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Strong Positions and Laryngeal Features in Yukatek Maya[*]

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1. Introduction

Yukatek Maya (YM) has two phonological phenomena, allophonic aspiration and [h]-epenthesis, which insert the feature [spread glottis] at the right edge of the prosodic word (ω) and phonological phrase (φ) respectively. Providing an OT analysis, then, requires constraints which privilege [s.g.] in certain `weak' positions. This sort of constraint, however, conflicts with many theories of positional privilege since it prefers a marked form in a 'weak' position. Despite this, we show that a limited class of such constraints are necessary to account for aspiration and [h]-epenthesis in YM. Furthermore, these processes are argued to instantiate a cross-linguistic pattern favoring certain laryngeal features at the right edge of larger prosodic constituents. This pressure, which we term **Final Laryngeal Strengthening**, is argued to be the phonologization of a gradient phonetic pressure: the articulatory effort required to maintain persistent voicing throughout longer prosodic units.

2. Aspiration and [h]-Epenthesis in Yukatek Maya

Before moving on to describe ω-final aspiration and φ-final [h]-epenthesis, it is necessary to provide background on a few relevant aspects of the phonology of Yukatek Maya more generally. The consonantal phonemes of YM are laid out in (1). Crucial for present purposes is that the language contrasts two series of stops: plain (unaspirated) and ejective. The phonemic role of [s.g.], then, is limited to the glottal fricative /h/ with [constricted glottis] ([c.g.]) being the primary laryngeal feature relevant in phonemic contrasts among stops. YM has a typical five vowel system, /a e i o u/, with four different

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vowel shapes: short /a/, long low tone /aa/, long high tone /áa/, and creaky voiced /a'a/. Note again the high functional load of [c.g.] relative to [s.g.] and [Voice].

(1)

	Labial	**Alveolar**		**Palatal**	**Velar**	**Glottal**
Plain Stop	p	t	ts	ch	k	‘
Ejective	p’	t’	ts’	ch’	k’	
Implosive	b					
Fricative		s		x		h
Nasal	m	n				
Approximants		l		y	w	

2.1 Word-final Aspiration

Previous literature on Yukatek Maya, such as Blair & Vermont-Salas (1965), describes plain stops as being allophonically aspirated whenever they are syllable-final as in (2).

(2a) suu**t**$^{\mathbf{h}}$ ‘return’ (*suut)
(b) síini**k**$^{\mathbf{h}}$ ‘ant’ (*síinik)
(c) a**t**an ‘wife’ (*at^{h}an)
(d) **ch**eel ‘rainbow’ (*ch^{h}eel)
(e) **ts**íimin ‘horse’ (*ts^{h}íimin)

While (2) is consistent with σ-final aspiration, it is equally consistent with ω-final aspiration. Distinguishing between these two hypotheses is non-trivial since morpheme structure restrictions on native lexical words (they must be CVC or CVCVC) ensure that there are no monomorphemic word-internal codas. The crucial data motivating Blair & Vermont-Salas (1965)'s generalization comes from morphologically complex forms such as N-N compounds (CV**C**.CVC) which could plausibly be taken to constitute multiple prosodic words (or multiple minimal prosodic words under a theory such as Ito & Mester (to appear)). The only place where we do find morpheme-internal codas is following vowel syncope, as in (3). Plain stops in this position surface unaspirated.

(3) /atan-il/ → [a**t**.nil] ‘wifehood’ (*[at^{h}.nil])

Furthermore, we conducted testing with English names and nonce words embedded in lines of a play written in Yukatek Maya and found that, unlike ω-final codas like [pat^{h}], word-internal codas were uniformly unaspirated by speakers reading the play (e.g. such as [put.nam] instead of *[put^{h}.nam]). Summing up, all available evidence suggests that the right descriptive generalization regarding aspiration in Yukatek Maya is that stops are aspirated if and only if they occur in (minimal) prosodic word-final position.

2.2 Phrase-final [h]-Epenthesis

In addition to ω-final aspiration, Yukatek Maya has another phonological process which inserts [s.g.] at the right edge of a prosodic unit: φ-final [h]-epenthesis. This process

involves the epenthesis of [h] at the end of otherwise vowel-final phonological phrases. Before discussing the details, however, we present independent evidence for the location of phonological phrase boundaries in YM from the bounded application of a rule of debuccalization. While part of this process – the deletion/delinking of supralaryngeal features – is truly independent from our present concerns, another part – the retention of laryngeal features – can potentially be seen as another case of FLS.

2.2.1 Phonological Phrasing in YM: Evidence from Debuccalization

Yukatek Maya has a debuccalization process (previously described by Straight (1976) and Orie & Bricker (2000)) where a consonant's supralaryngeal features are deleted if immediately followed by a nearly identical consonant.[1] This process, illustrated in (4)-(6) (data from Orie & Bricker (2000)), only occurs across prosodic word boundaries since the aforementioned morpheme structure restrictions block adjacent consonants within morphemes. As (7) shows, identity of manner or place alone is insufficient to license debuccalization.

Debuccalization deletes most consonants:
(4a) /k'am makal/ → [k'a makal] 'receive elephants ears'
(b) /p'is sakal/ → [p'i sakal] 'measure cloth'

Ejectives surface as glottal stop:
(5a) /saak' kaal/ → [saa' kaal] 'itchy neck'
(b) /sop' bak'/ → [so' bak'] 'sell meat'

Allophonically aspirated stops and the palatal fricative /x/ surface as [h]:
(6a) /páap^{h} p'aak/ → [páah p'aak] 'spicy tomato'
(b) /xot^{h} t'u'ul/ → [xoh t'u'ul] 'cut rabbit'
(c) /boox xa'ak'/ → [booh xa'ak'] 'black spice'

Non-identical Consonants do not debuccalize:
(7a) /páap^{h} t'u'ul/ → [páap^{h} t'u'ul] 'spicy rabbit'
(a) /páap^{h} makal/ → [páap^{h} makal] 'spicy elephant ears'

While previous authors has focused primarily on characterizing the classes of segments that undergo this phenomena, they are unanimous that the process occurs whenever the linear environment (two nearly identical adjacent consonants) is met. We have seen that debuccalization can occur across both morphological and prosodic word boundaries (in fact it appears to *always* occur across such boundaries). However, in all of the data provided by previous authors, debuccalization occurs between two morphemes

[1] See also McCarthy (1988) for further analysis of these facts and their implications for theories of feature geometry. I should note, however, that much of the discussion in this and other works is centered on the implications of a single data point from Straight (1976) involving the affricate /ts/ (/uts tin/ → [us tin]). Speakers consulted for the present work, as well as data presented in Orie & Bricker (2000) show /ts/ deleting entirely rather than surfacing as [s].

which are syntactically close to one another. Looking more carefully at Orie & Bricker (2000), we find that, of their 34 examples of debuccalization, 16 are [Verb + Bare Direct Object], 3 are [Verb + Derivational Suffix], 11 are [Attributive Adjective + Noun], and 4 are [N+N] or [V+V] compounds. All of these sequences plausibly form syntactic constituents which would be prosodized together.

In our fieldwork examining different syntactic configurations in (8), however, we find that debuccalization does not occur despite the presence of the relevant linear environment. In (8a), the object, *puut*, occurs in the focus/cleft construction; in (8b), the wh-word *máax* has undergone A´-movement to a position in the left periphery; in (8c), debuccalization fails to apply between the verb and the postverbal subject, *Karmen*, which we take to be outside of VP.

(8a) puu**t**^{h} **t**-u maan-ah Juan
papaya PFV-ERG.3 buy-CMP Juan
'It was papaya that Juan bought'

(b) máa**x** **x**ot le t'u'u'l-o'
who cut the rabbit-DISTAL
'Who cut the rabbit?'

(c) puut^{h} k-u maan-i**k**^{h} **k**armen
papaya IMP-ERG.3 put-INC Carmen
'It is papaya that Carmen is buying'

Given the asymmetry between (4)-(6) and (8), we propose that debuccalization is prosodically bounded by the phonological phrase. Debuccalization fails to apply in the examples in (8) because the linear environment crosses a φ-boundary. Using the absence of debuccalization as a probe, then, we can diagnose phonological phrase boundaries in Yukatek Maya as follows[2]:

(9) $(\text{Focus})_{\varphi}$ $(\text{Aspect V } \text{DP}_{\text{obj}})_{\varphi}$ $(\text{DP}_{\text{subj}})_{\varphi}$

In an edge-based approach such as Selkirk & Shen (1990), the generalization is that right edges of lexical maximal projections are aligned with phonological phrase boundaries (this can also be implemented in OT using an undominated Generalized Alignment constraint). The φ-boundaries in (9) occur at the right edge of the VP (which coincides with the right edge of the object DP) and the right edge of the focused XP. The only potentially problematic case is that of attributive adjectives and following nouns which, according to our debuccalization diagnostic, do not contain a phonological phrase boundary. If adjectives head APs which occur as NP-specifiers or adjuncts, we would expect a φ-boundary here. However, it is not clear that Yukatek Maya gives us any reason to believe there is in fact an AP in A-N sequences. First, sequences of multiple

[2] The preverbal topic position is clearly prosodically separated from the rest of the clause, probably by a larger prosodic boundary such as the Intonational Phrase (see Avelino (2008) for detailed discussion).

attributive adjectives are rare or non-existent. Second, items translated as degree words like *hach* `very' are often not syntactically local. Finally, adjective-like elements can be used in clearly nominal ways with no morphological difference, suggesting that A-N sequences might be best analyzed as N-N compounds. While we leave resolution of these issues to future work, the lack of a boundary between attributive adjectives and the nouns they modify does not constitute evidence against the proposed phonological phrasing algorithm.

2.2.2 Epenthesis of [h] is φ-final

Having independently established phonological phrasing based on the domain of application for debuccalization, we turn now to another phonological process referring to this same prosodic constituent: φ-final [h]-epenthesis. The generalization of this process which we will arrive at is that otherwise vowel-final phonological phrases always surface with a final [h] inserted. While the details are slightly different, we have another process which, like ω-final aspiration, preferentially inserts [spread glottis] at the right edge of a prosodic constituent.

While we have characterized this process as involving the epenthesis of [h], this is not immediately apparent since **all phonological phrases in Yukatek Maya end in a consonant**. The synchronic source of this surface generalization is obscured by the fact that all native lexical words and most function words end in consonants. There are, however, two places where we do see an active phonological process creating consonant-final φs: vowel-final borrowings from Spanish and a vowel final function word, *wáa*. In both cases, the consonant inserted is [h].

While *native* lexical words must end in consonants, recent borrowings from Spanish end in vowels. When these words (which are generally nouns) occur at the end of a phonological phrase, they surface with a final [h] as in (10a). This [h], however, is demonstrably not part of the underlying representations of these words. Unlike coda [h] in native YM words in (11), the final [h] in borrowings does not surface when the word is φ-medial as in (10b) (the glottal stop in (10b) is inserted to avoid vowel hiatus).

(10a) estudiante → estudiante[h]‘student’
(b) estudiante’il maaya t’áan `student of Mayan language’ (*estudiante[h]il)

(11a) huu[h] `iguana’
(b) huu[h]il ha’ (*huu[‘]il ha’)

The second place where we see [h]-epenthesis emerging is with native *function* words which are not subject to the CVC/CVCVC requirement. While most function words have coda consonants, there is one function word, the alternative marker *wáa*, which is vowel final and has variable positioning within the phonological phrase. Phonological phrase-finally, as in (12a), epenthetic [h] is inserted; phrase medially, as in (12b), no consonant is inserted. There is no motivation to insert [h] in (12b) since the

word is not phrase-final, and there is no motivation to insert glottal stop or a glide since there is no hiatus to avoid.

(12a) Juan-**wáah**]$_{\varphi}$ uk' le sa'-o'
Juan-ALT drink the atole-DISTAL
'Is it Juan who drank the atole?'

(b) tak in hant-ik **wáa** ba'ax]$_{\varphi}$
want ERG.1 eat-INC ALT what
'I want to eat something'

3 Cross-linguistic Context

Thus far, we have examined two phonological processes – word-final allophonic aspiration and phrase-final [h]-epenthesis – which preference a particular marked form, [s.g.], in particular positions: the right edges of the prosodic word and phonological phrase. The existence of such processes is entirely unexpected for `pure prominence' theories of positional privilege (i.e. Positional Markedness and Positional Faithfulness). These seemingly exceptional processes, however, are quite similar to one another: they target the same marked feature and the same class of `weak' positions. We argue, then, that rather than being random exceptions to pure prominence, these processes are instances of a systematic and well-defined subpattern of positional asymmetries – **Final Laryngeal Strengthening** (FLS). The present section, then, aims to show that FLS, while restricted in particular ways, is regular and robustly attested cross-linguistically.

3.1 Final Laryngeal Strengthening

The two processes we have examined both involve [s.g.], inserting this feature at the right edge of the prosodic word and phonological phrase. Both processes go against pure prominence and do so in a particular way. The marked feature they involve is always a laryngeal feature (i.e. it seems that no language has a phonological process inserting [n] or [t] φ-finally), and the weak position they each refer to is always the right edge of a prosodic constituent (i.e. it seems that no language has a process inserting [s.g.] only in unstressed syllables).

Aspiration: While the word-final aspiration pattern of Yukatek Maya may be unexpected from the point of view of English, it is fairly common across languages (see Vaux & Samuels (2005) for a catalog of such cases). For example, we find unrelated languages like Sierra Popoluca (Elson (1947)) which exhibit word final aspiration of plain stops.[3] We also find languages like Kashmiri and Hupa where an aspiration contrast is neutralized to the aspirated form in word-final position (Vaux & Samuels (2005)). Additionally, there are languages like Quiegolani Zapotec (Regnier (1993)) where stops

[3] As in Yukatek Maya, previous literature has taken Sierra Popoluca aspiration to be syllable-final on the basis compounds and other morphologically complex forms such as pet^{h}-kuy `broom' (lit. sweep-stick). I believe reasoning parallel to the above will show prosodic word-finality to be the true pattern.

which are unaspirated in other positions surface as aspirated utterance-finally. Finally, following Jessen & Ringen (2002), if we take [s.g.] rather than [-voice] to be the feature crucial to word-final 'devoicing' in many dialects of German, this process can potentially be seen as another case of preferentially aligning [s.g.] with the right edge of a prosodic constituent.

Glottalization: While preferential retention/insertion of [c.g.] in final-position appears to be less widely attested (or at least less widely discussed) than [s.g.], it nevertheless is attested. For example, Fallon (2002) cites the example of Tigre (p. 92) which contrasts plain stops with ejective stops word-initially but neutralizes them in other positions. They are neutralized to plain stops in word-medial position, but ejectives in word-final position. The feature [c.g.] is inserted or retained word-finally.

Epenthesis: The other process we saw in Yukatek Maya was a phrase-level epenthesis of [h] in otherwise vowel-final phonological phrases. A number of similar such processes are described by Barnes (2006). For example, Afar has a rule epenthesizing [h] in stressed open syllables utterance-finally and sometimes phrase-finally. Dagbaani has a process of glottal stop-epenthesis that occurs in certain word-final open syllables. Finally, in K'ichee', a distantly related Mayan language, Henderson (2009) describes a process of φ-final [h]-epenthesis similar to the one described above in Yukatek Maya.

3.2 The Limits of Final Laryngeal Strengthening

Given the cross-linguistically robust pattern of Final Laryngeal Strengthening described above, it is instructive to see what kinds of formally similar processes do not seem to be attested. While there may be accidental gaps in the processes described above (e.g. the lack of Intonation Phrase-level FLS), there do seem to be two interesting restrictions on FLS processes which are not accidental: the types of laryngeal features targeted and the prosodic constituents targeted.

First, FLS processes only refer to [spread glottis] and [constricted glottis], but not to [+voice] or supralaryngeal features (and not [-s.g.] or [-c.g.] if we were to take these features as bivalent rather than privative). We see phrase and utterance-final aspiration and [h]-epenthesis, but no cases of phrase or utterance-final *voicing*. The second restriction we see is that Final Laryngeal Strengthening processes only target prosodic units at least as large as the prosodic word. We have seen that the two cases of syllable-final aspiration previously claimed in the literature – Yukatek Maya and Sierra Popoluca – both appear to be better analyzed as word-final aspiration. If this reanalysis is right, we are left with no attested processes preferentially inserting [s.g.] or [c.g.] at the right edge of the syllable, foot or mora. This restriction stands in stark contrast to Davis & Cho (2003)'s alignment-based approach of initial aspiration in English (foot-initial) and Korean (syllable-initial).

While these restrictions may appear somewhat unrelated, we will argue in §5 that they have a common phonetic source. In particular, that Final Laryngeal Strengthening is

the phonologization of the articulatory effort required to maintain constant voicing throughout larger prosodic constituents. Before doing so, however, §4 formulates a family of OT constraints modeling FLS and uses it to analyze the various instances of FLS in Yukatek Maya.

4. Final Laryngeal Strengthening in OT

The two Final Laryngeal Strengthening processes we have identified in Yukatek Maya – word-final aspiration and phrase-final epenthesis – both require crucial reference to *edges* of prosodic constituents. The natural way to capture this pattern in OT, then, is using Generalized Alignment (McCarthy & Prince (1993)) constraints aligning particular features ([s.g.] or [c.g.]) with the right edge of prosodic constituents as in (13) (see Davis & Cho (2003) for such an approach to the initial aspiration). We refrain from using the name **Align** to refer to them in order to highlight the asymmetries between FLS and `strong position' alignment constraints; they are formally the same. The restrictions on the possible values α and β may take encode the attested restrictions on FLS processes in §3.2.

(13) **Final Laryngeal Strengthening**(α-*laryngeal feature,* β-*prosodic unit*): 'Every β-final segment should bear feature [α] where α ∈{[s.g.], [c.g.]} and β ∈{ω, φ, IP, *u*}

For Yukatek Maya aspiration, then, the relevant FLS constraint is FLS([s.g], ω). Following the approach of Davis and Cho (2003) for initial aspiration, we can derive the pattern in Yukatek Maya by ranking this constraint over one penalizing all [s.g.] segments as in (14).

(14)

/páap/	Dep[Root]	FLS([s.g.], ω)	*[s.g.]
páap		*!	
☞ páap^{h}			*
p^{h}áap		*!	*
p^{h}áap^{h}			**!

We must also assume that Dep[Root] outranks both of these to capture the fact that we do not insert [h] to satisfy FLS([s.g], ω).[4] This is in stark contrast with the level of the phonological phrase where we *do* epenthesize [h] in order to satisfy FLS. We capture the behavior of [h]-epenthesis, then, by ranking the phonological phrase-level constraint, FLS([s.g.], φ), over Dep[Root] as in (15).

[4] Despite Morpheme Structure Restraints and the consonant-finality of most suffixes in YM, there are two environments where vowel-final prosodic words surface: the output of debuccalization of word-final sonorants (e.g. k'an nook' → [[k'a]$_{\omega}$ [nook']$_{\omega}$]$_{\varphi}$ 'yellow cloth') and words containing the right-leaning clitic variant of the definite article *–e* (Juan [uk'-e]$_{\omega}$ sa'o').

(15)

/albahaca/	FLS([s.g], φ)	Dep[Root]
aalbahaaka	*!	
☞ aalbahaakah		*

While both the prosodic word and phonological phrase exhibit Final Laryngeal Strengthening, there is an asymmetry between the two seen in the subranking in (16). In ω-final position, [s.g] is inserted only as a secondary articulation to already existing segments. In φ-final position, however, [s.g.] is inserted even if it must be epenthesized.

(16) FLS([s.g], φ) >> Dep[Root] >> FLS([s.g.], ω)

This subranking accords with Flack (2007)'s principle stating that constraints targeting the edges of prosodic domains are universally ranked according to the prosodic hierarchy (i.e. Con_{u} >> Con_{IP} >> Con_{φ} >> Con_{ω}). While Flack attributes this general property of edges of prosodic constituents to formal properties of these constraints, we will see that this particular ranking is independently expected for Final Laryngeal Strengthening given its phonetic underpinnings.

Armed with Final Laryngeal Strengthening constraints, we have seen that providing an empirically adequate account of aspiration and [h]-epenthesis in Yukatek Maya is quite simple. More difficult, however, is to provide a general theory of constraints encoding positional asymmetries that predicts which combinations of positions and features form licit constraints and which do not. With respect to the right edges of prosodic constituents, we have seen that only a very limited subset of the possible combinations of prosodic constituents and features is attested. One interesting result is that FLS derives a surface pattern of consonant-finality in φs without the use of **FinalC** (McCarthy (1993)), thus bolstering theoretical and empirical arguments against FinalC by Ito & Mester (to appear) and others. The grammar only requires *specific* positional constraints targeting right edges of prosodic constituents but not others.

5. A Phonetic Grounding for Final Laryngeal Strengthening

We have seen that Final Laryngeal Strengthening processes in Yukatek Maya are amenable to a relatively simple OT analysis. Taken together with the cross-linguistic survey of similar such processes presented in §3, we have argued that **Con** has an empirical need for this very particular class of positional constraints targeting a ‘weak' position. This section aims to provide a motivation for FLS that explains why these particular constraints are licit while most ‘weak position' constraints (following Beckman (1998), Zoll (1998), and other `pure prominence' work) are not.

We argue that FLS is the phonologization of a phonetic pressure: the articulatory effort required to maintain constant voicing throughout longer prosodic units. We see this gradient pressure instantiated in two well-known ways: phrase-final devoicing and creaky

voice (Barnes (2006) and references therein). Extending Barnes (2006)'s analysis of phrasal epenthesis in Dagbaani and Afar, we can analyze Final Laryngeal Strengthening in general as the phonologization of this pressure. Speakers gradiently devoice or use creaky voice towards the end of higher prosodic units, and this pressure is reinterpreted as a phonological target. While we will speak of this as the (direct) phonologization of an *articulatory* pressure, it is not immediately clear whether it is mediated by *perception*. We cannot rule out the possibility that speakers gradiently devoice and use creaky voice and hearers reinterpret this pattern as being a phonological target. In either case, though, the explanation is ultimately articulatory in nature.

This phonetic motivation for FLS, then, explains the two typological restrictions on such processes that we saw in §3: (i) the laryngeal features that can be targeted and (ii) the prosodic units whose right edges can be targeted. The features relevant for FLS, [spread glottis] and [constricted glottis], correspond with the two ways in which consistent voicing is avoided gradiently. The reason why we do not see, say, phrase-final voicing is because there is no gradient process corresponding to this (in fact, the gradient pressure specifically discourages the maintenance of voicing throughout the phonological phrase). Similarly, this phonetic motivation explains why *laryngeal* features are the relevant ones; we don't find processes such as phrase-final insertion of [n], [t], or other segments.

Having characterized FLS as a phonologization of a phonetic pressure, we also explain the restriction on the size of the prosodic units targeted. FLS constraints only refer to right edges of larger prosodic constituents because it is only here that the gradient phonetic pressure is noticeably robust. Unlike phrases or utterances, it is reasonable to assume that it does not require an appreciable amount of articulatory effort to maintain constant voicing throughout a syllable. We expect, then, that this pressure is phonologized only for larger constituents and that this articulatory pressure will be greater for larger prosodic units (e.g. the utterance) than for smaller ones (e.g. the prosodic word).

This difference in the amount of articulatory pressure at different prosodic levels is directly reflected in its phonologization by the relative *ranking* of categorical FLS constraints. Above, we have seen empirical arguments that, in Yukatek Maya, the following subranking holds: FLS([s.g.], φ) >> FLS([s.g.], ω). Given our phonologization account, we expect that this pattern holds more generally and that all FLS constraints are universally ranked according to the prosodic hierarchy as in (17).

(17) FLS([s.g.], *u*) >> FLS([s.g.], IP) >> FLS([s.g.], φ) >> FLS([s.g.], ω)

While we have seen this prediction upheld in Yukatek Maya with respect to FLS([s.g.], ω) and FLS([s.g.], φ), testing these predictions more broadly is an avenue for future work. The universal ranking in (17) does not appear to face any immediate problems from the typology of FLS processes presented in §3. We do not find any attested languages that have, for example, aspiration phrase-finally but epenthesis word-finally. Note, however, that demonstrating that such a case exists would require us to find

a language with not only the relevant process or processes, but also with prosodic structures that do not obey strict-layering. To falsify (17), we would need to find the situation schematized in (18) where there is material at the right edge of a larger prosodic unit (say, φ) that is not also at the right edge of smaller prosodic units (in this case, ω).

(18) $[[CVCV_1]_\omega\ CV_2]_\varphi$

The universal ranking proposed in (17) predicts that any FLS process targeting V_1 will also target V_2. This predicts that no FLS process should happen word-finally but not phrase-finally. Conversely, we do predict there to be processes that occur phrase-finally but not word-finally. This prediction is upheld by Yukatek Maya [h]-epenthesis, Quiegolani Zapotec utterance-final aspiration, and many other examples discussed above.

Final Laryngeal Strengthening is the phonologization of the gradient pressure against constant modal phonation throughout larger prosodic units. This explains the two apparent restrictions on such processes as well as making an interesting prediction with regards to the universal ranking of FLS constraints. The account, though, raises a basic question: what principles restrict the types of positional constraints that Con possesses? Final Laryngeal Strengthening presents an interesting test case since it is a robustly attested class of processes that prefers marked forms in ‘weak' positions.

6. Positional Asymmetries in OT

One of the guiding principles of Optimality Theoretic phonology is that the set of constraints, **Con**, is (i) universal and (ii) as minimal as is empirically adequate (so as to limit the factorial typology of possible languages). The typology of Final Laryngeal Strengthening processes demonstrated that (i) plausibly holds of the FLS constraints in (13). Addressing the concern in (ii), however, requires us to have a general algorithm for determining whether a proposed constraint is licit. With respect to *positional constraints*, Con_{pos}, one of the leading approaches is what Barnes (2006) terms `pure prominence' theories (i.e. Positional Faithfulness (Beckman (1998)) and Positional Markedness (Zoll (1998)). For reasons of space, we will only discuss Positional Faithfulness, though the same criticisms should hold for Positional Markedness *mutatis mutandis*.

Positional Faithfulness posits that the constraints in Con_{pos} are all and only those that can be formed by relativizing a general faithfulness constraint to a particular strong position (roots, onsets, initial syllables, and stressed syllables, among others). While the set of strong positions is rooted in perceptual, psycho-acoustic, and other similar concerns, this set is immutable. A given position is either strong with respect to *all* phonological features or not. This makes Positional Faithfulness well-suited to capture the fact that most positional asymmetries do privilege these `strong’ positions.

With respect to laryngeal features, for example, a pure prominence theory allows us to readily account for the initial-aspiration patterns of languages like English and Korean. As Davis and Cho (2003) note, a constraint driving initial aspiration, such as AlignL-([s.g.], ω), is a licit member of Con_{pos} because it can be formed by relativizing a

constraint to a ‘strong position'. Final Laryngeal Strengthening, however, represents a *systematic exception* to this more general pattern. FLS constraints are relativized to a particular class of what pure prominence takes to be ‘weak positions': right edges of certain prosodic units. Moreover, we have seen that these positions are not privileged with respect to just any phonological features, but rather, only [s.g.] and [c.g.].

The existence of a regular, phonetically coherent set of exceptions to pure prominence such as FLS can be readily captured if our theory of positional privilege has access to phonetic information. Con_{pos}, then, contains all and only those constraints which correspond to a positionally biased *phonetic* pressure (constraints which *phonologize* phonetic pressures in Barnes (2006)'s sense). Both FLS and ‘strong position' asymmetries are of this sort and therefore can be captured in a uniform fashion. FLS, as we argued in §5, phonologizes the articulatory pressure (possibly mediated by perception) against constant voicing throughout larger prosodic units. ‘Strong Position' constraints phonologize the perceptual phonetic pressures which are the basis for Beckman (1998)’s ‘strong’ positions. What FLS shows us, then, is that these perceptual and articulatory pressures themselves must be part of the theory of positional privilege rather than a single fixed set of positions which reflect these pressures indirectly. A phonetically informed theory of positional privilege is more flexible than pure prominence approaches, and it is this flexibility that allows it to account for Final Laryngeal Strengthening.

While space precludes a full discussion of other theories of positional privilege, we would like to comment briefly on apparent issues FLS raises for one leading approach: Evolutionary Phonology (Blevins (2006) and references therein). Whereas Positional Faithfulness suffered from being too restrictive, EP appears to be too permissive. One of the key results of the cross-linguistic typology presented in §3 is that there are two principled restrictions on the sorts of Final Laryngeal Strengthening processes we find (only [s.g.] ad [c.g.] and only larger prosodic units). An analogy-based model like EP struggles to explain why these restrictions ought to hold. If Blevins (2006) is right that there are synchronic ω-final voicing processes, we might expect that these could be reinterpreted over time as φ-final voicing since phonological phrases generally end in prosodic words. Alternatively, we might expect that φ-final vowel syncope might lead directly to φ-final voicing (parallel to Blevins' explanation of apparent word-final voicing in Somali). A principled explanation of why these evolutionary pathways are not possible might prove possible, but EP is insufficiently restrictive without it.

The other restriction that Evolutionary Phonology does not readily predict is the lack of syllable-final (or foot-final) aspiration or glottalization. Recalling the arguments presented in §2.1, we have seen that σ-final aspiration appears not to exist (in contrast to ω-final aspiration, which is quite abundant). EP leads us to expect that ω-final aspiration could be reanalyzed over time as σ-final since prosodic words end in syllables and often consist only of one syllable. An analogical model like EP needs to explain why this particular analogy is different than others (e.g. the reanalysis of phrase-final devoicing as word-final devoicing Blevins (2006) discusses). One possible explanation would be to

deny that the syllable exists, at least in the same way that words do. This would appear to explain the lack of σ-final aspiration, but would require a different approach to the whole range of phenomena which have been analyzed with crucial reference to the syllable. To sum up, EP correctly predicts that Final Laryngeal Strengthening should exist, but it also makes available evolutionary pathways for other similar processes which appear to be unattested.

7. Conclusion

We have examined two similar phonological processes in Yukatek Maya: aspiration and [h]-epenthesis. The environment for aspiration, we have argued, is the right edge of the prosodic word. The environment for [h]-epenthesis is the right edge of a larger prosodic unit: the phonological phrase. We have seen that these two processes in Yukatek Maya are straightforwardly captured in an OT framework, but require constraints which align a marked feature, [s.g.], with a canonically 'weak' position. Finally, we have discussed the implications of such constraints for theories of positional privilege in phonology.

At the level of the prosodic word, we have seen that FLS([s.g], ω) drives aspiration. This same constraint can also potentially help us to account for another word-final phonological process we have seen: debuccalization (páa**p^{h}**]$_{\omega}$ p'aak → páa**h** paak). In particular, FLS explains why debuccalization *retains laryngeal features* at all (as opposed to deleting the entire segment). It is unclear if this can serve as a more general cross-linguistic explanation for debuccalization, but for Yukatek Maya it would allow us to use an independently needed constraint to capture this puzzling property.

Setting aside debuccalization, we have seen that the typology of Final Laryngeal Strengthening processes reveals principled restrictions on the prosodic units and features targeted. These restrictions, however, can be readily captured by treating Final Laryngeal Strengthening as the *phonologization* of a well-attested gradient phonetic tendency towards non-modal phonation towards the end of larger prosodic units. Given the phonetic unity of such processes, we require a theory of positional privilege with access to certain phonetic information. This, however, is fundamentally at odds with `pure prominence' theories which disallow this kind of fine-grained sensitivity to phonetics. The robustness and phonetic coherence of Final Laryngeal Strengthening, however, demonstrate that this kind of sensitivity is empirically necessary in order to formulate an adequate theory of positional asymmetries.

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