Prosodic Markedness in Prominent Positions*

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1. Introduction

It is well known that prominent prosodic positions (onsets, root-initial syllables, main-stressed syllables) can contain a greater variety of segment types than non-prominent positions (Trubetzkoy 1939, Beckman 1998, and many others). In other words, the inventory of segments possible in non-prominent positions is a subset of those found in prominent positions. For example, in the Nilotic language Shilluk, root-initial syllables can contain plain, palatalized, and labialized consonants while only plain consonants can appear in non-initial syllables (Gilley 1992, Beckman 1998).

In this paper, I will show that there are also a number of cases where the opposite situation exists: non-prominent positions can house a larger array of segment types than prominent positions. For example, in Campidanian Sardinian non-initial syllables can house glides and [r], but initial syllables cannot (Bolognesi 1998):

(1) Glide and [r] Neutralization in Campidanian Sardinian:

arɔza	*rose*	*rɔza	(from Latin *rosa*)
ariku	*rich*	*riku	(from Italian *ricco*)
eja	*yes*	*ja	
koja	*wedding*	*jako	
mandawa	*send to*	*wandama	

There are also languages in which the segments allowed in prominent positions and those permitted in non-prominent positions form disjoint sets (also see Beckman 1998:§2.4.3.3). For example, in the Polynesian language Niuafo'ou, voiceless high vowels always appear in non-initial unstressed syllables after voiceless consonants; voiced vowels cannot appear in this environment. However, the opposite is true for initial syllables and stressed syllables: vowels are always voiced, never voiceless:

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(2) Vowel Allophony in Niuafo'ou:

[kití:]	*game*	*[ki̥tí:]	cf [kìti̥kíti̥]
[kulí:]	*dog*	*[ku̥lí:]	cf [tìki̥si̥nále]

I propose that the phenomena illustrated in (1) and (2) are due to the reduction of prosodic markedness in prominent positions. 'Prosodic markedness' refers to segmental sonority and prosodic structure. For example, initial syllables can be required to have prosodically unmarked – i.e. low-sonority – onsets as in (1), and stressed syllables can be forced to have unmarked (i.e. high-sonority) nuclei, as in (2). Prominent positions can also be required to contain certain prosodic structures that are not required in other positions (e.g. onsets – see §3.3).

Furthermore, I propose that non-prosodic – or 'featural' – neutralization never occurs in prominent positions alone. Featural neutralization is the elimination of contrasts found in subsegmental features such as place, voice, nasality, and so on. So, all neutralization and allophony in prominent positions relates to sonority and prosodic structure, never to individual features.

To account for these generalizations within Optimality Theory, I invoke markedness constraints that refer specifically to prominent positions. These constraints are of two types, relating to sonority and prosodic structure. The sonority constraints are an adaptation of Prince & Smolensky's (1993) syllable margin and nucleus sonority constraints, relativized to prominent positions.

For example, $*\text{MAR}_{\sigma 1}$/glide bans high-sonority consonants – i.e. glides – in the margins of initial syllables, $*\text{NUC}_{\acute{\sigma}}/\text{V}^{\text{-Voice}}$ bans low-sonority vowels from the nuclei of stressed syllables, and $*\text{MAR}_{\text{ONSET}}$/liquid bans liquids from onsets but not codas. The structural constraints are also commonly accepted constraints (e.g. ONSET – Prince & Smolensky 1993), again relativized to prominent positions (e.g. $\text{ONSET}_{\acute{\sigma}}$ "Main-stressed syllables must have onsets"). To account for the lack of featural neutralization, I argue that there are no constraints of the form $*\Pi$/Feature, where Π is a prominent position.

In section 2, the prosodic markedness constraints that cause neutralization and allophony in prominent positions are introduced.

A series of case studies in section 3 demonstrates the constraints' efficacy in dealing with prominent-position neutralization and allophony. In addition, faithfulness constraints are shown to be inadequate in accounting for these phenomena. The constraints are also shown to have a variety of implications for prominence-driven stress.

Section 4 considers the empirical implications of the proposal, especially with regard to neutralization of underlying contrasts, and the constraints' influence on syllabification.

In section 5, various aspects of constraint form are addressed, including the issue of why only prosodic factors can cause neutralization in prominent positions. I argue that this follows from 'prosodic accessibility': markedness constraints may only refer to relations between elements on the same plane (Ito & Mester 1992, de Lacy 1997, Hagstrom 1997).

Conclusions are presented in section 6.

2. Prosodic Markedness in Prominent Positions

The aim of this section is to introduce the constraints that are responsible for neutralization and allophony in prominent positions. As mentioned in the introduction, and defended in section 3, such neutralization and allophony comes about because of a need to reduce prosodic markedness. 'Prosodic markedness' relates to segmental sonority, prosodic structure, and other prosodic elements such as tone. The majority of cases discussed in the following sections deal with segmental sonority since sonority effects on neutralization and allophony in prominent positions are clearly visible, and stand in stark contrast to the 'standard' type of neutralization found in non-prominent positions. Constraints that refer to prosodic structure in prominent positions have been discussed in a variety of other works, so less extensive discussion will be provided in this paper (see de Lacy 1997, 1999 and references cited therein).

It may seem somewhat surprising that segmental sonority is identified here as a prosodic feature, but it is certainly not a subsegmental feature like [coronal] or [+voice]. Rather, sonority is the summation of subsegmental features, and a property of the segment as a whole (Sievers 1881, Jespersen 1904, Clements 1990). In addition, sonority is clearly relevant to the formation of prosodic structure, while the influence of individual features is more tenuous (Dell & Elmedlaoui 1985, 1988, Prince & Smolensky 1993, de Lacy 1997 and references cited therein, also see §4).

There are two relatively uncontroversial generalizations about segmental sonority (Dell & Elmedlaoui 1985, Clements 1990):

(3)
- Syllable margins (onsets, codas) prefer elements of low sonority.
- Syllable nuclei prefer elements of high sonority

Prince & Smolensky (1993) proposed to capture these generalizations within Optimality Theory by means of a fixed ranking of constraints:

(4) (a) The margin sonority hierarchy:

|| *MAR/vowel » *MAR/glide » *MAR/liquid » *MAR/nasal » *MAR/obstruent ||

(b) The nucleus sonority hierarchy:

|| *NUC/obstruent » *NUC/nasal » *NUC/liquid » *NUC/glide » *NUC/vowel ||

The exact sonority distinctions (i.e. vowel *vs* glide *vs* liquid, etc.) are not particularly important here. The important part is the mechanism: by constraint ranking the generalizations in (3) can be captured.

The present proposal is a straightforward adaptation of the sonority constraints to refer to the prominent positions identified by Beckman (1998): i.e. initial syllables – σ_1, main-stressed syllables – $\acute{\sigma}$, and onsets):[1]

[1] In the present paper, only prosodically prominent positions have been considered, but Beckman (1998) and Alderete (1999) argue that the morphological category *root* also counts as prominent. I have found no evidence that neutralization can occur in roots alone, and not in affixes, indicating that there are no constraints of the form $*\text{MAR}_{\text{ROOT}}/\alpha$ or $*\text{NUC}_{\text{ROOT}}/\alpha$. Perhaps future research will fill this gap. If it does not, this fact suggests that there is some fundamental difference between prosodically prominent and morphologically prominent categories that can be reflected in constraint form.

(5) (a) Margin sonority in Prominent Positions

σ_1: || *MAR$_{\sigma 1}$/vowel » *MAR$_{\sigma 1}$/glide » … » *MAR$_{\sigma 1}$/obstruent||

$\acute{\sigma}$: || *MAR$_{\acute{\sigma}}$/vowel » *MAR$_{\acute{\sigma}}$/glide » … » *MAR$_{\acute{\sigma}}$/obstruent||

onset: || *MAR$_{\text{ONSET}}$/vowel » *MAR$_{\text{ONSET}}$/glide » … » *MAR$_{\text{ONSET}}$/obstruent||

(b) Nucleus sonority in Prominent Positions

σ_1: || *NUC$_{\sigma 1}$/obstruent » … » *MAR$_{\sigma 1}$/glide » *NUC$_{\sigma 1}$/vowel ||

$\acute{\sigma}$: || *NUC/$_{\acute{\sigma}}$obstruent » … » *MAR$_{\acute{\sigma}}$/glide » *NUC$_{\acute{\sigma}}$/vowel ||

As an example, the constraint *MAR$_{\sigma 1}$/glide bans glides in the margins of initial syllables. A special note is necessary for ONSET: *MAR$_{\text{ONSET}}$/glide bans glides in onsets alone, not codas; it is synonymous with the formalism *ONSET/glide. *NUC$_{\text{ONSET}}$/α constraints are irrelevant since onsets do not contain a nucleus constituent.

Invoking constraints that relate segmental sonority and prominent positions is not a new idea. Both Kenstowicz (1996) and de Lacy (1997) employ constraints that relate sonority to stressed syllables to account for sonority-driven main stress (also see §3.1.3, §3.2.1 below). In fact, the constraints presented in (5) are essentially supplied 'for free' since they come about through the combination of independently needed elements – the sonority constraints and prominent positions – by means of an independently needed process – prominence alignment (Prince & Smolensky 1993:127). Prominence Alignment is a process that takes structural elements (e.g. Nucleus, Margin) and combines them with a substantive scale (e.g. sonority). The resulting combination is transformed into constraints. The prominent-position prosodic markedness constraints in (5) are simply the alignment of structural elements – i.e. prominent positions, margins, and nuclei – with the sonority scale. So, given the independent motivation for prominent positions and the sonority constraints, the present proposal really amounts to little more than recognition of the predictions of the present theory.

Apart from the sonority constraints presented above, there are purely prosodic constraints as well, relating prominent positions to certain purely prosodic desiderata. For example, ONSET$_{\sigma 1}$ and ONSET$_{\acute{\sigma}}$ require onsets in initial syllables and main-stressed syllables respectively. These can also effect a type of neutralization: they cause the prosodic structures found in certain prosodic positions to be fewer than in other positions. A limited set of cases will be discussed in this regard – see §3.3. The reader is referred to de Lacy (1997) and references cited therein for further discussion of this type of constraint. In addition, the relation of prominent positions to other prosodic elements such as tone will only be briefly mentioned as it is explored more extensively in other work (see de Lacy 1999 and references cited therein).

3. Case Studies

The empirical aim of this section is to establish that there are indeed cases where prominent positions cannot house all the elements found in non-prominent positions. Evidence for this point is found in each of the cases discussed below. The examples are chosen to show that neutralization is found in all prominent positions: stressed syllables, root-initial syllables, and onsets.

The theoretical aims of this section are three: to show that (1) the constraints presented in section 2 are adequate – they can account for the facts, (2) they are restrictive – i.e. unable to generate unattested neutralizations and allophonies, and (3) within Optimality Theory they are the only possible solution to the phenomena under discussion.

Section 3.1 examines relevant cases involving the sonority of margins in prominent positions; section 3.2 does the same for syllable nuclei. Structural constraints on prominent positions are discussed in section 3.3.

3.1 Margins, Sonority, and Prominent Positions

The purpose of this section is to demonstrate the need for constraints of the form $*\text{MAR}_{\Pi}/\alpha$, where Π is a prominent position. To do so, a case of glide-vowel allophony in the Polynesian language Niuafo'ou will be analyzed in detail. Not only will the $*\text{MAR}_{\Pi}/\alpha$ constraints be shown to account for the facts, they will be shown to be the only solution to this problem – faithfulness constraints and other types of markedness constraints will be shown to be inadequate (§3.1.1). The issue of restrictiveness – that only prosodic factors are neutralized in prominent positions – is raised in §3.1.2. Predicted effects on main stress that result from the symmetry of the prosodic constraints' form are discussed in §3.1.3. This section concludes with a more general overview of the empirical consequences of the prosodic markedness constraints in §3.1.4, identifying processes which support their existence in a variety of languages.

The Polynesian language Niuafo'ou has syllables of the shape $(C)V_i(V_{i/k})$, with an optional onset consonant and an absolute ban on codas (Tsukamoto 1988). Like many Polynesian languages, glides are prohibited in native words. However, they are allowed in loanwords, and there they are in complementary distribution with the high vowels [i u]. The glides [j w] usually appear before vowels:

(6)	[ju.ní.ti̥]	*unit*	*[iuniti̥]
	[wa.é.a]	*wire*	*[uaea]
	[we.lì.ŋa.tó.ni̥]	*Wellington*	*[ueliŋatoni̥]
	[wa.í.ne]	*wine*	*[uaine]

However, glides never appear before main-stressed vowels:[2]

(7)	[i.á.te]	*yard*	*[já.te]	
	[u.á.fu̥]	*wharf*	*[wá.fu]	
	[u.ípi̥]	*whip*	*[wí.pi]	
	[ku.á.ta]	*quarter*	*[kwá.ta]	Tsukamoto (1988:28)

Descriptively speaking, the distribution of glides and vowels is a rather standard case of glide formation, attested in a wide variety of languages (Rosenthall 1994 and references cited therein).[3] To account for the requirement that glides appear pre-vocalically, the constraint ONSET – requiring syllables to have onset consonants – can be employed. ONSET must outrank constraints that require preservation of underlying

[2] This statement probably should not be generalized to "before all stressed syllables" due to the example [njù.i.ó.ka] "New York". However, this is the only example mentioned in Tsukamoto (1988). The matter warrants further investigation.

[3] Note that the distribution of glides and high vowels cannot be due to the influence of the source language – i.e. English. In English, *whip* is [wɪp], not *[u.ɪp]. Discussion of why native words do not allow glides at all would take us too far afield. See Broselow (1999), Paradis (1996) and Ito & Mester (1995) for relevant discussion. Suffice to say that loanwords form a distinct class of lexical items in Niuafo'ou.

vocalic status. Assuming that vowels are distinguished from glides by whether they have a mora or not, the relevant faithfulness constraint must be IO-IDENT-μ:

(8) IO-IDENT-μ: If $x\Re y$ then x and y have the same numbers of moras.

In the tableaux below, [i] and [u] will be used to stand for the mora-bearing versions of [j] and [w]. As the following tableau shows, this ranking produces the right result, with underlying [i] being realized as [j] before a vowel, but not elsewhere:

(9)

	/iuniti/	ONSET	IDENT-μ
	ì.u.ní.ti	x x!	
☞	ju.ní.ti		x

The quirk in the Niuafo’ou system is the fact that glides cannot appear before stressed vowels. To put this restriction in slightly different terms, glides cannot appear as the onset of stressed syllables. The prevention of an otherwise general process from applying in a specific environment indicates that there is some environment-specific constraint that outranks the triggering constraint. At this point, a constraint from the previous section can be employed: *MAR$_{\acute{\sigma}}$/glide, banning glide onsets in stressed syllables. With *MAR$_{\acute{\sigma}}$/glide outranking the triggering constraint ONSET, glide formation is blocked in the specific environment of main-stressed syllables:

(10)

		*MAR$_{\acute{\sigma}}$/glide	ONSET	IDENT-μ
(a)	/iate/	*MAR$_{\acute{\sigma}}$/glide	ONSET	IDENT-μ
	já.te	x!		x
☞	i.á.te		x x	
(b)	/iuniti/	*MAR$_{\acute{\sigma}}$/glide	ONSET	IDENT-μ
	i.u.ní.ti		x x!	
☞	ju.ní.ti			x

Form (a) shows that an underlying vowel is blocked from surfacing as a glide in main-stressed syllables while form (b) shows that glides are not blocked in other environments.

While tableau (10) shows that glides in stressed syllables are effectively banned by *MAR$_{\acute{\sigma}}$/glide, it remains to show that such a constraint provides the only possible account of the Niuafo’ou glide-formation restriction. In the realm of markedness constraints, though, there are few contenders which could replace *MAR$_{\acute{\sigma}}$/glide effectively. To block any process in a specific environment, an adequate markedness constraint must mention the environment – i.e. the onset of main-stressed syllables, and thwart the triggering constraint – i.e. ONSET. The constraint *MAR$_{\acute{\sigma}}$/glide fits the bill admirably in this regard. It is difficult to conceive of an alternative markedness constraint that mentions the necessary environment and blocks ONSET while being substantially different from *MAR$_{\acute{\sigma}}$/glide. It remains to consider faithfulness constraints as an alternative.

3.1.1 Faithfulness Constraints

Faithfulness constraints cannot provide an adequate account of Niuafo'ou glide formation. The prime contender for this account would be the positional faithfulness constraint σ́-IDENT-μ, requiring retention of vowel-glide distinctions in main-stressed syllables. Initially, such a constraint seems to have some promise:

(11)

	/iate/	σ́-IDENT-μ	ONSET	IDENT-μ
	já.te	x!		x
☞	i.á.te		x x	

However, this solution runs afoul of Richness of the Base (Prince & Smolensky 1993). Richness of the Base states that there are no restrictions on input form. So far, only forms with underlying high vowels have been examined. By Richness of the Base, though, underlying forms with glides – e.g. [jate] – must also be considered. As the following tableau shows, positional faithfulness constraints incorrectly allow the glide to remain in the stressed syllable:

(12)

	/jate/	σ́-IDENT-μ	ONSET	IDENT-μ
☞	já.te			
	i.á.te	x!	x x	x

The prosodic markedness constraint *MAR$_{σ́}$/glide fares far better: even with an underlying glide, the correct form results:

(13)

	/jate/	*MAR$_{σ́}$/glide	ONSET	IDENT-μ
	já.te	x!		
☞	i.á.te		x x	x

In a way, this result is to be expected. Faithfulness constraints promote the preservation of underlying contrasts; unlike markedness constraints, they cannot enforce restrictions. Neutralization and allophony are processes which impose restrictions on possible outputs, hence they must be effected by markedness constraints. Neutralization and allophony in prominent positions, therefore, must be effected by markedness constraints specific to those positions.

3.1.2 Featural Markedness

One of the arguments in this paper is that markedness constraints that refer to prominent positions are all prosodic, referring to either sonority or structure. It is hardly surprising, therefore, that the relevant constraint in Niuafo'ou is *MAR$_{σ́}$/glide – a constraint which bans high sonority segments from the prominent main-stressed syllable. So, it is predicted that featural distinctions that are not sonority-related cannot be invoked in neutralization and allophony in prominent positions. More concretely, since there is no sonority distinction between [w] and [j] (as place of articulation is not relevant in sonority

– Clements 1990:313), there can be no language Niuafo'ou-prime which allows [j] as the onset of a stressed syllable, but not [w]: i.e. ✓[játe] but *[wáfu].

In the present theory, the fact that only prosodic factors matter is claimed to be due to the lack of *Π/Feature constraints, where Π is a prominent position. If *Π/Feature constraints exist, Niuafo'ou-prime can be produced easily:

(14)

	/jate/	*σ́/w	ONSET	*σ́/j
!☞	já.te			x
	i.á.te		x x!	
	/wafu/	*σ́/w	ONSET	*σ́/j
	wá.fu	x!		
☞	u.á.fu		x x	

The issue addressed in this section is whether the ban on *Π/F constraints really prevents all cases of featural neutralization/allophony in prominent positions. After all, if the prosodic markedness constraints can simulate the effects of featural markedness, they are evidently not restrictive enough.

In general, the ban on *Π/F constraints does seem to limit neutralization and allophony in prominent positions to dealing with sonority. However, there is one specific situation where this is not true – where apparent featural neutralization takes place: if there is no compatible segment for a segment to neutralize with, it will not alter, while other elements of the same sonority will neutralize. Compatibility is a language-particular issue; in OT terms, it is regulated by faithfulness constraints.

A concrete example of this situation is found in Gujarati (Cardona 1965:28). In Gujarati, the glides [w] and [j] are in complementary distribution with the high vowels [u] and [i]. Word-initially, though, [w] never appears – it neutralizes with [v]: [vat] *matter, story*, *[wat] *cf* [dʒowu] *I see* (See §3.1.4 for further details). In the present theory, this case is analogous to Niuafo'ou, with glides banned in a prominent positions. The difference is that the relevant prominent position in Gujarati is the initial syllable, not the main-stressed syllable, indicating the relevant constraint here is *MAR$_{\sigma1}$/glide.[4]

The problem is that *MAR$_{\sigma1}$/glide predicts that the palatal [j] should also neutralize initially. It does not: e.g. [jar] *dear fellow*, [jəie] *we go*.

This fact presents a conundrum for the present approach, and a case of featural neutralization, much as the hypothetical type described above.

However, special conditions hold in Gujarati. By neutralizing to [v], /w/ retains its continuancy, place, and voicing, indicating that the faithfulness constraints to these features are ranked high. If the faithfulness constraints apply equally to /j/, the ideal consonant that for it to neutralize with would be [z] or [ʒ]. However, neither [z] nor [ʒ] is allowed in Gujarati.[5] Since there is no [z/ʒ], the only sound that /j/ can be realized as that maintains its continuancy, voicing, and place is [j] itself. Hence, initial [j] is as

[4] Main stress placement is influenced by segmental sonority. The irrelevance of stress for the ban on initial glides is shown in [vəḍé] *by means of*, *[wəḍé].

[5] To be more precise, [z] is allowed, but only to a very limited extent, appearing only in names and certain borrowings (Cardona 1965:25).

prosodically unmarked as it is possible to be; less prosodically marked segments are banned by independent constraints:

(15)

	/wat/	*z/ʒ	IDENT-cont, place, voice	*MAR$_{\sigma1}$/glide
	wat			x!
☞	vat			
	/jar/	*z	IDENT-cont, place, voice	*MAR$_{\sigma1}$/glide
☞	jar			x
	zar	x!		
	sar		x!	

The Gujarati glide-restriction also shows that while the generalization that there is no featural neutralization in prominent positions is generally true, some small leeway is warranted. However, the prediction is that the exceptions to the rule will only arise under very specific circumstances: where the target of neutralization is banned for independent reasons. Therefore, the majority of neutralizations in prominent positions are still predicted to behave according to sonority desiderata, not featural ones.

3.1.3 Constraint Symmetry: Sonority-Driven Stress

Positing constraints of the form *x/y makes a variety of predictions. This is because such constraints are ‘symmetrical’ in their potential effects: (1) if *x* is kept constant, then *y* should change, and (2) if *y* is kept constant, *x* should change (see de Lacy 1999:§6 for a more in-depth discussion). In the case of *MAR$_{\acute{\sigma}}$/glide in Niuafo’ou, the placement of stress was kept constant, so banning glides in stressed syllables. However, the opposite is also predicted to occur: if faithfulness to glides is high-ranked and stress-locating constraints are relatively low, stress will be forced to move away from a syllable with a glide onset.

The Australian language Alyawarra verifies this prediction. In Alyawarra, main stress falls on the leftmost syllable with an onset, unless that onset is a glide (Yallop 1977:43):[6, 7]

(16) (a) i.lí.pa *axe*, *í.li.pa
(b) rín.ha {3rd person pronoun}
(c) ju.kún.t^{j}a *ashes*, *jú.kun. t^{j}a
(d) walíjmparra *pelican*, *wálijmparra

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[6] Yallop (1997:43) proposes that word-initial glides form diphthongs with the following vowel, so they really form onsetless syllables. There is no independent evidence for this, though; Yallop’s proposal is motivated by the desire to simplify the description of stress placement. One reason to think that glides are really consonants is the fact that they can appear in front of diphthongs: e.g. [al.kwij.la] *am/is/are eating* (p.42). The nucleus in this word would have to be [wij] – a triphthong, which is typologically marked, to say the least.

[7] To be more precise, Yallop (p.43) states that stress never falls on an initial [wa] or [ju] syllable. However, there are only three vowels: [i u a], and [wi] is banned (p.20), while Yallop argues that [wu] is really phonemically /u/. In other words, [wa] is the only sequence of [w]+V possible. Both [ju] and [ja] seem to be possible, though Yallop suggests that [ji] is phonemically just /i/. It is not stated in the data whether stress also avoids initial [ja].

The constraint ALIGN-σ́-L expresses the tendency for stress to appear at the left edge while the avoidance of onsetless syllables is prompted by the constraint ONSET$_{\acute{\sigma}}$, requiring that stressed syllables have onsets (de Lacy 1997, see section 3.3 below):

(17)

	/ilipa/	ONSET$_{\acute{\sigma}}$	ALIGN-σ́-L
	í.li.pa	x!	
☞	i.lí.pa		x
	/rinha/	ONSET$_{\acute{\sigma}}$	ALIGN-σ́-L
☞	rín.ha		
	rin.há		x!

The final step is to explain why stress avoids syllables with glide onsets. Enter the constraint *MAR$_{\acute{\sigma}}$/glide:

(18)

	ju.kun.t^{j}a	IDENT-μ	*MAR$_{\acute{\sigma}}$/glide	ALIGN-σ́-L
☞	ju.kún.t^{j}a			x
	jú.kun.t^{j}a		x!	
	i.ú.kun.t^{j}a	x!		

So, the predicted effects of the *MAR$_{\acute{\sigma}}$/α constraints are supported by Alyawarra. In fact, the phenomena of sonority-sensitive stress supports their existence. To account for sonority-sensitive stress, markedness constraints that mention both stressed syllable margins and levels of sonority are needed (Kenstowicz 1996, de Lacy 1997). The form of such constraints would almost inevitably allow symmetrical effects, predicting the existence of sonority-based neutralization and allophony in main-stressed syllables. In other words, denying the existence of the *MAR$_{\acute{\sigma}}$/α constraints not only eliminates a simple explanation for neutralization and allophony in prominent positions, it also eliminates a straightforward account of sonority-sensitive stress (also see §3.2.1 below).

3.1.4 Extensions

In previous sections, only the main-stressed syllable and the most sonorous consonants – glides – have been considered. However, the prosodic constraints can also refer to root-initial syllables and onsets, and other sonority levels are predicted to be relevant. In this section, empirical support for this generality is presented.

❑ *MAR/w in Other Positions

As mentioned in §3.1.2, Gujarati provides evidence that there is need for a constraint that bans glides in the margins of root-initial syllables: [w] is not allowed root-initially, neutralizing to [v] (Cardona 1965: 28).[8] This case is one that unambiguously

[8] [w] can appear in the initial syllable, but only as the second consonant of a complex onset: i.e. ✓#CwV, *wV. The failure of [w] to neutralize to [v] in this position can be explained as due to a condition on sonority distance: [CvV]$_\sigma$ contains an onset with consonants that are just too close, sonority-wise. This constraint would outrank *MAR$_{\sigma 1}$/glide.

refers to the initial syllable, and not to main stress; the neutralization still takes place if the initial syllable is not stressed (see footnote 4).

However, Gujarati provides evidence for more than the constraint $^*\text{MAR}_{\sigma1}$/glide. The full details of the prohibitions on [w] are as follows:

(19) (a) [w] is always neutralized to [v] initially: [vat] *matter,story*, *[wat]
(b) [w] can appear in codas, even in initial syllables: [gaw] *cow*
(c) [w] is in free variation with [v] in medial onsets: [səwar]~[səvar] *morning*

As discussed above, generalization (a) − that [w] never appear initially − can be ascribed to the effect of $^*\text{MAR}_{\sigma1}$/glide. With this constraint outranking the constraints that preserve glides, neutralization will take place in the initial syllable alone.

Generalization (b) presents a problem, though. The constraint $^*\text{MAR}_{\sigma1}$/glide bans glides in both onsets and codas of initial syllables, but neutralization only happens in onsets, not codas. The constraint $^*\text{MAR}_{\text{ONSET}}$/glide provides a solution: with $^*\text{MAR}_{\text{ONSET}}$/glide conjoined with $^*\text{MAR}_{\sigma1}$/glide, only glides in the onset of the initial syllable will be banned.

Generalization (c) offers even better evidence for an independent $^*\text{MAR}_{\text{ONSET}}$/glide constraint. It is evident that there is a tendency to avoid [w] in onsets since [w] is in free variation with [v]. In codas, though, [w] is perfectly acceptable. The tendency to avoid onset [w] is straightforwardly expressed by $^*\text{MAR}_{\text{ONSET}}$/glide.

There is also some diachronic support for $^*\text{MAR}_{\text{ONSET}}$/glide: Eastern-Polynesian languages are divided in terms of whether they have a [w] or [v] reflex of the same proto-segment (Clark 1976 − [j] is banned in these languages). Since all Eastern Polynesian languages only have onsets (codas are not allowed), this situation could be due to a desire to avoid high-sonority onsets, paralleling the synchronic Gujarati case. Further evidence that onsets can shun high-sonority elements independently of codas is presented below and by Parker (in prep.).

❑ Other *MAR/*x* Constraints

At this point, only constraints against glides in prominent positions have been shown to be useful. With the proposal in §2, though, other high-sonority consonants can also be avoided in such positions.

- Liquids

Although details of the sonority scale are debated, it is universally accepted that liquids are high in sonority. Steriade (1982) argues that there is a sonority distinction between rhotics and laterals, with the former more sonorous than the latter. This is borne out in Campidanian Sardinian, where initial rhotics and glides [j w] are banned, but laterals are not, and neither are less sonorous elements (see (1) for relevant data, and Bolognesi 1998). Similarly, liquids are banned from the initial syllable in Golin (Papua New Guinea − Bunn & Bunn 1970:4) and in Arabana-Wangkangurru (where the initial syllable is also the main-stressed syllable − Hercus 1972).[9]

9 A potentially related case is Bhojpuri (Shukla 1981), where aspirated sonorants (nasals, liquids) are banned word-initially, but allowed elsewhere (e.g. [ja:mʰa:b] *yawning*). The problem is that plain sonorants

- [h] and [ʔ]

Exactly where [h] and [ʔ] are in the sonority hierarchy is a very contentious matter. Chomsky & Halle (1968:354) group them with glides, while others suggest that sonority is irrelevant – they are essentially unranked with respect to other segments (see Churma 1995). In either case, the present theory predicts that there are constraints of the form $*\textsc{mar}_{\Pi}$/h,ʔ, where Π is a prominent position. Such constraints provide a straightforward account of a number of apparently unrelated phenomena. These are cases where [h] and [ʔ] are excluded or avoided in prominent positions: onsets, initial syllables, and main-stressed syllables.

In Chamicuro, both [h] and [ʔ] are avoided in onsets, but can freely appear in codas (see Parker in prep. for extensive discussion):[10]

(20) meʔ.sa *table* *ʔe.sa
kah.pu *bone* *ha.pu

These facts fall out straightforwardly from the present proposal: $*\textsc{mar}_{onset}$/h,ʔ outranks faithfulness constraints that preserve these segments.

A more striking case involving [h] occurs in Huariapano (Parker 1998). Parker shows that there is a process of coda *h*-insertion, with a complex conditioning environment that need not concern us here. Significantly, coda [h] cannot appear in the initial syllable when it also bears primary stress:

(21)

Main Stress:	[yò.mï.ràh.ka.tíh̲.kạỹ]	*they hunted*
Initial with Secondary Stress:	[čìh̲.kï.na.máŋ]	*corner*
Initial stressless:	[nah̲.káʔ]	*manioc beer*
Initial with Main Stress:	Not attested.	

Parker also points out the following significant alternation: the initial syllable in [nî.tï] 'day' has primary stress, so it cannot contain a coda [h]. However, when a stress-attracting suffix is added to the root, an initial coda-[h] appears: [nïh̲.tî.no] *day (locative)*.

Such facts follow straightforwardly by locally conjoining two prominent position sonority constraints: $*\textsc{mar}_{\acute{\sigma}}$/h & $*\textsc{mar}_{\sigma 1}$/h (Smolensky 1993, 1997). This conjoined constraint bans [h] that appears both in a main-stressed and initial syllable, but does not prohibit [h]'s from main-stressed non-initial syllable, nor from an initial syllable without main-stress:[11]

are acceptable word-initially: e.g. [man] *mind* (p.34). While this prohibition may be related to sonority, it is unclear how to account for the aspiration facts.

[10] Parker shows that coda [h] and [ʔ] cannot be treated as prosodic features or a reflex of vowel length: both consonants pattern like other coda consonants for phonological processes.

[11] This analysis was originally suggested by Steve Parker (p.c.). An interesting fact is that [h] is not banned in the *onsets* of initial main-stressed syllables: e.g. [híwi] *branch, stick*. We can deal with this by positional faithfulness, with $\acute{\sigma}_1$-IDENT-h outranking $*\textsc{mar}_{\acute{\sigma}1}$/h.

(22)

	/nah.ki /	*MAR$_{\acute{\sigma}}$/h & *MAR$_{\sigma 1}$/h	MAX-IO
	náh.ki	x	
☞	ná.ki		x
	/nah.kaʔ/	*MAR$_{\acute{\sigma}}$/h & *MAR$_{\sigma 1}$/h	MAX-IO
☞	nah.káʔ		
	na.káʔ		x!

In summary, Huariapano shows that there are specific markedness constraints against [h] in main-stressed and initial syllables, while Chamicuro shows that [h] can be neutralized in onsets. So, there must be constraints that militate against [h] in prominent positions. Further evidence that [h] is avoided word-initially is found in Saramaccan, where both [w] and [h] are in free variation with ∅ stem-initially (Rountree 1972).

The cases that neutralize [h] in prominent positions underscore the fact that prosodic prominent-positional markedness constraints have effects that are directly opposite to those generated by positional faithfulness. With positional faithfulness, underlying contrasts are maintained in prominent positions. So, there should be languages in which onsets are the *only* position that can contain [h] (likewise for main-stressed syllables and initial syllables). English is a case in point: [h] is only allowed in the onset of main-stressed syllables: witness the alternation *vehicle* [víəkl]~*vehicular* [vi.h̲í.kjə.lə]. The fact that both sorts of languages exist – ones that maintain [h] in prominent positions and others that neutralize it – show that positional faithfulness and prosodic prominent-position markedness constraints are both needed.

- Voicing

A number of researchers have argued that the sonority scale is not a single scale, but rather the combined effect of several subhierarchies. Both Goldsmith (1990:111-112) and Gnanadesikan (1997) have argued that one of these subhierarchies involves voice, with voiced segments more sonorous than voiceless ones. In present terms, this would mean that there exist constraints such as ||*MAR$_{\acute{\sigma}}$/[+voiced] » *MAR$_{\acute{\sigma}}$/[-voiced]|| and ||*MAR$_{\sigma 1}$/[+voiced] » *MAR$_{\sigma 1}$/[-voiced]||.

Evidence for neutralization of voiced segments in initial syllables was presented by Trubetzkoy (1939:80, 235). He pointed out that voiced consonants in Erza-Mordvin and certain Bavaro-Austrian dialects are neutralized in initial syllables.[12] As shown in the case studies above, with the constraint *MAR$_{\sigma 1}$/+voice outranking the relevant faithfulness constraint, the desired results are achieved.

Confirmation of the existence of the related constraint *MAR$_{\acute{\sigma}}$/+voice comes from a different source – Pirahã stress (Everett & Everett 1984, Everett 1988). As pointed out in §3.1.3, constraints of the **x*/*y* variety can affect either *x* or *y*. In the case of *MAR$_{\acute{\sigma}}$/w, the constraint was shown to force stress off syllables with onsets. The exact same phenomenon is found with *MAR$_{\acute{\sigma}}$/+voice in Pirahã.

[12] Consultation with a native speaker of one of these dialects confirms that it is really voicing that is neutralized, and not – for example – geminates (Birgit Alber, p.c.). Note that Trubetzkoy also made this claim for Saami (then 'Lapp'), but subsequent investigation has shown the 'voiced' stops to be geminates (Patrik Bye, p.c.).

As in many other languages, Pirahã main stress falls on bimoraic syllables in preference to monomoraic ones. However, a further division within syllables of the same moraicity is made: syllables with voiceless onsets attract main stress over those with voiced onsets:[13]

(23) káa.gai *word*
bii.sái *red*
ʔá.ba.gi *toucan*
kagihí *wasp* Everett & Everett (1984)

A full analysis of all of the Pirahã divisions of weight would be beyond the scope of this paper (see de Lacy 1997 for a full analysis). The point that is of present interest is the attraction of main stress to syllables with voiceless onsets. With the constraint *MAR$_{\acute{\sigma}}$/+voice, providing an account is a straightforward matter: voicing specifications are kept constant by ranking a faithfulness constraint to [voice] over *MAR$_{\acute{\sigma}}$/[+voice], while *MAR$_{\acute{\sigma}}$/[+voice] outranks constraints on main-stress placement (i.e. ALIGN-σ́-R):

(24)

/kaagai/	IDENT-[voice]	*MAR$_{\acute{\sigma}}$/[+voice]	ALIGN-σ́-R
☞ káa.gai			x
kaa.gái		x!	
kaa.kái	x!		

• <u>Other Sonorities</u>

Invoking prominent-position specific sonority constraints may also help to explain some rather puzzling cases of allophony. Root-initially, the following changes take place in the following languages:

(25) Navajo: fricatives → affricates Fountain (1998:288)
Nuer: f → pf
Sosva (Vogul): s → tʃ
Sorbian: x → kx Trubetzkoy (1939:273*ff*)

These cases cannot be explained by positional faithfulness because they involve allophony, not maintenance of contrast.

The common theme that seems to unite these cases is that all change a simplex sound into an affricate root-initially. From a featural markedness point of view, this allophony makes little sense: no language treats complex segments as less marked than simplex ones, and I am not aware of any language that has affricates but no fricatives, although the opposite situation is common (e.g. all Eastern-Polynesian languages). However, sonority may provide an answer. In all cases, the affricate segment contains a segment that is less sonorous than the simplex one. For example, Nuer's [pf] contains a stop, which is less sonorous than the simplex fricative [f]. If an affricate's sonority is judged to be the same as its least sonorous member, then all the cases represent a

[13] The onset consonants in Pirahã are [p t ʔ s h b g]. Note that there are no sonorants (except perhaps for [h] and [ʔ]). With [h] and [ʔ] aside, Pirahã could be explained without invoking a separate voicing hierarchy in sonority.

reduction in sonority. Unfortunately, there is almost no other evidence that relates to the sonority relationship between affricates and fricatives, so this idea must remain at the level of conjecture at this point. However, if these allophonic alternations are driven by sonority, constraints of the $*\textsc{Mar}_{\sigma 1}$/fricative variety are certainly needed.[14]

- Impossible Systems

The fixed ranking of the sonority constraints makes predictions about the classes of sounds that will be affected in any prominent-position neutralization or allophony. Specifically, if a margin consonant of sonority Σ is affected in a prominent-position neutralization or allophony, then every consonant of greater sonority than Σ will also be affected. As an example, this limitation rules out systems where only obstruents are neutralized in a prominent position, but sonorants remain intact.

While the broad predictions of the fixed ranking are rather evident, more detailed predictions depend on the number of sonority distinctions that are posited, and how they interact. For example, it is difficult to say what the predictions for fricatives and stops are – whether they should be treated as a single sonority class, or as two (see Clements 1990 for discussion). Such a decision comes down to empirical investigation.

In addition, the unitary status of the sonority hierarchy may also be a cause for variation. If the sonority hierarchy is really a conglomeration of several subhierarchies, as proposed by Goldsmith (1990) and Gnanadesikan (1997), the ranking of segment types may vary somewhat depending on which subhierarchy has primacy. Again, this is a matter for empirical investigation.

By no means does this indeterminacy about the exact nature of the sonority hierarchy evacuate the present proposals. There is enough consensus about the sonority hierarchy to make broad predictions, such as the ones above. Whether the present theory makes accurate predictions, though, depends on empirical investigation.

In conclusion, there is a variety of evidence for constraints of the *MAR/*x* variety that refer specifically to prominent positions. The next step in the argument is to show that there are also analogous constraints of the *NUC/*x* variety.

3.2 Nucleii, Prosody, and Prominent Positions

The aim of this section is to show that constraints of the type *NUC/*x* have instantiations specific to prominent positions. The Polynesian language Niuafo'ou is again relevant. In both native words and loans, the high vowels /i/ and /u/ devoice in two environments:

[14] One difficulty would be to explain why every sound that is more sonorous than fricatives does not also turn into an affricate in these languages. The answer could be due to high-ranking restrictions on exactly which complex segments are possible in the language. One obvious reason is that maintenance of identity is required in these cases: the affricate always properly contains the features of the simplex segment: p→pf̲, x → kx̲, etc. If more sonorous sounds (i.e. sonorants) to turn into affricates, their identity would be lost. Other types of highly marked sounds, such as pre- or post-nasalized stops, would have to be produced. This presents a situation identical to the Gujarati glide case in §3.1.2.

(26) • After a voiceless stop and before a voiceless consonant or word boundary:
[kà.pi̥.ká.pi̥] *wedge* *cf* [mòkimóki̥] *break into small pieces*
[tá.pi̥] *wipe* *cf* [tá.ŋi], *[tá.ŋi̥] *weep*
[hàu.ʔa.lì.ki̥.sí.a] *attended by chiefs*

• After voiceless fricatives (f, s, h) and before consonants:
[mòfi̥mófi̥] *slight fever* *cf* [mòkimóki̥]
[pàsi̥kála] *bicycle*
[làhi̥láhi̥] *somewhat many* *cf* [mòfuíke], *[mòfu̥íke] *earthquake*

However, devoicing never takes place in stressed syllables:

(27) [tú.tu̥] *[tú̥.tu̥] *set fire*
[tù.ku̥.tú.ku̥] *[tù̥.ku̥.tú̥.ku̥] *put down for a while*
[hí.fo] *[hí̥.fo] *descend*

Particularly revealing in this regard is the form [láhi̥] *much*. When a stress-attracting suffix is added, the devoiced [i] in the citation form must be voiced: [lahíni̥], *[lahi̥ni̥] *much*+deictic.

Devoicing is not just blocked in stressed syllables, it also cannot happen in root-initial syllables of native words, regardless of stress:

(28) [kití:] *[ki̥ti:] *game*
[tutúku̥] *[tu̥túku̥][15] *stop*
[hihífo] *[hi̥hífo] *west*

In sonority terms, voiceless vowels rank below voiced ones (see the preceding section). Since syllable nuclei prefer high sonority vowels, it is unsurprising that voiceless vowels are banned in prominent positions – i.e. main-stressed syllables and initial syllables.[16]

The analysis of devoicing in Niuafo'ou is much the same as the account of glides in section 3.1. The constraints $*\mathrm{NUC}_{\acute{\sigma}}/V^{-VD}$ and $*\mathrm{NUC}_{\sigma 1}/V^{-VD}$ must outrank the constraint that requires devoicing, which will be termed AGREE(voice) – requiring agreement in voicing of adjacent segments – for convenience.[17] AGREE(voice) must outrank faithfulness constraints to vocalic [voice] features:

(29)

	/tutu/	$*\mathrm{NUC}_{\acute{\sigma}}/V^{-VD}$	$*\mathrm{NUC}_{\sigma 1}/V^{-VD}$	AGREE(voice)	IDENT-[voice]
	tú.tu			x x!	
☞	tú.tu̥			x	x
	tú̥.tu̥	x!	x		x x

[15] Unlikely this is a faith-BR effect: cf mofu̥mofuike – the [u] of the RED is devoiced, but the Base is not.
[16] I could find no data that could determine whether devoicing was also blocked in secondary-stressed syllables. In all potentially relevant cases, the secondary-stressed syllable was also initial: e.g. [tù.ku̥.tú.ku̥].
[17] It is not the aim of this paper to develop a coherent theory of devoicing within OT. See Tsuchida (1997) and references cited therein for discussion.

	/kiti:/	*NUC$_{\acute{\sigma}}$/V^{-VD}	*NUC$_{\sigma 1}$/V^{-VD}	AGREE(voice)	IDENT-[voice]
☞	ki.tí:			x x	
	ki̥.tí:		x!	x	x

As with the prohibition on glides, faithfulness constraints cannot achieve the desired results. A positional faithfulness constraint requiring vowel voicing to be maintained incorrectly predicts that there is a phonemic contrast between voiced and voiceless vowels in stressed and initial syllables:

(30)

	/tutu/	σ́-IDENT-voice	AGREE(voice)	IDENT-[voice]
	tú̥.tu	x!	x	x
☞	tú.tu̥		x	x
	tú̥.tu̥	x!		x x
	/tu̥tu/	σ́-IDENT-voice	AGREE(voice)	IDENT-[voice]
	tú̥.tu		x!	
	tú.tu̥	x!	x	x
☞	tú̥.tu̥			x x

So, Niuafo'ou shows that prosodic markedness constraints that refer to the nucleus sonority of prominent positions are necessary. The following section presents further support for these constraints.

3.2.1 Extensions

- <u>Initial Syllables</u>

As shown in Niuafo'ou, the initial syllable can require nucleii of low sonority. Another case like this is found in Tamil (Beckman 1998). In initial syllables, vowels have a tense, peripheral quality: [i a u]. In non-initial syllables, though, they are lax and centralized: [ɪ ɜ ʊ]. Beckman (1998) provides an account of why [i a u] are not allowed in non-initial syllables using positional faithfulness. However, this still leaves the question of why [ɪ ɜ ʊ] are not allowed in initial syllables. In present terms, the answer relates to the fact that lax/centralized vowels are less sonorous than full/peripheral vowels. This generalization has ample support in a variety of sonority-driven stress systems, where full vowels attract stress over lax and centralized vowels (Kenstowicz 1996, de Lacy 1997: [Lg *Au*]). The neutralization of lax vowels in the initial syllable is therefore due to a sonority requirement: ||*NUC$_{\sigma 1}$/laxV » FAITH » *NUC$_{\sigma 1}$/full vowel||.

Another interesting case of this type is found in Carib (Grimes – Lg of the Guianas p.38ff). In Carib, diphthongs have the form [V^{-HIGH}V^{+HIGH}] (i.e. [ai au ei eu oi ou]) (Grimes p.38ff– *Lgs of the Guianas*). As mentioned in section 2, the most unmarked diphthong is one with a large sonority difference between its members. Significantly, initial syllables only allow [ai] and [au], while the full range of diphthongs may appear elsewhere. Again, this can be accounted for by invoking a markedness constraint that maximizes diphthong sonority distance specifically in initial syllables. In fact, Trubetzkoy reports that Standard Czech goes even further than Carib, banning all diphthongs from the initial syllable, but allowing them elsewhere.

- Stressed Syllables

Many languages have restrictions similar to the Niuafo'ou case, but instead of banning voiceless vowels from stressed syllables, they prohibit reduced vowels instead. To account for this, constraints equivalent to *NUC$_{\acute{\sigma}}$/ə have been employed (Oostendorp 1995, Urbanczyk 1998, Kenstowicz 1996).

As shown in section §3.1.3, constraints of the *$x_{\acute{\sigma}}$/y variety can affect the placement of stress. For the *NUC$_{\acute{\sigma}}$/x, this means that vocalic sonority should be able to affect the placement of main stress. This prediction is borne out in languages with 'sonority-driven' stress systems. A few representative cases will be mentioned here (see Kenstowicz 1996, de Lacy 1997, and Gordon 1998 for further examples). The examples below show that main stress prefers high-sonority nuclei over those of lower sonority:

(31)
- Jaz'va dialect of Komi (Itkonen 1955, Lytkin 1961):
  Main stress falls on the leftmost syllable with a non-high vowel (/a e o/):
  mijánlan^j *we* buzginám *we hit*
- Chukchee (Skorik 1961, Krause 1979, Kenstowicz 1996):
  Main stress falls on the leftmost non-high full vowel (/a e o/):
  wéni-wen *bell* nuté-nut *land*
  else on the leftmost high full vowel (/i u/)
  pipíqəlg-ən *mouse* γənín *your*
  else on the rightmost syllable of the base:
  məcə́kw-ən *shirt*
- Kobon (Davies 1981 *cf* Kenstowicz 1996):
  Main stress falls on the leftmost /a/:
  kɨ.dol.máŋ *arrow type*
  else on the leftmost mid vowel (/e o/)
  si.óg *bird species*
  else on the leftmost high peripheral vowel (/i u/)
  wí.ər *mango tree*
  else on the leftmost schwa:
  gɨ.sə́ *to tap*
  else on the leftmost syllable.

Such systems receive a straightforward explanation with constraints of the *NUC$_{\acute{\sigma}}$/x variety. Faithfulness constraints that preserve vowel features must outrank *NUC$_{\acute{\sigma}}$/x otherwise neutralization will occur. But with *NUC$_{\acute{\sigma}}$/x outranking constraints on stress placement (e.g. ALIGN-σ́-Left), sonority-sensitive stress will occur. The following tableau shows the ranking for Komi Jaz'va:

(32)

	/mijánlan^j/	IDENT-F	*NUC$_{\acute{\sigma}}$/i,u	ALIGN-σ́-L
	míjanlan^j		x!	
☞	mijánlan^j			x
	májanlan^j	x!		

For a more in-depth discussion of the analysis of such systems, see Kenstowicz (1996) and de Lacy (1997).

One interesting prediction is made by the present approach. According to Beckman (1998), prominent positions include main-stressed syllables, but there is little evidence for secondary-stressed syllables as prominent. This means that while there are *NUC/*x* constraints specific for main-stress, there are none that relate specifically to secondary stress. In terms of sonority-driven stress, this means that sonority can be significant in the placement of main stress, but not secondary stress. This prediction is borne out – while there are quite a number of languages with sonority-driven main stress, there are no examples where the placement of secondary stress (i.e. footing) is driven by sonority considerations (de Lacy 1997:§5).

As a final note on stressed syllables, I note that prosodic markedness constraints are not limited to mentioning sonority. Other prosodic elements such as tone and prosodic structure can be mentioned with relation to prominent positions. For further discussion on the relation between main stress and tone, see de Lacy (1999) and references cited therein; for the relation between main stress and prosodic structure, see de Lacy (1997) and references cited therein.

- <u>Long Vowels</u>

Steriade (1995) identifies long vowels as prominent. If so, this means that there are a set of constraints such as *$\text{NUC}_{\text{V:}}/x$, regulating the sonority of the nuclei of long vowels. These constraints predict that contrasts found in short vowels could be neutralized in long vowels. They further predict that such neutralization will tend towards more sonorous elements.

This prediction is borne out in Yokuts, where all long vowels are non-high on the surface, but short vowels can be high or non-high (Newman 1944). This neutralization of height contrasts in long vowels can be explained by ranking the constraint *$\text{NUC}_{\text{V:}}$/i,u over IDENT-[high].

3.3 Structural Unmarkedness in Prominent Positions

The thesis of this paper is that prominent positions aim to reduce prosodic markedness. The previous sections have presented a variety of sonority-related cases to support this proposal. However, sonority is not the only aspect of prosodic markedness – prosodic structure is also relevant. The aim of this section is to show that constraints on prosodic markedness can be specifically relativized to prominent positions. Such constraints cause 'prosodic neutralization', where prominent positions contain a subset of the possible prosodic structures available in other positions.

A well-established generalization is that syllables with onsets are less marked than those without. This generalization is embodied in the constraint ONSET "Syllables must have onset consonants." (Prince & Smolensky 1993). This constraint is purely a prosodic requirement, requiring that two prosodic elements be associated. I suggest that such constraints can be relativized to prominent positions: i.e. ONSET/σ_1 "Initial syllables must have onsets" and ONSET/$\acute{\sigma}$ "Main-stressed syllables must have onsets." Evidence for the existence of both these constraints is presented below:

- <u>Main-Stressed Syllables</u>

The constraint ONSET$_{\acute{\sigma}}$ requires syllables with main stress to have an onset. A number of languages exhibit this constraint. The following data shows this constraint in Dutch (Booij 1995:191):

(33)	(a) [paʔɛ́lja]	*paella*	*[pa.ɛ́lja]	[aʔórta]	*aorta*	*[a.órta]
	(b) [xá.ɔs]	*chaos*		[fára.o]	*Pharaoh*	

The examples in (a) show that onsets are essential in main-stressed syllables, while those in (b) show that unstressed syllables can be onsetless.[18]

As emphasized in previous sections (§3.1.3, 3.2.1), constraints of the form *x*/*y* are symmetric in potential effect: keeping *x* constant forces *y* to change while keeping *y* constant forces *x* to change. This is the same for ONSET$_{\acute{\sigma}}$. If stress is kept constant, the nature of the stressed syllable is forced to change by adding an onset; if onset consonants are kept constant by ranking faithfulness constraints high, the location of stress is forced to change. So, the constraint ONSET$_{\acute{\sigma}}$ predicts that main-stress placement can be onset-sensitive.

The validity of this claim has already been mentioned in two previous case studies in this paper: Alywarra and Pirahã. In both, main stress is attracted to syllables with onsets, ignoring onsetless syllables. The following tableau presents the analysis of these languages using ONSET$_{\acute{\sigma}}$ (see de Lacy 1997 for a more in-depth discussion):

(34)

	/ilipa/	DEP-IO	ONSET$_{\acute{\sigma}}$	ALIGN-$\acute{\sigma}$-L
	ílipa		x!	
	ilípa			x
☞	ʔílipa	x!		
	/rinha/	DEP-IO	ONSET$_{\acute{\sigma}}$	ALIGN-$\acute{\sigma}$-L
	rínha			
☞	rinhá			x!

As a note on this result, the symmetry of ONSET$_{\acute{\sigma}}$ provides a theoretical argument that stress can be onset-sensitive (a much debated issue – Davis 1985, Hayes 1995 and references cited in these works): if one denies that stress is onset-sensitive, then one denies the existence of ONSET$_{\acute{\sigma}}$. If ONSET$_{\acute{\sigma}}$ does not exist, though, languages such as Dutch and German are left unaccounted for.

Although only ONSET has been discussed here, I believe that many other prosodic constraints can also refer to prominent positions. Of course, the exact nature of this reference is a matter of empirical investigation (for stressed syllables and their relation to prosodic structure, see de Lacy 1997, 1999).

[18] This distinction only holds where the first vowel in hiatus is low. If it is high, glide-formation always results. See Kitto & de Lacy (1999) for some relevant discussion.

• <u>Initial Syllables</u>

English is an example of a language which requires word-initial syllables to have onsets, but does not require this of word-internal syllables (Liberman & Prince 1977). It achieves this aim in various ways in different dialects (e.g. r-intrusion in Boston English and New Zealand English, allomorphy *a~an*, or [ʔ] insertion). It compares to languages such as Samoan, which contrast ʔ-initial words with vowel-initial ones (Mosel & Hovdhaugen 1992). To account for this, the constraint ONSET$_{\sigma 1}$ can be used, outranking DEP-IO.

While ONSET$_{\sigma 1}$ provides an account of the English facts, there is an alternative account: with IO-CONTIGUITY outranking ONSET, word-internal epenthesis will be prevented, but peripheral epenthesis will be allowed.

The case studies above shows that purely prosodic constraints that refer to prominent positions effect a type of neutralization: the structures allowed in prominent positions (i.e. syllables with onsets) are a subset of those permitted in other positions (i.e. syllables with or without onsets).

4 Empirical Consequences: Neutralization and Syllabification

Underlying the proposal in this paper is the view that the grammar places two demands on prominent positions: it requires them to maintain underlying contrasts and have reduced prosodic markedness. These requirements can come into conflict; while the former requirement avoids neutralization, the latter often demands it. In §4.1, the empirical predictions of this conflict are examined. Of special interest is why preservation in prominent positions is so common whereas neutralization seems to be relatively rare.

In §4.2, the symmetrical effects of the prosodic markedness constraints are examined. As noted in §3.1.3 and §3.2.1, the prosodic markedness constraints can either cause neutralization or can force prosodic structure (main stress) to be driven to other positions. While this prediction is desirable for main stress, it seems to create problems for onset creation: constraints of the form *MAR$_{\text{ONSET}}$/α repel segments from onsets, in direction conflict with the constraint ONSET. This problem is discussed in detail.

4.1 The Nature of Neutralization

For any given language, it has been often claimed that if a consonant can appear in a coda, it can also appear in an onset, but not vice-versa (Goldsmith 1990). This relation − termed the Subset Generalization here − is captured straightforwardly using positional faithfulness: with a faithfulness constraint that preserves material in onsets alone and context-free *Feature constraints, codas alone will be neutralized (Beckman 1998). There is no possible constraint ranking that will produce the opposite: neutralization in onsets, but not in codas. Since there are faithfulness constraints for the root-initial syllable and stressed syllable as well, the same sort of asymmetry is predicted to exist for these positions.

At first glance, the markedness constraints proposed in this paper seem to produce exactly the opposite result. As shown in the case studies in the previous section, they cause neutralization in prominent positions alone, predicting that elements in a prominent position should be a subset of those found in non-prominent positions. It seems that the present proposal directly contradicts positional faithfulness, and therefore contradicts the Subset Generalization.

However, the present proposal does not directly counter the effects of positional faithfulness. Although it does cause neutralization in prominent positions alone, this neutralization is limited in terms of sonority. For example, since place distinctions do not count in sonority, the prosodic markedness constraints cannot force neutralization of place distinctions in prominent positions. More concretely, there can be no language in which place distinctions in onsets are fewer than in codas. Also, if any restrictions are to be imposed by prosodic markedness constraints on prominent positions, they will always ban highly sonorous elements in onsets and low-sonority elements in nuclei. There can be no language, for example, where only sonorants are allowed in onsets and not obstruents; since obstruents are low in sonority, if they are prohibited then the higher sonority sonorants must also be banned. This compares to the relative power of positional faithfulness, which predicts that any featural contrast may be neutralized in non-prominent positions (e.g. place, voice, nasality). In short, prosodic markedness constraints predict that the neutralizations possible in prominent positions are far more limited than those possible in non-prominent positions.

Though prosodic markedness constraints are evidently quite limited in the types of neutralization they can cause in prominent positions, the subset problem still remains: prosodic markedness constraints do predict that there can be fewer contrasts in prominent positions than in non-prominent positions. The problem is probably not with the constraints, but with the Subset generalization. As shown in the preceding sections, the generalization simply does not hold (also see Parker in prep.). As discussed above, there are cases where prominent positions have a subset of these elements found in non-prominent positions:

(35)
- Chamicuro codas can contain [h] and [ʔ], but onsets cannot.
- Niuafo'ou stressed syllables do not allow glides, but unstressed syllables do.
- Neo-Štovakian (NS) dialects of Serbo-Croatian only allow high tone in stressed syllables, but both high and low tone can appear elsewhere. (Inkelas & Zec 1988, Zec 1994).

Similarly, there are cases where the elements allowed in prominent positions and those allowed in non-prominent positions form <u>disjoint</u> sets: for example, the initial syllable in Nuer can contain [pf] but not [f], while non-initial syllables contain [f], but not [pf]. As shown in the case studies, without markedness constraints such neutralization and allophony is impossible to explain.

Further support for the existence of the prosodic markedness constraints are found in the effects predicted by their symmetry: $*\text{NUC}_{\acute{\sigma}}$/ə, for example, can either ban [ə] in the main-stressed syllable or force main stress to move to a schwa-less syllable. If prosodic markedness constraints do not exist, a rather straightforward account of sonority-driven stress is lost (Kenstowicz 1996, de Lacy 1997).

So, while prosodic markedness constraints in prominent positions do contradict the Subset generalization, this contradiction is both constrained and necessary. This reduces the Subset Generalization from its status as an absolute universal to a universal tendency. The real issue, then, is why neutralization in prominent positions is not as common or pervasive as neutralization in non-prominent positions. I suspect that the solution to this is outside the scope of a formalist explanation. As Beckman (1998) has argued, there are several processing and comprehension reasons for favouring contrast in prominent positions. Since prosodic markedness constraints reduce contrast in those positions, functional pressures will keep them from being too pervasive.

4.2 Syllabification and Constraint Symmetry

As emphasized throughout this paper, the prosodic markedness constraints have symmetric effects. A constraint like $*\text{NUC}_{\acute{\sigma}}/x$ can cause *x* to be banned in main-stressed syllables or it can force stress to move to a syllable without *x*. However, this symmetry presents a problem when constraints such as $*\text{MAR}_{\text{ONSET}}/x$ are considered. These constraints can ban *x* from onsets, or – symmetrically – force the onset to avoid *x*. This latter situation is illustrated with $*\text{MAR}_{\text{ONSET}}$/liquid below:

(36)

	/pala/	$*\text{MAR}_{\text{ONSET}}$/liquid	ONSET
	pa.la	x!	
☞	pal.a		x

As shown in the tableau, with $*\text{MAR}_{\text{ONSET}}$/liquid outranking ONSET, liquids will be forced to appear in codas, creating an onsetless syllable. The problem with this result is that, pushed to the extreme, this approach predicts a language that avoids onsets when all $*\text{MAR}_{\text{ONSET}}/x$ constraints outrank ONSET. In short, the $*\text{MAR}_{\text{ONSET}}/x$ constraints collectively form a NO-ONSET constraint – hardly a desirable typological result (but see Breen & Pensalfini 1999 on Arrernte/Aranda).

Two ways to deal with this problem and maintain the existence of $*\text{MAR}_{\text{ONSET}}/x$ constraints are presented below:

- <u>Fixed ranking: ||ONSET » […onset…]$_{\text{C}}$||</u>

If ONSET always outranks every constraint that mentions onsets, the right result is achieved:[19]

(37)

	/pala/	ONSET	$*\text{MAR}_{\text{ONSET}}$/liquid
☞	pa.la		x
	pal.a	x!	

While seemingly *ad hoc*, this approach does deal with another problem, noted by Wilson (1999) and Keer (1998): if consonants neutralize to produce better overall featural markedness, they may end up forced into codas by positional faithfulness constraints:

[19] In a sense this is a required anti-Paninian ranking, with the general constraint ONSET over the special $*\text{MAR}_{\text{ONSET}}/\alpha$ constraints.

(38)

	/taba/	*+voice	IDENT$_{ONSET}$[+voice]
	ta.ba	x!	
	tab.a	x!	
	ta.pa		x!
☞	tap.a		

If ONSET always dominates IDENT$_{ONSET}$[+voice], though, the ONSET-violating candidates will be ruled out straight away:

(39)

	/taba/	*+voice	ONSET	IDENT$_{ONSET}$[+voice]
	ta.ba	x!		
	tab.a	x!	x	
☞	ta.pa			x
	tap.a		x!	

In a sense, this fixed ranking simulates (a part of) a principle of earlier theories that prosody cannot be 'undone' to satisfy a featural condition; onsets are first built (i.e. /taba/ → [ta.ba]), then featural conditions (such as *+voice) apply (i.e. [ta.ba] → [ta.pa]), but prosodic structure cannot be undone and rebuilt to satisfy other conditions (i.e. [ta.pa] [tap.a]). With ONSET outranking constraints that place featural conditions specifically on onsets (i.e. *MAR$_{onset}$/x, IDENT$_{ONSET}$F), the creation of onsets again has primacy over featural restrictions.[20]

❑ <u>Deny the Problem</u>

An alternative approach is to deny that the predictions of this approach are incorrect: it is possible to violate ONSET in order to satisfy *MAR$_{ONSET}$/x. However, – like violations of the Subset generalization – some functional pressure makes ONSET-violating rankings relatively rare. So, we could reasonably expect a language where high-sonority consonants are syllabified into codas, not onsets, but low-sonority ones end up in onsets; an input such as /pawa/ would end up as [paw.a], for example, but /pata/ as [pa.ta]. Initial glides would not be prevented from appearing, though: /wati/ would end up as [wa.ti] since [w] could not form a syllable on its own: [w.a.ti] (assuming that the glide cannot be changed into a [u]: [u.a.ti]). Also, post-consonantal glides would end up in an onset if complex margins are banned: /patwi/ → [pat.wi], *[patw.i]. Whether such a language exists is an issue for further investigation, but it does not seem implausible.

An alternative way to slightly limit the effect of *MAR$_{ONSET}$/x constraints is to claim that they are actually positive: MAR$_{ONSET}$→x "Onsets must have segments of sonority x." While such markedness constraints can cause high-sonority consonants to end up in codas in spite of ONSET, they cannot cause low-sonority elements to end up in onsets. Compare the following tableaux, with the positive version first, then the negative version:

[20] Of course, constraints that do not specifically refer to onsets may outrank ONSET. For example, a constraint that requires main-stressed syllables to be bimoraic can produce [pát.a], contra ONSET. Since the triggering constraint does not mention the onset, though, it is free to outrank ONSET.

(40)

	/pata/	MAR$_{ONSET}$ → obstruent	ONSET
☞	pa.ta		
	pat.a		x!

(41)

	/pata/	*MAR$_{ONSET}$/obstruent	ONSET
	pa.ta	x!	
☞	pat.a		x

Unfortunately, with the ranking ||*MAR$_{ONSET}$→obstruent » *MAR$_{ONSET}$→fricative …||, positive constraints only prevent the problem from occurring with the least sonorous elements:

(42)

	/pasa/	MAR$_{ONSET}$ → obstruent	MAR$_{ONSET}$ → fricative	ONSET
☞	pa.sa			
	pas.a	x!		x

There may be ways to circumvent this problem by changing the form of the constraints, but they are beyond the scope of this paper (see de Lacy 1997, in prep.). In any case, it is evident that there are ways to mitigate the syllabification problem presented by *MAR$_{ONSET}$/*x* constraints.

5 Constraint Form

One claim of this paper is that markedness that refer to prominent positions only refer to prosodic elements – sonority and prosodic structure. The aim of this section is to determine why this is the case, or more specifically, why there are no constraints of the form *Π/Feature, where Π is a prominent position.

In all the case studies in section 3, prominent positions are forced to become less prosodically marked relative to non-prominent positions. Neutralization of specific features (e.g. place features, voice, nasality) does not seem to occur in prominent positions. This contrasts with the more common type of neutralization, where specific features are neutralized in non-prominent positions. Accordingly, it was proposed that only constraints of the form *Π/Σ (Π is a prominent position, Σ is a sonority/prosodic structure) exist. Constraints of the form *Π/Feature do not exist.

I consider this limitation in constraint form part of a more general phenomenon: Prosodic Accessibility (Ito & Mester 1992, de Lacy 1997 and references cited therein). It has long been recognized that the elements that are relevant in the formation of feet are very few: namely moras and syllables (and perhaps segmental sonority – see Zec 1999, de Lacy in prep.). Specific features are not relevant in computing foot-harmony. For example, no language determines the relative harmony of feet on the basis of whether they have coronal onsets or not. The same is true of prominence-driven stress: while syllable-internal structure and segmental sonority can influence main stress, segmental features cannot (de Lacy 1997). Ito & Mester (1992) suggest that this is due to a notion of 'accessibility': only a limited number of tiers below a certain node is relevant in computing its well-formedness. In de Lacy (1997) I formalized this a restriction on constraint form: markedness constraints can only refer to elements that are on the same plane: either prosodic elements alone or featural elements, but not a mixture of both.

With the Prosodic Accessibility restriction, the present ban on *Π/Feature constraints follows straightforwardly. Since prominent positions are prosodic elements, they cannot be mentioned in a constraint that refers to features. Unfortunately, apart from noting that the *Π/F restriction is part of a far more pervasive restriction, I have little to say about the reasons for the Prosodic Accessibility restriction itself. I suspect it represents a fundamental division between prosodic structure and subsegmental features that is generally recognized but not truly captured in current phonological theories.

If Prosodic Accessibility is correct, though, it has implications for neutralization in non-prominent positions. It favours Beckman's (1998) Positional Faithfulness approach, which employs context-free *F constraints, and is not compatible with a more traditional positional markedness approach that bans certain features in prosodic positions, such as *CODA/voice (e.g. Ito 1986, Goldsmith 1990, Zoll 1997 and references cited in these works). Of course, the implications of Prosodic Accessibility for constraint form go far beyond neutralization, limiting templatic restrictions on prosodic structures (for some related discussion, see Lamontagne 1993). A full exploration of Prosodic Accessibility and its limitations on constraint form must be left for another time due to its extensive effects.

- <u>Functional and Formal Motivations</u>

An issue that has gained more and more importance in recent work relates to the motivations for constraints: are there functional pressures that influence a particular constraint's form, or is the constraint essentially arbitrary in nature (for a relevant discussion, see Pater 1995 and Hyman 1998). As mentioned above, the aim of this paper is to show that prominent positions seek to reduce prosodic markedness. The question of present interest is whether there are functional reasons that could motivate such constraints, or if the constraints are essentially arbitrary, resulting through the arbitrary application of constraint-formation processes. Both explanations are explored here. While the shortness of the following discussion precludes any firm conclusions, the view that the constraints are arbitrary is simple and appealing.

Beckman (1998:chapter 1) argues that there are a variety of functional reasons that certain prosodic positions are prominent. For root-initial syllables, the reasons have to do with lexical access and retrieval. Stressed syllables and onsets, on the other hand, have a phonetic *raison d'être*: they are loci of salient physical cues (e.g. increased duration, amplitude, pitch extrema, release bursts, etc.). If it is correct that these facts motivate the need to retain contrasts in prominent positions (Hawkins & Cutler 1988, Beckman 1998), then entirely different functional reasons must be found to motivate the grammar's desire to reduce prosodic markedness in prominent positions – a desire that effectively reduces the number of contrasts in prominent positions.

One phonetic property that seems to have potential value – at least for stressed syllables and root-initial syllables – is duration. Increased duration is often one of the correlates of stress, and initial syllables are also often longer than others. If the prosodic markedness constraints effectively attract segments with longer inherent duration into prominent positions, this could (potentially) reduce the amount of effort needed to increase duration in those positions. This idea seems promising for nuclei in prominent positions, at least. Segments of longer inherent duration (and lower sonority) are preferred by these positions. For example, [a] has a longer inherent duration than [i] and [u], and is more desirable in prominent positions.

It is unclear whether duration provides a complete enough motivation for the prosodic markedness constraints, though. Some languages make fine distinctions in sonority. For example, Kobon prefers [ə] to [ɨ] in sonority-driven stress (Davies 1981). Whether the difference in the duration of these vowels is significant enough to warrant the former's preferred status seems unlikely, though it is a matter that can only be ultimately settled by exact measurements. Another problem is that lengthening of *final* syllables is a reasonably common occurrence. If the prosodic markedness constraints are an attempt to help with lengthening, one would expect prosodic markedness constraints for final syllables as well. To my knowledge, no convincing cases exist. The exact relation of the duration idea to onset-sonority in prominent positions is also not clear. Do low-sonority margins increase the duration of prominent positions, compared to high-sonority margins?

In any case, attempting to find a single feature that motivates all prosodic markedness constraints may be misguided (see Smith in prep. for relevant discussion). There may be many different functional motivations, all converging on a the formally unitary set of prosodic markedness constraints.

The alternative is to see the constraints as essentially arbitrary, without a functional motivation. In this conception, the prosodic markedness constraints are simply the result of the blind application of constraint combination processes. Such an idea is actually somewhat appealing. Beckman (1998) has argued that there are a set of prominent positions ($\acute{\sigma}$, σ_1, onsets). Suppose that these positions can be freely combined with any sort of constraint.[21] This would produce positional faithfulness constraints and the prominent-position prosodic markedness constraints as a matter of course (also see Bye & de Lacy 2000). A meta-principle such as the Accessibility Hypothesis would prevent the prominent positions from combining with *F constraints. So, prosodic prominent-position markedness constraints could come about through free (and arbitrary) combination of prominent position with different types of constraints.

Of course, which view the reader chooses to favour is essentially up to their philosophy at this point, and to future research. The sole purpose of the preceding discussion was to point out that there are alternative explanations for the genesis of the prosodic markedness constraints, and that an adequate explanation must account for the fact that the grammar places often conflicting requirements on prominent positions: to preserve underlying contrasts and to reduce prosodic markedness.

6 Conclusions

In this paper, I have argued that prominent prosodic positions (main-stressed syllables, root-initial syllables, and onsets) can be specifically required to be prosodically unmarked. Prosodic markedness relates to segmental sonority and prosodic structure, and excludes featural markedness, which relates to individual subsegmental features such as place and nasality, for example.

[21] This approach is most compatible with a conception of constraint formation as the complete instantiation of a limited number of constraint schemas (see Green 1993 for discussion).

The constraints that actuate this proposal are adaptations of previously proposed constraints: Prince & Smolensky's (1993) syllable sonority constraints, and prosodic constraints such as ONSET. The innovation in the present work is that these constraints can refer specifically to prominent positions, a proposal partly anticipated in works on prominence-driven stress (Kenstowicz 1996, de Lacy 1997).

The constraints were shown to account for neutralization and allophony in prominent positions. They were also shown to provide a restrictive account of sonority-driven stress. The form of the constraints provides a reason for two generalizations about sonority-driven stress: (1) segmental sonority can only influence the placement of main stress, not secondary stress, and (2) subsegmental features cannot influence main stress placement. The first generalization is due to the fact that only main stress is a prominent position, not secondary stress (see Beckman 1998). The second is due to the ban on *Π/Feature constraints (where Π is a prominent position), which also serves to prohibit featural neutralization in prominent positions.

The present work adds to the growing body of literature on positional markedness constraints – markedness constraints that refer to prosodic positions. However, positional markedness constraints are usually assumed to refer to non-prominent positions, such as the coda (Ito 1986, Lombardi 1998, Zoll 1997 *cf* Beckman 1998). In the present work, it is claimed that there are constraints that refer specifically to prominent positions, and – if the Accessibility Hypothesis is accurate – there are no constraints of the *π/Feature variety, where π is a prosodic position. Whether there is truly a need for markedness constraints on prominent positions as well as for non-prominent positions will no doubt be debated in the future. However, I note that support for markedness constraints that refer to prominent positions is slowly amassing (Bye in prep., Parker in prep., Smith in prep.).

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