restriction on the inventory of segments can be enforced by the constraints LAR (Place) and IDENT ^{LAR} (Place) in (44) below.

(44) a. **LAR *Place**
Laryngeal segments must be placeless.

b. **IDENT ^{LAR} (Place)**
An input laryngeal segment and its output correspondent must have identical place specifications.

These two constraints must dominate IDENT ^{ONS} (Place), and by transitivity of ranking the place markedness constraints *DORSAL, *LABIAL » *CORONAL. IDENT^{LAR} (Place) will prevent assimilation to a laryngeal consonant whether it be partial as shown in (45.i) below for the input /soʔ.moʔ/ 'bewildered' or total as shown in (45.ii) below for the input /ploʔ.kom/ 'can'.

(45.i) Input: /soʔmoʔ/ ‘bewildered’	IDENT^{LAR} (Place)	IDENT^{ONS} (Place)
a. ☞ soʔ.moʔ		
b. sob.moʔ	*!	

(45.ii) Input: /ploʔkom/ ‘can’	IDENT^{LAR} (Place)	IDENT^{ONS} (Place)
a. ☞ ploʔ.kom		
b. plok.kom	*!	

Each of candidates (45b) is ruled out by the high-ranking constraint IDENT^{LAR} (Place), leaving (45a) as the optimal form; an input laryngeal consonant is always mapped onto an output placeless laryngeal.

Thus far, the analysis has accounted for the behavior of nasals and laryngeals in word-medial syllables. Now we turn our attention to codas in word-final syllables. As we have seen, codas in word-medial syllables are restricted to consonants that are either placeless or homorganic to a following onset. In contrast, all place of articulation may occur independently in the final consonant of the word. Representative examples of word-final codas are given in (46). Coda segments, which bear an independent place of articulation, appear in boldface.

(46) Acehnese word-final codas

sa.ɟɨ^{ə}**p**	‘wing’
mãn.drɛ̃**t**	‘type of drink made of ginger or cardamom’
tiŋ.gro**m**	‘to push using foot’
pan.te**n**	‘poetry’
sim.pa**ŋ**	‘side road’

As shown in (46) all place features occur freely in final syllables. The diagnostics for strong position, then are well-established; more marked elements being permitted in a privileged position. Here because a place contrast is supported in final syllables, final syllables constitute prominent domain. Place features are fully contrastive in prosodic-final syllables. This type of asymmetry calls for a Beckman-style final-syllable faithfulness constraint in (47).

(47) **Ident-place (σ, final)**
Every segment of word-final syllable is featurally identical to its input correspondent.

This constraint requires positional maintenance of contrast of place of articulation in the coda of a final syllable; a privileged position. This pattern is exactly what is predicted by positional faithfulness theory: high-ranking IDENT-PLACE (σ, FINAL) dominating context-independent markedness subhierarchies *DORSAL, *LABIAL » *CORONAL leading to the occurrence of more marked structures in final syllables. This is illustrated in tableau (48), which shows the interaction of these constraints for [ʔɨ̃ŋkot ‘fish’].

(48) Input: /ʔɛ̃nkot/ 'fish'	IDENT ONS (Place)	IDENT-PLACE (σ, FINAL)	*DOR	*LAB	*COR	IDENT (Place)
a. ʔɛ̃n.kot			*		*!	
b. ☞ ʔɛ̃ŋ.kot			*			*
c. ʔɛ̃n.tot	*!				*	
d. ʔɛ̃ŋ.koʔ		*!	*			*

The independent coronal place of articulation of the coda consonant in the fully faithful candidate (48a) fatally violates *CORONAL. The assimilation of place in candidate (48b) avoids this violation by assimilating the onset's place features to the preceding coda. IDENT ONS (Place) ranked above the place markedness constraints accounts for the optimality of candidate (48b) and the non-optimality of candidate (48c) which contains only coronal consonants. Another strategy to avoid markedness violation, seen in (48d), is the deletion of place features from word-final coda consonant [t] which yields a glottal stop [ʔ]. This runs into a fatal violation of IDENT-PLACE (σ, FINAL). Thus the domination of IDENT-PLACE (σ, FINAL) over place markedness constraints will permit freestanding consonantal place in the coda of a final syllable.

In sum, positional contrast of place specifications is maintained only in a prominent position. The full inventory of place contrast in Acehnese is attested in onset position and word-final codas. Outside these two positions of privilege, place is neutralized. High-ranking IDENT^{ONS} (Place) protects consonants in onset position from undergoing neutralization, thereby permitting the full range of place contrasts in onset position. Likewise IDENT-PLACE (σ, FINAL) ensures maintenance of contrast of place of articulation in final syllables. Consequently the asymmetry between privileged linguistic positions and non-privileged positions follows from the interaction of the positional and context-free faithfulness constraints with the place markedness constraints. The positional faithfulness proposal thus treats CODA-COND in a simple and direct fashion. The strength of the present analysis is that no such appeal to the *Linking Condition* or *Harmonic Ranking*: Faith [Place] Obstruent » faith (Place) Nasals, is necessary. Unlike the proposals considered above, it handles the restriction on place features without complications and using place markedness constraints, which are necessary component of universal grammar.

4. Conclusion

We have argued that Acehnese is subject to a generalization such that syllables may not end in a segment specified for place features. This fact cannot emerge naturally from any reasonable account in traditional OT or in optimality-theoretic alignment approach.

We have already dismissed various OT alternatives. One obvious reason is that they rely on outside stipulation in order to exempt place-linked structures from violating CODA-COND.

A second problem for these approaches is that they miss the key generalization that it is always the coda consonant, rather than the onset, which is unfaithful.

If, however, we adopt a positional faithfulness theory and onset/coda asymmetries are recast as constraints and those constraints can outrank markedness constraints, then the generalization is readily treated. This analysis thus constitutes a general argument for the OT framework and a specific argument for positional faithfulness theory.

The assumption that generalizations must be stated on output forms makes OT more explanatory than any other phonological paradigm, a point illustrated by our analysis of blocking effects. Recall that when [n] appears before palatal [c] as in (18),

this does not result in [ɲ] an identically specified for place phoneme of the language. Similarly when CODA-COND is violated in the final consonant of the word, we have coronal, labial, and velar nasals. Palatal nasals are again excluded. We can provide a unified account of these two functionally related phonological phenomena. Arguably, this blocking effect in both environments (word-medial position as well as word-final position) is due to the workings of the inviolable constraint *COMPLEX^{COD}. OT captures the unity of these two blocking effects straightforwardly.

Finally the Acehnese data bear on a number of fairly diverse theoretical issues. First, the data provide support for the position taken in Steriade (1987), Bessell (1992) among others, that the laryngeals [ʔ and h] lack place specifications altogether. Second, the idiosyncratic behavior of assimilation caused by the palatal stop provide further support for the *Revised Articulator Theory* Halle et al (2000), in which spreading is implemented as operations on terminal features dominated by the Place class node. Thus relevant features are targeted directly by virtue of their status as place features without the mediation of a mother node.

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