# DERIVING ECONOMY: SYNCOPE IN OPTIMALITY THEORY

A Dissertation Presented

by

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# ABSTRACT

DERIVING ECONOMY: SYNCOPE IN OPTIMALITY THEORY

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This dissertation proposes that markedness constraints in Optimality Theory are lenient: a form can be marked with respect to a constraint only if there is another form that is unmarked. Thus, no constraint bans the least marked thing. The central consequence of this idea is that there are no economy constraints that penalize structure as such. Economy effects follow from the interaction of lenient markedness constraints. Economy constraints are shown to be not only unnecessary but actually harmful: their very presence in CON predicts unattested patterns that remove structure regardless of markedness.

Chapter 2 develops the theory of CON and argues that various structural economy effects (preferences for smaller structures over larger ones and for fewer structures over more) follow from constraint interaction. Also addressed are economy effects that involve the deletion of input structure, including foot-sized maximum effects in truncation and syllable-sized and segment-sized maximum effects in reduplication. OT's economy constraints of the *STRUC family are argued to produce unattested patterns under re-ranking and are excluded from CON as a matter of principle.

Chapter 3 examines metrical syncope in Hopi, Tonkawa, and Southeastern Tepehuan. Different patterns fall out from the interaction of the same metrical markedness constraints in language-specific rankings. All of these constraints have other, non-economy effects—in principle, they can be satisfied by the addition of structure as well as by removal of structure. Metrical shortening and syncope remove marked structure, not all structure: the well-formedness of an output is determined by the distribution of weight in its feet and exhaustivity of footing, not by the number of syllables, moras, and feet.

Chapter 4 examines differential syncope in Lillooet, Lushootseed, and the Lebanese and Mekkan dialects of Arabic. Under the leniency hypothesis, there are constraints against low-sonority syllable nuclei and foot peaks but not high-sonority ones; likewise, there are constraints against high-sonority foot margins but not high-sonority vowels in general. The interaction of lenient constraints cannot duplicate the effects of economy constraints. There are real crosslinguistic asymmetries in attested differential syncope patterns that can only be explained if we abandon the notion that "everything is marked."

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# CHAPTER 1

# INTRODUCTION

## 1.1 Introduction

This dissertation argues that in Optimality Theory (Prince and Smolensky 1993), economy effects follow from the interaction of independently motivated constraints rather than from special economy principles. This theory of economy effects relies on the idea that constraints in CON are limited in what they can ban: no constraint can ban the least marked non-null thing along some particular dimension of markedness.

The interaction of independently motivated constraints in OT is rich enough to account for observed economy effects, whereas economy constraints contribute nothing to the understanding of these processes. In addition to being unnecessary, economy constraints can be shown to be a further imposition on the theory, since their presence in the grammar predicts unobserved patterns that remove structure without regard for markedness.

While a range of economy effects is addressed, the empirical focus is on syncope. I show that the various vowel deletion processes that are collectively referred to as "syncope" belong to a larger class of phenomena, some of which do not involve deletion at all. A constraint that is satisfied by syncope in one language may be satisfied by featural change, augmentation, or an altogether different process in another language.

This chapter presents an outline of the thesis. Section 1.2 summarizes the formal aspects of the proposal, §1.3 discusses economy effects, and §1.4 discusses syncope.

Section 1.5 addresses the status of economy principles in the present theory, and §1.6 is a summary outline of the chapters.

## 1.2 <u>Theory of CON</u>

### 1.2.1 Introduction: lenient markedness

The theory of economy effects that I propose relies on the idea that markedness constraints are *lenient*: at least one non-null structure will not violate any markedness constraints on a given dimension of markedness. For example, whereas nasal vowels are marked, oral vowels are not, which means that there is a constraint *NASALV in CON but there is no constraint against oral vowels or all vowels.

The central consequence of this theory of CON is that constraints are limited in what they can ban; the idea that "everything is marked" is expressly rejected. Nihilistic constraints of the *STRUC family (Prince and Smolensky 1993, Zoll 1993, 1996) are excluded from CON as a matter of principle.

### 1.2.2 Harmonic scales and Lenient Constraint Alignment

The theory is formally implemented by deriving all markedness constraints from harmonic scales. Harmonic scales arrange linguistic entities in the order of markedness; for example, nasal vowels are more marked than oral vowels. The following harmonic scale encodes this ("$\succ$" stands for "is more harmonic than"):

(1) *Vowel nasality harmonic scale*: oral vowel $\succ$ nasal vowel

Every markedness constraint comes from a scale, but not every level on a scale corresponds to a markedness constraint. This is the heart of the lenient proposal: markedness constraints violate things that are marked on harmonic scales, but no constraint penalizes the least marked element. Based on (1), there will be a constraint against nasal vowels but not one against oral vowels:

(2) Markedness constraint based on (1): *NASALV
There is no constraint *ORALV or *V

For longer scales, the same is true: no constraint can penalize the least marked member of a scale, but all other members will violate constraints. For example, Prince and Smolensky's (1993) familiar sonority-based syllable peak harmony scale corresponds to the following constraint hierarchy:

(3) *Syllable peak harmony scale*: nuc/a ≻ nuc/ i ≻ ... nuc/s ≻ nuc /t
(4) *Syllable Peak Constraints:* *NUC/t>> *NUC/s.... >>*NUC/i
There is no constraint *NUC/a

All constraints are derived from scales by what I call Lenient Constraint Alignment, which is a modified version of Prince and Smolensky's Constraint Alignment. The difference is that under Lenient Constraint Alignment, the least marked thing on every scale, $a_n$, escapes constrainthood:

(5) **Lenient Constraint Alignment**
The Constraint Alignment of a harmonic scale $a_n \succ a_{n+1} \succ \ldots a_{m-1} \succ a_m$ is the constraint hierarchy $*A_m >> *A_{m-1} \ldots >> *A_{n+1}$.

The scales must meet certain requirements as well. The most important of these is the following principle:

(6) NOZERO: no scale containing *x* implies that $\varnothing \succ x$.

This principle requires scales to express non-trivial harmonic relations: no structure can be so marked that the only thing better than it is the absence of structure. In other words, scales can express the markedness of one structure relative to another but they cannot express economy.

### 1.2.3 Economy effects through constraint interaction

Crucially, while no markedness constraint is set up to favor ∅ above all other structures, a constraint ranking can still do so under certain circumstances. For example, if the ranking of faithfulness constraints prevents a marked structure from mapping to an unmarked structure, the only option may be mapping to ∅:

(7) Mapping to ∅ in the lenient model

| /x/ | IDENT [x] | *X | MAX |
|---|---|---|---|
| a. ☞∅ | | | * |
| b. x | | *! | |
| c. y | *! | | |

The constraint *X in (7), which might be based on a scale $y \succ x$, is satisfied equally well by either *y* or ∅, but IDENT[x] prevents *x*'s mapping to *y*. The only option under this ranking is for *x* to map to ∅. This is an economy effect: in this particular grammar, ∅ is preferred to *x*. In a grammar with a different ranking, say, {MAX, *X} >> IDENT[x], *x* would map to *y*, and no economy effect would be observed. Thus, the same markedness constraint produces an economy effect in one language but a featural change in another. Depending on the nature of *X and its interaction with other constraints, still other effects may be possible that may not involve unfaithfulness at all.

In a case like (7), it is the ranking that favors ∅ over *y*—not a constraint. This sort of effect is characteristic of Optimality Theory: results come from constraint interaction rather than from adding new constraints to the constraint set.

## 1.3 <u>Economy effects</u>

### 1.3.1 Introduction: kinds of economy effects

The basic recipe for economy effects outlined in §1.2.3 is simple, but constraint interaction in OT can be complex. I argue that constraint interaction provides all the complexity that is required to explain a wide range of economy effects.

The term "economy" traditionally refers to the preference for smaller structures and shorter derivations (Chomsky 1989, 1995). Economy effects in phonology result when the hierarchical structure imposed on the output is minimal, or when structure that was present in the input is deleted in the output. An example of the first kind of economy effect is non-iterative foot parsing, where only one foot is built even though several are possible. An example of the second kind of economy effect is truncation, as in *psychology* → *psych*.

### 1.3.2 Economy effects and unfaithful mappings

Limited structure building effects involve competing structural analyses of the same segmental string—e.g., /patakata/ → $(pata_{Ft})ka.ta$ vs. $(pata_{Ft})(kata_{Ft})$. The competition between such alternative parses is decided by markedness constraints—see §2.3.2 for details and examples of such effects.

The central focus of the dissertation is on economy effects that involve unfaithful mappings. Deletion makes the output visibly shorter compared to the faithful parse. The need for an adequate analysis of such effects goes beyond a desire for a parsimonious theory where abstract structure is assigned only "where needed" (cf. Chomsky 1991, 1995 on the assignment of N' structure in syntax). Here, I discuss two kinds of economy effects that involve unfaithful mappings: prosodic morphology effects (McCarthy and Prince 1986, 1993b, 1999) and syncope (§1.4).

The theory of Prosodic Morphology (McCarthy and Prince 1986, 1993b, 1999) provides tools for the understanding of truncation in hypocoristics (e.g., *Edelbert* → *Bert*), child speech (e.g., *banana*→ *nana*), and maximal word effects. The common feature of all of these processes is that their output is a prosodic word that contains at least and at most a binary foot.[1] As McCarthy and Prince's (1994a) show in their analysis of reduplicant disyllabicity in Diyari, these "one-foot-per-word" effects result from the interaction of constraints on metrical foot parsing that penalize unfooted syllables, degenerate feet, and iterative footing; no special templatic constraints or economy principles are needed.

Another area where restricting size has been an issue is in cases where reduplication copies as little as possible of the base—a segment if possible, a syllable if necessary. Under the assumption that reduplication is copying of the base that is regulated by faithfulness constraints (McCarthy and Prince 1995), failure to copy all of the reduplicant can be seen as a kind of deletion—in other words, an economy effect. Minimal reduplication has sometimes been used as evidence of economy constraints (Feng 2003, Riggle 2003, Spaelti 1997, Walker 1998, 2000), but I suggest that there is an alternative to the economy analysis: paradigm uniformity. What limits the size of the reduplicative suffix is the requirement that the reduplicated form be as similar as possible

[1] An interesting departure from this sort of pattern is found in Maori, where the word can contain some syllables in addition to the single foot but unfooted syllables are limited in number—see chapter 2 and de Lacy 2002b for a prosodic morphology analysis.

to the non-reduplicated base; the less is copied, the fewer violations of Output-Output faithfulness (Benua 1997) are incurred. I argue that the OO-faithfulness analysis has an advantage—it explains why size restrictions below the foot only hold of affixes but not of stems. This is not a prediction of the economy analysis—since anti-syllable economy constraints apply to all forms regardless of their paradigmatic status, we would expect to find some languages where even stems are limited to a single light syllable or even a single segment. Such languages are unattested.

Minimal copying in reduplication and "one-foot-per-word" effects are discussed in more detail in chapter 2 along with haplology, phonological word "wrapping," the harmony of the monosyllabic (H) foot, and others. The chief focus of chapters 3 and 4 is on the vowel deletion processes collectively known as syncope.

## 1.4 Metrical and differential syncope

### 1.4.1 Introduction

Syncope phenomena offer a particularly fertile ground for the study of economy effects, since examples are numerous and the interactions complex. An example of syncope from Hopi is given in (8). The syncopating vowels are underlined in the inputs:

(8) Some examples of syncope in Hopi (Hill et al. 1998, Jeanne 1978, 1982)

| | | | | | | |
|---|---|---|---|---|---|---|
| a. | /soma-ya/ | sómya | 'tie, pl.' | cf. | sóma | 'tie, sg.' |
| b. | /tooka-ni/ | tókni | 'sleep, future' | cf. | toóka | 'sleep, non-future' |
| c. | /navota-na/ | na.vót.na | 'inform, tell' | cf. | navóta | 'to notice' |

Such deletion shortens the output as compared with the faithful parse—cf. *tók.ni* and **too.ka.ni*. Correspondingly, it has frequently been attributed to economy rules and principles: deletion is assumed to apply wherever possible, but it is blocked by syllable structure constraints (Kisseberth 1970b), the OCP (McCarthy 1986), and so on.

The view advocated here is that a unified theory of syncope is impossible. The only thing all vowel deletion phenomena have in common is that a mapping has occurred that violates MAXV. There is no anti-vowel constraint *V (Hartkemeyer 2000) or anti-syllable constraint *STRUC(σ). There is also no demonstrable unity to vowel deletion processes; we might dub this "homogeneity of process/heterogeneity of target."[2] Thus, on the one hand, we find languages where syncope is one among several processes that achieve the same output target. Here, a single markedness constraint dominates several other constraints, MAXV among them:

(9) *Syncope is one among several processes*: M >> $F_1$>>MAXV>>$F_2$

On the other hand, we also find languages with a single syncope process that achieves several different output targets. Here, MAXV is dominated by several different markedness constraints.

(10) *Syncope achieves different goals*: {$M_1$, $M_2$, $M_3$}>>MAXV

In OT, this situation is not surprising or unexpected—it would indeed be surprising if syncope were a uniform process.

### 1.4.2 Metrical syncope

Chapter 3 examines a group of cases that might be collectively dubbed "metrical syncope," since they are analyzed as the interaction of metrical footing constraints with MAXV. All three languages that are analyzed in this chapter also have vowel shortening, which is an economy effect of sorts: its result is a reduction in the number of moras, compared to the faithful parse.

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[2] This is the opposite of "homogeneity of target/heterogeneity of process," a term that McCarthy 2002b uses to refer to conspiracies (Kisseberth 1970a).

Hopi, Tonkawa, and Southeastern Tepehuan differ in several systematic ways. Tonkawa and Southeastern Tepehuan have iterative syncope, while in Hopi only one vowel per word is deleted. In Hopi and Southeastern Tepehuan, vowel deletion applies after long vowels, while in Tonkawa it does not. All of these differences receive a principled explanation under the hypothesis that syncope and shortening are ways to avoid marked metrical configurations: unfooted syllables, stressed light syllables, unstressed heavy syllables, and so on. Whether and where vowels delete depends on the ranking of the relevant metrical constraints in the language.

In the case of Hopi (see (8)), the output of syncope satisfies SWP, or the requirement for stressed syllables to be heavy[3] (cf. *sóm.ya* ~ **so.má.ya*, *na.vót.na* ~ **na.vó.ta.na*), but syncope applies even in cases where the faithful candidate would satisfy SWP, i.e., after long vowels. Syncope after long vowels minimizes the number of syllables outside the main stress foot. All three winners (11) have the same structure: a single iambic foot with a heavy head, (H) or (LH), followed by one light unfooted syllable, L:

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[3] SWP, PARSE-σ, and NONFINALITY will be defined and provided with their harmonic scales in chapter 3.

(11) Hopi syncope, in brief

| | | SWP | PARSE-σ | MAXV |
|---|---|---|---|---|
| /soma-ya/ LL-L | a. ☞ (sóm)ya (H) L | | * | * |
| | b. (so.má)ya (LL)L | *! | * | |
| /tooka-ni/ HL-L | c. ☞(tók)ni (H)L | | * | * |
| | d. (tóo)ka.ni (H)LL | | **! | |
| /navota-na/ LLL-L | e. ☞(na.vót)na (L.H)L | | * | * |
| | f. (na.vó)ta.na (LL)LL | *! | ** | |
| | g. (náv)ta.na (H)LL | | **! | * |

The only reason Hopi has syncope rather than stressed syllable lengthening or post-stressed consonant gemination, as in many other iambic languages (see Hayes 1995 and chapter 3 for examples), is that MAXV is dominated by DEP. Likewise, PARSE-σ is satisfied by deletion (of vowels) in Hopi but by the addition of structure (feet) in Tonkawa—the difference here is due to the ranking of PARSE-σ with respect to constraints against iterative footing. (For detailed analyses, see chapter 3).

What these languages do not provide is evidence of syllable economy. Neither syllables nor vowels are in any way marked in these languages. Analyses in terms of economy constraints cannot explain exactly how syncope works without appealing to additional mechanisms. For example, in Hopi, the second vowel deletes in /LLL/ words but the third in /LLLL/ words. In the prosodic analysis, the asymmetry is explained by appealing to NONFINALITY: most iambic languages avoid final stress (Hung 1994), so the third vowel cannot be deleted in /LLL/ words. In a syllable economy analysis, this asymmetry is a mystery—why delete the third vowel in /navota-na/, yielding the trisyllabic output *na.vot.na*, when you can delete the second and the fourth vowels and get a disyllabic output, **nav.tan*? Economy analyses of metrical syncope must appeal to prosodic constraints to function, but prosodic analyses do not require economy constraints.

In chapter 3 I also show that economy constraints are not only unnecessary but also harmful: their very presence in the grammar predicts unattested patterns. No metrical constraint distinguishes between the iambic feet (H) and (LH)—they are equally well-formed, all other things equal. Yet in terms of economy, (H) is better—it contains only one syllable, compared to (LH)'s two. The prediction of a theory that has syllable economy is that some languages should map /LH/ to (H), as in /pataa.../ → (pát)..., not *(pa.táa)... This sort of pattern is unattested, and it can only be ruled out if economy constraints are excluded from CON.

### 1.4.3 Differential syncope

Chapter 4 addresses differential syncope patterns, where only a subset of a language's vowel inventory syncopates. Differential syncope is just like metrical syncope in being not one process but many. Some languages delete only vowels of low sonority, e.g., *ə* (Lillooet) or *i* (various dialects of Arabic), whereas other languages delete only vowels of high sonority, e.g., *a* (Lushootseed). An example of differential syncope of *i* from Lebanese Arabic is given in (12).

(12) Lebanese Arabic differential syncope (Haddad 1984)

a. High vowel syncope

| | | | |
|---|---|---|---|
| /nizi̱l-it/ | níz.lit | ‘she descended’ | cf. nízil |
| /ni̱zil-t/ | nzílt | ‘I descended’ | |

b. No syncope of /a/ in the same environment

| | | | |
|---|---|---|---|
| /saħab-it/ | sá.ħa.bit | ‘she withdrew (tr.)’ | *sáħ.bit |
| /xazaʔ-t/ | xazáʔt | ‘I tore’ | *xzáʔt |

Low- and high-sonority differential syncope do not exactly mirror each other. We find that *ə* and *i* often delete in a wide range of environments, their appearance largely controlled only by phonotactic constraints (as in Lillooet and Mekkan Arabic) or by high-ranking metrical constraints (as in Lebanese Arabic). Conversely, vowels like *a* only delete in specific environments; thus, in Lushootseed, *a* deletes only in environments where it must be unstressed (Urbanczyk 1996). This asymmetry follows under the view that not everything is marked. Consider the following constraint hierarchies and harmonic scales, formulated under Lenient Constraint Alignment:

(13) Constraints on the sonority of syllable nuclei (Prince and Smolensky 1993)
*Nuc/ə >> *Nuc/i,u >> *Nuc/e,o
*Nucleus harmony scale*: nuc/a ≻ nuc/e,o ≻ nuc/u,i ≻nuc/ə
There is no constraint *Nuc/a

(14) Constraints on the sonority of vowels in strong branches of feet
*Pk$_{Ft}$/ə >> *Pk$_{Ft}$/i,u >> *Pk$_{Ft}$/e,o (cf. de Lacy 2002a, Kenstowicz 1996b)
*Foot Head (peak) scale*: Peak$_{Ft}$/a ≻ Peak$_{Ft}$/e,o ≻ Peak$_{Ft}$/u,i ≻ Peak$_{Ft}$/ə
There is no constraint *Pk$_{Ft}$/a

(15) Constraints on the sonority vowels in weak branches of feet
*Mar$_{Ft}$/a >> *Mar$_{Ft}$/e,o>>*Mar$_{Ft}$/i,u (cf. de Lacy 2002a, Kenstowicz 1996b)
*FtNonHead (margin) scale*: Mar$_{Ft}$/ə ≻Mar$_{Ft}$/u,i ≻ Mar$_{Ft}$/e,o≻ Mar$_{Ft}$/a
There is no constraint *Mar$_{Ft}$/ə

Since these hierarchies are formulated leniently, not one of them penalizes the entire range of vowels. The constraints in the hierarchy (13) ban a wide range of syllable nuclei, but they do not ban *a*. The highest-ranked constraint in (15) bans *a*, but only in the margin of a foot—i.e., in unstressed position. In chapter 4, I show that even if all of the constraints in (13)-(15) were high-ranked in a language, they still could not "gang up" and duplicate the effects of a general constraint against vowels, *V (Hartkemeyer 2000), or the effects of the economy constraint against syllables, *STRUC(σ) (Zoll 1993, 1996).

All of the constraints in (13)-(15) have motivation outside of syncope. The hierarchies in (14) and (15) have received a lot of attention recently—they are involved in the assignment of sonority-driven stress (de Lacy 2002a, Kenstowicz 1996b) and vowel reduction (Crosswhite 1999a), which are not economy effects at all. Likewise, the nucleus sonority hierarchy in (13) determines the course of syllabification (Dell and Elmedlaoui 1985, Prince and Smolensky 1993) and has been argued to determine the quality of epenthetic vowels in languages that epenthesize *a* (de Lacy 2002a).

Some of these effects coexist with syncope in the phonologies of the languages considered in chapter 4. Thus, Mekkan Arabic not only syncopates *i* but also epenthesizes *a*, showing that *i* is doubly marked: it deletes and it is not epenthesized. In Lushootseed, syncope of unstressable *a* is really just a minor aspect of the larger sonority-sensitive stress system: stress also retracts from *ə* to fuller vowels, *ə́* is replaced with a full vowel in stressed reduplicants, and unstressed *a* reduces to *ə* wherever deletion is not permitted. The same markedness constraints are involved in all of these patterns—economy effects are in no way special.

Chapter 4 also addresses the issue of vowels whose distribution is predictable from phonotactics, which I call "cheap vowels." An example of this is the distribution of schwa in Lillooet. In this language, every word must contain at least one vowel, and tautosyllabic clusters of sonorants are prohibited, as are sonority sequencing violations. Schwa surfaces only when its presence is required by these constraints:

(16) Lillooet schwa (van Eijk 1997)

| | | | | | |
|---|---|---|---|---|---|
| a. | təq | ‘to touch’ | cf. | tq-alk’əm | ‘to drive, steer’ |
| b. | $\check{x}^w$əm | ‘fast’ | cf. | $\check{x}^w$m-akaʔ | ‘to do smt. fast’ |
| c. | s-nəm-nəm | ‘blind’ | cf. | nəm’ə-nm-’əp | ‘going blind’ |

In OT, inputs are assumed to be unrestricted—this is known as Richness of the Base (Prince and Smolensky 1993). Cheap vowels cannot simply be banned from the input and inserted “where needed,” as they often are in rule-based analyses (Bobaljik 1997, Brainard 1994, and others). The grammar of Lillooet must work whether the input contains too many schwas or too few. If the input contains too many schwas, then they must be deleted, and if it contains too few, they must be inserted. Thus, schwas are both the most marked and the least marked vowels in the language: they must be marked to delete, and they must be unmarked to be epenthesized. The analysis I propose takes this duality of schwa to heart: I claim that it is the most marked *syllable nucleus* but the least marked *epenthetic vowel*. To this effect, I propose a hierarchy of constraints that ban epenthetic segments with too much prominence. According to these constraints, highly sonorant vowels must be recoverable (cf. Alderete 1999, Steriade 1995):

(17) REC/a>>REC/e,o>>REC/i,u

RECOVER/x: “A syllable nucleus with the prominence *x* must have a correspondent in the input.”

The interaction of these constraints with the *NUC/x hierarchy in (13) can produce a pattern where the vowels of lowest sonority (e.g., *ə* and *ɨ*) have the “cheap vowel” distribution, but this interaction cannot produce a pattern where only *a* is a cheap vowel.

This, too, turns out to be an area where the lenient theory differs from the "everything-is-marked" theory: I show that once economy theory is enriched enough to deal with rich outputs, it can produce a grammar where only *a* syncopates and is inserted and other unattested patterns.

### 1.5 Economy principles

The argument against economy principles and constraints is two-pronged. On the one hand, economy effects follow straightforwardly from the interaction of independently motivated constraints, as long as these constraints are properly understood. This makes economy principles superfluous—they do not contribute anything to the understanding of economy effects and should be excluded from the theory by Ockham's Razor. On the other hand, economy constraints are dangerous in OT: their very presence in the grammar predicts unattested patterns that independently motivated constraints cannot produce. This requires that they be excluded from the theory.

In the Lenient model of CON, economy constraints are excluded as a matter of principle. On the one hand, they cannot be based on any harmonic scale that satisfies the NOZERO principle, since they almost by definition imply that ∅ is more well-formed than any other structure. For example, *STRUC(σ) really expresses the harmonic relationship $\varnothing \succ \sigma$, but this is not a possible harmonic scale in the theory. On the other hand, since no constraint can ban the least marked member of the harmonic scale, I show that another class of economy constraints is also excluded from CON: nihilistic constraints against highly sonorant nuclei, voiceless obstruents, oral vowels, and other unmarked things (cf. Clements 1997).

Yet another class of constraints whose membership in CON is put into question is gradient alignment constraints. While gradient alignment constraints are not, strictly speaking, *STRUC constraints, they have certain properties of economy constraints—for one thing, they can "count" syllables, feet, moras, and so on. Their ability to count necessitates harmonic scales of infinite length, which are an impossibility in a finite CON.

## 1.6 Outline of the thesis

The thesis is organized as follows. Chapter 2 presents the theory of CON and shows how several kinds of economy effects follow from the interaction of leniently formulated constraints. *STRUC constraints receive a formal definition under this theory and are excluded as a matter of principle.

Chapter 3 contains detailed analyses of Hopi, Tonkawa, and Southeastern Tepehuan and discusses some aspects of the theory of metrical parsing that is assumed in these analyses.

Chapter 4 contains case studies of Lillooet, Lebanese Arabic, Mekkan Arabic, and Lushootseed. In addition to discussing differential constraint hierarchies, the chapter contains a proposal for epenthetic vowel quality. The differences in the typological predictions of the present theory and "everything-is-marked" theories are discussed at length.

# CHAPTER 2

# MARKEDNESS, ECONOMY, AND *STRUC

## 2.1 <u>Introduction</u>

In Optimality Theory (Prince and Smolensky 1993), to be marked means to violate a markedness constraint. Yet without formal restrictions on the content of markedness constraints, practically everything can be and sometimes is assumed to be marked. In this chapter, I propose an amendment to this view. I argue that markedness constraints are limited in what they can assign violation marks to—for every markedness constraint, there is at least one non-null structure that fully satisfies it. In this sense, markedness constraints are *lenient*.

This view is formally implemented as a theory of the constraint module CON. Markedness constraints are derived from harmonic scales that compare non-null structures with each other. No markedness constraint penalizes the most harmonic element on a scale, and no harmonic comparison is nihilistic. This means that no individual constraint is set up to prefer the absence of structure to every other alternative—there are no economy constraints in the grammar.

Although no individual constraint is an economy constraint, the interaction of constraints in a language-specific grammar can result in what appears to be minimization of structure—that is, *economy effects*. Yet there is nothing about economy effects that would suggest an overarching "principle of least effort" or general economy principle—the effects can always be reduced to the interaction of independently motivated constraints. These constraints can be shown to have other effects in the grammar—effects that do not result in economy of any kind. The reason for this is that every marked configuration can be avoided in a variety of ways—McCarthy (2002b) dubs this property of OT grammars *homogeneity of target, heterogeneity of process*. Deletion of structure is just one way to remove a marked configuration, but because there is always a less marked thing out there, *change* of structure should also be an option.

This view of economy effects is not universally accepted. Formal economy principles are often thought to be a necessary property of generative grammar because human language is recursive, which means that grammars must be able to produce structures of unbounded size. To limit this troubling but necessary ability, both syntacticians and phonologists have relied on economy principles, which range from the very general "Avoid Structure" (Rizzi 1997) to the fairly specific constraint against syllables *STRUC(σ) (Zoll 1993, 1996), its precursor the Syllable Minimization Principle (Selkirk 1981), and many others.[4]

One of the consequences of the present proposal is that economy constraints like *STRUC(σ) are excluded from CON as a matter of principle. This turns out to be a wecome result, because economy constraints are redundant in the theory where all economy effects result from constraint interaction. Not only are economy constraints redundant—

[4] For discussion of economy principles in syntax, see Chomsky and Lasnik 1977, Chomsky 1989, 1995, Grimshaw 2003, Poole 1998, Woolford 1995, and various papers in Barbosa et al. 1998. For discussion of economy principles in phonology, see Broselow 1995, Lindblom 1983, McCarthy 2002b, Noske 1984, Prince and Smolensky 1993/2002, Zoll 1993, 1996. For various applications of *STRUC constraints, see Causley 1997, Davis and Zawaydeh 1996, de Lacy 1999, Fukazawa 1999, Hewitt and Crowhurst 1996, Orgun 1996, Prince and Smolensky 1993/2002, Raimy and Idsardi 1997, Selkirk 2000, Truckenbrodt 1999, Walker 2003, Zoll 1993, 1996. Several of these works will be addressed in some detail in the coming pages.

they are also harmful. Their very presence in CON predicts that certain deletion processes should target structure that is unmarked (e.g., syllables regardless of metrical context), and this prediction is not supported by typological evidence.

This proposal for the reformation of CON puts another set of constraints in a questionable position: gradient alignment constraints (McCarthy and Prince 1993a, Prince and Smolensky 1993). Although gradient alignment constraints are not formally equivalent to economy constraints, their effects are very similar—both sets of constrains can keep track of the lengths of outputs. Some of the typological arguments against *STRUC constraints readily extend to alignment constraints. Interestingly, the present theory encounters some difficulty in relating alignment constraints to scales—they require either scales of infinite length or additional formal mechanisms. Thus this work adds to the arguments of McCarthy (to appear) that gradience cannot be a property of OT constraints.

The rest of the chapter is organized as follows. Section 2.2 presents the theory of the constraint set CON and discusses some of its implications for the formulation of constraints. In §2.3, I show how the interaction of independently motivated constraints produces a wide range of economy effects, and in §2.4 I provide a formal definition for *STRUC constraints and show how and why they should be excluded from the theory. Section 2.6 concludes.

## 2.2 The theory of CON: scales and Lenient Constraint Alignment

### 2.2.1 Introduction

Markedness is a matter of comparing non-null forms to each other rather than an abstract, platonic property: no form is marked except insofar as it compares to another non-null form.[5] Null structures vacuously satisfy all markedness constraints—they do not need to be specially favored by them. This section presents a theory of the constraint module CON that formally develops this idea. The theory has two components. First, all markedness constraints must be derived from harmonic scales and can never penalize the least marked member on a scale—they are lenient. Second, the scales themselves must meet certain requirements: they cannot imply that ∅ is more marked than a non-null form.

In the remainder of this section, I start by looking at harmonic scales and harmonic alignment of Prince and Smolensky 1993, which forms an important background to the proposal. Section 2.2.4 presents Lenient Constraint Alignment and §2.2.5 lays out the principles that harmonic scales must obey. Section 2.2.6 explores some of the issues in relating various kinds of markedness constraints to scales. Section 2.2.7 discusses the Null Output, which plays an important role in the proposal, and addresses its status in the present theory.

### 2.2.2 Harmonic scales

Optimality Theory does not necessarily offer guidelines for what markedness constraints can militate against, though a constraint's validity can be tested by examining the typological consequences of introducing it into CON. The theory of CON developed here looks at markedness constraints from another angle. Whether or not M is a valid constraint depends on the harmonic comparisons it implies; some comparisons are argued

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[5] The proposal developed here is quite distinct from Comparative Markedness (McCarthy 2002c):

to be invalid. For every constraint, the markedness comparison must be encoded in a *harmonic scale*.

A harmonic scale orders linguistic entities along some dimension of markedness (Prince and Smolensky 1993). For example, nasal vowels are universally more marked than oral ones (McCarthy and Prince 1995). This is reflected in the following binary harmonic scale ("≻" means "is more harmonic than"):

(1) *Vowel nasality scale*: oral vowel ≻ nasal vowel

Similarly, voiced obstruents are universally more marked than voiceless ones (Lombardi 1995, 2001), which can also be stated in terms of a scale:

(2) *Obstruent voicing scale*: voiceless obstruent ≻ voiced obstruent

Harmonic scales are not new or unique to this theory. Prince and Smolensky 1993 introduce harmonic scales that encode the relative well-formedness of syllable onsets (margins) and nuclei (peaks) depending on their sonority; the more sonorant a nucleus, the better. For onsets, the opposite is true:

(3) *Peak harmony scale*: pk/a ≻ pk/ i ≻ ... ≻ pk /t

(4) *Margin harmony scale*: m/t ≻ ... ≻ m/i ≻ m/a

These scales are derived from *prominence scales*. *Prominence scales* are not statements of markedness; rather, they are orderings of linguistic entities according to salience. For example, a syllable peak is a more prominent position than a syllable margin, and a sonorant segment is more prominent than an obstruent (">" stands for "is more prominent than"):

(5) *Peak/margin prominence scale*: peak > margin

(6) *Sonority scale*: a > i > ... > t

There is a preference for prominent positions to be occupied by prominent segments, and vice versa. The formal mechanism Prince and Smolensky devise for capturing this preference is called *Harmonic Alignment*:

(7) Suppose given a binary dimension $D_1$ with a scale X > Y on its elements {X, Y}, and another dimension $D_2$ with a scale a > b > … > z on its elements. The *harmonic alignment* of $D_1$ and $D_2$ is the pair of Harmony scales:

$H_X$: X/a ≻ X/b ≻… ≻X /z [more harmonic … less harmonic]

$H_Y$: Y/z ≻… ≻Y/b ≻ Y/a (Prince and Smolensky 1993:155)

Harmonic Alignment has been used extensively in OT to derive harmonic scales—it has been applied to sonority and stress (Kenstowicz 1996b), syntactic person and subject/object (Aissen 1999, Artstein 1998), and tone (de Lacy 2002b).

So, some harmonic scales are primitive (e.g., the vowel nasality scale and the obstruent voicing scale), while others are derived by Harmonic Alignment.[6] Primitive scales may be based on substantive principles: nasal vowels are perceptually weaker than oral ones, while voiced obstruents are marked for aerodynamic reasons. Apart from expressing linguistically sound tendencies, scales must meet certain formal requirements—these will be discussed in §2.2.5. I now turn to the procedure for mapping harmonic scales to constraints.

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[6] De Lacy (2002a) lays out some principles for determining which scales are derived and which are primitive. In his theory, featural markedness scales (e.g., vowel nasality) never combine with structural elements for the purposes of constraint construction, while prominence scales (e.g., sonority) always do. This is basically what I assume here.

### 2.2.3 The Constraint Alignment of Prince and Smolensky 1993

Harmonic scales are not constraints: they cannot evaluate candidates and they cannot interact with other constraints in a ranking. For creating constraints from harmonic scales, Prince and Smolensky 1993 propose a different operation: Constraint Alignment (defined in (8)). Constraint Alignment assigns each element on a harmonic scale to a negatively stated markedness constraint. The result is a fixed hierarchy of constraints, whose order is the reverse of the relevant harmonic scale.

(8) The *constraint alignment* is the pair of constraint hierarchies:

a. $C_X$:*X/Z >> … *X/B >> *X/A [more marked >> … >> less marked]
b. $C_Y$:*Y/A >> *Y/B >>…>>*Y/Z (Prince and Smolensky 1993:155)

When this version of Constraint Alignment applies to the peak/margin hierarchies, it yields the following two constraint hierarchies:[7]

(9) *Peak constraints*: *NUC/t>>...>>*NUC/i >>*NUC/a

(10) *Margin constraints*: *ONS/a>>*ONS/i>>...>>*ONS/t

From the vowel nasality scale, a binary hierarchy is produced, where the constraint against unmarked oral vowels is universally ranked below the constraint against nasal vowels:

(11) *NASALV>>*ORALV (McCarthy and Prince 1995)

Fixed rankings are not a necessary aspect of this theory of markedness—the same markedness relationship can be expressed through constraints in a stringency relation (de Lacy 2002a, Prince 1997a). De Lacy proposes a version of Constraint Alignment that

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[7] Prince and Smolensky call the constraints *P/x and *M/x instead of *NUC/x and *ONS/x. I will use *NUC/x and *ONS/x throughout to distinguish the syllable peak/margin constraints from the foot peak/margin constraints (Kenstowicz 1996b).

produces not fixed rankings but rather stringent constraint hierarchies, which impose the same harmonic orderings on the candidate set even when their ranking is permuted. For example, based on the obstruent voicing scale, there will be two constraints formulated in such a way that their ranking never results in voiceless obstruents being more marked than voiced ones, as shown in (12). The relative markedness of voiced and voiceless obstruents is invariant under re-ranking: regardless of the ranking of *VOICEDOBS and *OBS, the voiceless obstruent candidate incurs fewer constraint violations and is therefore universally less marked.

(12) Stringent constraints: {*VOICEDOBS, *OBS}

| | *VOICEDOBS | *OBS |
|---|---|---|
| a. pa | | * |
| b. ba | * | * |

Whether these hierarchies are freely rankable or in a fixed ranking, they share a common feature: the hierarchies contain constraints against the least marked thing on the scale. *OBS or *VOICELESSOBS are essentially economy constraints—they have no other purpose but to penalize unmarked structure (I will return to constraints of this sort in §2.5). I propose to modify Constraint Alignment so that constraints against the unmarked are excluded from CON as a matter of principle.

### 2.2.4 Lenient Constraint Alignment

In the model of CON advocated here, all markedness constraints are derived from harmonic scales by an operation similar to Prince and Smolensky's Constraint

Alignment.[8] The difference is that every element on every scale has a corresponding markedness constraint against it except for the least marked one. The least marked element on every scale gets an "exemption." This *Lenient* Constraint Alignment is defined as follows:

(13) **Lenient Constraint Alignment**
The Constraint Alignment of a harmonic scale $a_n \succ a_{n+1} \succ \ldots\ a_{m-1} \succ a_m$ is the constraint hierarchy $*A_m >> *A_{m-1} \ldots >> *A_{n+1}$.

The most harmonic member of every scale, $a_n$, does not correspond to any constraint. The lowest-ranked constraint in the hierarchy militates against the next most harmonic member, $a_{n+1}$. This is the chief difference between (13) and Prince and Smolensky's version.

To see how LCA works, consider the obstruent voicing scale. The least marked element in the scale is *voiceless obstruent*. According to LCA, every element in the scale except the least marked one is assigned to a markedness constraint. There is only one such element in the scale, *voiced obstruent*, so only one constraint is derived: *VOICEDOBS. The unmarked element in the scale, *voiceless obstruent*, has no corresponding markedness constraint against it.

(14) *VOICEDOBS: *[+voice, -son] "voiced obstruents are prohibited."
*Harmonic scale:* voiceless obstruent $\succ$ voiced obstruent

When LCA applies to a longer scale, the result is the same: the constraint against the least marked element in the peak harmony scale, low vowels, is left off the resulting constraint

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[8] In a footnote on p. 453, Ito and Mester 1997 suggest that constraints may be "formally understood as zero-level preference relations holding between linguistic structures." This is exactly what Lenient Constraint Alignment allows us to do.

hierarchy. For syllable onsets, the result is the same: the scale does not contain a constraint *NUC/t against voiceless obstruent onsets.

(15) *Syllable Peak Constraints:* *NUC/s>> *NUC/n.... >>*NUC/i
*NUC/a is not a constraint

(16) *Syllable Margin Constraints*: *ONS/a>>...*ONS/n>>*ONS/s
*ONS/t is not a constraint

This approach formalizes an intuition that other researchers have expressed: constraints should penalize only marked things. For example, Clements 1997 voices a concern about "anti-tendency" constraints like *NUC/a and *ONS/t:

(17) ...Voiceless stops are optimal syllable margins across languages; all known languages syllabify voiceless stops as margins in at least some circumstances, and the great majority do in all circumstances. We might say instead that this constraint expresses an *antitendency*—the contrary of a universally observed tendency—which is regularly and consistently violated in all known languages...[*NUC/a] encapsulates the statement that 'members of sonority class *a* [low vocoids] must not be parsed as a syllable Peak.' This statement ... expresses an antitendency, since low vocoids constitute the optimal representative of the class of syllable peaks across languages.[9] (Clements 1997:299-300)

In the same vein, Pater 1997 excludes the constraint against voiceless obstruent onsets from his onset sonority constraint hierarchy, and de Lacy 2002a argues (following Kiparsky 1994) that unmarked things are not protected by special faithfulness constraints, whereas marked things are.

[9] Clements actually goes on to add that constraints against consonantal margins and vocalic nuclei in general are "antitendency" constraints—e.g., languages don't usually balk at parsing most consonants as syllable margins, just as they do not shrink away from vocalic nuclei. There is some evidence of these constraints' activity. Pater 1997 discusses evidence for constraints against the more sonorant consonants as onsets in child speech, and there is also evidence from reduplication in adult languages such as Sanskrit (Steriade 1988). In chapter 4, I discuss various evidence for the constraints against low-sonority syllabic nuclei.

Kiparsky 1994 also discusses markedness constraints, although his approach is to doubly punish marked things rather than favor unmarked things—for example, he has constraints against labial and dorsal place and constraints against consonantal place in general. The latter constraint is not possible under Lenient Constraint Alignment, assuming that unmarked consonantal place is the least marked element on the place scale. Lenient Constraint Alignment ensures that unmarked things enjoy a special, markedness-free status in the grammar: they are literally unmarked because they do not violate the relevant markedness constraints.

Anchoring all constraints in scales brings up the issue of how the resulting constraints express hierarchical markedness relations—stringently or through a universally fixed ranking. This issue arises whenever a scale has three or more levels, i.e., when two or more constraints are derived from it. Since the arguments about stringency/fixed rankings are of little relevance to the topic of economy and would detract too much from the main concern of this chapter, I refer the reader to the extensive discussion in the works of Prince (1997b, 1997c, 1999) and de Lacy (1997, 2002a). What I will do here is provide a modified version of Constraint Alignment that is compatible with the stringent formulation of hierarchical constraints.

The stringency version of Lenient Constraint Alignment is based on de Lacy's schema for scale-referring markedness constraints, given in (18). De Lacy's definition maps every element in the scale to a markedness constraint. In the Lenient theory, the modification is to exclude the least marked element (see (19)).

(18) **Featural scale-referring markedness constraints (**de Lacy 2002a:30)

For every element *p* in every scale S, there is a markedness constraint *m*.
*m* assigns a violation for each segment that either
(i) contains *p*
or (ii) contains anything more marked than *p* in scale S.

(19) **Lenient Constraint Alignment (stringent version)**

For every element $a_i | i > n$ in scale S ($a_n \succ a_{n+1} \succ ... a_{m-1} \succ a_m$), there is a markedness constraint $C_M$.
$C_M$ assigns a violation to every element that
(i) contains $a_i$
or (ii) contains anything more marked than $a_i$ in scale S.

Given a scale X≻Y≻Z, (19) yields two constraints—one that penalizes only Z, one that penalizes Z or Y, and none that refer to X. Regardless of the ranking of *Z and *Z-OR-Y, candidate X emerges as the least marked, Y as more so, and Z as the most marked member of the set. No constraint penalizes X, Y, *and* Z:

(20) Stringent constraints generated by LCA

| | *Z | *Z-OR-Y |
|---|---|---|
| a. X | | |
| b. Y | | * |
| c. Z | * | * |

Just like the fixed ranking version of LCA (13), the stringent LCA maps every member of the scale to a constraint except for the least marked member.

Simply leaving the least marked member of every scale off of the resulting constraint hierarchy does not by itself rid CON of economy constraints—for that, the harmonic scales themselves must meet certain requirements. These requirements are discussed in the next section.

### 2.2.5 Requirements for harmonic scales

Formally, scales are defined as *partial orders*: they are irreflexive, transitive, and asymmetric.[10] A scale cannot state that something is more marked than itself, and it cannot reverse the markedness relation that it itself imposes. This means that scales of the following sort are illegitimate:

(21) Illegitimate scales

| | | |
|---|---|---|
| a. | $\mathbf{x} \succ \mathbf{x}$ | (not irreflexive) |
| b. | $\mathbf{x} \succ \mathrm{y} \succ \mathrm{z} \succ \mathbf{x}$ | (not irreflexive or transitive) |
| c. | $\mathbf{x} \succ \mathrm{y} \succ \mathbf{x}$ | (not asymmetric or irreflexive) |

Second, scales cannot state that ∅ is less marked than another member of a scale.[11] (For now, I will use ∅ in an intuitive sense, to mean roughly "something unpronounced." A more precise definition will be given in §2.2.7.) Zero already satisfies all markedness constraints vacuously—including it in every (or any) markedness comparison introduces a perilous redundancy into the grammar. To formally exclude such redundancies, the following condition must hold of harmonic scales:

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[10] Irreflexivity: $\forall x(\neg Rxx)$; transitivity: $\forall x \forall y \forall z((Rxy \mathbin{\&} Ryz) \rightarrow Rxz)$; asymmetry: $\forall x \forall y(Rxy \rightarrow \neg Ryx)$(Partee et al. 1993). Asymmetry implies irreflexivity: if x is more marked than itself through transitivity, it is more marked than itself.

[11] I will restrict my attention to comparisons in the *unmarked* direction, though the question whether a comparison can imply that ∅ is more *marked* than something is an interesting one. Given my framework, a scale like $\varnothing \succ x$ can only give rise to a constraint *∅, which is a general "have structure" constraint. Constraints that demand the presence of specific structures are numerous, e.g., ONSET, FTBIN, PARSE-σ, or Grimshaw's (2003) OBHEAD and OBSPEC (see §2.3.4). Yet general constraints like *∅ may present a problem that is the opposite of Economy—Profusion. For my purposes, it is sufficient to require that ∅ be banned from the unmarked ends of a comparison, though it may be necessary to exclude ∅ from scales altogether. This does not exclude things like syntactic traces from scales—a trace can be defined as an empty projection that is contained in a projection together with some non-empty projections.

(22) NOZERO: No harmonic scale containing x implies that $\varnothing \succ x$.

Scales that disobey NOZERO include trivial binary comparisons ("∅ is better than a syllable"), zero-extended scales ("∅ is better than a voiceless obstruent, which is better than a voiced obstruent"), or the more bizarre zero-linked scales ("a trace is better than ∅, but ∅ is better than a non-empty projection").

(23) Illegitimate scales

a. $\varnothing \succ x$
b. $\varnothing \succ x \succ y$
c. $x \succ \varnothing \succ y$

NOZERO applies to both primitive and derived harmonic scales, though it applies to derived scales only vacuously: Harmonic Alignment is simply not set up to produce zero-extended scales. Recall from §2.2.2 that Harmonic Alignment applies to prominence scales, whose high end is occupied by a prominent segment such as a low vowel or a prominent position, e.g., the syllable peak. Zero cannot belong at the prominent end of a prominence scale, because *anything* is more prominent than ∅. As a result, ∅ can never be at the unmarked end of a harmony scale. As for primitive harmonic scales (such as the obstruent voicing scale) and the more formal scales (discussed in §2.2.6), these are prohibited from containing ∅ by (22).

The NOZERO principle might seem redundant if all scales can be stated in stringent terms. In a stringent scale, the unmarked is the superset of the marked. For example, in the stringent version of the vowel nasality scale, *vowel ≻ nasal vowel* ($V \succ V_{nas}$), the marked nasal vowels form a subset of all vowels (This way of looking at markedness is reminiscent of underspecification—see Archangeli 1984, 1988, McCarthy and Taub 1992, Pulleyblank 1988, Steriade 1995). Zero-extending the scale to $\varnothing \succ$ *vowel* $\succ$ *nasal vowel* violates the subset relationship, because $\varnothing$ is not a superset of *vowel*.

It is doubtful whether this approach can be extended to all scales, however. The problem is that once we move past the relatively simple featural markedness, stating scales in stringent terms becomes very difficult. For example, although nasal vowels are marked in general, they are not marked when adjacent to a nasal consonant. Conversely, oral vowels are in general unmarked, but they are marked when adjacent to a nasal consonant: $V_{nas}N$ is more harmonic than $V_{oral}N$. A non-stringent scale for this is straightforward: $V_{nas}N \succ V_{oral}N$. Stating this markedness relationship in stringent terms is a challenge—neither of the unmarked sequences is a superset of the marked. The same is true of many other markedness relationships—in the majority of cases, it is not possible to identify the marked structure by labeling it with a feature that the unmarked structure lacks. For this reason, the NOZERO principle is a necessary part of the theory.

Even though *scales* cannot state that $\varnothing$ is more harmonic than a non-null structure, a *ranking* can still select $\varnothing$ as the most harmonic candidate. This is a crucial aspect of the theory to which I will return in §2.2.7.2.

At this point, it is appropriate to consider a broader range of constraints and the harmonic scales on which they are based.

### 2.2.6 Relating markedness constraints to scales

The purpose of Lenient Constraint Alignment and the principles governing scales that were identified in §2.2.5 is to prevent constraints from penalizing all structure indiscriminately, as economy principles do. This theory of economy can only succeed if *all* constraints are derived from scales—otherwise there is no way to ban arbitrary anti-structure constraints like *STRUC(σ) from CON.[12] This subsection identifies some issues in relating various kinds of markedness constraints to scales.

Scales are the real primitive in this theory—constraints are not. Ultimately, finding appropriate scales for previously proposed constraints is a problem for the analyst, not for the theory proposed here. For the purposes of this proposal, scales are required to express the relative ill-formedness of a particular form or structure and give a viable non-null alternative to it, but exactly how this is done is a separate matter. In this section, I discuss some possible formulations of scales for paradigmatic, syntagmatic,[13] and alignment constraints, though it should be kept in mind that there is no general "recipe" for scales.

Paradigmatic constraints are context-free constraints that ban segments with certain combinations of features—for example, *ŋ, *FRONTROUNDV, *VOICEDOBS, and *NASALV. Scales for such constraints are not hard to find: they reflect the relative markedness of some feature combination, e.g., "front rounded vowels are more marked than front unrounded and back rounded vowels."

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[12] Alan Prince (p.c.) remarks that this is a necessary condition but not a sufficient one. Even if all constraints are lenient and derived from proper scales, it is also crucial that inputs be unrestricted. If inputs are restricted in any way, the theory will not achieve its results. For example, if the vowel inventory of a language is somehow artificially limited to {ɨ, y, ə}, the constraints against these vowels will act as economy constraints. For this reason alone, richness of the base must be a crucial assumption in the present theory. In chapter 4, I discuss cases where constraints against marked vowels interact with MAXV to produce economy effects, but these effects hold only over words that have such vowels—the rest of the language is unaffected precisely because inputs are unrestricted.

[13] The terms "syntagmatic" and "paradigmatic" in reference to constraint varieties are due to Pulleyblank 1997.

(24) *FRONTROUND "If a vowel is front, it is not round."
*Vowel rounding scale*: {[+front, -round], [-front, +round]} $\succ$ [+front, +round]

Syntagmatic, or context-sensitive constraints, are based on more complex scales. The levels of these scales are occupied not by simple feature combinations but by sequences of segments and by structural configurations. For example, the scale for ONSET must state that consonant-initial syllables are superior to vowel-initial syllables:

(25) *Onset scale*: $[_{\sigma}$C... $\succ$ $[_{\sigma}$V...

Syntagmatic (context-sensitive) constraints don't always refer to linear sequences of segments—many such constraints prohibit structural configurations. The scales for these constraints scales may be based on formal principles as opposed to the more phonetically oriented ones. For example, Cohn and McCarthy 1994/1998 derive the constraint[14] *(HL) from a scale based on the Grouping Harmony principle (Prince 1990). This scale shows a preference for a greater weight ratio between the second and the first syllable of a foot:

(26) GRPHARM, or *(HL)[15]
*Grouping Harmony scale*: (LH) $\succ$ (LL), (HH) $\succ$ (HL)

Again, just like the nasalization and onset scales, the Grouping Harmony scale orders structural configurations from most harmonic (LH) to least harmonic (HL). By Lenient

[14] H stands for "heavy syllable," L stands for "light syllable," and round brackets () are placed around feet throughout.

[15] Based on a ternary scale like Grouping Harmony, one would expect a constraint that bans HH and LL, as well. Cohn and McCarthy do not propose one. Of course, HH is ruled out by Prince's (1990) WSP. LL violates SWP (see §2.3.2.3 and chapter 3).

Constraint Alignment, there is a constraint against (HL), but none against (LH).[16] The scale in (26) contains all the necessary information for formulating a constraint: it describes the most marked configuration, (HL), and offers some viable alternatives to it, i.e., (HH), (LL), and (LH).

In addition to paradigmatic and syntagmatic constraints of the sort already discussed, a third subtype of markedness constraints has been proposed: Alignment constraints (McCarthy and Prince 1993a, Prince and Smolensky 1993). These raise a formal issue of some importance to scales. Alignment constraints evaluate forms gradiently: for example, ALL-FT-L (a.k.a. ALIGN (Ft, L, Wd, L)) assigns a violation mark for every syllable that separates the left edge of a foot from the left edge of a prosodic word. This gives Alignment an economy flavor: the longer the word, the worse its violations will be. (The economy potential of Alignment is well-known; see §2.3 and especially §2.5.2.2).

Interestingly, there is no straightforward way to relate Alignment constraints to harmonic scales. The problem is that gradient constraints of this sort are able to make an infinitely large number of markedness distinctions, and therefore they require scales of infinite length. Yet scales of infinite length are an impossibility in Optimality Theory: CON is finite, so scales must be as well (see McCarthy (to appear) for some related discussion).

Thus, the least marked element on the scale for ALL-FT-L is *not* null—it is a foot that is perfectly aligned (in this, alignment constraints differ from *STRUC constraints; see

[16] Which is not to say that LH is a universally well-formed foot. LH may be banned in a trochaic system by a high-ranked WSP, but it will never be ill-formed in an iambic system.

§2.5.2.2). Yet the scale does not end by stating that a misaligned form is more marked than a perfectly aligned form—it goes on to state that a perfectly aligned form is more harmonic than one misaligned by one syllable, which is in tern less harmonic than a form misaligned by two syllables, which is less harmonic than a form misaligned by three syllables, and so on *ad infinitum*.

(27) Gradient ALL-FT-L: $[_{PrWd}\ (_{Ft}... \succ [\sigma\ (_{Ft}... \succ [\sigma\sigma\ (_{Ft} ... \succ [\sigma\sigma\sigma\ (_{Ft} ... \succ ...$

The infinite scale problem is a distinctly different matter than a constraint's ability to order candidates according to their magnitude of violation of a categorical constraint. For example, the ONSET scale states that a consonant-initial syllable is more harmonic than a vowel-initial syllable. In ordering *candidates*, ONSET will impose the ordering {*a* ≻*a.a* ≻ *a.a.a* ≻ ...}, but as McCarthy (to appear) argues, the ability to keep track of multiple loci of violation is a necessary aspect of EVAL.[17] It is unnecessary and undesirable for *scales* to count loci of violation—it is sufficient that constraints do so.

It is possible to avoid the infinite scale problem by reformulating the scale in (27) in a more elegant form (see (28)). Note that this particular formulation distinctly resembles an economy principle, since size is a matter of comparison here:

(28) Gradient ALL-FT-L: $[_{PrWd}\sigma_n\ (_{Ft}... \succ [_{PrWd}\sigma_{n+1}\ (_{Ft} ...$

The *n~n+1* aspect of this scale is a property that scales for categorical constraints lack, since those constraints are finite orderings. Nothing in the present theory rules out scales like (28), but there are other ways of excluding them from CON: gradient alignment

[17] As Prince and Smolensky (1993) repeatedly emphasize, EVAL does not really "count," rather, it compares the magnitude of violation of a constraint by different candidates.

constraints violate McCarthy's (to appear) definition of an OT constraint. Prohibiting gradience at scale level is not formally necessary to exclude it from the theory.[18]

The issue is actually more general: what about scales of the form $\sigma \succ \sigma\sigma \succ \sigma\sigma\sigma \succ \sigma\sigma\sigma\sigma \succ ...$ or $\sigma_n \succ \sigma_{n+1}$ (where $n \neq \varnothing$)? Scales of this form will give rise to constraints that do not necessarily prefer ∅ to any other candidate but are still intuitively economy constraints—they favor smaller structures over larger ones.[19] The problem here is that scales of this sort have no formal or substantive grounding. In addition to meeting the formal requirements on scales set forth in the present theory, scales need to express real linguistic tendencies; there is not evidence that the markedness of a form is proportional to the number of syllables in it. Another problem with "counting" scales is that languages—to put it simply—do not count. For all of these reasons, "counting" scales cannot be a part of the grammar.

To anticipate the upcoming discussion, it may now be apparent that economy constraints cannot be readily derived from any legitimate scales. The hallmark of a true economy constraint is its preference for ∅ above all other structures along a particular dimension of markedness; e.g., to *STRUC(σ), ∅ is better than a syllable, and to *VLESSOBS, ∅ is better than an obstruent. This point will be made precise in §2.4.4, where I will show that all *STRUC constraints share a common property in their relation to scales and are thereby prohibited from CON under the Leniency hypothesis.

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[18] This problem with gradient constraints is not an issue in any of the case studies in this thesis—categorical constraints are used throughout. See §2.3.2.2 for an introduction to ENDRULE-L and ENDRULE-R, which take over some of the functions of ALLFT-L and ALLFT-R. The analyses in chapters 3 and 4 make extensive use of categorical constraints.

[19] Thanks to Andries Coetzee for bringing this to my attention.

In summary, this subsection examined some issues in relating different kinds of constraints to scales. For my purposes, scales simply state that some configuration is marked relative to at least one other. I applied this general approach to just a few context-sensitive and context-free constraints. In the chapters that follow, I provide scales for all the markedness constraints used in the analyses.

### 2.2.7 Null Outputs

#### 2.2.7.1 <u>Defining the Null Output</u>

The notion of a Null Output,[20] or ∅, is of great importance to the proposal, since scales in CON are prohibited from implying its relative well-formedness. This section discusses the structural nature of ∅ and addresses its status in the theory.

Formally, the Null Output can be a number of things: a prosodic structure that is segmentally empty, an output in which every input segment has been deleted, or a segmentally empty output that bears no correspondence to the input at all. What I will do here is talk about how the present theory can be reconciled with the various proposals regarding the nature of the Null Output, though the theory need not be committed to any one of these proposals.

Under Prince and Smolensky's Containment model of input-output mappings, material can never literally removed from the output, but it can be prosodically underparsed. Thus a candidate in which every segment is deleted is formally the same as an unprosodified segmental string. Under Containment, there is only one type of Null

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[20] The Null Output is often discussed in the context of absolute ill-formedness. For discussion and applications of the Null Output, see Bakovic and Keer 2001, Benua 1997, Cohn and McCarthy 1994/1998, Kager 2000, Legendre et al. 1998, McCarthy to appear, Orgun and Sprouse 1999, Raffelsiefen 1996. See also the review in McCarthy 2002b:230.

Output—a partially or fully unprosodified candidate, which is "uniquely unsuited to life in the outside world" (Prince and Smolensky 1993:51). To be "partially unprosodified" means to lack an entire layer of prosodic structure. Thus, an output that has at least some of each of morae, syllables, feet, and prosodic word structure is fully prosodified in their sense, even if it has some extraprosodic material. This Null Output does not have any faithfulness violations, but it has egregious violations of constraints of the PARSE family (PARSESEG, PARSE-σ, and so on), which require elements to belong to proper levels of the Prosodic Hierarchy. Every segment of such an output is literally extrametrical.

Under Correspondence Theory (McCarthy and Prince 1995), more than one kind of output can be null because there is more than one way for a candidate to be unfaithful. There are two kinds of Null Output: ⊙, whose correspondence relation to the input is undefined (McCarthy to appear), and *e*, where every input segment has been deleted (Benua 1997). These two kinds of Null Outputs differ in their faithfulness violations: ⊙ violates Prince and Smolensky's M-PARSE (which militates against non-realization of morphemes), *e* violates IO-MAX (which militates against the deletion of individual segments):

(29) A Null Output is any candidate that

a. violates M-PARSE (McCarthy to appear),
b. contains no correspondence relations that satisfy IO-MAX (Benua 1997),
c. lacks one or more PH levels (Prince and Smolensky 1993).

Despite formal differences, all of these Null Outputs share a common trait: they lack phonetic realization. The theory may not be so rich as to permit all of these versions of the Null Output, but no scale can imply that a structure without a phonetic realization (regardless of its formal nature) is more harmonic than a non-null structure.

2.2.7.2 The status of Null Outputs in the theory

Although the Null Output cannot be more harmonic than a non-null structure on a harmonic scale, the Null Output *can* be less marked than another candidate with respect to a markedness constraint. This is crucial to the theory of economy effects developed here: no individual constraint prefers a Null Output to every other candidate, but a ranking can. This is because markedness constraints do not include any instructions on how to fix the markedness problem, as in: "replace a nasal vowel with an oral one." The grammar is free to select any alternative to a nasal vowel—a nasal consonant, an oral vowel, ∅, or any other form that is selected by other markedness and faithfulness constraints in the ranking.

This is schematically shown in (30). Given these constraints, any one of the candidates {x, y, ∅} is a possible winner in some language. If all the constraints in (30) dominate MAX, candidate (c) will be selected as the winner.

(30) The set of possible winners

| /x/ | *X | MAX | IDENT |
|---|---|---|---|
| a. x | * | | |
| b. y | | | * |
| c. ∅ | | * | |

This is actually a point of difference between the theory presented here and Targeted Constraint Theory (Wilson 2000, 2001, see also McCarthy 2002a). In Targeted Constraint Theory, constraints are also based on comparisons between forms, but there is a significant difference. Targeted constraints are not capable of comparing two candidates unless they are explicitly set up to compare them. For example, a constraint "Y≻X" will impose the harmonic ordering {y ≻x} on the candidates in (30), but they cannot assess the harmony of $x$ relative to ∅ or of $y$ relative to ∅. Moreover, Targeted Constraint Theory does not necessarily rule out constraints of the form "∅ ≻ X." In the Lenient theory, every constraint is capable of evaluating every candidate: even though ∅ is not on the scale that *X in (30) is based on, *X is still able to compare ∅ to $x$ or to $y$. The reader is referred to Wilson 2000, 2001 and to McCarthy 2002a for further discussion.

To sum up, although individual markedness constraints are not set up to favor ∅ above all other candidates, the grammar can do so under a particular ranking This is a crucial ingredient for economy effects—we want deletion to be an option in at least some cases.

### 2.2.8 Section summary

In this section, I outlined a proposal for the structure of the constraint set CON. According to this proposal, all markedness constraints must be based on scalar comparisons between marked structures and non-null unmarked structures. This approach offers a new way to look at markedness: to say that $x$ is marked is to say that there is a non-null $y$ that is less marked than $x$. One of the mechanisms of the theory is a lenient reformulation of Prince and Smolensky's Constraint Alignment, whereby the least marked element on every markedness scale is not mapped to a constraint but other levels are.

This modification of CON has a significant consequence: no constraints can penalize structure for the sake of penalizing structure. Any dispreference for structure, also known as economy, must follow from the interaction of constraints in language-specific grammars. The next section explores this in more detail by demonstrating how several economy effects are derived in the theory.

## 2.3 <u>Economy effects through constraint interaction</u>

### 2.3.1 Introduction

While economy principles and constraints do not exist, economy effects do. Broadly speaking, there are two kinds of structural economy effects. The first might be called *limited structure building*—the number of structural nodes in a given input is minimized. For example, instead of giving each of two syntactic phrases its own phonological phrase, the two syntactic phrases are lumped into a single phonological phrase whenever possible (see Selkirk 1995a, Truckenbrodt 1999 and others). The second is a more aggressive effect that results in actual deletion of input elements, such as truncation, syncope, and other processes that visibly make the output smaller.

I argue that the dispreference for structure can always be reduced to the interaction of other factors—there is never an overarching economy principle at work. As long as deletion is an available option in the grammar, some markedness constraints will be satisfied by deletion at least some of the time. Crucially, though, deletion is never the *only* option for satisfying a particular markedness constraint—it may be so in a given grammar, but there will be other grammars that achieve the same markedness goal in another way.

Recent work in OT has been rather successful in explaining many economy effects in terms of independently motivated constraints. In the remainder of this section, I will review some of the existing work on the subject and discuss a few new possibilities for analyzing economy effects.

### 2.3.2 Limited structure building

2.3.2.1 <u>One big structure is better than two smaller ones</u>

First, let's look at the preference for *fewer* structures. Consider the aforementioned preference for "lumping" several syntactic phrases into a single phonological phrase. Truckenbrodt 1999 proposes that this lumping is the effect of a constraint WRAP-XP, which requires each XP to be contained inside a phonological phrase. This constraint conflicts with ALIGN(XP, PhP). When several smaller XPs are contained in a larger XP, WRAP-XP penalizes all outputs that place smaller XPs into their own phonological phrases without "wrapping" the larger XP into one, but alignment constraints ban XP edges that do not coincide with phonological phrase edges:

(31) WRAP and ALIGN, after Truckenbrodt (1999)

| | WRAP-XP | ALIGN (XP, PhP) |
|---|---|---|
| $(_{PhP}[_{XP1}\,[_{XP2}\;\;]\,[_{XP3}\;\;]])$ | ✓ | *(XP3) |
| $[_{XP1}(_{PhP}[_{XP2}\;\;])(_{PhP}[_{XP3}\;\;])]$ | *(XP1) | ✓ |
| $(_{PhP}[_{XP}\;\;])$ | ✓ | ✓ |

Intuitively, neither of the constraints in (31) is an economy constraint: they do not *count* phonological phrases, since only the correspondences between edges matter. These are also not economy constraints from the formal point of view, since they can be related to scales that compare two non-null structures: a well-phrased one and a poorly phrased one. Yet if WRAP-XP dominates ALIGN, the effect will be a preference for fewer but larger phonological phrases—i.e., a structural economy effect in the sense of Chomsky 1991, 1995 and Rizzi 1997 but without economy principles or constraints.[21]

2.3.2.2 The "one foot per word" effect: one structure is better than many

Another class of limited structure building effects involves situations where only one constituent is built even though more than one is possible, but the size of the constituent is constant. An example of such an effect is non-iterative foot parsing.

First, a little background. In the theory of foot parsing of McCarthy and Prince 1993a, b, whether a language has iterative footing or non-iterative footing depends on the relative ranking of gradient alignment constraints and PARSE-σ. PARSE-σ demands that every syllable belong to a foot, while ALL-FT-L and ALL-FT-R require that every foot in a word stand at an edge, assigning violation marks for every syllable that stands between the edge of a foot and the edge of a prosodic word. Economy of footing, or the "one foot per word" effect, is obtained when either ALL-FT-L or ALL-FT-R dominates PARSE-σ; the relative ranking of the alignment constraints determines whether the single foot is at the left or the right edge.

(32) The "one foot per word" effect in gradient alignment theory

| | ALL-FT-L | ALL-FT-R | PARSE-σ |
|---|---|---|---|
| a. (σσ)σσ | | ** | ** |
| b. σσ(σσ) | ** | | ** |
| c. (σσ)(σσ) | ** | ** | |

[21] Paradoxically, Truckenbrodt still employs a *STRUC constraint in his system, *P-PHRASE, though it is never crucially active—it never makes any distinctions that other constraints do not make.

Kager 2001 argues that this constraint set overgenerates, imposing a symmetry on the typology of iambic systems that is not matched by the observed data (see also McCarthy (to appear) for other arguments against gradience in OT). An alternative to gradient alignment for deriving the "one foot per word" effect are the categorical ENDRULE constraints (McCarthy to appear), which are OT adaptations of Prince's (1983) proposal. The definitions of these constraints and their harmonic scales are given below.

(33) ENDRULE-L: "The head foot is not preceded by another foot within the prosodic word" (McCarthy to appear).
*Harmonic scale*: $[_{PrWd}$ x (HdFt)...] $\succ$ $[_{PrWd}$ ....(Ft)... (HdFt)...] x not a foot

(34) ENDRULE-R: "The head foot is not followed by another foot within the prosodic word" (McCarthy to appear).
*Harmonic scale*: [...(HdFt) x $_{PrWd}]$ $\succ$ [...(HdFt) (Ft) $_{PrWd}]$

ENDRULE constraints interact with PARSE-σ as shown in (35). A word with just one foot and no unfooted syllables satisfies both of the ENDRULE constraints and PARSE-σ: the main stress foot is not preceded or followed by another foot in the word. A word with a single foot that contains some unfooted syllables still satisfies both of the ENDRULE constraints, but it incurs some violations of PARSE-σ—the longer the word, the more violations. Exhaustively footed words with more than one foot will violate either ENDRULE-L or ENDRULE-R, depending on the position of the main stress foot.

(35) ENDRULE constraints and the "one foot per word" effect

| | ENDRULE-L | ENDRULE-R | PARSE-σ |
|---|---|---|---|
| (σσ) | | | |
| (σσ)σ | | | * |
| (σσ)σσ | | | ** |
| σσ(σσ) | | | ** |
| (σσ)σσσ | | | *** |
| (σσ)σσσσ | | | **** |
| (σ́σ)(σσ) | | * | |
| (σσ)(σ́σ) | * | | |
| (σ́σ)(σσ)(σσ) | | * | |
| (σσ)(σσ)(σ́σ) | * | | |

Collectively, these constraints distinguish between words with one foot and words with more than one foot, but feet are not counted beyond that. The only counting is done by PARSE-σ, which assigns violation marks for every additional instance of an unfooted syllable. This constraint set turns out to make all the necessary distinctions: in chapter 3 we will see languages where the number of *unfooted* syllables is minimized, but the number of *footed* syllables is never minimized except as a function of the foot's well-formedness (more on this in the next subsection.) No constraint forbids feet per se.

2.3.2.3 A smaller structure is better than a bigger one

This particular class of effects is in a way the opposite of the kind discussed in §2.3.2.1, which reveals a certain lack of real unity to economy effects—a problem for overly economy principles like Rizzi's (1997) "Avoid Structure." At a certain level of analysis, the preference for smaller structures over larger ones is really just a variation on the "one is better than many" effect. This is true of the preference for monosyllabic, heavy trochees (H) over trochees that consist of two light syllables (LL), which is instrumental in the case study of Tonkawa in chapter 3.

In the metrical theories of Prince 1990 and Hayes 1995, H and LL trochees are treated equivalently: they are both binary at the moraic level and they are both even (in terms of weight). For Prince 1990, this is the cumulative effect of FTBIN and GRPHARM, since both feet are equally unmarked with respect to these constraints. Yet it is not the case that *no* constraint distinguishes between H and LL trochees—the STRESS-TO-WEIGHT PRINCIPLE does. H satisfies the requirement for foot heads to be heavy, yet it is not the only foot to do so—as shown in (36), HL feet do as well. Only H satisfies both SWP and GRPHARM:

(36) Syllable economy in trochees through constraint interaction

| /pata/ | SWP | GRPHARM |
|---|---|---|
| a. (pát.ta) HL | | * |
| b. (páa.ta) HL | | * |
| c. (pát) H | | |
| d. (pát)ta H | | |
| e. (pá.ta) LL | * | |

Neither of the constraints in (36) prefers smaller structures to larger ones or counts syllables, yet collectively they converge on H as the best foot. The fact that it is monosyllabic is not a virtue by itself—rather, its weight distribution is its best attribute. Note also that among iambs, there is no preference for H over LH—unevenness is praised in iambs, and both H and LH satisfy the requirement for foot heads to be heavy. In §2.5.2.1, I will argue that their harmonic equality is supported by typological evidence.

To summarize, limited structure building effects result from the interaction of regular markedness constraints—no economy principles are necessary to derive them. In the next section, I turn to the more aggressive economy effects—ones that actually involve deletion of input material.

### 2.3.3 Deletion of input structure

Deletion is one of the most striking economy effects—it visibly makes the output shorter. Early on, Zipf (1949) observed that frequently used words and names undergo truncation (e.g., *popular* → *pop*), which he attributed to a general Principle of Least Effort that, he argued, governs many aspects of human behavior.[22] Since then, several linguists have shown that deletion (including truncation) is governed by the same constraints that are instrumental in non-economy processes. In this subsection, I show how a number of size maximum restrictions can be derived by appealing to regular markedness constraints for which there is independent motivation outside of economy processes.

#### 2.3.3.1 Foot-sized maxima derived

A major player in truncation is the metrical foot. Ito 1990 demonstrates that truncated forms of English loanwords in Japanese must be large enough to fit a disyllabic trochaic foot template (e.g., *herikoputaa*→ *he.ri* 'helicopter,' not **he*). The same is true of hypocoristics and other forms of truncation, where the foot restricts minimal size (Bethin 2002, Crowhurst 1992, McCarthy and Prince 1986, 1990, Weeda 1992, Woodbury 1985). If economy is really all that matters, then why not go with the shortest pronounceable word, e.g., one that is just a single light syllable? Clearly, crucial here is not size per se but prosodic well-formedness.

Particularly telling are cases where the foot is not only the size minimum but also the size maximum. Consider truncation in the speech of child learners of English (Pater

[22] For a nice overview of Zipf's Law (a.k.a. the Zipf-Mandelbrot-Pareto Law) and critique of Zipf's work, see Rapoport 1982.

and Paradis 1996, Pater 1997). Adult words of three syllables or longer are clipped to two syllables, but some disyllabic words (e.g., *giraffe*) are also truncated:

(37) Truncation in child speech (Pater 1997)

a. wǽ:dit 'rabbit'
b. té:do 'potato'
c. wæ:f 'giraffe'
d. ga:bɛdʒ 'garbage'

Pater 1997 observes that truncated words in child speech are not conforming to a disyllabic template—rather, the output of truncation is invariably a trochaic left-aligned foot. This explains why disyllabic words like *giráffe* undergo truncation—the adult form contains an unfooted syllable at the left edge, which is marked. Pater's analysis is an extension of McCarthy and Prince's (1994a) analysis of Diyari foot-sized reduplicants (discussed shortly). Pater argues that the foot-sized size maximum emerges from the interaction of ALL-FT-L, PARSE-σ, and MAX (see (38)). Disyllabic words that already have trochaic stress, e.g., 'rabbit,' do not undergo truncation. Disyllabic words that are stressed on the last syllable must be shortened so they are exhaustively parsed:

(38) Truncation without economy constraints in child speech

| | | ALL-FT-L | PARSE-σ | MAX |
|---|---|---|---|---|
| 'rabbit' | a. ☞(wǽ:dit) | | | |
| | b. (wæb) | | | **! |
| 'giraffe' | c. ☞(wæf) | | | ** |
| | d. gi(wæf) | **! | * | |
| 'hippopotamus' | e. ☞(pómus) | | | ***!*** |
| | f. (hìppo)(pómus) | **! | | ** |
| | g. (hìppo)(póta)mus | ** | * | |

This is really a variation on the "one foot per word" effect discussed in §2.3.2.2, except here it is coupled with a "no unfooted syllables" restriction. (Note also that the same effect can be obtained if ALL-FT-L is replaced with the non-gradient ENDRULE-L constraint in this tableau.)

Truncation in child speech is not shortening for the sake of making words shorter—clearly, it matters whether the adult word violates certain constraints. Shortening 'rabbit' to something like *wæb* would produce a more economical output that is also a trochaic, binary foot—witness 'giraffe' → *wæf*. The reason shortening does not apply here is that no metrical markedness constraint calls for it. An economy trigger/markedness blocker explanation (e.g., FTBIN>>*STRUC(σ)>>MAX) would incorrectly predict that all words should be clipped down to a CVC or CVV binary trochaic foot.

Pater argues that, although metrical markedness constraints are ranked below MAX and can be violated in adult English, they still have visible effects. The interaction of ALL-FT-L and PARSE-σ produces the so-called initial dactyl effect (McCarthy and Prince 1993a): when a trisyllabic sequence precedes the main stress, secondary stress usually appears on the initial syllable, e.g. *(Tàta)ma(góu)chi* not *Ta(tàma)(góu)chi*. ALL-FT-L enforces the requirement for the first syllable to be footed in adult English and in child English alike.[23]

Just like words in child speech, reduplicative morphemes in many adult languages are limited to a foot-sized unit (McCarthy and Prince 1986, 1993b). A famous example of this is reduplicant disyllabicity in Diyari (McCarthy and Prince 1994a). Although non-

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[23] In a theory with only categorical constraints, the effect has to be attributed to a different constraint. McCarthy (to appear) suggests PARSE-σ1, which requires the first syllable of the word to be footed—a kind of positional markedness constraint.

reduplicated forms can be longer than two syllables, the reduplicant is limited to the size of a trochaic foot:

(39) Diyari reduplicant disyllabicity (McCarthy and Prince 1994a)

| | | | |
|---|---|---|---|
| a. | /RED-wila/ | wila-wila | ‘woman’ |
| b. | /RED-ŋankanti/ | ŋanka-ŋankanti | ‘catifish’ |
| c. | /RED-$t^{j}$ilparku/ | $t^{j}$ilpa-$t^{j}$ilparku | ‘bird species’ |

McCarthy and Prince argue that the reduplicant is not just squeezed into a disyllabic template—rather, it has all the properties of the prosodic word in the language, including separate stress and no word-final codas (Austin 1981). The difference between the marked base and the unmarked reduplicant is that the reduplicant must be an exhaustively footed monopod, whereas the base does not have to be either. Again, well-formedness is important here, not shortness.

An interesting variation on the size maximum restriction holds of prosodic words in Maori, which de Lacy 2002b also analyzes in terms of metrical well-formedness constraints. The twist is that Maori words can contain unfooted syllables, but they cannot be *footable*—trisyllabic words are acceptable but quadrisyllabic words are not.

Truncation in Maori is often used to clip words down to the maximally trisyllabic size, but sometimes truncation does not reduce the size enough—there are still footable syllables in the word. De Lacy argues that in these cases, epenthesis applies, so that part of the word can form a separate prosodic word. Thus, in the first word in (40), *hikáia*, the suffix *–ia* is mapped faithfully because the word fits into the single-foot limit, but in *kopóua*, the suffix loses its first vowel. In longer words, though, deleting the single vowel does not produce the necessary improvement; in words with three moras and longer, the suffix heads its own prosodic word (square brackets indicate prosodic word boundaries, periods indicate syllable boundaries):

(40) Maori maximal words: truncation and augmentation (de Lacy 2002b)

a. /hika-ia/ → [hi.(kái).a] ‘plant passive’
b. /kopou-ia/ → [ko.(póu).a] ‘appoint passive’
c. /tapuhi-ia/ → [(tá.pu).hi] [(tí.a)] ‘sort out’ not *(tápu)hia

De Lacy’s gradient constraint analysis can be easily recast in terms of ENDRULE constraints, since ENDRULE constraints subsume the functions of his constraint *FT- “no non-head feet.” This analysis is sketched out in (41).

(41) Maori maximal words

| | | ENDRULE(L/R) | *LAPSE$_{FT}$ | DEP-C | MAX |
|---|---|---|---|---|---|
| /karaŋata/ | a. ☞ (kára)ŋa | | | | * |
| | b. (kára)ŋata | | *! | | |
| | c. (kára)(ŋáta) | *! | | | |
| /kopou-ia/ | d. ☞ko(póu)a | | | | * |
| | e. ko(póu)ia | | *! | | |
| | f. ko(póu)(ía) | *! | | | |
| | g. [ko(póu)][(tía)] | | | *! | |
| /tapuhi-ia/ | j. [(tápu)hi] [(tía)] | | | * | |
| | k.[(tápu)hia] | | *! | | * |
| | l. [(tápu)(hía)] | *! | | | * |

ENDRULE dominates MAX together with *LAPSE$_{FT}$ “adjacent unstressed moras must be separated by a foot boundary” (which de Lacy adopts from Green and Kenstowicz 1995, Prince 1983, Selkirk 1984b). Words that are just the right size (e.g., *hi(kái)a*) will not truncate, since they can be served with just one foot without any lapses. A hypothetical input like /karaŋata/ will have to be truncated because the only alternatives are lapses and iterative feet, as will *ko(póu)a*. Inputs like /tapuhi-ia/ are simply too long for deletion to make any difference—witness the failure of *(tápu)hia* to satisfy *LAPSE$_{FT}$. The only solution is to parse this word as two prosodic words, which requires the epenthesis of *t* in Maori. (The reader is referred to de Lacy's paper for a complete analysis of this complex pattern.)

Being shorter is not a goal in itself here—the well-formedness conditions that hold of the Maori prosodic word are just as possible to satisfy by insertion as by deletion. Deletion just happens to be preferred because MAX is ranked below DEP.

In general, the "one foot per word" effect results from the interaction of metrical constraints with MAX. These constraints are not economy constraints—none of them prefer smaller structures to larger ones. The preference emerges from their interaction in language-specific rankings.

#### 2.3.3.2 The syllable-sized limit on reduplicants: OO-correspondence

The prosodic explanation of foot template effects is now uncontroversial, but maximal size can be limited to a unit that is even smaller than the foot. Thus, reduplicants in many languages seem to copy as little as possible of the base (e.g., a syllable or even just one segment), which several researchers have attributed to economy constraints (Feng 2003, Riggle 2003, Spaelti 1997, Walker 1998, 2000, 2003). Interestingly, this size restriction is not widely attested outside of reduplication,[24] which makes it doubtful that general economy constraints are the answer. I propose that the size restrictor in these

[24] Walker 2003 argues that in Yuhup, *all* morphemes are limited in size to a single syllable: there is a requirement that morphemes and syllables correspond one to one. However, in the data Walker cites from Lopes and Parker 1999, every syllable also happens to be either CVV or CVC, which suggests that the real generalization concerns *feet*, not syllables. The fact that the foot is monosyllabic falls out under a trochaic analysis, assuming that SWP is high ranked. Walker notes that stressed syllables lengthen in Yuhup, which suggests that this analysis is on the right track.

cases is not economy but rather Output-Output faithfulness (Benua 1997, Burzio 1994, Kenstowicz 1996a).[25]

The reduplicated form stands in transderivational correspondence with the non-reduplicated form, which serves as the base in the OO-corespondence relationship. OO-DEP (Benua 1997) requires that every segment in the reduplicated form have a correspondent in the base, which effectively puts a limit on how much can be copied—a violation is incurred for every segment of the reduplicant. The reason anything is realized at all is MORPHREAL, which requires every morpheme to have a phonological exponent. In most cases, then, reduplicants (underlined in (42)) will copy just enough to give the reduplicant some realization, but not more:

(42) OO-correspondence and minimal copying in reduplication

| base: pa.ta<br>input:/RED-pata/ | MORPHREAL | OO-DEP |
|---|---|---|
| a. ☞ <u>pa</u>-pa.ta | | p |
| b. pa.ta | *! | |
| c. <u>pa.ta</u>-pa.ta | | pata! |

Spaelti (1997) discusses several such cases. For example, in the Rebi dialect of West Tarangan, a single consonant is copied wherever possible, while a syllable is added only where necessary. The reduplicant always immediately precedes the stressed syllable. As the patterns below show, the reduplicant copies a single consonant if it can serve as a coda to the pretonic syllable, as in *bimtɛ́mana* and *ta<u>r</u>púran*. Single segment reduplication

[25] Alber 2001 suggests that another pressure can act as a size restrictor for reduplicants: the requirement that every segment of the output be in the root-initial syllable (cf. Beckman 1998 on MAX-POSITION constraints). The full implications of this remain to be seen.

is blocked if the preceding syllable is closed and a single consonant cannot be appended to it, in which case the entire firsts CVC of the base is copied, as in *paylawláwana* (not **payw.láwana*). Single segment reduplication is also blocked by the constraint against geminates, so *nánay* reduplicates as *nanánay* not **nan.nánay*:

(43) Rebi West Tarangan reduplication (Spaelti 1997)

| | | | | |
|---|---|---|---|---|
| a. | /RED-bitɛma-na/ | bimtɛ́mana | 'small 3s.' | cf. bitɛ́mana |
| b. | /RED-tapuran/ | tarpúran | 'middle' | cf. tapúran |
| c. | /RED-paylawa-na/ | paylawláwana | 'friendly 3s.' | cf. payláwana |
| d. | /RED-nanay/ | nanánay | 'hot' | *nan.nánay |

The reduplicated and the non-reduplicated forms look quite similar in the default pattern—cf. *tarpúran* and *tapúran*. This similarity is achieved by copying as little as possible, i.e., just a single segment, while still realizing the reduplicative morpheme:

(44) Minimal copying in Rebi West Tarangan: just one segment

| base: ta.pú.ran<br>input: /RED-tapuran/ | MORPHREAL | OO-DEP |
|---|---|---|
| a. ☞ tar.pú.ran | | r |
| b. ta.pú.ran | *! | |
| c. ta.pú.ran-ta.pú.ran | | tapuran! |
| d. ta.pur.pú.ran | | pur! |

In words that begin in a CVC syllable, infixation of a single consonant is ruled out by *COMPLEX, which overrides the effects of OO-DEP:

(45) Minimal copying in Rebi West Tarangan: just one syllable

| base: pay.lá.wa.na<br>input: /RED-paylawa-na/ | *COMPLEX | MORPHREAL | OO-DEP |
|---|---|---|---|
| a. ☞ paylawláwana | | | law |
| b. paywláwana | *! | | w |

Walker 2000 discusses a similar pattern for Mbe, where she argues a nasal coda is the only exponent of the reduplicated part of a complex morpheme—in Mbe, if the reduplicant would have to copy an entire syllable, copying is blocked altogether. Here, the relevant constraints on codas actually dominate MORPHREAL. The common thread to these and other similar patterns is that reduplicants seem to be under a restriction against increasing the size of the word, but only with respect to another word *in the same derivational paradigm*. This is not syllable economy—it's paradigm uniformity.

This account of minimal copying predicts that such size restrictions will hold only of affixes (including reduplicative affixes) but not of stems. OO-DEP cannot have a size limiting effect on stems, since these add nothing new to the base. Only affixes do, so only they are limited in size to units smaller than a foot. This analysis also eliminates the need for the oft-criticized templatic constraint AFFIX≤σ (McCarthy and Prince 1994b). See McCarthy and Prince 1999 for some discussion.

An alternative explanation for minimal copying is in terms of *STRUC(σ) or syllable alignment (Feng 2003, Riggle 2003, Spaelti 1997, Walker 2000, 2003). These constraints apply not only to affixes but also to stems, so in principle it is possible for them to limit the size of every morpheme to a single segment or a single light syllable—both effects are unattested. Since the OO-DEP analysis is sufficient and makes just the right predictions, I suggest that the economy constraint analysis of minimal copying be abandoned, especially since economy constraints are not needed for any other reason.

#### 2.3.3.3 Haplology and the OCP

A group of deletion processes that might be called economy effects involve adjacent identical segments (OCP effects) or sequences (haplology). These are not economy effects in the most obvious sense of the word, but they do result in shorter outputs, and they have been analyzed in terms of economy constraints.

In (46), two kinds of deletion are shown: in the first case, dubbed anti-antigemination by Odden 1988, vowels delete between identical consonants, which appear as a geminate on the surface. Deletion does not apply between different segments.[26] In the second case, Basque, deletion targets one of two adjacent obstruents that are both continuant (or both non-continuant). In some cases, the entire consonant does not delete but instead deaffricates (Fukazawa 1999 argues that this is still deletion of *features*). Deletion does not apply otherwise, as in the last two examples.

(46) OCP deletion

a. Syncope between identical segments and gemination in Mussau (Blust 2001)

| | | | |
|---|---|---|---|
| /pa̲pasa/ | ppasa | ‘outrigger poles’ | |
| /gagaga/ | gagga | ‘tidal wave’ | |
| | biliki | ‘skin’ | *bilki, *bliki |
| | karasa | ‘whet, grind a blade’ | *karsa, *krasa |

b. Consonant deletion and de-affrication in Basque (Hualde 1991)

| | | | |
|---|---|---|---|
| /bat̲ paratu/ | baparatu | ‘put one’ | |
| /irabas-ts̲en/ | irabasten | ‘earn, win’ | |
| /hit̲s-t̲egi/ | histegi | ‘dictionary’ | |
| /itʃ-tsen/ | iʃten | ‘open’ | |
| | ibiltsen | ‘walk’ | *ibilten |
| | esne | ‘milk’ | *ene |

Morphological haplology can be defined as the non-realization of a morpheme when it is attached to a stem that contains an adjacent identical sequence of phonemes, as with the French suffix *–iste* [ist]. When the suffix attaches to a base that ends in a sequence that is partially or fully homophonous with *–iste*, part or all of the suffix is not realized:

[26] Here, the notion of adjacency has to be stretched to include consonants separated by a vowel—see McCarthy 1986 and Rose 2000b.

(47) French Haplology (de Lacy 1999, (a) and (b) from Corbin and Plénat 1992)

| | | | | |
|---|---|---|---|---|
| a. | /deiksis-ist/ | deiksist | ‘deixis + *ist*’ | *deiksisist |
| b. | /ametist-ist/ | ametist | ‘amethyst +*ist*’ | *ametistist |
| c. | /ego-ist/ | egoist | ‘egoist’ | |

These processes should be discussed in the context of a rather general constraint against identity, the OCP (Fukazawa 1999, Goldsmith 1990, Keer 1999, Leben 1973, McCarthy 1986, Myers 1997, Odden 1988, Rose 2000b, Suzuki 1998, Yip 1988, 1998; see also chapter 4). A rather striking thing about the OCP is just how many ways there are to satisfy it: dissimilation, allomorphy, lexical gaps, consonant deletion, syncope, and suppletion are all observed effects. It appears, then, that there is nothing at all special about deletion being part of this set—the interaction of the OCP with MAX straightforwardly predicts it.

Despite this range of effects, some have argued that structure-reducing operations of the sort illustrated above are in some way special and indicate that all structure is marked. Thus, de Lacy (1999) argues that morphological haplology is economy-driven coalescence. He observes that haplology does not always target morphemes with marked features, as in the case of Arabic /ta + ta + kassaru/ → *takassaru* ‘it (fem.sg.) breaks,’ **tatakassaru* (Wright 1971). Assuming that there is a markedness constraint against everything, even the apparently unmarked *ta*, haplology can be analyzed using Economy constraints of the *STRUC family and without resorting to constraints against adjacent identical sequences. De Lacy presents several arguments against an OCP analysis of haplology, but the OCP analysis has a strong virtue that *STRUC lacks: only the OCP can be satisfied by dissimilation, allomorphy, and other processes that do not involve deletion or coalescence.

OCP-driven deletion of single segments has similarly been analyzed in terms of economy principles. Because the OCP can target a sequence of any identical features and not just marked ones, Fukazawa 1999 analyzes it as the Local Conjunction of Economy constraints.[27] As the following quotation shows, this analysis also relies on the assumption that the best structure is no structure:

(48) All the features are marked in a sense; therefore, the constraints which prohibit them exist in the grammar... Thus for example, although the [cor] feature is relatively unmarked compared to the [dor] or [lab] feature, it is still marked, and the constraint against the [cor] feature does exist, namely, *[cor]. The OCP effects on this relatively unmarked feature [cor] can be accounted for based on the self-conjoined markedness constraint, namely, *[cor][cor]. In this respect, there are no OCP effects which the self-conjunction approach cannot explain. (Fukazawa 1999:19)

I assume that what is marked here is repetition and identity of features, not their mere occurrence (cf. Yip 1998). Any features can be targeted for deletion because any features can be repeated.[28]

Economy principles can be used in this fashion to explain vowel harmony, tone spreading, assimilation, Verner’s Law, and any other process that replaces a series of feature nodes with one shared feature. To my knowledge, not all of these avenues have been pursued, and for a good reason: these are processes that can just as well be explained as regular markedness effects. All economy effects can and should be analyzed in terms of markedness constraints.

---

[27] Local Conjunction combines the power of two constraints to create a third constraint that is active in a specific domain (Smolensky 1995). For example, the conjunction of ONSET and NOCODA in the domain of a syllable, [ONS&NOCODA]$_{\sigma}$, is a constraint that is violated by a syllable that simultaneously has a coda and lacks an onset, but not by a syllable that violates only one of the two conjoined constraints.

[28] Alderete 1997 argues that there is an implicational universal here—if unmarked features are targeted, then marked ones must be as well; see his analysis for more details

### 2.3.4 Economy of structure in Grimshaw's theory: a comparison

The approach to economy pursued here is inspired by Grimshaw 2003, who also argues that structural economy results from the interaction of independently motivated constraints rather than special economy principles. However, there is an important difference in the way the constraints in the two theories treat ∅.

Grimshaw 2003 shows for syntactic phrase structure that economy effects follow from Alignment and constraints that require syntactic positions to be filled—constraints needed for independent reasons. Although *individually* these constraints may prefer larger structures to small ones, *collectively* they prefer smaller structures. The more projections a form contains, the more violations of alignment it incurs in Grimshaw's system (alignment is reckoned gradiently, with one violation mark assigned for every projection that separates an element from the nearest phrase edge):

(49) Grimshaw's phrase structure economy

| | HEAD-LEFT | SPEC-LEFT | COMP-LEFT |
|---|---|---|---|
| a. [Head] | | | |
| b. [Spec H Comp] | * | | ** |
| c. [[Spec H Comp] H Comp] | ** | | **** |
| d. [[[Spec H Comp] H Comp] H Comp] | *** | | ****** |

Candidate (a) in (49) is as small as possible for a non-null structure and is perfectly aligned because it contains only one element. Any more internal complexity results in additional violation marks (b)-(d). This is an economy result—more structure means more markedness, yet no special economy constraints are used.

A preference for smaller structures need not entail a preference for empty structures. An interesting result of Grimshaw's system is shown in (50): a null projection (a) is harmonically bounded by candidates like (b) and (c), which are just as well aligned and satisfy at least one constraint that requires positions to be non-empty (OB-HEAD stands for "obligatory head," OB-SPEC stands for "obligatory specifier"):

(50) Empty structure disfavored

| | OB-HEAD | OB-SPEC | HEAD-LEFT, SPEC-LEFT |
|---|---|---|---|
| a. [__] | * | * | ✓ |
| b. [H] | | * | ✓ |
| c. [Spec] | * | | ✓ |

No special constraints that prefer smaller structures are required in this system because "economy of phrase structure is a theorem of the theory of phrase structure" (Grimshaw 2003:81).

Note, however, that the constraint set in (50) can actually favor wholesale deletion of input material, because the deletion candidate ∅ satisfies all of the constraints better than any other candidate. The null candidate is structurally distinct from the empty structure [___]—it contains no projections, so it cannot violate OB-SPEC or OB-HEAD.

(51) Grimshaw's constraints can favor wholesale deletion

| | OB-HEAD | OB-SPEC | HEAD-LEFT, SPEC-LEFT |
|---|---|---|---|
| a. [__] | * | * | |
| b. [H] | | * | |
| c. [Spec] | * | | |
| d. ∅ | | | |

Grimshaw assumes that deletion is not allowed in syntax and that underlying forms do not contain function words (see also Grimshaw and Samek-Lodovici 1995, Grimshaw 1997, Grimshaw and Samek-Lodovici 1998). Whether or not deletion (rather than underparsing) is actually allowed in syntax is not a settled issue. It might be argued that GEN is not allowed to alter the semantic content of the input (Ackema and Neeleman 1998, though see Bakovic and Keer 2001, Legendre et al. 1998 for alternative views).

However, deletion is necessary if inputs are unrestricted (Prince and Smolensky 1993): if an input contains too many pleonastics, for example, as in **Mary did buy the book* (with unstressed *did*), they must be deleted and inflection must be inserted so that a grammatical output is obtained. If deletion is not an option in syntax, then ∅ is not a problem for this theory of economy effects.

### 2.3.5 Section summary

In this section, I argued that a variety of economy effects follow from the interaction of constraints rather than from special economy principles. While individually these constraints do not prefer smaller structures to larger ones, collectively they may favor economical structure building and actual deletion of input material. Deletion is always just one of several solutions, however—none of the markedness constraints in the Lenient theory of CON are set up to favor ∅ above all other candidates.

One economy effect not yet discussed has long evaded a markedness explanation: vocalic syncope. Consider the following quote about a syncope process in Odawa:

(52) Why a rule should enter the language which simultaneously opacates a stress rule, destroys a surface alternating stress pattern and causes wholesale allomorphy, seems a question worth pondering. (Kaye 1974:149)

From the point of view of syllable structure, syncope is indeed puzzling, since it creates syllables with codas or complex onsets out of CV sequences. This has caused many researchers to appeal to economy principles (e.g., *V or *STRUC(σ)) and economy rules (e.g., V→∅) (Hammond 1984, Hartkemeyer 2000, Kiparsky to appear, Kisseberth 1970a, b, McCarthy 1986, Semiloff-Zelasko 1973, Taylor 1994, Tranel 1999). According to such analyses, syncope is a general, default operation—vowels are deleted whenever they are "unnecessary," just as "unnecessary" structure is deleted. This can be described as *Do*

*Something Except When Banned* (Prince and Smolensky 1993/2002). Under this view, the burden on the analyst is to explain only why deletion is blocked in certain contexts, but not why it is triggered in the first place.

Syncope is the empirical focus of chapters 3 and 4, where I argue that it results from the interaction of regular markedness constraints with MAXV. Because of the wealth and diversity of data, syncope is an ideal ground for the study of economy; yet I argue that there is no economy principle behind syncope—in fact, economy constraints are shown to be insufficient, unnecessary, or harmful.

The next section of this chapter focuses on *STRUC constraints, showing that they have harmful effects whether high ranked or not. Luckily, they cannot belong to CON if constraints are formulated leniently.

## 2.4 Ruling out *STRUC constraints

### 2.4.1 Introduction

In section §2.3 I argued that various economy effects follow from constraint interaction, without special economy principles. This is not an assumption shared in earlier OT work. To limit structure-building operations, Prince and Smolensky propose a special family of Economy constraints, *STRUC:

(53) Constraints of the *STRUC family ensure that structure is constructed minimally: a notion useful in syntax as well as phonology, where undesirable options (move-α; non-branching nonterminal nodes) typically involve extra structure... Pointless nonbranching recursion is ruled out by *STRUC, and bar-level can be projected entirely from functional information (argument, adjunct, specifier). In Economy of derivation arguments, there is frequently a confound between shortness of derivation and structural complexity, since each step of the derivation typically contributes something to the structure.

(Prince and Smolensky 1993:25, fn.13)

In the time since *STRUC constraints were originally proposed (Zoll 1993, 1996), they have been used in two senses that are not entirely distinct from each other: first, as a ban against nonterminal levels in some structural hierarchy (e.g., syllables), and second, as a ban on every element in the representation (e.g., features).

Intuitively, what all *STRUC constraints have in common is that they militate against all things, including those that are basic and unmarked. For example, *STRUC(σ) indiscriminately penalizes *all* syllables, whereas its more particular counterpart *$\sigma_{\mu\mu\mu}$ bans only *superheavy* syllables (see Chapter 3). Similarly, *C "no consonants" bans all consonants regardless of position, whereas NOCODA or *COMPLEX take syllable position into account. It is tempting to use this indiscriminateness as the unifying property of all *STRUC constraints. Nevertheless, non-*STRUC markedness constraints can be less complex or just as complex in definition as *STRUC constraints. No definitional property can usefully distinguish *NUC/t, a markedness constraint that expresses a strong cross-linguistic generalization, from *NUC/a, a *STRUC constraint whose only effect is economy (see §2.2.3 and §2.2.4). *STRUC constraints must therefore be identified by their external properties—the kinds of candidates that they penalize and their formal origins.

The theory of CON developed in §2.2 offers a way to define *STRUC constraints: they are the constraints that penalize the least marked non-null element on the relevant scale. In the remainder of this subsection, I will show how both kinds of *STRUC constraints are ruled out from CON under the proposed theory and why removing them from CON is necessary. But first let us review the two types of *STRUC constraints that have been proposed in OT (§§2.4.2, 2.4.3).

### 2.4.2 Prosodic Hierarchy-referring constraints

Prince and Smolensky's and Zoll's original *STRUC constraints ban the hierarchical structure that GEN imposes on the input: syllable structure, foot structure, or, in Prince and Smolensky's discussion, syntactic phrase structure. These constraints express the claim that *all structure is marked* and are a direct OT counterpart of Chomsky's (1991, 1995) Economy of Representation or Rizzi's (1997) "Avoid structure" principle.

In phonology, *STRUC constraints of this sort refer to the structure built by GEN that isn't necessarily present in the input:[29] *STRUC(μ) (Nishitani 2002), *STRUC(σ) (Kiparsky to appear, Zoll 1996), *STRUC(FOOT), *STRUC(PRWD), *STRUC(PHON-PHRASE) (Truckenbrodt 1999)—basically, they ban levels of the Prosodic Hierarchy. In the discussion that follows, these constraints will be called *PH-referring* *STRUC constraints.

Apart from the notional similarity between them, these constraints share an external property: only a Null Output can fully satisfy them. Thus, *STRUC(σ) can only be fully satisfied by a candidate that lacks the syllabic layer of prosodic structure or by one that contains no phonological material at all. The same is true for Truckenbrodt's (1999) *STRUC(PRWD) (see (54)). *STRUC(PRWD) assigns two violation marks to a candidate with two prosodic words *[pata][taa]* and one violation mark to the single prosodic word candidate *[patataa]*. Still, any null parse (c-e) will fare better than both *[patataa]* and *[pata][taa]*:

---

[29] In fact, many of the researchers cited here assume that prosodic structure is absent in the input and inserted only in GEN.

(54) PH-referring *STRUC and Null Outputs

| /pata-taa/ | *STRUC(PRWD) | MPARSE | MAX | PARSESEG |
|---|---|---|---|---|
| a. [patataa] | * | | | |
| b. [pata][taa] | ** | | | |
| c. ∅$_{no\ correspondence}$ | ✓ | * | | |
| d. <patataa>$_{unprosodified}$ | ✓ | | | ******* |
| e. ∅$_{deleted}$ | ✓ | | ******* | |

This is a property common to all PH-referring *STRUC constraints: they assign zero violation marks *only* to Null Outputs. A PH-referring *STRUC constraint expresses a harmonic ordering of the sort shown in (55): zero is better than a mora, syllable, foot, and so on:

(55) Orderings imposed by PH-referring *STRUC constraints

| Harmonic ordering | *STRUC constraint |
|---|---|
| $\varnothing \succ \mu$ | *μ (Crosswhite 1999b, Nishitani 2002) |
| $\varnothing \succ \sigma$ | *σ (Kiparsky to appear, Zoll 1993) |
| $\varnothing \succ$ Foot | *FOOT |
| $\varnothing \succ$ PrWd | *PRWD (Truckenbrodt 1999) |

### 2.4.3 Nihilistic *STRUC constraints

The second category of *STRUC constraints shares little if any notional unity: they ban consonants, vowels (Hartkemeyer 2000, Kiparsky 1994), stress (Kiparsky 2003), coronal place (Fukazawa 1999), low and high vowels (Beckman 1998, Lombardi 2003), voiceless obstruents, and so on. Despite their diversity, these constraints have the character of economy principles: through their interaction with other constraints, these *STRUC constraints can very effectively duplicate the effects of classic economy principles.

Not all economy processes reduce the number of moras, syllables, and feet. De Lacy 1999 discusses haplology in Russian (see also §2.3.3.3), where the suffix /sk/ 'inhabitant of' haplologizes with a homophonous adjectival suffix, e.g., /tom-sk-sk-ij/ → *tomskij*, **tomskskij* 'of Tomsk (city name).' If this is indeed a case of haplology,[30] it reduces not the number of syllables but the number of segments and features. De Lacy analyzes this haplology process using *STRUC, which he defines as a constraint that assigns a violation for every node in the output form. Every feature of the output incurs a violation of *STRUC, regardless of how unmarked it is. Constraints of this sort are very similar in spirit to PH-referring *STRUC constraints, since they embody the claim that *everything is marked*.

When *STRUC is generalized in this manner beyond PH-referring constraints, it includes the set of all regular markedness constraints plus a number of constraints against everything, including unmarked things: vowels, voiceless obstruents, sonorant syllable peaks, and so on. Consider Hartkemeyer's *V, which assigns violation marks to all vowels. Whether a vowel is oral (relatively unmarked) or nasal (relatively marked), it will incur one violation of *V. The only candidates in (56) without violations are the Null Output (c) and the non-vowel candidate (d):

---

[30] *Tomsk* itself is not monomorphemic but back-formed from *Tomskij ostrov* 'Tom' island'. The adjective *tomskij* is formed from the name of the river *Tom'* using the adjectival suffix *–sk*. A more accurate description of what happens in **tomskskij* may be that the adjectival suffix haplologizes with itself (Robert Rothstein, p. c.).

(56) Nihilistic *STRUC constraints

| | *NASALV | *V |
|---|---|---|
| a. u | | * |
| b. ũ | * | * |
| c. ∅ | | ✓ |
| d. w | | ✓ |

This is a point of difference between the classic, PH-referring *STRUC constraints and nihilistic *STRUC constraints: the Null Output is not the only candidate that receives zero marks from the latter type of *STRUC. The next section presents a way to unify both types of *STRUC constraints by looking at them in terms of harmonic scales, which allows us to eliminate them from the theory altogether.

### 2.4.4 *STRUC constraints are impossible to derive from proper scales

While *STRUC constraints differ in the sort of harmonic orderings they impose on candidates, they agree in the harmonic orderings they impose on the members of a scale. According to a PH-referring *STRUC constraint, ∅ is more harmonic than a given level of the Prosodic Hierarchy. According to a nihilistic *STRUC constraint, ∅ is more harmonic than the least marked member of a harmonic scale. We can therefore pin down the property common to all *STRUC constraints:

(57) A *STRUC constraint bans the least marked non-null element on some scale.

All nihilistic *STRUC constraints can be related to scales in a fairly straightforward way: *ONS/t is derived from the onset sonority scale, *NUC/a is derived from the nucleus sonority scale, *ORALV (or *V) can be derived from the vowel nasality scale, and so on:

(58) Onset sonority harmonic scale : <u>Ons/t</u> ≻ ... ons/i ≻ ons/a

↑

*ONS/t

(59) Vowel nasality harmonic scale: <u>Oral vowel</u> ≻ nasal vowel
↑
*ORALV (or *V)

These are the constraints that are not produced by Lenient Constraint Alignment (see §2.2.4), since it maps every member of a scale to a constraint *except for* the least marked member. A way to sneak around Lenient Constraint Alignment is to zero-extend scales, tacking ∅ as the least marked member of every scale. If all scales begin with ∅, then obstruent onsets, oral vowels, and other unmarked things are no longer the least marked things on their scales, and Lenient Constraint Alignment will create constraints against them but not against ∅. Scales of this sort, however, are prohibited by the NOZERO principle: scales cannot make vacuous harmony comparisons; harmony relationships must hold between two non-null structures. Thus, a scale like (60) cannot be used to sneak in a constraint against oral vowels (or all vowels) into CON:

(60) *Vowel nasality harmonic scale*: ∅ ≻ <u>Oral vowel</u> ≻ nasal vowel

The NOZERO principle is also the stumbling block for PH-referring *STRUC constraints. They must also be based on scales, but they have not been traditionally conceived in terms of scales because these constraints are really not comparative. According to *STRUC(σ), the syllable is not marked relative to some other structure (e.g., the mora), it is marked absolutely—only nothing is better than a syllable. Because of this, though, *STRUC(σ) cannot be based on a scale like (61), since it violates the NOZERO principle:

(61) Syllable scale 1: ∅ ≻ <u>σ</u>
↑
*STRUC(σ)

Removing ∅ from the scale leaves the unary scale (62). Nothing in the theory rules out unary scales, but Lenient Constraint Alignment cannot create a constraint based on them because it skips the least marked member of the scale. The least marked member of the scale in (62) is also its only member, so it is not eligible for constrainthood—the schema is set up so that it can only apply to a minimally binary scale. The presence of unary scales in the grammar has no affect on the constraint set.[31]

(62) Syllable scale 2: σ

Neither variety of *STRUC constraints can belong to CON if markedness constraints are formulated in such a way that they cannot penalize a structure unless there is some other structure that is less marked. Markedness constraints express the markedness of one form *relative* to another. All legitimate markedness constraints are based on scalar comparisons of this sort—comparisons that *STRUC constraints are incapable of making, because of their nihilistic nature.

### 2.4.5 Section summary

*STRUC constraints are OT's counterpart to the traditional idea that there are general economy principles constraining linguistic structure. Notionally, *STRUC constraints come in two varieties. The first is structural economy constraints; in

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[31] Several interlocutors have suggested that the harmonic scale for constraints like *STRUC(σ) is the Prosodic Hierarchy. The chief problem with this strategy is that there is no evidence that shows prosodic words to be more marked than feet or feet to be more marked than syllables. It would be extremely difficult to come by such evidence, since it would have to be of the sort that shows, for example, that two prosodic words are less marked than a single foot. This is impossible, because higher-level prosodic constituents imply the presence of lower-level prosodic constituents. The Prosodic Hierarchy is not really a harmonic scale but a theory of the hierarchical organization of phonological representations, so no constraints can be derived straight from it without intermediate formal principles (e.g., EXHAUSTIVITY of Selkirk 1995).

phonology, these are the constraints against various levels in the Prosodic Hierarchy. The second kind of *STRUC is a more diverse set of constraints that embody the claim that "everything is marked": voiceless obstruents, oral vowels, sonorant nuclei, and so on. Together with regular markedness constraints, the latter type of *STRUC constraints duplicates the effects of structural economy. The theory of constraints developed here offers a way to unite the two sets: a *STRUC constraint bans the least marked non-null structure on its harmonic scale. Since scales cannot make vacuous markedness comparisons with null structures or penalize the unmarked, *STRUC constraints are excluded from the theory as a matter of principle.

## 2.5 Harmful effects of *STRUC constraints

The argument against economy principles is two-pronged. On the one hand, economy constraints are unnecessary because economy effects follow from independently motivated constraints (§2.3; see also chapters 3 and 4). On the other hand, economy constraints have harmful effects as freely rankable constraints. This section examines some of these effects.

In OT, a grammar is a language-particular ranking of universal constraints, and any ranking of constraints must produce an actual or at least a plausible grammar. *STRUC constraints are unlike other markedness constraints in that they are not freely rankable. *STRUC constraints upset the factorial typology in two ways: when high-ranked, they produce defective languages, and when low-ranked, they can have odd effects that stem from their nihilistic dislike of structure.

### 2.5.1 Why *STRUC must always be low-ranked

When *STRUC constraints are called upon to perform their economy duties, they always come second to other, higher-ranked demands. This is generally true of all economy principles: they limit but never ban. For example, as Grimshaw 2003 notes, Rizzi's "Avoid structure" principle (Rizzi 1997:314) is always "overridden" by other structure-building principles, since structure is never successfully avoided. The same is true of economy principles in phonology: *STRUC is dominated by at least some constraints in every analysis that employs it. For example, Hartkemeyer 2000 observes that *V must always be dominated, because the ranking of *V above all Faithfulness constraints describes an impossible language that lacks all vowels. Likewise, in Zoll's original analysis of Yawelmani ghost segments, *STRUC(σ) is allowed only to check epenthesis and to require the deletion of subsegmental features but never of whole segments (Zoll 1993, 1996).

It is not difficult to see why *STRUC constraints must be artificially restricted to the bottom of every language-particular ranking. If constraints like *OBS or *V can be undominated, the result is languages without obstruents or vowels, both unattested. Similarly, the existence of constraints like *ONS/t predicts languages that have no onsets, since they penalize the least marked onset of them all (Pater 1997).

This banishment of *STRUC from the top of every hierarchy is surprising under traditional OT assumptions that constraints are freely rankable (with the possible exception of constraints based on multi-valued prominence/markedness scales). Since *STRUC constraints are not based on such scales, their obligatory low ranking is hard to justify.[32] It is not clear which constraints universally dominate *STRUC. Faithfulness constraints cannot universally dominate *STRUC, since *STRUC must at least dominate MAX in at least some languages for deletion economy effects. As for markedness, the constraints that must dominate *STRUC differ from language to language. For example, in Lillooet, syncope cannot create onset clusters with rising sonority but can result in final stress, while in Lebanese Arabic it is the other way around. The constraints that block syncope must be ranked in the opposite way in the two languages: in Lillooet, it's SONSEQ>>*STRUC>>NONFINALITY, while in Lebanese Arabic, it's NONFINALITY>>*STRUC>>SONSEQ (for detailed analyses of these cases without *STRUC constraints, see Chapter 4). Thus we cannot even be sure which constraints universally dominate *STRUC—we only know that *some* must.

### 2.5.2 Odd effects under re-ranking

Even when dominated by other constraints, *STRUC constraints can have odd effects. By penalizing all structure without reference to markedness, PH-referring *STRUC constraints can produce implausible patterns that hinge only on reducing the number of structural nodes in the output. The pre-eminent *STRUC constraint, *STRUC(σ), predicts one such unattested pattern.

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[32] The obligatory low ranking challenge cannot be addressed in the same way as the question that is often brought up against OT by skeptics: "if constraints are freely rankable, why are there no languages in which all markedness dominates all faithfulness?" (McCarthy 2002b:243-244). The problem here is a different one: "why isn't there a language in which just one *STRUC constraint is undominated?" *None* of the *STRUC constraints proposed in the literature is ever found at the top of a language's hierarchy.

#### 2.5.2.1 Syllable economy and syncope

To understand the oddity of this pattern, we need a little background on attested metrical syncope patterns (these will be discussed in more detail in chapter 3). In the metrical theories of Hayes 1995 and Prince 1990, H and LH feet are equally well-formed as iambs: both are binary and satisfy the weight requirements on iambic feet by having heavy heads. Although these feet are equally well-formed metrically, they are not equally economical: (H) has one fewer syllable than (LH). Economy processes that show a preference for (H) over (LH) are not atttested, yet they are possible if *STRUC(σ) is admitted into CON.

First, let us briefly review what economy effects are attested in iambic languages. In many iambic languages, syncope applies to /LL.../ to yield (H)... and to /LLL.../ to yield (LH). Deletion of a vowel here frees up a consonant to serve as a weight-bearing coda in an iambic foot:

(63) Attested syncope patterns in iambic languages

| | | | | |
|---|---|---|---|---|
| a. | /takapa/ | → | (ták)pa | not *(ta.ká)pa |
| | LLL | | HL | (LL)L |
| b. | /takapana/ | → | (ta.káp)na | not *(ta.ká)pa.na |
| | LLLL | | (LH)L | (LL)LL |

The outputs of syncope in (63) perform better than the faithful alternatives on the STRESS-TO-WEIGHT PRINCIPLE because their foot heads are heavy, not light. Syncope patterns just like this are found in Hopi (Jeanne 1978, 1982) Southeastern Tepehuan (Kager 1997, Willett 1982), Aguaruna (Alderete 1998, Payne 1990), and Central Alaskan Yupik (Gordon 2001, Hayes 1995, Jacobson 1985, Miyaoka 1985, Woodbury 1987).

Southeastern Tepehuan is unusual among these languages because it also deletes long vowels in some circumstances. Kager 1997 argues that such deletion minimizes the number of unfooted syllables. Long vowels syncopate only when the result is footed more exhaustively, so syncope applies only in the second example in (64) (the pattern is only shown schematically; for a more detailed discussion see chapter 4).

(64) Syncope of long vowels

| | | | | |
|---|---|---|---|---|
| a. | /takaapa/ | (ta.káa)pa | *(ták)pa | |
| | LHL | (LH)L | HL | |
| b. | /taakaapan/ | (táak)pan | not *(táa)kaa.pan or | *(taa)ka.pan |
| | HHH | (H)H | (H)HH | (H)LH |

The output of syncope performs better on PARSE-σ than the faithful alternative—syncope allows the winner to pack more syllables into the foot. The important point here is that *syllables* are not counted—*unfooted syllables* are.

What we do not find, however, is an iambic language with a pattern just like Southeastern Tepehuan except that long vowels are deleted wherever it is possible to reduce the number of syllables:

(65) Non-occurring syncope pattern in iambic languages

| | | | | | |
|---|---|---|---|---|---|
| a. | /takaapa/ | tak.pa | σσ | not *ta.kaa.pa | σσσ |
| b. | /taakapa/ | taa.kap | σσ | not *taa.ka.pa | σσσ |

Yet with *STRUC(σ) in the grammar, this sort of pattern is predicted. Consider the tableau in (66), which includes metrical constraints, MAX-V, and *STRUC(σ). The constraints that are instrumental here are SWP (“if stressed, then heavy”), PARSE-σ (“no unfooted syllables”), NONFINALITY (“no final stress”), MAXV (“no V deletion”), and *STRUC(σ) (“no syllables”). As long as NONFINALITY dominates PARSE-σ and *STRUC(σ) dominates MAXV, /takaapa/ will map to *(ták)pa*:

(66) Iambic syllable reduction syncope with *STRUC(σ)

| | | SWP | NONFIN | *(σ) | PARSE-σ | MAXV |
|---|---|---|---|---|---|---|
| /takaapa/ | a. (ta.káa)pa | | | ***! | * | |
| | b. (ta.káap) | | *! | ** | | * |
| | **c. ☞(ták)pa** | | | ** | * | * |
| /taakapa/ | d. (táa)ka.pa | | | ***! | **! | |
| | e. ☞(táak)pa | | | ** | * | * |
| /takapa/ | f. ☞(ták)pa | | | ** | * | * |
| | g. (ta.káp) | | *! | ** | | * |
| | h. (ta.ká)pa | *! | | *** | * | |

There is no metrical preference for (H) iambs over (LH) iambs—none of the metrical constraints in (66) favors *(tak)pa* over *(ta.kaa)pa*. These two types of feet are distinguished only by the number of syllables they have, i.e., by their performance on *STRUC(σ). If *STRUC(σ) is excluded from (66), *tak.pa* does not have a chance of emerging as the winner in any grammar—from the point of view of markedness (as opposed to economy principles), the deletion of the second vowel in /takaapa/ is gratuitous. The unattested pattern /takaapa/ → *tak.pa* is economy for economy's sake.

2.5.2.2 Syllable Alignment as an economy device

Some gradient Alignment constraints (McCarthy and Prince 1993a) can have a very similar effect. Consider the syllable alignment constraints of Mester and Padgett 1994, which assign a violation mark for every mora that stands between, a given edge of a syllable and the corresponding edge of a prosodic word: ALIGN-L(σ, PrWd). In fact, although Mester and Padgett proposed these constraints to analyze the so-called directional syllabification pattern in dialects of Arabic (see Broselow 1992a, Farwaneh 1995, Ito 1986), their economy potential was quickly realized. Spaelti 1997 and Walker

1998 use syllable alignment to limit the size of the reduplicant[33] (see §2.3.3.2 for a non-economy alternative), Davis and Zawaydeh 1996 rank syllable alignment constraints above MAXV to analyze Cairene Arabic syncope, Kager 1995 uses syllable alignment to derive stem disyllabicity in Guugu Yimidhirr, and Ussishkin 2000 proposes a different twist on syllable alignment, σ-ALIGN, to derive the disyllabic maximum size of stems in Hebrew, which is also enforced through syncope.

Under Ussishkin's (2000) theory of Hierarchical Alignment, binarity is optimal at all prosodic levels because it ensures that every constituent shares at least one edge with the prosodic word, thereby achieving prominence: if the prosodic word consists of one or two syllables, each syllable stands at an edge, but if the prosodic word consists of three syllables, the middle syllable is in a non-prominent position. The difference between this version of syllable alignment and that of Mester and Padgett 1994 is in the nature of the quantification over edges: in Mester and Padgett's version, the edge of every syllable must coincide with the *same* edge of a prosodic word, while Ussishkin's σ-ALIGN requires that the edge of every syllable coincide with *some* edge of a prosodic word.

Syllable alignment constraints are not fully equivalent to *STRUC(σ)—they differ in their assessment of monosyllabic words. *STRUC(σ) starts counting at *one* syllable, but syllable alignment is a bit more lenient—it starts counting at *two* syllables (except for Ussishkin's (2000) version, which starts counting at *three*):

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[33] Walker 2000 actually departs from the syllable alignment analysis of Mbe in favor of *STRUC(σ), noting that the two strategies achieve nearly identical results.

(67) Hypothetical syllable alignment constraints and their economy effects

| | *STRUC(σ) | ALIGN-L(σ, PrWd) | σ-ALIGN |
|---|---|---|---|
| a. [σ] | * | | |
| b. [σσ] | ** | * | |
| c. [σσσ] | *** | ** | * |
| d. [σσσσ] | **** | *** | ** |

Formally, syllable alignment constraints are not *STRUC constraints—they do not penalize the least non-null member on a harmonic scale. When it comes to scales, though, gradient syllable alignment is fairly suspect—it necessitates either scales of infinite length or $n \succ n+1$ scales. Infinitely long scales are an impossibility since CON must be finite, while $n \succ n+1$ scales add a powerful device to the theory that is otherwise unnecessary (this point was first raised in §2.2.6).

As for σ-ALIGN, it is neither a *STRUC constraint nor a gradient alignment constraint—it does not assess the distance between a medial syllable and a word edge, distinguishing only between medial syllables (bad) and edge syllables (good). Nevertheless, it may be necessary to give σ-ALIGN the slip as well, since it has the same effect as *STRUC(σ) in the matter of /takaapa/ → *(ták)pa*. The problem is that neither gradient syllable alignment nor σ-ALIGN pay any regard the prosodic status of the syllables in question—the thing that matters to these constraints is the number of syllables in the output, not metrical well-formedness.

Consider the tableaux below, which are versions of (66) with *STRUC(σ) replaced by gradient syllable alignment and σ-ALIGN, respectively. The third output, *(ták)pa*, is harmonically bounded by *(takáa)pa* if ALIGN-L(σ, PrWd) and σ-ALIGN are excluded from CON, but if they are present, *(ták)pa* has a serious shot at being the winner—all that's required is that the relevant syllable-counting constraint dominate MAXV and that NONFINALITY dominate PARSE-σ.

(68) Economy for economy's sake, with gradient syllable alignment of Mester and Padgett (1994)

| /takaapa/ | NONFIN | ALIGN-L(σ, PrWd) | MAXV | PARSE-σ |
|---|---|---|---|---|
| a. (takáa)pa | | **! | | * |
| b. (takáap) | *! | * | * | |
| c. ☞(ták)pa | | * | * | * |

(69) Economy for economy's sake, with σ-ALIGN of Ussishkin (2000)

| /takaapa/ | NONFIN | σ-ALIGN | MAXV | PARSE-σ |
|---|---|---|---|---|
| a. (takáa)pa | | *! | | * |
| b. (takáap) | *! | | * | |
| c. ☞(ták)pa | | | * | * |

Exclusion of these constraints from CON still leaves the analyst some devices for analyzing maximum size restrictions—see §2.3.3.2.

To summarize, I argue that the ability to penalize syllables without reference of their metrical status is harmful whether it is an attribute of a true economy constraint like *STRUC(σ) or of syllable alignment constraints. All three kinds of constraints discussed here can favor an unattested pattern where H is chosen over the otherwise well-formed LH iambic foot. The only way to avoid this situation is to not let constraints penalize syllables except qua their metrical affiliation.

PH-referring economy constraints are not the only constraints with harmful effects—in the next section, I explore some predictions of having nihilistic constraints "against everything."

#### 2.5.2.3 Emergence of the marked in reduplication and positional faithfulness

Even when nihilistic *STRUC constraints are dominated, they can have effects in situations that McCarthy and Prince (1994a) dub ‘the emergence of the unmarked.’ The effect of nihilistic *STRUC constraints, however, is more appropriately described as emergence of the marked—by penalizing unmarked segments, they can favor outputs that are marked. Two environments where the effects of nihilistic *STRUC constraints can be felt are reduplicants and non-privileged positions.

Reduplicants often contain a subset of the language’s sound inventory, and it has been claimed that it is always the unmarked subset (Alderete et al. 1999, McCarthy and Prince 1994a, 1995). For example, in Tübatulabal, the first onset of the base is copied into the reduplicant as a stop with the least marked place of articulation, glottal:

(70) ʔ-reduplication in Tübatulabal (Alderete et al. 1999, Voegelin 1958)

| | | | | |
|---|---|---|---|---|
| a. | pɨtɨta | → | ʔɨ-pɨtɨta | ‘to turn over’ |
| b. | to:yan | → | ʔo:-doyan | ‘he is copulating’ |
| c. | ʃiʔiwɨ | → | ʔɨ:-ʃiʔiwɨ | ‘it looks different’ |
| d. | ʔa:baʔiw | → | ʔa:-ʔabaʔiw | ‘it is showing’ |

Alderete et al. 1999 argue that *ʔ* is the default segment in Tübatulabal because it violates the lowest-ranked place markedness constraint, *PL/PHAR:

(71) *PL/LAB, *PL/DORS>>*PL/COR>>*PL/PHAR (Lombardi 2001, 2002, Prince and Smolensky 1993)

This hierarchy is ranked between MAX-$C_{IO}$ and MAX-$C_{BR}$, as shown in (72): in normal input-output mappings, consonants with any place are mapped faithfully (cf. (d) and (d)), but in reduplication copying, only glottal stops[34] are permitted to surface (cf. (a) and (b)). Non-glottal consonants are deleted and replaced by epenthetic *ʔ*. Alderete et al. argue that the reason any consonants surface at all in the reduplicant is that ONSET is high-ranked (cf. (a) and (c)):

(72) The Tübatulabal onset (from Alderete et al. 1999:345)

| /RED-toyan | MAX-$C_{IO}$ | ONS | *PL/COR | *PL/PHAR | MAX-$C_{BR}$ | DEP-$C_{BR}$ |
|---|---|---|---|---|---|---|
| a. ☞ ʔo:-doyan | | | d, y, n | ʔ | d, y, n | ʔ |
| b. to:-doyan | | | t!, d, y, n | | y, n | |
| c. o:-doyan | | *! | d, y, n | | d, y, n | |
| d. ʔo:-ʔoʔaʔ | d, y, n! | | | ʔ, ʔ, ʔ, ʔ | ʔ, ʔ | |

If the ranking of ONSET and *PL/PHAR were reversed, however, the result is a pattern where *no* consonants are permitted in the reduplicant. This would look like this:

(73) Onsetless reduplicants (an unattested pattern)

a. /RED+napa/ a.a-na.pa
b. /RED+ʔita/ i.a-ʔi.ta
c. /RED+weta/ e.a-we.ta

The same result can be obtained by ranking the non-lenient version of the onset sonority hierarchy (see (10)) below ONSET and MAX-$C_{IO}$. Since the onset sonority hierarchy and the place markedness hierarchy penalize the entire range of possible consonants, their ranking between Max-$C_{IO}$ and Max-$C_{BR}$ obliterates consonants from reduplicants. This is while the normal onset inventory of the language is harmonic:

[34] The place hierarchy analysis alone cannot explain why *h* is copied as *ʔ*: /RED-hu:ʔ/ → *ʔu:-hu:ʔ* 'it leaked (Crowhurst 1991:52). Presumably, either the constraint against fricatives or *ONS/FRIC rules out the faithful copying of *h*.

(74) Onsetless reduplicants

| /RED+ʔita/ | MAX-IO | *ONS/t | MAX-BR |
|---|---|---|---|
| a. ʔiʔa-ʔita | | *!*** | |
| b. ☞i.a-ʔita | | ** | ** |
| c. i.a-i.a | *!* | | |

The culprits here are *PL/PHAR and *ONS/t: because they penalize the least marked elements on their respective scales, they act as *STRUC constraints. If these constraints were eliminated, *not* copying ʔ would not be an option because it gratuitously violates MAX-BR.

These sorts of constraints can have a similar effect when they interact with positional faithfulness. Beckman 1998 reports numerous patterns where marked structure is allowed to surface only in special positions, e.g., the initial segment of the word but not elsewhere. The prediction is, then, that given the ranking $F_{pos}$>>*STRUC>>F, structure marked with respect to nihilistic *STRUC constraints should only be present in designated positions. For example, consider the following hypothetical language, which has consonants only in the initial syllable but hiatus elsewhere:

(75) Consonants in initial syllable only

a. /nalikepati/ → ná.i.e.a.i
b. /wata/ → wá.a
c. /aina/ → á.i.a

All onset constraints including *ONS/t are dominated by MAX-INITIAL but not by the non-positional MAX. Thus, word-initial consonants are preserved but word-internal ones must delete:

(76) Consonants deleted except in first syllable

| /wata/ | MAX-INITIAL | *ONS/w | *ONS/l | *ONS/n | *ONS/t | MAX |
|---|---|---|---|---|---|---|
| a. ☞wa.a | | * | | | | * |
| b. wa.ta | | * | | | *! | |
| c. a.a | *! | | | | | ** |

Nihilistic constraints against vowels also have the potential for favoring unattested syncope patterns. In chapter 4, I discuss the effects of context-free markedness constraints *LOW and *NONLOW (Lombardi 2003) in more detail. In brief, the issue is that there is an asymmetry in differential syncope patterns: there are languages where low sonority vowels (e.g., *ə* or *i*) delete wherever possible, and there are languages where high sonority vowels (e.g., *a*) delete in unstressed positions, but there are no languages where high sonority vowels delete wherever possible but other vowels do not. This asymmetry can be explained only if there are no context-free markedness constraints against high sonority vowels. If *LOW is allowed into the grammar, the pattern is wrongly predicted to exist. In chapter 4, I discuss this prediction in more detail and provide an alternative to the context-free markedness theory of epenthetic vowel quality that allows us to expunge *LOW and *NONLOW from CON.

The patterns discussed here are inevitable under the view that "everything is marked." The only way to get around such predictions is to exclude certain constraints from CON. A straightforward way to do that is to formulate constraints leniently based on harmonic scales.

### 2.5.3 Section summary

This section has defined *STRUC constraints and discussed some of their harmful effects: unattested inventory gaps (e.g., languages without obstruents or vowels) and bizarre structure-reducing patterns such as syncope to reduce the number of syllables, "emergence of the marked" in reduplication, and absence of elements like consonants (not traditionally seen as marked) outside privileged positions. These patterns are nothing more than slight improvisations on the originally intended function of Economy constraints: favoring smaller structures. The problems that Economy constraints cause cannot generally be solved by restricting their ranking—they suggest that constraints of this sort must be excluded from the theory altogether.

## 2.6 Chapter summary

This chapter presented a theory of economy effects without economy principles. Economy effects, it was argued, are nothing but a consequence of a language-specific ranking of constraints. Moreover, economy effects never target unmarked structure—if something is deleted, the goal is a less marked output rather than a shorter output.

The theory relies on a different conception of markedness: markedness is always a relative property. A structure can only be marked if there is another non-null structure that is not marked. This is formally encoded in the Lenient Theory of CON, whereby constraints penalize every element on their respective harmonic scale except for the most harmonic one. The scales themselves cannot stipulate nihilistic comparisons, e.g., "$x \succ \varnothing$." Language-specific grammars can prefer $\varnothing$ to every other candidate in a comparison, but individual constraints do not.

A consequence of this approach is that economy constraints are banned from CON, which I argue is necessary in any case because they have harmful typological effects. The argument takes a different turn in the next chapter, where I show that a particular economy effect, metrical syncope, can be analyzed to great effect in terms of independently motivated constraints, which account not only for the details of the syncope processes in the languages examined but also for other aspects of their phonologies. Conversely, economy constraints contribute nothing to the understanding of these processes.

# CHAPTER 3

# METRICALLY CONDITIONED SYNCOPE

## 3.1 Introduction

In the theory proposed here, structures cannot be marked with respect to a constraint unless there are structures that are unmarked with respect to the same constraint. In a way, nasal vowels are only marked because plain oral vowels are not. Similarly, syllables by themselves are not marked, but syllables in certain metrical contexts are. This was already touched upon in §2.3, which discussed a range of truncation processes and other maximum size effects. In this chapter, the approach is extended to a range of diverse economy effects that are collectively known as metrically conditioned syncope.[35]

The interaction of some metrical constraints with MAX can produce a wide range of syncope patterns. Here, I will look at the interaction of MAX with PARSE-σ, STRESS-TO-WEIGHT (SWP), WEIGHT-TO-STRESS (WSP), and GRPHARM. Of these constraints, PARSE-σ and SWP are of a particular interest because some of their effects are economy effects. Thus, deletion of unfootable vowels can improve a candidate's performance on PARSE-σ, while deletion of a vowel immediately after a stressed light syllable in a language with moraic codas produces an output that performs better on SWP than a faithful parse does.

[35] *Syncope* here will refer to interconsonantal vowel deletion, e.g., /pat<u>a</u>ka/ → *pat.ka* or /p<u>a</u>taka/ → *pta.ka*. *Apocope* is final vowel deletion, e.g., /patak<u>a</u>/ → *patak*. I will also use "vowel deletion" to refer to either or both of these processes.

The interaction of metrical constraints is well-known to be instrumental in vowel shortening, as well—as we will see, vowel shortening and syncope often coexist in the same grammar as ways to improve foot shape.

The result of both vowel shortening and syncope is structural economy, but the markedness constraints whose interaction produces these patterns are in no sense economy constraints. Rather, they militate against specific structural configurations: not all syllables but unfooted syllables, not all feet but feet with light heads, heavy non-heads, uneven parts, and so on. Deletion is not a way to get rid of *structure*, it is a way to get rid of *marked structure*.

The theory of CON developed in Chapter 2 precludes the existence of *STRUC constraints. I argue that if such constraints were to exist, they would either contribute nothing to the understanding of metrical syncope and shortening or make the wrong predictions with respect to their application.

The chapter starts with two in-depth case studies of Hopi and Tonkawa syncope and shortening. These are cases of so-called rhythmic vowel deletion, which was first analyzed in OT by Kager 1997. His own prosodic analysis of Southeastern Tepehuan is also considered in this chapter.

I start by examining Hopi syncope and shortening. I show that when the processes are examined in the larger context of Hopi prosody, their true motivation becomes apparent: vowels do not syncopate and shorten for the sake of reducing the number of syllables and moras; rather, the outputs of syncope and shortening are optimal in that they contain the minimal number of *unfooted* syllables and have the best *iambic feet*.

I then present a re-analysis of Tonkawa, where vowels delete in an alternating pattern and which is often cited as a classic example of "delete wherever you can." When Tonkawa syncope and vowel shortening are examined in terms of foot structure, they no longer seem like default processes at all—there is every indication that syncope and shortening build *optimal trochaic feet*. I also show that economy constraints make either the wrong predictions or no predictions about where deletion and shortening should apply in Tonkawa.

The last case study is Southeastern Tepehuan, in which "the output goal of apocope/syncope is *not* to minimize the number of syllables as such, but to minimize the number of syllables that stand *outside the foot*" (Kager 1997:475). This language deletes in alternating syllables like Tonkawa, but its footing is non-iterative like that of Hopi. This difference between Southeastern Tepehuan and Hopi on the one hand and Tonkawa on the other hand is straightforwardly captured by simply re-ranking constraints, yet it cannot be easily replicated in an economy analysis. Furthermore, I show that economy constraints can produce an *unattested pattern* that is a slight variation on Southeastern Tepehuan, but they cannot account for Southeastern Tepehuan itself—this argument continues a point made in chapter 2.

I show that analyses of Hopi, Tonkawa and Southeastern Tepehuan in terms of economy principles encounter a central problem: general anti-structure constraints cannot control the locus of deletion and shortening, so deletion is predicted to occur where it doesn't. To get around this, such analyses must appeal to prosodic constraints like $*\sigma_{\mu\mu\mu}$ and WSP, which are themselves sufficient to account for the pattern. Economy constraints are shown to be unnecessary to account for syncope: at best they are useless and at worst harmful.

## 3.2 Metrical constraints and the typology of metrical syncope

There are several constraints whose interaction with MAXV can result in vowel deletion in metrically defined contexts. In this section, I review some of these constraints and sketch out their interaction as relevant to the case studies in this chapter.

#### 3.2.1.1 PARSE-σ

PARSE-σ assigns one violation mark to every syllable that is not immediately dominated by a foot node:

(1) PARSE-σ: "Syllables are parsed by feet" (Prince and Smolensky 1993).
*Harmonic scale*: $\sigma/\text{Ft} \succ \sigma/\text{PrWd} \succ \sigma/\text{PPh}$ (/ = "immediately dominated by")

PARSE-σ is one of a larger family of EXHAUSTIVITY constraints, which require every element of the Prosodic Hierarchy to be dominated by an immediately higher level (Selkirk 1995b). I interpret Selkirk's EXHAUSTIVITY as a formal principle that informs the harmonic scale in (1): the principle itself is formulated in fairly general terms but the resulting constraints are calibrated to penalize specific prosodic levels that are not exhaustively dominated.

The most commonly discussed effect of PARSE-σ is not an economy effect at all—exhaustive footing. The obvious way to satisfy PARSE-σ is to build a foot around a syllable. Depending on the ranking of the relevant constraints, satisfaction of PARSE-σ may entail building less-than-perfect degenerate feet, creating stress clashes, and so on. These are in a sense anti-economy effects—the constraint is satisfied by the addition of foot structure.

Because syllables are (typically) headed by vowels, the deletion of a vowel can also remove violations of PARSE-σ. For example, in Yidiɲ, the last vowel of an odd-parity word is deleted but the last vowel of an even-parity word is preserved. (Round brackets indicate foot boundaries.)

(2) Yidiɲ odd-parity apocope (Dixon 1977a, b)

| | | | | |
|---|---|---|---|---|
| a. | /gindanu/ | (gin.dá:n) | 'moon-absolutive' | not *(gin.dá:)nu |
| b. | /gindanu-ŋgu/ | (gínda)(núŋgu) | 'moon-ergative' | |

This pattern indicates that PARSE-σ dominates MAXV: apocope applies when the vowel cannot be incorporated into a binary foot (Dixon 1977a, b, Hayes 1995, Hung 1994, Kirchner 1992, though see Hall 2001 for an alternative analysis without PARSE-σ).

If footing is not iterative, the ranking PARSE-σ >> MAXV can favor pervasive syncope, deleting vowels wherever possible outside the main foot: /takapana/ → *tak(pána)*, /takapawana/ → *tak.pa(wána)*, /takapatawana/ → *tak.pat(wána)*, etc. A possible example of such a pattern is Afar, where deletion affects vowels outside the foot but not inside wherever the CVC syllable structure permits: /xamila/→ *xa(míla)*, but /xamila-í/ → *xam(lí)*, not **xa.mi(lí)* (Bliese 1981).

### 3.2.1.2 The STRESS-TO-WEIGHT PRINCIPLE

Another prosodic constraint that can be satisfied by vowel deletion is SWP, which requires stressed syllables to be heavy:

(3) STRESS-TO-WEIGHT PRINCIPLE (SWP): "Heads of feet are minimally bimoraic."[36]
*Harmonic scale*: $\acute{\sigma}_{\mu\mu\mu} \succ \acute{\sigma}_{\mu\mu} \succ \acute{\sigma}_{\mu}$

This constraint assigns a violation mark to a (LL) foot but not to a (H) foot. In a language with moraic consonants, it is possible to satisfy SWP by deleting the second vowel from a /CVCV/ sequence. The result is a (CVC) foot, which satisfies SWP. If the SWP is ranked above MAXV, the vowel following a light stressed syllable will delete, resulting in an output with fewer syllables. This is an economy effect, yet SWP has other effects as well. Heavy stressed syllables can also be created by vowel lengthening (as in many Germanic languages (Riad 1992), Ilokano (Hayes and Abad 1989), and Central Alaskan Yupik(Gordon 2001, Hayes 1995, Jacobson 1985, Miyaoka 1985, Woodbury 1987)) and consonant gemination (Norton Sound Unaliq (Jacobson 1985), Italian, and others). Hayes 1995:83 discusses a number of examples of iambic systems which augment stressed syllables by lengthening the vowel or geminating the consonant, including Hixkaryana, Surinam Carib, Menomini, Cayuga, Central Alaskan Yupik, Sierra Miwok, Munsee, Menomini, Southern Paiute, and many others. Gemination and lengthening are certainly not economy effects—they are quite the opposite, since they result in larger structures.

#### 3.2.1.3 A mini typology of metrical syncope

The factorial typology of the three constraints SWP, PARSE-σ and MAXV produces four types of patterns, shown in (4). First, if MAXV dominates both markedness constraints, then there is either no syncope or the pattern is essentially nonmetrical (see

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[36] SWP is also defined "if stressed, then heavy." Prince (1990) names it but argues against it. SWP harks back to Prokosch's Law (1938) and the Obligatory Branching Parameter (Halle and Vergnaud 1978, Hammond 1984, Hayes 1980). See also Fitzgerald 1999, Goodman 1990, Ham 1998, Hayes 1995, Jacobs 2000, 2001, Kager 1997, 1999, Morén 1999, Myers 1987, Riad 1992.

chapter 4 for some such patterns). In some of these languages, SWP and PARSE-σ may actually be satisfied in other ways, i.e., through gemination, vowel lengthening, and/or exhaustive footing. Second, if PARSE-σ dominates MAXV but SWP does not, then vowels that are unfootable in the faithful candidate will delete. This is the pattern in Yidiɲ. Third, if SWP dominates MAXV but PARSE-σ is ranked below MAXV, deletion will apply to LL sequences (converting them into H feet). This pattern is attested in Panare (Payne and Payne 2001). Finally, if both SWP and PARSE-σ dominate MAXV, the result is a pattern where deletion applies both to vowels that occur in in LL sequences and to vowels that are unfootable in the faithful candidate. This kind of pattern is found in Hopi (§3.3), Southeastern Tepehuan (§3.5), and Aguaruna (Alderete 1998, Payne 1990). Tonkawa, which is the subject of §3.4, has a variation of this pattern—there are no unfootable vowels because footing is iterative, but deletion always applies after light syllables.

(4) Predicted syncope patterns with SWP and PARSE-σ

| | | |
|---|---|---|
| **MAXV**>>PARSE-σ, SWP | /pataka/ → *(pata)ka*, not **pat.ka* | many lgs. |
| PARSE-σ>>**MAXV**>>SWP | /pataka/ → *(patak)*, not **(pata)ka*<br>/patakata/ → *(pata)(kata)* | Yidiɲ |
| SWP>>**MAXV**>>PARSE-σ | /pataka/ → *(pát)ka*, not **(pá.ta)ka*<br>/paataka/ → *(páa)(ták)* or *(páa)ta.ka* not **(pát)ka* | Panare |
| SWP, PARSE-σ>>**MAXV** | /patakata/ →*(pa.tak)ta*, not **(pa.ta)ka.ta*<br>/pataakata/→ *(paták)ta*, not **(patáa)ka.ta* | Hopi,<br>SE Tepehuan |

#### 3.2.1.4 ENDRULE and other constraints

Both PARSE-σ and SWP can interact with other constraints in complex ways, so the picture in (4) is a rather incomplete. Some of the constraints that play an important role in the case studies in this chapter are defined below. WSP (see (5)) assigns violation marks both to unfooted heavy syllables and to footed heavy syllables that are not stressed:

(5) WEIGHT-TO-STRESS PRINCIPLE (WSP): "If heavy, then stressed." (Prince 1990)
*Harmonic scale*:[37] $\breve{\sigma}_{\mu} \succ \breve{\sigma}_{\mu\mu} \succ \breve{\sigma}_{\mu\mu\mu}$

One effect of WSP that has little to do with economy is attraction of stress to heavy syllables from light ones. In Panare, Tübatulabal, Axininca Campa, and numerous other languages, the default alternating stress pattern is disrupted to avoid unstressed heavy syllables (see Hayes 1995, McCarthy and Prince 1993b, Prince and Smolensky 1993). Another effect that does result in economy is the shortening of vowels in unstressed syllables (as in Latin; see §3.4.2.2). All three case studies discussed in this chapter have shortening of this sort. Yet another important effect of WSP is that it can prevent syncope from creating unstressed heavy syllables, as it does in Hopi (see especially §3.3.4.2).

For various reasons discussed in chapter 2, I assume that all constraints in CON are categorical (see also McCarthy to appear for additional arguments). Here I discuss how iterative vs. non-iterative footing is obtained without gradient alignment, since this will be important in this chapter.

Iterative footing violates at least one of the ENDRULE constraints (McCarthy to appear, Prince 1983), which were briefly discussed in chapter 2. These constraints require that the head foot of a prosodic word be the first (or last) foot in the prosodic word:

---

[37] This scale actually gives rise to two constraints, $\text{WSP}_{\mu\mu}$ "No unstressed bimoraic syllables" and $\text{WSP}_{\mu\mu\mu}$ "No unstressed trimoraic syllables" (cf. Kager's (1997) "gradient" WSP, which assigns two violation marks for unstressed superheavies but only one for unstressed heavies.) The relevant constraint in Hopi is $\text{WSP}_{\mu\mu}$. $\text{WSP}_{\mu\mu\mu}$ plays a role in Tonkawa and Tepehuan, and also in Lebanese Arabic (chapter 4).

(6) ENDRULE-L: “The head foot is not preceded by another foot within the prosodic word” (McCarthy to appear).
*Harmonic scale*: $[_{PrWd}$ x (HdFt)...] ≻ $[_{PrWd}$ ....(Ft)... (HdFt)...] *x* not a foot

(7) ENDRULE-R: “The head foot is not followed by another foot within the prosodic word” (McCarthy to appear).
*Harmonic scale*: [...(HdFt) x $_{PrWd}]$ ≻ [...(HdFt) ... (Ft) $_{PrWd}]$ *x* not a foot

Consider how these constraints interact with PARSE-σ. ENDRULE-L, for example, can be satisfied by two kinds of structures: an iteratively footed word whose leftmost foot is the head of the prosodic word, e.g., (σ́σ)(σσ) or σ(σ́σ)(σσ), and any non-iteratively footed word, whose head foot is both the leftmost and the rightmost foot in the word:

(8) ENDRULE constraints and iterative footing

| | ENDRULE-L | ENDRULE-R | PARSE-σ |
|---|---|---|---|
| a. (σ́σ)(σσ) | | * | |
| b. (σσ)(σ́σ) | * | | |
| c. σσ(σ́σ) | | | ** |
| d. (σ́σ)σσ | | | ** |
| e. σ(σ́σ)(σσ) | | * | * |

Although at least one of the ENDRULE constraints must be violated when footing is iterative, both are satisfied when there is only one foot in the word—thus we get non-iterative footing when ENDRULE constraints dominate PARSE-σ. Another feature of ENDRULE constraints is that they do not actually require the head foot to be leftmost or rightmost in the word—this is one of several differences between ENDRULE constraints and ALL-FT-L/R (McCarthy and Prince 1993a; see McCarthy to appear for more discussion). ENDRULE constraints do not “count” the number of feet that stand between a head foot and a word edge—a word with one offending foot is as marked as a word with twenty such feet.

As for the position of the single foot in a non-iteratively footed word, it will be determined by the positional licensing constraints of Kager 2001. These constraints include ones that require syllables at edges to be footed. Kager frames these as categorical alignment constraints, ALIGN-L(WD, FT) and ALIGN-R (WD, FT), but I will follow McCarthy's usage and call them PARSE-σ-INITIAL (or PARSE-σ1 for short) and PARSE-σ-FINAL to avoid confusion with gradient alignment constraints.

This provides the necessary background for the case studies.

## 3.3 Hopi

### 3.3.1 Introduction

Hopi (Northern Uto-Aztecan, Southwestern USA) has a pattern of syncope and vowel shortening that applies to the second or the third underlying vowel of the word. Thus, both underlying /LL-L/ words and /HL-L/ words surface as HL:[38]

(9) Suffixation on LL bases: syncope (Hill et al. 1998, Jeanne 1978, 1982)

| | | | | | | |
|---|---|---|---|---|---|---|
| a. | /soma-ya/ | sómya | 'tie, pl.' | cf. | sóma | 'tie, sg.' |
| b. | /soʔa-ya/ | sóʔya | 'die, pl.' | cf. | sóʔa | 'die, sg.' |

(10) Suffixation on HL bases: syncope and shortening

| | | | | | | |
|---|---|---|---|---|---|---|
| a. | /tooka-ni/ | tókni | 'sleep, future' | cf. | toóka | 'sleep, non-future' |
| b. | /mooki-ni/ | mókni | 'die, future' | cf. | moóki | 'die, non-future' |

In longer words, however, syncope applies only once but strikes the *third*, not the *second* vowel:

(11) In /LLLLL/ words, delete the third underlying vowel

| | | | | |
|---|---|---|---|---|
| a. | /aŋa-ka̲tsina/ | a.ŋak.tsi.na | 'Long Hair kachina' | *aŋ.ka.tsi.na |
| b. | /tuhisa̲-tuwi/ | tu.his.tu.wi | 'ingenuity' | *tuh.sa.tu.wi |

[38] L=light syllable, H=heavy syllable throughout.

In this section, I present a detailed analysis of Hopi phonology and argue that there is a principled explanation for this asymmetry between words with three underlying vowels and words with four underlying vowels or more. Hopi has an output target—an iambic foot (H) or (LH) at the beginning of the word, followed by at least one unstressed syllable. In words that have only three underlying vowels, syncope applies to the second vowel because this ensures a (H)L output. The weight profile of the output is also very important to the outcome of both syncope and shortening: syncope can never create an unstressed H syllable. What matters in Hopi is not the length of the output but its markedness with respect to metrical constraints.

The same constraints whose interaction favors syncope and shortening are also active in determining the stress pattern: SWP, PARSE-σ, WSP, and NONFINALITY(σ). Syncope, shortening and foot construction all work together to produce outputs that are metrically optimal given the Hopi ranking.

I argue that an analysis of Hopi in terms of economy constraints is problematic. An economy principle analysis seems initially plausible: if syncope is indeed an economy process of reducing the number of syllables, feet, and moras, then /HLL/ words are a prime target for some deletion and shortening, since they contain more structure than /LLL/ words. Yet this economy principle approach encounters problems with /LLLLL/ words: since these are longer than either /LLL/ or /HLL/, economy constraints predict that deletion should apply more than once. This sort of analysis also fails to explain why deletion targets different positions in words of different length without appealing to additional mechanisms. More generally, any analysis of Hopi that is agnostic of prosodic structure misses a real connection between the surface stress pattern and the application of syncope and shortening: metrical well-formedness is a real goal in Hopi; short words are not.

### 3.3.2 Hopi phonology: the bigger picture

Hopi syncope and vowel shortening are closely tied to stress, so I present the stress facts first (§3.3.2.1). Syncope and shortening are described in §3.3.2.2 and §3.3.2.3 respectively. I draw on the descriptions by Jeanne 1978, 1982, and Hill and Black 1998. Forms are taken from Jeanne's work, Halle 1975, and the *Hopi Dictionary* (Hill et al. 1998).

#### 3.3.2.1 Stress pattern

Hopi has CVV, CVC and CV syllables. There are generally no clusters, except word-finally two-consonant clusters are tolerated when they arise through morpheme concatenation. CVV and CVC syllables count as heavy in the weight-sensitive stress system of Hopi, which is described as follows:

(12) Hopi stress: Stress initial syllable if heavy; otherwise stress second syllable. In disyllables, stress the initial syllable. No secondary stress has been reported.

The stress pattern is illustrated in (13)-(15).

(13) Stress initial syllable if heavy

a. ʔác.ve.wa ‘chair’
b. soó.ya ‘planting stick’

(14) Otherwise stress second syllable

a. ca.qáp.ta ‘dish sg.’
b. qö.tö́.som.pi ‘headband sg.’
c. ki.yá.pi ‘dipper sg.’

(15) In disyllables and monosyllables, stress first syllable

a. kó.ho ‘wood’
b. táa.vok ‘yesterday’

| | | | | | | |
|---|---|---|---|---|---|---|
| c. | má.mant | ‘maidens’ | | | | |
| d. | pám | ‘he/she’ | | | | |

#### 3.3.2.2 Syncope patterns

Syncope applies to the second vowel in words that have just three vowels underlyingly. This can be seen in (16) and (17). Note that in both cases the outputs have the shape CVCCV, or (H)L, which is also the shape that reduplicated forms take in (18).

(16) Syncope in /LLL/ words: second vowel deletes

| | | | | | | |
|---|---|---|---|---|---|---|
| a. | /som<u>a</u>-ya/ | sóm.ya | ‘tie, pl.’ | cf. | só.ma | ‘tie, sg.’ |
| b. | /soʔ<u>a</u>-ya/ | sóʔ.ya | ‘die, pl.’ | cf. | só.ʔa | ‘die, sg.’ |
| c. | /soma-ŋ$^{w}$i/ | sóm.ŋ$^{w}$i | ‘tie, nomic’ | | | |

(17) Syncope in /HLL/ words: second vowel deletes, first vowel shortens

| | | | | | | |
|---|---|---|---|---|---|---|
| a. | /tooka-ni/ | tók.ni | ‘sleep, future’ | cf. | toó.ka | ‘sleep, non-future’ |
| b. | /mooki-ni/ | mók.ni | ‘die, future’ | cf. | moó.ki | ‘die, non-future’ |
| c. | /naala-ya-n-ta/ | nál.yan.ta | ‘to be alone by oneself’ | | | cf. náa.la ‘alone’ |

(18) Reduplication of /LL/

| | | | | | |
|---|---|---|---|---|---|
| a. | /RED-koho/ | kók.ho | ‘wood pl.’ | cf. | kó.ho |
| b. | /RED-sihɨ/ | sís.hɨ | ‘flower pl.’ | cf. | sí.hɨ |
| c. | /RED-como/ | cóc.mo | ‘hill pl.’ | cf. | có.mo |

In words with more than three underlying vowels, deletion affects the third vowel. The four- and five-vowelled words in (19) exemplify this.[39]

(19) Syncope in /LLL.../ words: third vowel deletes

| | | | | | |
|---|---|---|---|---|---|
| a. | /navot<u>a</u>-na/ | na.vót.na | ‘inform, tell’ | cf. | navóta ‘to notice’ |
| b. | /kaway<u>o</u>-sa-p/ | ka.wáy.sap | ‘as high as a horse’ | cf. | kawáyo ‘horse’ |
| c. | /aŋa-k<u>a</u>tsina/ | a.ŋák.tsi.na | ‘Long Hair kachina’ | cf. | áŋa ‘long hair,’ katsína ‘kachina [a spirit being]’ |

[39] Syncope appears to apply in derived environments only; words like *navota, kawayo, katsina*, and *tuhisa* do not undergo syncope (*kawayo* is a Spanish loan). I have no account of this aspect of Hopi syncope at present. For some work on derived environment effects in OT, see Kiparsky to appear, Lubowicz 2002, McCarthy 2002c, Polgardi 1995.

| | | | | | | |
|---|---|---|---|---|---|---|
| d. | /tuhisa-tuwi/ | tu.hís.tu.wi | ‘ingenuity’ | cf. | tuhisa ‘ingenious,’ túwi ‘knowledge’ | |
| e. | /qövisa-tapna/ | qö.vís.tap.na | ‘make pout, sulk’ | cf. | qövísa ‘bad sport’ | |

The generalization that unites these patterns is that deletion produces a (H) or a (LH) sequence at the left edge of the word followed by at least one syllable; in other words, syncope produces a left-aligned iambic foot that is non-final in the word.

#### 3.3.2.3 Vowel shortening patterns

Vowels shorten in several environments in Hopi. One is unstressed syllables. When a second syllable long vowel is final in the word, it is shortened:

(20) Shortening word-finally

| | | | | | | |
|---|---|---|---|---|---|---|
| a. | /panaa/ | pá.na | ‘act on’ | cf. | pa.naá.qe | ‘act on, conj.’ |
| b. | /sowaa/ | só.wa | ‘eat’ | | so.waá.qe | ‘eat, conj.’ |
| c. | /pitɨɨ/ | pí.tɨ | ‘arrive’ | | pi.tɨɨ́.qey | ‘arrive, conj.+acc.’ |

Shortening also applies to closed syllables, whether derived by syncope or not:

(21) Suffixation on /HL/ bases: syncope and shortening

| | | | | | | |
|---|---|---|---|---|---|---|
| a. | /tooka-ni/ | tó.kni | ‘sleep, future’ | cf. | tóo.ka | ‘sleep, non-future’ |
| b. | /mooki-ni/ | mók.ni | ‘die, future’ | cf. | móo.ki | ‘die, non-future’ |

(22) Shortening in underlyingly closed syllables

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| a. | /naaqvɨ/ | náq.vɨ | ‘eat’ | cf. | /RED-naaqvɨ/ | náa.naq.vi | ‘eat pl.’ |
| b. | /tɨɨsna/ | tɨ́s.na | ‘body dirt’ | cf. | /RED-tɨɨsna/ | tɨ́ɨ.tɨs.na | ‘body dirt pl.’ |

Finally, long vowels shorten in sequences, as demonstrated by the reduplication examples in (23).

(23) /HL/ reduplication with shortening

| | | | | |
|---|---|---|---|---|
| a. | /RED-noova/ | nóo.no.va | ‘food pl.’ cf. | nóo.va |
| b. | /RED-moola/ | móo.mo.la | ‘mule pl.’ | móo.la |
| c. | /RED-ʔaaya/ | ʔáa.ʔa.ya | ‘rattle pl’ | ʔá.ya |
| d. | /RED-soohɨ/ | sóo.so.hɨ | ‘star pl.’ | sóo.hɨ |

I have found no long vowel prefixes or suffixes, so reduplicated forms provide the only examples of long vowels in sequences.[40]

To summarize, Hopi long vowels shorten in closed syllables and in unstressed positions.

### 3.3.3 Analysis of Hopi stress

#### 3.3.3.1 Non-iterative footing

Stress in Hopi is iambic (Hayes 1995, Hung 1994): a single foot is built at the left edge of the word, and the final syllable is extrametrical. The pattern results from the interaction of the following constraints:

(24) ENDRULE-R, ENDRULE-L, PARSE-σ, NONFINALITY(σ), PARSE-σ1.

There is no secondary stress, so both ENDRULE constraints must dominate PARSE-σ. It is more important to have no intervening feet between the right edge of the head foot and the right edge of the prosodic word than to foot iteratively. A violation of ENDRULE-R is incurred by the iterative loser *(qötö̋)(sòm)pi* because the main stress foot is not final in the word. A violation of ENDRULE-L is incurred by (qötö̀)(sóm)pi because its main stress foot is not initial in the word:

---

[40] According to Hill and Black, there is another shortening process that affects a first-syllable long vowel in compounding, e.g. *<u>sii</u>va* 'metal' + *qöpqö* 'fireplace' → *sivaqöpqö* 'stove,' *<u>muu</u>yaw* 'moon' + *<u>taa</u>la* 'light' → *muytala* 'moonlight,' but *<u>qöö</u>tsa* 'white' + *ko<u>waa</u>ko* 'chicken' → *qötsako<u>waa</u>ko* 'white chicken.' This process is probably not part of the same system as the shortening processes discussed here. Hill and Black also do not mention whether there is secondary stress in compounds like *qötsa-kowaako*.

(25) One foot is built at the left edge

| /qötösompi/ | ENDRULE-R | ENDRULE-L | PARSE-σ |
|---|---|---|---|
| a. ☞(qötő́)sompi | | | ** |
| b. (qötő́)(sòm)pi | *! | | * |
| c. (qötȍ)(sóm)pi | | *! | * |

The position of the main stress foot is determined by the high-ranking PARSE-σ1. PARSE-σ1 must dominate all the constraints that can favor non-initial feet, because the first syllable is consistently footed regardless of what follows (this will be shown shortly).

3.3.3.2 <u>The role of NONFINALITY(σ)</u>

As we will see in §3.3.4.2, NONFINALITY(σ) plays a pivotal role in the outcome of syncope—the output of syncope always satisfies this constraint even if this comes at the expense of less-than-perfect footing. In addition to this effect, it controls stress assignment in LL disyllables in an interaction that Prince and Smolensky dub "rhythmic reversal" (Prince and Smolensky 1993:58).

Default stress in Hopi is iambic, which suggests that RHTYPE=IAMB (see (27)) dominates RH-TYPE=TROCHEE—witness *(kiyá)pi* ≻ **(kîya)pi*. However in disyllables, stress falls on the initial syllable in order to avoid violating NONFINALITY(σ):[41]

[41] This NONFINALITY constraint penalizes final syllables that bear stress, but there is another version of NONFINALITY that bans final syllables not only from being stressed but from being footed—NONFINALITY(FT) (cf. Prince and Smolensky 1993). This constraint can only be active in trochaic languages (where it favors antepenultimate stress), since they alone can have footed word-final syllables that are not stressed. See chapter 4 for discussion of NONFINALITY, where a more complete version of its harmonic scale will be given.

(26) NONFINALITY(σ): "The prosodic head of a word does not fall on the word-final syllable" (Prince and Smolensky 1993:42).
*Harmonic scale*: $[_{\text{PRWD}} \ldots \breve{\sigma}] \succ [_{\text{PRWD}} \ldots \acute{\sigma}]$

Since (L) feet are generally avoided in the language (there are no L words, meaning FTBIN is undominated), the only way to satisfy NONFINALITY(σ) is to foot disyllables as trochees. This violates RH-TYPE=IAMB:[42]

(27) RHTYPE=IAMB: "Feet are prominence-final" (Prince and Smolensky 1993:56).
*Harmonic scale*: $(\ldots\acute{\sigma}) \succ (\ldots\breve{\sigma})$

Switching to trochaic feet in disyllables is a common pattern for iambic languages. Prince and Smolensky discuss rhythmic reversal in their analysis of Southern Paiute, and numerous other examples can be found in Hung 1994 who actually briefly discusses Hopi in this context.

(28) Foot shape is sacrificed to avoid final stress

| /koho/ | NONFINALITY(σ) | RHTYPE=IAMB | RHTYPE=TROCH |
|---|---|---|---|
| a. ☞(kóho) | | * | |
| b. (kohó) | *! | | * |

NONFINALITY(σ) is very high-ranked in Hopi and dominated only by the morphology-phonology interface constraint LX≈PR. LX≈PR requires that all lexical words correspond to prosodic words, i.e., be footed, etc. We see its effect in monosyllabic words like *pám*: the only way to foot them results in final stress (30) (cf. the analysis of Latin

[42] RHTYPE=IAMB according to this scale is defined "$*\breve{\sigma})_{\text{Ft}}$." By this definition, (H) is both an optimal trochee and an optimal iamb, since it is both prominence-initial and prominence-final. This is an economy result: the smallest foot is preferred by the grammar to larger feet simply because it does not contain any non-prominent material.

extrametricality in Prince and Smolensky 1993). Monosyllables are the only forms that violate NONFINALITY(σ) in Hopi.

(29) LX≈PR "lexical words must correspond to prosodic ones."

(30) Final stress not avoided when there is only one syllable

| /pam/ | LX≈PR | NONFINALITY(σ) |
|---|---|---|
| a. ☞(pám) | | * |
| b. pam | *! | |

3.3.3.3 The role of WSP

Another constraint that affects the outcome of syncope and vowel shortening is WSP (see (5)), which disfavors unstressed bimoraic syllables (CVV and CVC). Although WSP plays an important role in blocking syncope, it is not ranked high enough to affect stress placement very much. Thus, WSP is dominated by NONFINALITY(σ). In LH disyllables, stress falls on the initial syllable even though the result is an unstressed H syllable.

(31) Heavy syllables unstressed in final position

| /mamant/ | NONFINALITY(σ) | WSP |
|---|---|---|
| a. ☞( mámant) | | * |
| b. ma(mánt) | *! | |

WSP is also dominated by the constraint that determines the placement of the main stress foot in Hopi, PARSE-σ1. The first syllable of the word is always footed, even if this leaves heavy syllables unstressed. Footing the CVC in addition to footing the first syllable is also a conceivable alternative, but a poor one in Hopi because it violates one of the undominated ENDRULE constraints:[43]

(32) Heavy syllables left unfooted outside the initial disyllabic window

| /qötösompi/ | PARSE-σ1 | ENDRULE-R | ENDRULE-L | WSP |
|---|---|---|---|---|
| a. ☞(qötö̋)sompi | | | | * |
| b. qö(tösóm)pi | *! | | | |
| c. (qötö̋)(sòm)pi | | *! | | |
| d. (qötö̆)(sóm)pi | | | *! | |

Although the constraints on footing dominate WSP, its activity is visible in unstressed vowel shortening because it is ranked above MAX-μ. Recall that long vowels never occur word-finally in Hopi—there are even alternations that show this, as in /panaa/ → *(pána)* but /panaa-qe/ → *(panáa)qe*. A long vowel can only surface if it is stressed and non-final, satisfying NONFINALITY(σ) and WSP. This pattern is analyzed in §3.3.4.1.

3.3.3.4 Summary of the analysis of stress

To sum up, NONFINALITY(σ) is dominated only by LX≈PR, and WSP is dominated by NONFINALITY(σ), ENDRULE-R, ENDRULE-L and PARSE-σ1. WSP and PARSE-σ cannot be ranked with respect to each other at this point, but they will be ranked in the subsequent sections based on the evidence from syncope and vowel shortening. The rankings established so far are summarized in (33).

---

[43] There is a plausible alternative to this analysis, namely, that consonants do not bear weight outside the main stress foot. In other words, candidates like *(qötö̋)sompi* violate not WSP but WEIGHT-BY-POSITION (Hayes 1989, 1994, Rosenthall and van der Hulst 1999). The WSP analysis explains both shortening and why syncope fails to create unstressed CVC syllables, which the WBP analysis does not do.

(33) Rankings for the footing pattern

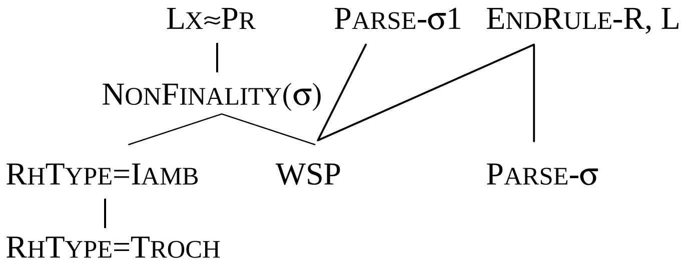



Tableau (34) shows how these rankings work together to produce the stress pattern. Since only markedness constraints interact in this ranking, inputs are omitted. Because of the number of constraints involved in this interaction, the tableau is given in the comparative format (Prince 1998a, 2000). Instead of showing the individual violation marks that each candidate incurs from each constraint, comparative tableaux show whether a constraint favors the winning candidate (W) or a loser it is being compared with (L). For every winner~loser comparison, the highest ranked constraint on which the candidates differ must favor the winner. I will use comparative tableaux throughout chapters 3 and 4 to introduce and/or summarize the more complex ranking arguments.

The first pair of forms shows that a single foot must be built at the left edge, to avoid violations of EndRule-R and NonFinality(σ). The loser's footing, **ki(yapí)*, is favored by Parse-σ-Final (not shown). Also, the default foot is iambic, not trochaic, as shown by the comparison *(kiyá)pi~*(kíya)pi*. The next two comparisons show that the first syllable must be footed even when this results in unstressed heavy syllables: Parse-σ1 dominates WSP. Non-iterative footing in *(qötö̋)som.pi* also indicates that EndRule-R dominates Parse-σ: the main stress foot must be final in the word even if this means two unfooted syllables. The last two comparisons show the role of NonFinality(σ) in the footing of monosyllables and disyllables.

(34) Stress pattern

| | ER-R | PRS-σ1 | LX≈PR | NF | WSP | PRS-σ | IAMB | TROCH |
|---|---|---|---|---|---|---|---|---|
| a. (kiyá)pi~ki(yapí) | | W | | W | | | | |
| b. (kiyá)pi~(kíya)pi | | | | | | | W | L |
| c. (má.mant)~ma(mánt) | | W | | | L | W | | |
| d. (qötő́)som.pi~qö(tösóm)pi | | W | | | L | | | |
| e. (qötő́)som.pi~(qötő́)(sòm)pi | W | | | | L | L | | |
| f. (pám)~pam | | | W | L | | L | | |
| g. (kóho)~(kohó) | | | | W | | | L | |

### 3.3.4 Non-iterative footing, syncope, and vowel shortening in Hopi

Foot construction is not static in Hopi. Rather, shortening and syncope interact with foot construction to ensure (i) that the output has optimal iambic feet, i.e., (H) or (LH), and (ii) that the number of unfooted syllables is minimal and that their shape is optimal—L.

3.3.4.1 Analysis of long vowel shortening

Recall that WSP is dominated in Hopi by NONFINALITY(σ) and PARSE-σ1, which means that heavy syllables cannot "pull" stress off of light syllables: *má*<u>*mant*</u> ≻ **mamánt* and *qötő́*<u>*somp*</u>*i* ≻ **qötösómpi*). Despite being dominated by these constraints, WSP is still active, and its most visible effect is vowel shortening. While unstressed CVC syllables are tolerated, unstressed CVV syllables are routinely shortened. The relevant examples are repeated in (35):

(35) Shortening word-finally[44]

| | | | | | |
|---|---|---|---|---|---|
| a. /panaa/ | (pána) | 'act on' | cf. | (panaá)qe | 'act on, conj.' |
| b. /pitɨɨ/ | (pítɨ) | 'arrive' | | (pitɨɨ́)qey | 'arrive, conj.+acc.' |

Unstressed CVC syllables must be tolerated because MAXC is undominated in the language—consonants are never deleted. Thus, words like *qötö̋<u>som</u>pi* cannot get around violating WSP by deleting a consonant, **qötö̋sopi*. On the other hand, long vowels are routinely shortened in unstressed positions.

Vowel shortening indicates that WSP dominates the constraint against vowel shortening, MAX-μ (McCarthy and Prince 1995). I treat MAX-μ as a constraint against shortening specifically as opposed to vowel deletion—MAX-μ and MAXV assign distinct violations, although a mora is lost in both cases. MAXV is violated when the entire vowel root node is deleted, whereas MAX-μ is violated when a mora is lost without deleting the vowel. MAX-μ is not violated when a vowel is deleted with all of its moras:

(36) MAX-μ "No shortening": "For every V that corresponds to V' in the output, every μ that is linked to V has a correspondent μ' linked to V'."

MAX-μ must be violated in Hopi in some situations: since NONFINALITY(σ) prevents the last syllable in an (LH) word from being stressed, as in **panáa*, and WSP disfavors (LH) trochees like **pánaa*, the only possible outcome given the Hopi ranking is shortening to (LL), *pána*:

[44] Jeanne analyzes these forms as exceptions to syncope based on *pánani* 'act on, fut.' and *sówani* 'eat, fut.' The stress pattern in these forms suggests that they treat –*ni* as a stress-neutral suffix (or a clitic), which also explains why syncope does not apply but shortening does: there is a prosodic word boundary between the last syllable of the base and the clitic, *[[pána]ni]*. If these are exceptional, it is not with respect to syncope. According to *the Hopi Dictionary*, they reduplicate just as LL forms, with syncope in the base: *papna, soswa*, etc.

(37) Shortening in word-final syllables

| /panaa/ | NONFINALITY(σ) | WSP | MAX-μ |
|---|---|---|---|
| a. ☞(pána) | | | * |
| b. (pánaa) | | *! | |
| c. (panáa) | *! | | |

Under this ranking, long vowels must also shorten outside the main foot (38), e.g., in reduplication (see (38)). If neither vowel is shortened, the result would violate WSP since it is impossible to foot both vowels in Hopi. Thus, **(nóo)noo.va* is out on WSP, and **(noo)(noo)va* is out on ENDRULE constraints.[45]

(38) /HL/ reduplication with shortening

| | | | | | |
|---|---|---|---|---|---|
| a. | /RED-noova/ | (nóo)no.va | 'food pl.' | cf. | (nóo)va |
| b. | /RED-moola/ | (móo)mo.la | 'mule pl.' | | (móo)la |

As we will see shortly, WSP has another effect in Hopi: it controls the syncope process.

3.3.4.2 Analysis of short vowel syncope

The ideal prosodic word in Hopi consists of an initial iambic foot followed by a single unstressed light syllable: (LH)L or (H)L. This is in part the effect of NONFINALITY(σ), WSP, and PARSE-σ. As we will see in this section, syncope works towards this goal, as well.

---

[45] Why not **(no.nóo)va*? This sort of output achieves maximal footing and preserves the long vowel in the base, performing better than *(nóo)no.va* on FAITH-IO. I assume that the reduplicant morpheme attracts stress—it is an underlyingly stressed suffix (Alderete 1998, Revithiadou 1999). Since the stressed syllable must be heavy in Hopi (see §3.3.4.2), the long vowel is realized in the reduplicant (for some related issues, see Fitzgerald 1999, Riggle 2003, Struijke 2001). Deletion of the long vowel in the base to **nón.va* is prevented by a special faithfulness constraint that requires input long vowels to have output correspondents—see §3.4.6.2. This analysis also explains the reduplication pattern of LL bases: /RED-koho/ → *(kók)ho*. For an alternative analysis of Hopi reduplication, see Hendricks 1999.

*Syncope in /LLL.../ words*. As shown in (39) (repeated from (19)), the third underlying vowel deletes in words that have four or more underlying vowels, the first three of which are short:

(39) Deletion in /LLL.../ words

| | | | | |
|---|---|---|---|---|
| a. | /navota̲-na/ | na.vót.na | 'inform, tell' | *(na.vó)ta.na |
| b. | /aŋa-ka̲tsina/ | (a.ŋak)tsi.na | 'Long Hair kachina' | *(a.ŋá)ka.tsi.na |
| c. | /tuhisa̲-tuwi/ | (tu.his)tu.wi | 'ingenuity' | *(tu.hí)sa.tu.wi |

The first two syllables in such words must be grouped into an iambic foot, yet the faithful parse *(a.ŋá)ka.tsi.na* violates SWP, the requirement for stressed syllables to be heavy (see (3)) Conceivably, SWP could be satisfied by lengthening the second vowel or geminating the following consonant. Neither lengthening nor gemination are available options in Hopi, though. We have seen that disyllabic forms like *sóma* do not surface as **sóoma* or **sómma*, although this would remove the need to foot them trochaically. This indicates that DEP-μ dominates SWP, preventing stressed syllable augmentation. (The forms **somma* and **sooma* violate DEP-CONS-μ and DEP-VOC-μ, respectively.)

(40) No augmentation

| /soma/ | DEP-μ | SWP | RHTYPE=IAMB |
|---|---|---|---|
| a. ☞(só.ma) | | * | * |
| b. (sóm)ma | *! | | |
| c. (sóo)ma | *! | | |

Syncope in disyllables is blocked by NONFINALITY(σ), to which I will return shortly. In longer words, though, SWP can be satisfied by vowel deletion. Fitzgerald 1999 argues that the same ranking holds in another Uto-Aztecan language, Tohono O'odham, where base vowels syncopate when a CV reduplicant is prefixed: /RED-toki/ → *tót.ki* 'cotton,' not **(tóto)ki*. The difference between Hopi and Tohono O'odham is that in Hopi, the syncope process is generalized to all morphologically derived forms, not just reduplicated ones:

(41) SWP>>MAXV: heavy stressed syllables by syncope

| /navota-na/ | SWP | MAXV |
|---|---|---|
| a. ☞(navót)na | | * |
| b. (navó)tana | *! | |

Note that it is the third and not the second vowel that undergoes syncope in *navótna*. Such deletion creates a perfect iambic foot (LH), packing the maximal amount of syllables into the foot while minimizing the number of unfooted syllables. Deleting in the second syllable would also satisfy SWP, but the (H)LLL result incurs more violations of PARSE-σ. Note that this result obtains regardless of the ranking of PARSE-σ with respect to MAXV—both candidates in (42) satisfy SWP equally well, differing only in the number of unfooted syllables. In other words, the largest foot wins:

(42) PARSE-σ and foot-packing (PARSE-σ and MAXV not yet ranked)

| /navota-na/ | SWP | MAXV | PARSE-σ |
|---|---|---|---|
| a. ☞(na.vót)na | | * | * |
| b. (náv)ta.na | | * | ** |

The Hopi pattern is not unique—a similar pattern of third vowel syncope has been reported for other languages, notably Southeastern Tepehuan (see §3.5) and Aguaruna. Payne (1990:163) describes third vowel deletion in Aguaruna as affecting words with “three moras or more”:

(43) Aguaruna third vowel syncope (Alderete 1998, Payne 1990)

| | | | | |
|---|---|---|---|---|
| a. /ičina̲ka-na̲/ | i.čin.kan | ‘clay pot (Acc)’ | cf. | i.či.nak |
| b. /ipaku̲/ | i.pak | ‘achiote’ | cf. | i.pa.kun |
| c. /tutupɨ̲/ | tu.tup | ‘back’ | cf. | tu.tu.pɨn |

Such patterns of deletion clearly necessitate some reference to an initial iambic foot, and the analysis can be straightforwardly couched in terms of PARSE-σ and SWP.

*Syncope in /LLL/ words*. In words with three underlying short vowels, deletion strikes the second and not the third vowel in Hopi: /soma-ya/ → *sóm.ya*, not **so.máy*. The reason for this is NONFINALITY(σ): final stress is generally avoided in Hopi, and NONFINALITY(σ) disfavors the deletion pattern that would result in final stress (see (44)). This is despite the more exhaustive parsing that a final-deletion output could achieve: deleting the last vowel (as in **somáy*) creates an output with a single, canonical LH iambic foot and no unparsed syllables (In fact, as we will see in §3.5, this is the output that wins in Southeastern Tepehuan, because NONFINALITY(σ) and PARSE-σ are ranked in the opposite way). The output *(sóm)ya* is selected because it satisfies NONFINALITY(σ) at the expense of violating PARSE-σ. Another candidate not included in the tableau is **(só.may)*. It is ruled out both by SWP and WSP, since its stressed syllable is light and its unstressed syllable is heavy.

(44) Syncope does not create final stress

| /soma-ya/ | NONFINALITY(σ) | PARSE-σ |
|---|---|---|
| a. ☞(sóm)ya | | * |
| b. (so.máy) | *! | |

As mentioned above, NONFINALITY(σ) also explains why vowels do not delete in LL disyllables like *sóma* and *kóho*.[46] These contain LL trochaic feet, which violate SWP since their head syllables are not heavy. However, these violations are required by the high-ranking NONFINALITY(σ), as was shown in (28), and they cannot be avoided because NONFINALITY(σ) also dominates MAXV. Thus, /soma/ does not map to **sóm* because this output incurs a NONFINALITY(σ) violation. Augmentation is not an option here, either, so the canonical LL trochee emerges instead:

(45) NONFINALITY(σ) and DEP-μ prevent unfaithfulness in LL disyllables

| /soma/ | DEP-μ | NONFINALITY(σ) | SWP | MAXV |
|---|---|---|---|---|
| a. ☞(sóma) | | | * | |
| b. (sóm) | | *! | | * |
| c. (sóo)ma | *! | | | |

*Syncope in /HLL.../ words*. In words that begin in long vowels, SWP can be satisfied by a faithful output, without deletion. Yet syncope applies in /HL-L/ words ((46), repeated from (10)):

(46) Suffixation on HL bases: syncope and shortening

| | | | | | | |
|---|---|---|---|---|---|---|
| a. | /tooka-ni/ | tókni | 'sleep, future' | cf. | toóka | 'sleep, non-future' |
| b. | /mooki-ni/ | mókni | 'die, future' | cf. | moóki | 'die, non-future' |

Why syncopate here if not to reduce the number of syllables in the output? The phonology of Hopi provides an answer to this question: syncope reduces the number of *unfooted* syllables. This has to do with the fact that footing is non-iterative. PARSE-σ is

[46] Actually, the explanation could be that syncope generally does not affect morphologically underived words. The analysis here is meant to account for the failure of syncope in hypothetical derived words as well, e.g., /t-ata/ → **tat*.

dominated by constraints such as ENDRULE-R and NONFINALITY(σ), but it still exerts an effect whenever it can. In /HLL/ words, it is possible to reduce the number of violations of PARSE-σ by syncope, so this is exactly what happens in (47). (The shared violations of PARSE-σ are required by high-ranking NONFINALITY(σ).)[47]

(47) PARSE-σ>>MAXV: syncope after long vowels

| /tookani/ | PARSE-σ | MAXV |
|---|---|---|
| a. ☞(tok)ni | * | * |
| b. (too)ka.ni | **! | |

/LLL.../ *words revisited*. Although PARSE-σ dominates MAXV, there are plenty of unfooted syllables in Hopi—recall *(aŋák)tsi.na*. The reason for this is that WSP dominates PARSE-σ: syncope can never create heavy unstressed syllables. WSP in a sense controls syncope. The number of unfooted syllables can only be minimized in this very specific situation: when a long vowel is followed by a CV sequence, the short vowel deletes and the long vowel shortens in the resulting closed syllable.

WSP has a dual role in Hopi. On the one hand, it requires unstressed long vowels to shorten by dominating MAX-μ (see §3.3.4.1). On the other hand, it prevents unfooted syllable syncope from creating unstressed CVC syllables by dominating PARSE-σ. This is shown in (48). All three candidates in (48) perform equally well on SWP—deleting either the second or the third vowel creates a heavy foot head. The decision is passed down to

[47] The winner here is unfaithful in more than one way: it deletes the vowel *a* and shortens the long vowel of the base. This shortening is required by $*\sigma_{\mu\mu\mu}$: "No trimoraic syllables." This constraint is not violated in Hopi (except in words with low tone—low tone must be realized on long vowels in Hopi, so low tone syllables are allowed to be superheavy CVVC). Long vowels shorten in syncope words (/tooka-ni/ → *tok.ni*, **took.ni*) and in underlyingly superheavy syllables, as was shown in (22).

WSP and PARSE-σ. The ranking WSP>> PARSE-σ selects the candidate that packs the maximum number of syllables into the main foot but does not attempt to reduce the number of unfooted syllables further. Note also that the last candidate, *(aŋ)kats.na*, is locally harmonically bounded in this iambic system: not only does it not do any better than the winner on PARSE-σ, it also violates WSP.

(48) Syncope cannot create unstressed H syllables

| /aŋa-katsina/ | SWP | WSP | PARSE-σ | MAXV |
|---|---|---|---|---|
| a. ☞(aŋák)tsi.na | | | tsi, na | * |
| b. (aŋák)tsin | | tsin! | tsin | ** |
| c. (áŋ)kats.na | | kats! | kats, na | * |

Under this ranking, syncope should apply whenever it cannot affect the violations of WSP—for example, when the heavy syllable is present in the output whether or not syncope applies. The testing ground for this prediction is longer words that have the shape /HLH.../. In such words, syncope still applies to the second syllable: /naala-ya-n-ta/ → *(nál)yan.ta* 'to be alone by oneself,' cf. *náala* 'alone.'[48] Note that in *nál.yan.ta*, the second syllable is heavy whether or not syncope applies—consonants cannot be deleted. The number of unfooted syllables can be safely minimized, so syncope and shortening apply here just as in /tooka-ni/→ *tók.ni*.

*Vowel shortening revisited*. PARSE-σ compels vowel deletion in very specific circumstances by dominating MAXV, but it can also conceivably compel vowel

[48] For reasons yet to be understood, syncope generally does not apply to the second syllable of /LL-H.../ words; thus, *qötö́sompi* 'headband' is not **qö́tsompi*. Any account of this pattern will also have to explain why syncope *does* apply in /HL-H.../ words. I will leave this puzzle of Hopi phonology for future research.

shortening. For example, shortening the first long vowel in a disyllable could produce an output that is exhaustively footed, as in /taavok/→ **(távok)*. We do not find this in Hopi—long vowels do not shorten when they are in position to be stressed, so /taavok/ maps to *(táa)vok*. Shortening cannot create a violation of SWP at the expense of exhaustive parsing—foot form is praised above exhaustive footing in Hopi:

(49) Foot form vs. exhaustive footing

| /taavok/ | NONFINALITY(σ) | SWP | PARSE-σ |
|---|---|---|---|
| a. ☞(táa)vok | ✓ | | * |
| b. (távok) | ✓ | *! | |

To summarize, vowel shortening and syncope are used to do the things that foot building cannot accomplish in Hopi: they minimize the number of unfooted syllables, maximize the weight of stressed syllables, and minimize the weight of unstressed syllables. There is every reason to think that outputs in Hopi must meet certain standards of prosodic well-formedness, but there is no indication that there is a general economy principle at work here. This is not a pattern of "delete wherever syllable structure permits"—this sort of an approach to Hopi is not very illuminating, as we will see in §3.3.6.

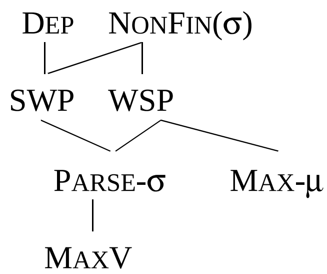
### 3.3.5 Summary of the Hopi analysis

Let us review how syncope and shortening function within the prosodic system of Hopi. The crucial rankings are summarized in (50)-(52).

(50) *Directionality of footing*: ENDRULE-R, ENDRULE-L >> PARSE-σ

(51) *Final extrametricality*: LX≈PR >> NONFINALITY(σ)>>RHTYPE=IAMB

(52) *Syncope/shortening*:




This grammar is shown in action in the comparative tableau (53). Syncope must create heavy foot heads, which is shown by the failure of **(so.má)ya*. Vowels are also deleted in forms like /tooka-ni/ to reduce the number of unfooted syllables; this state of affairs indicates that both SWP and PARSE-σ dominate MAXV. The site of deletion is determined by NONFINALITY(σ) and WSP: deletion can never create a stressed final syllable (thus no **so.máy*) or an unstressed heavy syllable (thus no **aŋák.tsin*). The dispreference for unstressed heavy syllables is also seen in the vowel shortening process: unstressed long vowels shorten in /panaa/ and /noo-noova/. Finally, foot shape takes priority over exhaustive footing—shortening does not apply to stressable long vowels even though this might pack more syllables into the foot.

(53) Syncope and the stress system

| /soma-ya/ | NONFIN | ER-R | WSP | SWP | PARSE-σ | MAXV | MAX-μ |
|---|---|---|---|---|---|---|---|
| a. (sóm)ya~(somáy) | W | | | | L | | |
| b. (sóm)ya~(somá)ya | | | | W | | L | |
| /tooka-ni/ | | | | | | | |
| c. (tók)ni~(tóo)ka.ni | | | | | W | L | L |
| d. (tók)ni~(tóo)kan | | | W | | | | L |
| e. (tók)ni~(tóo)(kàn) | W | W | | | | | L |
| /soma/ | | | | | | | |
| f. (sóma)~(sóm) | W | | | L | | W | |
| /aŋa-katsina/ | | | | | | | |
| g. (aŋák)tsi.na~(áŋ)ka.tsi.na | | | | | W | | |
| h.(aŋák)tsi.na~(aŋák)tsin | | | W | | L | W | |
| /naala-ya-n-ta/ | | | | | | | |
| i. (nál)yan.ta~(náa)la.yan.ta | | | | | W | L | L |
| /panaa/ | | | | | | | |
| j. (pána)~(pá.naa) | | | W | | | | L |
| k.(pána)~(pa.náa) | W | | | L | | | L |
| /taavok/ | | | | | | | |
| l. (táa)vok~(tá.vok) | | | | W | L | | W |

The real output goal in Hopi are monopod outputs with heavy heads, non-final stress, a minimal number of unfooted syllables, and as few unstressed heavy syllables as possible. The fact that winning outputs are shorter (i.e., more economical than their faithful competitors) is just a result of the language-specific ranking of faithfulness and markedness constraints in the grammar: syncope and vowel shortening are used because stressed syllable augmentation and iterative footing do not happen to be available alternatives.

### 3.3.6 Comparison with an economy constraint analysis of Hopi

Hopi syncope is analyzed by Jeanne 1978, 1982, who proposes the following basic rule of two-sided open syllable syncope. Rules of this sort date back to Kuroda's (1967) analysis of Yawelmani:

(54) V $\rightarrow \varnothing$ / VC__CV (Jeanne 1978, 1982)

The vowel deletion rule in (54) accounts for deletion in three-vowel inputs, both /HLL/ and /LLL/, but it is not sufficient for inputs with more than three vowels, such as /aŋa-katsina/$\rightarrow$ *aŋák.tsi.na*. Jeanne does not discuss such forms—she only addresses /HLL/ and /LLL/. Yet the problem is clear: the two-sided open syllable syncope rule does not offer guidance as to which vowel to delete in longer inputs, where several medial vowels are eligible. Syncope rules can be formulated to apply directionally and iteratively (see §3.4.8.2 and Phelps 1975), but this may not help in Hopi since in /aŋa-katsina/ the *middle* vowel deletes.

The common thread for all the Hopi patterns is that the deleted vowel is post-tonic, but the syncope rule cannot be ordered after stress assignment and formulated to refer only to post-tonic vowels, because syncope sometimes deletes the vowel that would be stressed by default: in /soma-ya/, the second vowel would be stressed (cf. *kiyápi*) except that it is deleted. There are various solutions to this (see Kager 1997 for some discussion), but the point still stands: the analysis of Hopi syncope and stress assignment requires some reference to foot structure.

The same issue arises in OT analyses in terms of economy constraints. The basic syncope pattern in trivocalic words may be explained using the ranking *COMPLEX>> *STRUC(σ) >> MAXV, NOCODA: "reduce the number of syllables wherever possible by deleting vowels without creating clusters; codas are acceptable." Syncope in /HL-L/ words is also expected—if it is possible to reduce the number of syllables, syncope should apply:

(55) A *STRUC analysis of Hopi syncope

| | | *COMPLEX | *STRUC(σ) | MAXV | NOCODA |
|---|---|---|---|---|---|
| /soma-ya/ | a. ☞som.ya | | ** | * | * |
| | b. so.ma.ya | | ***! | | |
| | c. sma.ya | *! | ** | * | |
| | d. smya | *! | * | ** | |
| | e. ☞so.may | | ** | * | * |
| /tooka-ni/ | f. ☞tok.ni | | ** | * | * |
| | g. too.ka.ni | | ***! | | |
| | h. ☞too.kan | | ** | * | * |

This analysis encounters the same problem as the rule analysis: lack of control over the site of deletion. Candidates *som.ya* and **so.may* have identical violation profiles, yet only *som.ya* is acceptable in Hopi. Economy constraints like *STRUC(σ) do not distinguish post-tonic syllables from final syllables—to them, all syllables are marked. Thus, while they express the popularly held belief the that languages favor shorter structures, they do not offer much guidance as to which shorter structures are preferred to which.

The exit strategy for an economy analysis is to appeal to various markedness and faithfulness blockers (Hartkemeyer 2000, Kisseberth 1970b, Taylor 1994, Tranel 1999). The all-purpose blocker is *COMPLEX, but its powers are exhausted after it strikes down **smaya*; *Complex does not distinguish *som.ya* from **so.may*. These candidates can be teased apart—one could argue that *som.ya* is preferred because it preserves the word-final segment, obeying ANCHOR-R ("the rightmost element of an input has a correspondent in the output" (McCarthy and Prince 1995), Hartkemeyer 2000 applies it to syncope). In Hopi, though, this does not apply—word-final segments do get deleted in compounds, as in /tuhis<u>a</u>-tuwi/ → *tuhistuwi* 'ingenuity.'

The best explanation is the one suggested by the phonology of Hopi itself: syncope creates a H syllable at the beginning of the word because the foot is built at the beginning of the word, and because final stress is generally avoided. An analysis that places syncope in the broader context of the language's phonology manages to capture the prosody-syncope connection and to explain the mechanics of syncope without appealing to ad-hoc explanations.

The real problems with the *STRUC analysis come to light when we look at words with more than three underlying vowels, e.g., /LLLLL/ words. These are ripe for shortening, and yet only one vowel is deleted in each. This is spelled out in (56). The actual winner *a.ŋak.tsi.na* deletes just one vowel, and yet it loses to candidates (c) and (d), which contain fewer syllables and which are equally well-formed phonotactically. What's worse, *STRUC cannot distinguish (c) from (d) and (a) from (b)—they are tied in the number of syllables. Recall that under the prosodic analysis, (c) is actually harmonically bounded by (d) because (c) it has an unstressed H and does no better on PARSE-σ than (d). This contrast cannot be captured in a syllable-counting analysis.

(56) *STRUC fails to explain longer words

| /aŋa-katsina/ | *COMPLEX | *STRUC(σ) | MAXV |
|---|---|---|---|
| a. 💣a.ŋak.tsi.na (actual winner) | ✓ | ****! | * |
| b. a.ŋa.kats.na | | ****! | * |
| c. ☞aŋ.kats.na | ✓ | *** | ** |
| d. ☞a.ŋak.tsin | ✓ | *** | ** |

Appeals to positional faithfulness constraints like ANCHOR-R do not help here. Recall the earlier problem of distinguishing *som.ya* from *so.may*, where a possible explanation was that word-final vowels could not be deleted. In longer words, vowels are deleted regardless of position: in /aŋa-k<u>a</u>tsina/ the vowel is deleted from the first syllable of the second word, *aŋák.tsi.na*, while /tuhis<u>a</u>-tuwi/ deletes the vowel from the last syllable of the first word, *tu.his.tu.wi*. In both cases, the vowel is deleted from what would be the *third* syllable—an environment that makes sense if syncope is creating LH feet but not if syllables are deleted for the sake of deleting syllables.

The account can be saved by appealing to prosodic constraints like WSP and PARSE-σ, but this considerably weakens the economy principle stance—if economy principles cannot do without prosodic constraints and prosodic constraints are sufficient on their own, what is the use for economy principles?

There is another problem with this account, and of a more fundamental sort. It is unclear exactly what sort of economy principle is at work in Hopi, since both syllables and moras appear to be "economized" but only in certain environments. Consider *tok.ni*, which *STRUC(σ) cannot distinguish from **too.kan*. The actual winner is shorter, but not in terms of syllables—in terms of moras. Is it *STRUC(μ) that distinguishes them? That seems like a promising strategy, but it also predicts that shortening should apply fairly generally, even to /HL/ words like /tooka/→ **tó.ka*. Shortening in stressed syllables could be blocked by the SWP, but by now the *STRUC analysis has appealed to practically every markedness constraint that was argued to be instrumental in the metrical analysis!

Economy principles in phonology can be made fairly specific by making *STRUC constraints refer to specific levels of structure. This is arguably necessary because we see their independent "effects" (though see §2.3). One could claim that Hopi has foot economy, since only one foot is built (though the traditional PARSE-σ analysis is usually deemed sufficient). Hopi would also have syllable economy, but of an odd sort: light open syllables are “marked” in second or third position following another light open syllable, but not later in the word—we can appeal to WSP to explain that. The same is true for long vowel economy: long vowels are preserved in the first or in the second syllable, but never in both (enter SWP). The *STRUC constraints themselves have gradually become a useless appendage in the analysis—as can be seen in the comparative tableau below, they do no work that the other constraints cannot do:

(57) *STRUC constraints do no work once the analysis is fully developed

| | | SWP | WSP | PARSE-σ | MAXV | *σ | *μ |
|---|---|---|---|---|---|---|---|
| /soma-ya/ | a. sóm.ya~só.ma.ya | W | | | L | W | W |
| | b. sóm.ya~smá.ya | W | | | | | |
| | c. sóm.ya~só.may | W | W | | | | |
| /tooka-ni/ | d. tók.ni~tóo.ka.ni | | | W | L | W | W |
| | e. tók.ni~tóo.kan | | W | | | | W |
| /aŋa-katsina/ | f. a.ŋák.tsi.na~aŋák.tsin | | W | L | | L | L |

To gain any insight into patterns like that of Hopi, we have to appeal to devices that go beyond counting syllables, moras, and feet. What matters is the *positions* of syllables and moras and the *kinds* of feet, not their number. Independently motivated metrical constraints not only explain these patterns straightforwardly—they are sufficient by themselves.

The point here is not that *STRUC analyses can’t be made to work—they can, once enough machinery is implemented. This is in part an Ockham’s Razor argument—*STRUC is unnecessary in the theory, so it must be excluded from the theory. Yet these constraints are not only unnecessary but actually harmful, as we will see in §3.5.5. They are a double burden on the theory.

## 3.4 <u>Tonkawa</u>

### 3.4.1 Introduction: a new look at Tonkawa

Tonkawa (Coahuiltecan, Texas, extinct) syncope is often cited as *the* example of constrained deletion of “unnecessary” vowels (Côté 2001, Hartkemeyer 2000, Kisseberth 1970b, Lee 1983, McCarthy 1986, Phelps 1975, Taylor 1994). In this section I present a re-analysis of Tonkawa. I show that the process can be better understood in terms of building better feet rather than deleting “unnecessary” vowels.

The patterns of deletion in Hopi and Tonkawa differ in a number of ways that are directly connected to their prosody. Footing is non-iterative and iambic in Hopi but is iterative and trochaic in Tonkawa, and this has consequences for deletion. In Hopi syncope results both in better feet and in more exhaustive foot parsing, while in Tonkawa only foot shape matters because footing is always exhaustive. Furthermore, in Hopi feet are iambic, (LH) and (H), while in the Tonkawa only trochaic feet are built—(H), (HL) and (LL). This difference arises because RHTYPE=IAMB and RHTYPE=TROCHEE are ranked differently in the two languages.

Tonkawa provides another insight into vowel deletion processes: it shows that apocope and syncope are uniform in process but have different targets, at least in this language. This lends support to one of the central ideas of this work: there is no inherent unity to economy effects.

The traditional analysis of Tonkawa *is* in terms of economy constraints and rules. I argue that here, just as in the case of Hopi, the prosodic analysis requires no economy constraints, yet the economy analysis cannot do without prosodic constraints. Because prosodic constraints are sufficient on their own, I argue that economy constraints are unnecessary.

In §3.4.2 I introduce the overview of Tonkawa prosodic phonology, including its syllable structure, vowel shortening patterns, and the three vowel deletion processes of hiatus elision, apocope, and syncope. I then develop an analysis of Tonkawa prosody, vowel shortening (§3.4.3), and syncope (§3.4.5). Section §3.4.8 discusses alternative analyses of Tonkawa.

### 3.4.2 Tonkawa patterns

Words of Tonkawa consist of CVC, CVV, and CVVC syllables, with occasional CV syllables in-between: “each syllable of a Tonkawa word must begin with a consonant and, if possible, be composed of consonant plus vowel plus consonant” (Hoijer 1933:21). Except for two systematically exceptional cases, CV syllables do not occur in adjacent positions.[49] As for the weight of these syllables, I will assume that all syllables are heavy except for CV—arguments will be provided throughout the analysis.

The patterns of shortening and syncope follow the following generalizations, which will be exemplified shortly:

(58) Generalization for vowel shortening: A long vowel shortens following an initial light syllable /#LH.../, in what would be the weak branch of a trochaic foot.

(59) Generalizations for vowel deletion: Vowel deletion applies:
  a. Word-finally;
  b. To the first of two vowels in hiatus;
  c. To a non-root-final vowel in (what would be) the weak branch of a LL trochaic foot.

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[49] Some CV sequences arise because long vowels and root-final vowels cannot be deleted. See § 3.4.6.

3.4.2.1 Stress

Unlike Hopi stress, the Tonkawa pattern is not described in detail, though much can be inferred from vowel shortening and syncope. Hoijer's descriptions are as follows:

(60) Accent in Tonkawa is evenly distributed—each syllable receives substantially the same accentuation. (Hoijer 1933:22)

(61) Tonkawa utterances consist of a succession of more or less evenly stressed syllables.[50] (Hoijer 1946:292)

I take these statements to mean that Tonkawa footing is iterative; this is hardly surprising since Tonkawa words consist mostly of heavy syllables. Additional evidence for iterativity of footing comes from the distribution of long vowels.

3.4.2.2 Vowel shortening as evidence for trochaic feet

Hoijer's description of stress is not detailed enough to deduce whether Tonkawa has iambic or trochaic stress, but the patterns of vowel shortening strongly indicate that footing is trochaic. The distribution of long vowels is limited in a way similar to the Latin pattern called *brevis brevians* or "iambic shortening":

[50] Hoijer goes on to add that "disyllabic forms, however, are generally pronounced with a somewhat heavier stress on the final syllable, whereas in polysyllabic words the main stress moves to the penult." It is possible that the remark about disyllables refers to apocope words like *notox* 'hoe,' where the second syllable is the heavier one. However, the placement of main stress does not play a central role in any of the processes discussed here, so it will not be analyzed or considered further.

(62) Latin (Allen 1973, Mester 1994, Prince 1990, Prince and Smolensky 1993)

| | | | | |
|---|---|---|---|---|
| a. | /ego:/ | → | (ego) | |
| | LH | | (LL) | not *(LH) |
| b. | /de:sino:/ | → | (de:)(si.no) | |
| | HLH | | (H)(LL) | not *(H)L(H), (HL)(H) or *(H)(LH) |
| c. | /ambo:/ | → | (am)(bo:) | |
| | HH | | (H)(H) | no change |
| d. | /studeo:/ | → | (stu.de)(o:) | |
| | LLH | | (LL)(H) | no change |

This shortening allows for the elimination of unstressed H syllables and for exhaustive footing into ideal trochaic feet, (H) and (LL) (Hayes 1995, Prince 1990). The Tonkawa pattern is similar—the only difference is /HLH/ words, where shortening does *not* apply. I will return to this in the analysis of shortening in §3.4.4.

The actual facts of Tonkawa shortening are as follows. Long vowels surface faithfully in the first syllable ((a)-(b) in (63)) and in a syllable that follows a heavy syllable ((c)-(d) in (63)), but they shorten following a light *initial* syllable (64). This distribution makes sense if a canonically trochaic (H) or (LL) foot is built at the left edge, but not if it is a canonical iamb (LH) or (H)—(LH) makes a better iamb than (LL), as we saw in §3.3. The inferred footing of the outputs is shown using round brackets.

(63) Long vowels surface as long in the first syllable or following H

| | | | | |
|---|---|---|---|---|
| a. | /kaana-oʔ/ | (kaa)(noʔ) | 'he throws it away' | |
| b. | /kaana-n-oʔ/ | (kaa.na)(noʔ) | 'he is throwing it away' | |
| c. | /nes-kaana-oʔ/ | (nes)(kaa)(noʔ) | 'he causes him to throw it away' | |
| d. | /yaaloona-oʔ/ | (yaa)(loo)(noʔ) | 'he kills him' | *(yaa)lo..., *(yaa.lo)... |
| e. | /taa-notoso-oʔs/ | (taa)(not)(soʔs) | 'I stand with him' | |

(64) Vowel shortening after initial light syllable

| | | | | |
|---|---|---|---|---|
| a. | /xa-kaana-oʔ/ | (xa.ka)(noʔ) | 'he throws it far away' | *(xa.kaa)(noʔ) |
| b. | /ke-yaaloona-oʔ/ | (ke.ya)(loo)(noʔ) | 'he kills me' | *(ke.yaa)(loo)(noʔ) |
| c. | /ke-taa-notoso-oʔ/ | (ke.ta)(not)(soʔ) | 'he stands with me' | *(ke.taa)(not)(soʔ) |
| d. | /we-naate-oʔ/ | (we.na)(toʔ) | 'he steps on them' | *(we.naa)(toʔ) |

There is no shortening in syllables after the second syllable, since there the long vowel can be stressed:

(65) No shortening after noninitial light syllable

| | | | |
|---|---|---|---|
| a. /ha-koxo-naa-ken/ | (hak.xo)(naa)(ken) | ‘you went in’ | *(hak)(xo.na)(ken) |
| b. /we-tasa-sooyan-oʔs/ | (wet.sa)(soo.ya)(noʔs) | ‘I swim off with them’ | |

Long vowels in closed syllables also follow this pattern—they appear long in the first syllable or after a heavy syllable, as shown in (66), but shorten following a light initial syllable (67).

(66) CVVC surfaces faithfully word-initially or after a heavy syllable

| | | |
|---|---|---|
| a. /soopka-oʔ/ | (soop)(koʔ) | ‘he swells up’ |
| b. /cˀaapxe-oʔ/ | (cˀaap)(xoʔ) | ‘he puts up a bed’ |
| c. /ʔatsoo-k-laknoʔo/ | (ʔat)(sook)(lak)(noʔo) | ‘came to life, it is said’ (ʔatsoo- ‘to revive,’ -k ‘participial verb suffix,’ -laknoʔo ‘narrative enclitic’)[51] |

(67) CVVC shorten after light syllable

| | | |
|---|---|---|
| a. /ke-soopka-oʔ/ | (ke.sop)(koʔ) | ‘I swell up’ |
| b. /we-cˀaapxe-oʔ/ | (we.cˀap)(xoʔ) | ‘he puts up several beds’ |

To summarize, the pattern of vowel shortening indicates that Tonkawa has a requirement for there to be a trochaic foot—(H), (LL), or (HL)—at the left edge of the word.

3.4.2.3 Vowel deletion patterns

Kisseberth 1970b identifies three circumstances under which vowels delete in Tonkawa. *Apocope* deletes word-final vowels, and *hiatus elision* affects vowels in

[51] In Hoijer’s orthography, *c* is the dental affricate, and *ts* is a cluster of two consonants.

hiatus.[52] The third process is *syncope*, which deletes vowels roughly in the environment of vowel shortening.

*Hiatus elision*. When two vowels meet at a morpheme boundary, as in (68), the first is deleted. Hiatus sequences are underlined in the URs.

(68) Vowel deletion resolves hiatus

| | | | | |
|---|---|---|---|---|
| a. | /ke-we-yamaxa-oo-ka/ | kew.yam.xoo.ka<br>*kew.yam.xa.oo.ka | ‘you paint our faces’ | |
| | cf. /ke-yamaxa-n-oʔ/ | key.ma.xa.noʔ | ‘he is painting my face’ | |
| b. | /pile-oʔ/ | pi.loʔ | ‘he rolls it’ | *pi.le.oʔ |
| | cf. /pile-n-oʔ/ | pi.le.noʔ | ‘he is rolling it’ | |

*Apocope*. Most words end in consonants (though there are a few exceptions, as Phelps 1975 and Kisseberth 1970b both note). Underlyingly final vowels are deleted by a a productive process of apocope.

(69) Word-final vowel deletion (apocope)

| | | | | | |
|---|---|---|---|---|---|
| a. | /notoxo/ | no.tox | ‘hoe’ | cf. not.xo.noʔ | ‘he is hoeing it’ |
| b. | /picena/ | pi.cen | ‘steer, castrated one’ | cf. pic.na.noʔ | ‘he is cutting it’ |

*Syncope*. As shown in (70), syncope deletes every other vowel of the word, starting from the second and proceeding rightwards (with some exceptions, discussed below). If the word underlyingly begins in /LL/, the second vowel is always deleted to create a (H) foot (see (a), (d)). If the word begins in /LLL/, then a (HL) foot is created (see (b), (e), (g)). The examples are shown with their inferred foot structure.

[52] My terminology differs from that of Kisseberth 1970b and Phelps 1975. Their Word-Final Vowel Deletion corresponds to my *apocope*; their Vowel Elision is my *syncope*, and their Vowel Truncation is my *hiatus elision*. Hiatus elision has been called *synaloepha*, but Trask 1996 defines this as coalescence of vowels across a word boundary. In Tonkawa, deletion applies word-internally between adjacent morphemes.

(70) Syncope

| | | | |
|---|---|---|---|
| a. | /yakapa-oʔ/ | (yak)(poʔ) | ‘he hits it’ |
| b. | /we-yakapa-oʔ/ | (wey.ka)(poʔ) | ‘he hits them’[53] |
| c. | /ke-yakapa-nes-ʔoʔ/ | (key)(ka.pa)(nes)(ʔoʔ) | ‘they two strike me’ |
| d. | /ke-we-yamaxa-oo-ka/ | (kew)(yam)(xoo.ka) | ‘you paint our faces’ |
| e. | /yamaxa-noʔ/ | (yam.xa)(noʔ) | ‘he is painting his face’ |
| f. | /nes-yamaxa-oʔ/ | (nes)(yam)(xoʔ) | ‘he causes him to paint his face’ |
| g. | /ke-yamaxa-oʔ/ | (key.ma)(xoʔ) | ‘he paints my face’ |

Syncope is directional, which is shown in (71). This directionality property was first noted by Phelps 1975, and it has always been a puzzle under the “delete wherever you can” approach. Phonotactic constraints permit the deletion of either the second or the third underlying vowel, and yet it is the second syllable that is consistently affected. This pattern is not puzzling if a trochaic foot is constructed at the left edge as shown—*(wén.to)* is a better trochee than *(wé.not)*:

(71) Left-to-right directionality

| | | | |
|---|---|---|---|
| a. | /we-notoxo-oʔ/ | (wen.to)(xoʔ) | *we(not)(xoʔ) |
| b. | /ke-we-yakapa-nesʔ-oo-ka/ | (kew)(yak.pa)(nes)(ʔoo.ka) | *ke(wey)(kapa)... |
| c. | /ke-we-yamaxa-oo-ka/ | (kew)(yam)(xoo.ka) | *ke(wey)(maxa)... |

The following examples show that unlike Hopi, Tonkawa syncope is iterative. In a /LLLLL.../ sequence, syncope will apply to the second and the fourth vowels (I have not found any /LLLLLL.../ words in Hoijer’s corpus). The root of the last form in (72) drops its /h/ after a consonant.

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[53] According to Hoijer’s analysis of this form, the root is not *yakapa* but *kapa*. The prefix *ya-* is causative (Hoijer 1949:28-29, 72). Witness the reduplicated form he gives, *yakakpa-* (rep.) ‘to hammer, hit, strike’. This suggests that the stem condition on vowel deletion traditionally assumed in the literature on Tonkawa is not entirely correct: some prefixes may be affected as well (*/ke-we-yamaxa-oo-ka/*→ *kew.yam.xoo.ka* ‘you paint our faces,’ */ke-tas-hecane-oʔs/* → *ket.sec.noʔs* ‘he lies with me’).

(72) Syncope is iterative

| | | | |
|---|---|---|---|
| a. | /ke-w<u>e</u>-yak<u>a</u>pa-nesʔ-oo-ka/ | (kew)(yak.pa)(nes)(ʔoo.ka) | ‘you two strike us’ |
| b. | /ke-w<u>e</u>-yam<u>a</u>xa-oo-ka/ | (kew)(yam)(xoo.ka) | ‘you paint our faces’ |
| c. | /ke-t<u>a</u>s-(h)ec<u>a</u>ne-oʔs/ | (ket)(sec)(noʔs) | ‘he lies with me’ |

There is one exception to iterativity: if the vowel in the syncope position is root-final, syncope does not apply (shown in (73) a, c, d). In this respect syncope is unlike hiatus elision and apocope, which routinely apply to the last vowel of the root. This is most striking in forms like (b) and (c): hiatus elision *targets* the root-final rather than the suffix-initial vowel in (b), but syncope fails to delete the root-final vowel in (c). Examples (d) and (e) make the same point for apocope.

(73) Root-final vowel never syncopates but may elide or apocopate

| | | | | |
|---|---|---|---|---|
| a. | /ya-seyake-n-oʔ/ | (yas)(ya.ke)(noʔ) | *(yas)(yak)(noʔ) | ‘he is tearing it’ |
| b. | /pil<u>e</u>-oʔ/ | (pi.loʔ) | *(pi.leʔ) | ‘he rolls it’ |
| c. | /pile-n-oʔ/ | (pi.le)(noʔ) | *(pil)(noʔ) | ‘he is rolling it’ |
| d. | /we-notoxo-n-oʔ/ | (wen)(toxo)(noʔ) | *(wen)(tox)(noʔ) | ‘he is hoeing it’ |
| e. | /notox<u>o</u>/ | (no.tox) | *(not.xo) | ‘hoe’ |

In words like /notoxo/, where the phonotactics allow only one of syncope or apocope to apply, apocope wins: *notox*, not **not.xo*.

Syncope applies in almost the same environment as vowel shortening: after #CV (above) but not after #CVC *or* #CVV. This is shown in (74) for both monomorphemic and complex words. (I rely on Hoijer’s (1949) analysis of underlying forms, since alternations are not always available.) In this Tonkawa is unlike Hopi, where deletion does apply after long vowels with a subsequent shortening of the vowel (/tooka-ni/ → *(tok)ni*). The reason for this difference lies not in iambic vs. trochaic footing but in the iterativity of footing: in Tonkawa, the syllable after the initial H syllable is footed, but in Hopi it is not:

(74) Initial long vowels do not condition second syllable syncope

| | | | | |
|---|---|---|---|---|
| a. | /heepane-ook/ | (hee.pa)(nook) | ‘council’ | *(hep)(nook), *(heep)(nook) |
| b. | /taa-notoso-oʔs/ | (taa)(not)(soʔs) | ‘I stand with him’ | *(tan.to)(soʔs) |
| c. | /xaa-yakew/ | (xaa.ya)(kew) | ‘butter’ | *(xay)(kew) |
| | | cf. xaa ‘fat,’ koykew- ‘to make,’ ya.kew.ʔan ‘sausage’ | | |

It is all the more interesting that deletion does not apply after long vowels to yield **(heep)(nook)*, etc. since there is no general prohibition on long vowels in closed syllables in Tonkawa. They are found both in morphologically derived and basic environments:

(75) Long vowels in closed syllables

| | | | |
|---|---|---|---|
| a. | /xa-henk$^{w}$aana-/ | <u>xeen</u>.k$^{w}$aa.na- | ‘to run far away’ |
| b. | /xaan-eel/ | xaa.<u>neel</u> | ‘there he goes!’ |
| c. | /xeecwal/ | <u>xeec</u>.wal | ‘alligator’ |

Recall from (66) and (67) that CVVC syllables surface faithfully word-initially or after a heavy syllable but not after an initial light syllable, */soopka-oʔ/→ soop.koʔ* ‘he swells up’ but */ke-soopka-oʔ/ → (ke.sop)(koʔ)* ‘I swell up.’ There is a process of closed syllable shortening, but it only applies when the long vowel occurs in a closed syllable that follows a light syllable—the one environment where a heavy syllable cannot head its own foot.

These complex patterns can be summarized in a fairly simple way by referring to weight and feet—the following generalizations are repeated from (58) and (59).

(76) <u>Generalization for vowel shortening</u>: A long vowel shortens following an initial light syllable /#LH.../, in what would be the weak branch of a trochaic foot.

(77) <u>Generalizations for vowel deletion</u>: Vowel deletion applies
- a. Word-finally;
- b. To the first of two vowels in hiatus;
- c. To a non-root-final vowel in (what would be) the weak branch of a LL trochaic foot.

### 3.4.3 Analysis of metrical foot parsing in Tonkawa

Most aspects of the unfaithful mappings in Tonkawa can be elucidated under specific assumptions about its system of metrical foot parsing. In this section, I lay out these assumptions, which inform the analysis of shortening and syncope that follows.

Foot parsing in Tonkawa must be iterative. This assumption is consistent with Hoijer's descriptions in (60)-(61), and further evidence for it will be provided in the analysis of vowel shortening in §3.3.4. Consider now tableau (78), where several possible foot parses for the input /pile-n-oʔ/ are given. Main stress falls on the rightmost foot, which suggests that ENDRULE-R dominates ENDRULE-L: no foot stands between the main stress foot and the *right* edge of the word, but a foot may stand between the main stress foot and the *left* edge of the word—compare (a) and (b). Furthermore, constructing just one foot (as in (c)), which would be both initial and final in the word, is not an option because PARSE-σ also dominates ENDRULE-L:

(78) Iterative footing

| /pile-n-oʔ/ | PARSE-σ | ENDRULE-R | ENDRULE-L |
|---|---|---|---|
| a. ☞(pì.le)(nóʔ) | | | * |
| b. (pí.le)(nòʔ) | | *! | |
| c. pi.le(nóʔ) | *!* | | |

Tonkawa has trochaic feet: (H), (LL), and (HL). In a form like *pi.le.noʔ*, there will be an initial secondary stress.

(79) Trochaic, not iambic feet

| /pile-n-oʔ/ | RHTYPE=TROCHEE | RHTYPE=IAMB |
|---|---|---|
| a. ☞ (pì.le)(nóʔ) | | * |
| b. (pi.lè)(nóʔ) | *! | |

As we will see in §3.4.4 and §3.4.5, a trochaic analysis is necessary to explain the patterns of shortening and syncope.

My extensive examination of Hoijer's (1933, 1946, 1949) corpus has not uncovered any CV monosyllables, so I assume that degenerate feet (Ĺ) are not allowed in the language—FTBIN is undominated. L monosyllables can be excluded under the ranking Prince and Smolensky (1993) propose for Latin word minimality effects: FTBIN>>{LX≈PR, MAX}.

In addition to light monosyllables, another situation where degenerate feet are an issue arises when a L syllable occurs between two H syllables or initially before a H syllable. In such situations, exhaustive footing cannot be achieved without constructing a less-than-perfect trochaic foot (HL) or (LH)—in the terminology of Mester 1994, the light syllable is "prosodically trapped." In Latin, HL<u>H</u> and L<u>H</u> words undergo shortening. In Tonkawa, they do not—I assume that such words are footed exhaustively. Thus, a (HL) foot is preferred to both (H)L and (H)(L). The suboptimal parses violate PARSE-σ or FTBIN; the optimal uneven trochee parse violates GRPHARM:

(80) No degenerate feet or prosodic trapping

| /we-notoxo-oʔ/ | FTBIN | PARSE-σ | GRPHARM |
|---|---|---|---|
| a. ☞(wèn.to)(xóʔ) | | | * |
| b. (wèn)to(xóʔ) | | *! | |
| c. (wèn)(tò)(xóʔ) | *! | | |

Under this ranking, (HL) feet are also preferred to either (LH) or to (L)(H); thus, we get *(wet.sa)(soo.ya)(noʔs)* 'I swim off with them' and not **(wet)(sa.soo)(ya.noʔs)*, **(wet)sa(soo)ya(noʔs)* or **(wet)(sa)(soo)(ya)(noʔs)*. The parse **(wet)(sa.soo)(ya.noʔs)* would violate WSP (see next section), **(wet)sa(soo)ya(noʔs)* would violate PARSE-σ, and **(wet)(sa)(soo)(ya)(noʔs)* would violate FTBIN. Violating GRPHARM is the least of four evils here.

In the metrical theories of Prince 1990 and Hayes 1995, uneven trochees are seen as inferior to (H) and (LL). The uneven trochee analysis is not the only possible analysis of Tonkawa, but the alternative cannot be implemented without some additional complications—I will return to this in §3.4.4. The rankings established in this section are:

(81) *Iterative footing, main right*: PARSE-σ, ENDRULE-R>>ENDRULE-L

(82) *Trochaic, not iambic feet*: RHTYPE=TROCHEE>>RHTYPE=IAMB

(83) *No degenerate feet; uneven trochees okay*: FTBIN, PARSE-σ>>GRPHARM

### 3.4.4 Analysis of vowel shortening in Tonkawa

The trochaic analysis of Tonkawa explains various aspects of the vowel shortening process. First of all, second-syllable shortening shows that (ĹH) feet are strongly disfavored. Second, the failure of long vowels to shorten outside of the #LH environment is consistent with their status as heads of iterative feet. Third, the non-application of shortening in certain environments shows that sequences of (H) feet are preferred to both (HL) and (LL) feet, and that feet with heavy heads are preferred to (LL). The constraints that are instrumental in this pattern are GRPHARM, WSP, SWP, and PARSE-σ.

#### 3.4.4.1 <u>#LH vowel shortening</u>

Vowels shorten in /LH.../ words but not in /HL.../, which is consistent with trochaic footing—if Tonkawa were iambic, then there would be no reason to shorten in the already perfect iambic foot (LH). This is exactly parallel to *brevis brevians* in Latin (see §3.4.2.2).

(84) *Brevis brevians* shortening, Tonkawa-style

| /xa-kaana-oʔ/ | RhType=Trochee | RhType=Iamb |
|---|---|---|
| a. ☞(xá.ka)(noʔ) | | * |
| b. (xa.káa)(noʔ) | *! | |

Unstressed heavy syllables are marked in both iambic and trochaic languages with respect to WSP. Vowel shortening in /xa-kaana-noʔ/ → *(xa.ka)(noʔ)* is favored by the ranking WSP>>Max-μ: unstressed vowels must be short. As shown in (85): the (Ĺ L) foot beats the inferior trochaic candidate (Ĺ H) despite being unfaithful to length.

(85) Shortening: WSP>>Max-μ

| /xa-kaana-oʔ/ | WSP | Max-μ |
|---|---|---|
| a. ☞(xá.ka)(noʔ) | | * |
| b. (xá.kaa)(noʔ) | *! | |

A plausible way to avoid both shortening and the unstressed heavy syllable is to build a (H) foot away from the left edge, leaving the first syllable unfooted: **xa(kaa)(noʔ)*. This option is not available because footing is always exhaustive. It is also not possible to avoid violating WSP and Parse-σ by building a LH foot, since this violates RhType=Trochee. A degenerate foot analysis (as in (e)) is out on FtBin:

(86) Non-alternatives to shortening

| /xa-kaana-oʔ/ | PARSE-σ | WSP | RHTYPE=TROCHEE | FTBIN | MAX-μ |
|---|---|---|---|---|---|
| a. ☞(xà.ka)(nóʔ) | | | | | * |
| b. xa(kàa)(nóʔ) | *! | | | | |
| c. (xà.kaa)(nóʔ) | | *! | | | |
| d. (xa.kàa)(nóʔ) | | | *! | | |
| e. (xà)(kàa)(nóʔ) | | | | *! | |

Shortening affects long vowels in the second syllable whether it is open (CVV) or closed (CVVC). Shortening in a CVVC sequence does not eliminate the violation of WSP, but it diminishes the problem. The heavier the syllable, the worse it is in unstressed position (Prince and Smolensky 1993), so an unstressed bimoraic CVC syllable is better than an unstressed trimoraic CVVC syllable. This is encoded in the WSP harmonic scale, which gives rise to two WSP constraints: the "regular" WSP, or $\text{WSP}_{\mu\mu}$, and $\text{WSP}_{\mu\mu\mu}$:

(87) Harmonic scale for unstressed syllable weight: $\breve{\sigma}_{\mu} \succ \breve{\sigma}_{\mu\mu} \succ \breve{\sigma}_{\mu\mu\mu}$
*Constraints:* $\text{WSP}_{\mu\mu\mu}$, $\text{WSP}_{\mu\mu}$

(88) $\text{WSP}_{\mu\mu\mu}$: "No unstressed trimoraic syllables." ($\text{WSP}_{\mu\mu}$ and $\text{WSP}_{\mu\mu\mu}$ are the categorical alternative to Kager's (1997) gradient WSP.)

Throughout the analysis, I use WSP for $\text{WSP}_{\mu\mu}$ unless a distinction needs to be explicitly made between the two constraints.

As shown in (89), $\text{WSP}_{\mu\mu\mu}$ dominates MAX-μ, so unstressed CVVC syllables shorten to CVC (see (a)). The only alternative to this is deleting the coda consonant (c), which violates the undominated MAXC.

(89) Shortening of superheavy unstressed syllables

| /ke-soopka-oʔ/ | $WSP_{\mu\mu\mu}$ | MAXC | $WSP_{\mu\mu}$ | MAX-μ |
|---|---|---|---|---|
| a. ☞(ké.sop)(kóʔ) | | | * | * |
| b. (ké.soop)(kóʔ) | *! | | * | |
| c. (ké.so)(kóʔ) | | *! | | * |

$WSP_{\mu\mu}$ must be dominated by PARSE-σ—if there were no need to foot everything, the superheavy syllable could head its own trochaic foot and shortening would not be necessary:

(90) Unstressed heavy syllables tolerated to foot initial syllable

| /ke-soopka-oʔ/ | PARSE-σ | $WSP_{\mu\mu}$ | MAX-μ |
|---|---|---|---|
| a. ☞(ke.sop)(koʔ) | | * | * |
| b. ke(soop)(koʔ) | *! | | |

Thus, vowels shorten in the second syllable to reduce the weight of an unstressed syllable, which is the weak branch of a left-aligned trochaic foot. This is a very specific environment for shortening, but it really amounts to unstressable long vowels being shortened but not stressable ones. Uneven (HL) trochees are a very efficient way to achieve exhaustive footing—if (HL), (H), and (LL) feet are allowed but (LH) feet are frowned upon, then #LH sequences are the only environment where shortening becomes necessary.[54] The only place where H syllables cannot be stressed is after an initial light syllable—PARSE-σ requires that the second vowel be incorporated into the initial trochaic

[54] Except for medial ...(LL)LH... As we will see shortly, such sequences routinely undergo syncope in Tonkawa and surface as (HL)(H) instead.

foot, and WSP requires that the second vowel be light. Everywhere else, long vowels can head their own feet, because footing is iterative.

At the end of §3.4.3 I alluded to the complications that arise in the analysis of vowel shortening if (HL) feet are not admitted into the system. The difficulty lies in explaining why "prosodically trapped" light syllables are not allowed initially but are allowed medially. Observe the following asymmetry:

| | | | | |
|---|---|---|---|---|
| (91) | Shortening applies | /xa-kaana-oʔ/<br><u>LH</u>H | → | xa.ka.noʔ<br><u>LL</u>H |
| (92) | Shortening does not apply | /we-tasa-sooyan-oʔs/<br>LL<u>LH</u>LH | → | wet.sa.soo.ya.noʔs<br>H<u>LH</u>LH |

If prosodically trapped, unfooted L syllables are allowed medially, as they would have to be under a strict (H)/(LL) analysis, then the obligatory footing of initial syllables could be explained by appealing to a high-ranking requirement for the initial syllable to belong to a foot:

(93) PARSE-σ1: "*$\sigma^o$ /[$_{Wd}$__, where $\sigma^o$ denotes a syllable that is not contained by a foot." (McCarthy to appear; cf. ALIGN-L(WD,FT) of McCarthy and Prince 1993a and Kager 2001).
*Harmonic scale*: $[_{PrWd}(_{Ft}\sigma\ ...)...] \succ [_{PrWd}\sigma^o......]$ $\sigma^o$ /___PrWd (immediately dominated by the PrWd)

While this is an equally workable analysis, it is slightly more complicated, so I opt for allowing (HL) trochees into the Tonkawa foot inventory.

There is also an equally viable alternative to the analysis of CVVC shortening in words like /ke-soopka-oʔ/ → *ke.sop.koʔ*, namely that codas contribute no weight in CVVC syllables and that the shortening of vowels here is the same exact process as CVV shortening. Under this analysis, CVC syllables count as light in (CV́.CVC) feet but as heavy in (CV́C) or (CV́C.CV) feet. In this case WSP would have to dominate WEIGHT-

BY-POSITION (“Coda consonants are moraic,” Hayes 1989, 1994, Rosenthall and van der Hulst 1999). I use WSP$_{\mu\mu\mu}$ because it also plays a role in the analysis of Lebanese Arabic in chapter 4, where a WEIGHT-BY-POSITION account is not as straightforward.

To summarize, the analysis of second syllable vowel shortening I presented relies on the assumption that footing is exhaustive, i.e., #L(H)... is not allowed, and that unstressed syllables must be as light as possible. The rankings presented in this section are given in (94).

(94) Rankings for #LH vowel shortening

{TROCHEE, WSP$_{\mu\mu\mu}$, FTBIN}    MAXC    PARSE-σ

WSP

MAX-μ

3.4.4.2 <u>Where shortening doesn’t apply: the role of faithfulness</u>

Any analysis of vowel shortening in Tonkawa must explain not only where it applies but also where it does not apply. This is relevant to the issue of economy, as well, because economy constraints and metrical markedness constraints differ in their predictions for shortening.

In Tonkawa, shortening does not apply to long vowels in initial syllables or in syllables that follow (H), i.e., */yaaloona-oʔ/* does not shorten to **(ya.lo)(noʔ)* or **(yaa.lo)(noʔ)*, */nes-kaana-noʔ/* does not shorten to **(nes.ka)(noʔ)*. These candidates are not gratuitously unfaithful, since both of them do better than the actual winners *(yáa)(lóo)(nóʔ)* and *(nés)(káa)(nósʔ)* on *CLASH, the constraint against adjacent stresses (Hammond 1984, Kager 1994, Liberman 1975, Liberman and Prince 1977, Prince 1983, Selkirk 1984b). Since shortening does not apply here, MAX-μ must dominate *CLASH, GRPHARM, or any other constraint that might favor shortening in these environments:

(95) No shortening even if clash or uneven feet result

| /yaaloona-oʔ/ | MAX-μ | GRPHARM | *CLASH |
|---|---|---|---|
| a. ☞(yàa)(lòo)(nóʔ) | | | ** |
| b. (yà.lo)(nóʔ) | **! | | |
| c. (yàa.lo)(nóʔ) | *! | * | |
| /kaana-n-oʔ/ | | | |
| d. ☞(kàa.na)(nóʔ) | | * | |
| e. (kà.na)(nóʔ) | *! | | |

Violations of GRPHARM and *CLASH could also in principle be avoided without shortening, by simply not footing exhaustively. This, however, is not an option under the already established ranking PARSE-σ>>MAX-μ: forms like **(káa)na.noʔ* or **(yáa)loo.noʔ* would incur egregious violations of PARSE-σ as well as WSP. As argued in the previous section, PARSE-σ dominates WSP, which dominates MAX-μ. Since MAX-μ in turn dominates GRPHARM and *CLASH, we get (96) through transitivity of domination. The tableau is given in comparative format to make the ranking argument more compact:

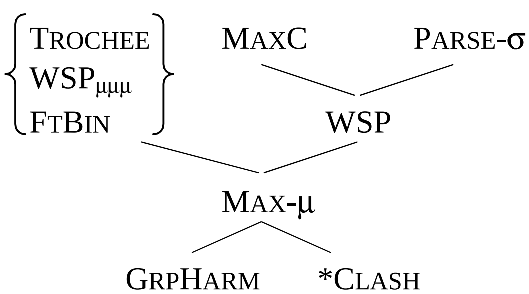
(96) Non-footing is not an option for avoiding clash or uneven feet

| /yaaloona-oʔ/ | PARSE-σ | WSP | MAX-μ | GRPHARM | *CLASH |
|---|---|---|---|---|---|
| a. (yàa)(lòo)(nóʔ)~(yáa)loo.noʔ | W | W | | | L |
| b. (yàa)(lòo)(nóʔ)~ya.lo(noʔ) | W | | W | | L |
| c. (yàa)(lòo)(nóʔ)~(yà.lo)(nóʔ) | | | W | | L |
| d. (yàa)(lòo)(nóʔ)~(yàa.lo)(nóʔ) | | | W | W | L |
| /kaana-n-oʔ/ | | | | | |
| e. (kàa.na)(nóʔ)~(kà.na)(nóʔ) | | | W | L | |
| f. (kàa.na)(nóʔ)~(káa)na.noʔ | W | W | | L | |
| g. (kàa.na)(nóʔ)~ka.na(nóʔ) | W | | W | L | |

This pattern reveals an “anti-economical” aspect of shortening: shortening in words like */yaaloona-oʔ/ could* yield a word with fewer feet and/or moras, yet it does not apply because it is more important to be faithful than to avoid clashes and uneven feet. This selective application of shortening turns out to be a major problem both for rule-based and *STRUC analyses: shortening needs to “know” the weight of adjacent syllables in order to apply. The easiest way to analyze this process is in terms of foot structure: the heavy-headed (H) and (HL) feet and sequences of adjacent (H) feet are preferred to (LL) in Tonkawa, even though such sequences may violate GRPHARM and *CLASH. Shortening only applies to unstressed heavy syllables that cannot head their own feet; if they can head their own feet, they are ideal. This fine control of shortening is possible with metrical constraints but not with a general economy constraint like *STRUC(μ), because *STRUC(μ) favors shortening in *all* situations. I will return to this in §3.4.8.4.

The new rankings that were established in this section are diagrammed below:

(97) *Vowel shortening*




These rankings are shown in action in the comparative tableau (98). The undominated constraints MAXC, RHTYPE=TROCHEE, and all the candidates that violate them have been left out. The comparisons between the winners *(we.na)(toʔ)* and *(ke.sop)(koʔ)* and their respective losers show the role of FTBIN, WSP, $WSP_{\mu\mu\mu}$ and PARSE-σ in shortening;

the success of *(kaa)(noʔ)*, *(kaa.na)(noʔ)* and *(yaa)(loo)(noʔ)* shows why shortening fails to apply elsewhere.

(98) Vowel shortening

| /we-naate-oʔ/ | WSP$_{\mu\mu\mu}$ | FtBin | Prs-σ | WSP | Max-μ | GrpHr | *Clash |
|---|---|---|---|---|---|---|---|
| a. (wè.na)(tóʔ)~(wè.naa)(tóʔ) | | | | W | L | | |
| b. (wè.na)(tóʔ)~we(náa)(tóʔ) | | | W | | L | | W |
| c. (wè.na)(tóʔ)~(wè)(náa)(tóʔ) | | W | | | L | | W |
| /ke-soopka-oʔ/ | | | | | | | |
| d. (kè.sop)(kóʔ)~ke(sòop)(kóʔ) | | | W | L | L | | W |
| e. (kè.sop)(kóʔ)~(kè.soop)(kóʔ) | W | | | | L | | |
| /kaana-n-oʔ/ | | | | | | | |
| f. (kàa.na)(nóʔ)~(kà.na)(nóʔ) | | | | | W | L | |
| /kaana-oʔ/ | | | | | | | |
| g. (kàa)(nóʔ)~(ká.noʔ) | | | | W | W | | L |
| /yaaloona-oʔ/ | | | | | | | |
| h. (yàa)(lòo)(nóʔ)~(yàa.lo)(nóʔ) | | | | | W | W | L |
| i. (yàa)(lòo)(nóʔ)~(yà.lo)(nóʔ) | | | | | W | | L |
| j. (yàa)(lòo)(nóʔ)~ya.lo.(nóʔ) | | | W | | W | | L |

Shortening in Tonkawa applies only to the second vowel in #LH. This is because (LH) feet are only an issue word-initially, where Parse-σ and RhType=Trochee force the second vowel into the weak branch of the foot by dominating Max-μ and RhType=Iamb, respectively. Everywhere else long vowels can and indeed must head their own feet. After a single light syllable word-internally in /we-tasa-sooyan-oʔs/→ *(wet.sa)(soo.ya)(noʔs)*, the long vowel does not shorten—the (HL)(HL)(H) output violates only GrpHarm, which is low-ranked in Tonkawa.

This is a very limited economy effect—shortening applies just once in a very specific environment. Not so for syncope, which is the subject of the next section.

### 3.4.5 Analysis of Tonkawa syncope

Syncope is directional and iterative, just like footing. Recall from Hoijer's descriptions that every syllable in Tonkawa is heavy and stressed. There is an output goal in Tonkawa: the ideal word consists of feet with heavy heads. Heavy foot heads were important in Hopi, as well, where /LLL/ words mapped to (H)L and /LLLL/ to (LH)L. Because Tonkawa is trochaic, syncope creates not (LH) but (H) and (HL) feet out of /LL/ sequences. This suggests that SWP dominates MAXV in Tonkawa just as in Hopi:

(99) Syncope: SWP>>MAXV

| | | SWP | MAXV |
|---|---|---|---|
| /yakapa-oʔ/ | a. ☞(yàk)(póʔ) | | * |
| | b. (yà.ka)(póʔ) | *! | |
| /ke-we-yamaxa-oo-ka/ | c. ☞(kèw)(yàm)(xóo.ka) | | ** |
| | d. (kè.we)(yà.ma)(xóo.ka) | **! | |
| /ke-tas-(h)ecane-oʔs/ | e. ☞(kèt)(sèc)(nóʔs) | | ** |
| | f. (kè.ta)(sè.ca)(nóʔs) | **! | |

(The shared violation marks of MAXV incurred by hiatus elision are suppressed in tableaux throughout this section.)

Just as in Hopi, the augmentation solution is not available: vowels are never lengthened and consonants are never geminated (in fact, geminates are generally prohibited in Tonkawa—see Kisseberth 1970b, McCarthy 1986). This suggests that DEP-μ dominates MAXV. Thus, vowels must be deleted because of the language-specific ranking of SWP and faithfulness, not because vowels or syllables are somehow marked or undesirable.

It is in principle also possible to avoid violations of SWP *and* MAXV by simply not footing the syllables after the second one, as in **(ket.se)ca.noʔs*. In this case, syncope is non-iterative because foot parsing is non-iterative. This is not an option in Tonkawa because PARSE-σ dominates MAXV. The ranking argument here is parallel to the one presented in the analysis of shortening, where #LH shortening could not be avoided by not footing the first syllable.

(100) Iterative footing means iterative syncope

| /ke-tas-(h)ecane-oʔs/ | PARSE-σ | MAXV |
|---|---|---|
| a. ☞(ket)(sec)(noʔs) | | ** |
| b. (ket.se)ca.noʔs | **! | * |

In a way, Tonkawa syncope is a more impressive economy effect than what happens in Hopi—recall that there, syncope applied only once in the vicinity of the main stress foot but not elsewhere. In Tonkawa, the well-formedness requirements on feet are enforced by syncope throughout the word because the feet themselves are present throughout the word. This difference between Hopi and Tonkawa is due to the language-specific ranking of PARSE-σ and ENDRULE constraints.

3.4.5.1 Directionality

In a line of /LLL.../, deletion could in principle affect either the second or the third underlying vowel, but it is inevitably the *second* vowel that syncopates. This result follows from already established rankings, shown in (101). Syncope affects the second vowel in /we-yakapa-oʔ/ because this creates a H foot head at the beginning of the word—footing into (HL) is permitted because GRPHARM is low-ranked.[55] The

[55] In a strict (H)/(LL) analysis, the directionality of syncope would have to be attributed to PARSE-σ1 (see (93)).

alternatives are a (LH) foot or a L(H) sequence with the first syllable left unfooted, which violate either WSP or PARSE-σ:

(101) The directionality of syncope

| /we-yakapa-oʔ/ | PARSE-σ | WSP | GRPHARM |
|---|---|---|---|
| a. ☞(wèy.ka)(póʔ) | | | * |
| b. we(yàk)(póʔ) | *! | | |
| c. (wè.yak)(póʔ) | | *! | |

This directionality of syncope is also consistent with a trochaic analysis. Consider tableau (102), where the two candidates differ in foot type. The winner deletes the second vowel, making four good trochees. The loser deletes the third vowel and has three iambic feet, (LH)(LH)(H). The (LL) foot of the winner violates RHTYPE=IAMB, but this is tolerated. The (LH) feet of the loser fatally violate RHTYPE=TROCHEE. (The last vowel of the root in (a) cannot delete for independent reasons—see §3.4.6.)

(102) Syncope builds trochaic feet

| /ke-yakapa-nes-ʔoʔ/ | RHTYPE=TROCHEE | RHTYPE=IAMB |
|---|---|---|
| a. ☞(kéy)(kápa)(nés)(ʔóʔ) | | * |
| b. (ke.yák)(pa.nés)(ʔóʔ) | **! | |

No independent parameters for syllable or rule directionality are needed here—the interaction of the foot parsing constraints alone produces the necessary results. Directionality is a long-standing issue in accounts of syncope that use economy rules and constraints (Broselow 1992a, Davis and Zawaydeh 1996, Farwaneh 1995, Ito 1986, Mester and Padgett 1994, Phelps 1975). If syncope is simply pruning stray syllables without reference to their context, then arbitrary directional parameters are necessary to explain language-specific patterns and cross-language variation. In actuality, the output of deletion has to look a certain way because of markedness—structure is not removed to make outputs shorter but to make them more harmonic.

3.4.5.2 No syncope after long vowels

Syncope in Tonkawa applies after short vowels but not after long ones—in this, Tonkawa is unlike both Hopi (§3.3) and Southeastern Tepehuan (§3.5). The reason syncope does not apply in /HL.../ words is that there is really nothing to gain, given the Tonkawa ranking. The faithful renderings of these inputs already have a heavy syllable in the right place. The relevant data[56] are repeated from (74) in (103):

(103) Initial long vowels do not condition second syllable syncope

| | | | | |
|---|---|---|---|---|
| a. | /heepane-ook/ | (hee.pa)(nook) | 'council' | *(hep)(nook), *(heep)(nook) |
| b. | /taa-notoso-oʔs/ | (taa)(not)(soʔs) | 'I stand with him' | *(tan.to)(soʔs) |
| c. | /xaa-yakew/ | (xaa.ya)(kew) | 'butter' | *(xay)(kew) |

The failure of syncope here is not surprising under the SWP analysis—the faithful output satisfies SWP *and* MAXV, so deletion is unnecessary. Syncope after long vowels is not completely pointless, though, because it could improve performance on GRPHARM. GRPHARM must therefore be dominated by MAXV:

(104) Uneven feet not fixed by syncope

| /heepane-ook/ | MAXV | GRPHARM |
|---|---|---|
| a. ☞(hee.pa)(nook) | | * |
| b. (heep)(nook) | *! | |

[56] Words like /kaana-n-oʔ/ and /naate-n-oʔ/ do not qualify as evidence here, because the second vowel is root-final and cannot be deleted for independent reasons. See §3.4.6.

Another way to avoid the violation of GrpHarm would be to shorten the first vowel without deleting the second, as in **(he.pa)(nook)*, but this is ruled out by the previously established ranking Max-μ>>GrpHarm.

Tonkawa is the opposite of Hopi and Southeastern Tepehuan, where the ranking Parse-σ>>MaxV favors syncope of unfooted syllables after the long vowel (recall the Hopi /tooka-ni/→ *tók.ni*). In Tonkawa, syllables after long vowels are footable, because Parse-σ is ranked above EndRule-L. The chief effect of this ranking is iterative footing, which adds structure instead of removing it. The same constraint, Parse-σ, is satisfied in different ways in these languages: in Hopi and Southeastern Tepehuan, structure is lost (vowels), and in Tonkawa, structure is gained (additional feet).

Although all three languages end up with shorter words than they would have without syncope and shortening, there are real differences between their syncope processes. We could speak of "unfootable syllable syncope" in Hopi, "SWP syncope" in Hopi and Tonkawa, and so on. The same constraints are active in all three languages discussed here, but whether or not their interaction results in economy effects depends on their language-specific rankings.

#### 3.4.5.3 A digression: the "no-superheavy-syllables" alternative

A more traditional analysis of the lack of syncope after long vowels invokes the prohibition on superheavy syllables: "...Syncope is blocked in these cases, since the output has [a] superheavy syllable CVVC, that exists underlyingly for some rare morphemes, but that no phonological rule in Tonkawa is supposed to produce" (Lee 1983:32-33). This rule-blocking explanation does not really work. Superheavy syllables are not banned in general—only in unstressed positions. Recall that CVVC syllables do shorten following a light initial syllable, as in */ke-soopka-oʔ/* → *(ke.sop)(koʔ)*, but they do not shorten when they can be stressed, i.e., initially (as in *(soop)(koʔ)* ‘he swells up’) or after heavy syllables (as in (ʔat)(sook)(lak)(noʔo) ‘came to life, it is said’). Furthermore, as Phelps 1975 notes, some processes in Tonkawa do create superheavy syllables. One such process is *h*-deletion/vowel coalescence, */xa-henk^waana-/* → *xeen.kwaa.na-* ‘to run far away.’

These are not really obstacles to an OT account, because $*\sigma_{\mu\mu\mu}$ can be dominated by the constraints responsible for coalescence, while still blocking other processes. This is sketched in (105). MAX-μ must be ranked above $*\sigma_{\mu\mu\mu}$: there is no shortening to get rid of underlying superheavy syllables, as in */soopka-oʔ/* → *soop.koʔ*, not **sop.koʔ*. In addition, $*\sigma_{\mu\mu\mu}$ must dominate any constraint that would favor syncope after long vowels, e.g., GRPHARM. Thus */xaa-yakew/* maps to *(xaa.ya)(kew)*, not **(xaay)(kew)*. The result is that underlying superheavy syllables surface faithfully but new ones are not created.

(105) The “no-new-superheavies” alternative

| | | MAX-μ | $*\sigma_{\mu\mu\mu}$ | GRPHARM |
|---|---|---|---|---|
| /xaa-yakew/ | a. ☞(xaa.ya)(kew) | | | * |
| | b. (xaay)(kew) | | * | |
| | c. (xay)(kew) | *! | | |
| /soopka-oʔ/ | d. ☞(soop)(koʔ) | | * | |
| | e. (sop)(koʔ) | *! | | |

The problem with this explanation is that it misses a real generalization: there is a strong pressure to have a heavy syllable at the left edge of the word, but the evidence for the role of $*\sigma_{\mu\mu\mu}$ in the grammar of Tonkawa is rather weak. I will assume that $*\sigma_{\mu\mu\mu}$ is ranked below MAX-μ but that it plays no role in blocking syncope.

#### 3.4.5.4 Interim summary

To summarize, I have argued that the directionality of syncope, its iterative application, and its non-application after long vowels are entirely consistent with the prosodic system of Tonkawa. The only new rankings established in this section are:

(106) *Iterative syncope*: SWP, PARSE-σ>>MAXV>>GRPHARM

I also argued against the traditional blocking analysis of the failure of syncope after long vowels. Syncope fails to apply after long vowels not because it is blocked by $*\sigma_{\mu\mu\mu}$ but because it is never triggered in that environment in the first place. Syncope is gratuitous when there is already a word-initial heavy syllable.

The main points of the analysis of syncope are summarized in the comparative tableau (107). The comparison *(yak)(poʔ)~(yáka)(poʔ)* supports the ranking SWP>>MAXV. Deletion of the second rather than the third vowel in *(wey.ka)(poʔ)* demonstrates the effect of PARSE-σ in controlling the directionality of syncope. Syncope fails to apply after a long vowel in *(xaa.ya)(kew)* because SWP is already satisfied, and all the constraints that would favor syncope in this environment (e.g., GRPHARM) are ranked too low to have any effect. Finally, *(ket)(sec)(noʔs)* shows that syncope must be iterative because it is tied to foot building, and non-iterative footing is not an option.

(107) Syncope in Tonkawa

| /yakapa-oʔ/ | PARSEσ | SWP | MXV | GRPHRM | ER-L |
|---|---|---|---|---|---|
| a. (yàk)(póʔ)~(yàka)(póʔ) | | W | L | | |
| /we-yakapa-oʔ/ | | | | | |
| b. (wèy.ka)(póʔ)~we(yàk)(póʔ) | W | | | L | |
| /xaa-yakew/ | | | | | |
| c. (xàa.ya)(kéw)~(xàay)(kéw) | | | W | L | |
| /ke-tas-(h)ecane-oʔs/ | | | | | |
| d. (kèt)(sèc)(nóʔs)~(két)se.ca.noʔs | W | | L | | L |

To conclude the analysis, we need to address some situations where syncope is blocked. This is done in the next subsection.

### 3.4.6 Blocking of long and root-final vowel syncope in Tonkawa

#### 3.4.6.1 <u>Introduction: the facts</u>

There are systematic exceptions to syncope in Tonkawa that involve long vowels and root-final vowels.[57] Underlyingly long vowels shorten but do not syncopate in the positions where short vowels delete, and root-final vowels also systematically fail to syncopate. The following examples illustrate this:

(108) Long vowels shorten but do not syncopate

| | | | | |
|---|---|---|---|---|
| a. | /xa-k<u>aa</u>na-oʔ/ | (xa.ka)(noʔ) | 'he throws it far away' | *(xak)(noʔ) |
| b. | /ke-y<u>aa</u>loona-oʔ/ | (ke.ya)(loo)(noʔ) | 'he kills me' | *(key)(loo)(noʔ) |
| cf. | /ke-y<u>a</u>maxa-oʔ/ | (key.ma)(xoʔ) | 'he paints my face' | |

[57] There are other well-known sets of exceptions that have to do with glottalized consonants, clusters, and the OCP—the reader is referred to the work of Kisseberth 1970b, McCarthy 1986, and Phelps 1975 for discussion, as I will not treat these here.

(109) Root-final vowels do not syncopate

| | | | | |
|---|---|---|---|---|
| a. | /ya-seyak<u>e</u>-n-oʔ/ | (yas)(ya.ke)(noʔ) | 'he is tearing it' | *(yas)(yak)(noʔ) |
| b. | /pil<u>e</u>-n-oʔ/ | (pi.le)(noʔ) | 'he rolls it' | *(pil)(noʔ) |

The explanation for both of these classes of exceptions is faithfulness.

3.4.6.2 Special protection for long vowels

Syncope in many languages affects only short vowels in a particular environment. In some cases, this can be explained in terms of markedness. For example, in Hopi, short vowels syncopate in the second syllable of /LLL/ words but long ones do not syncopate in /LHL/ because the SWP can be satisfied without deletion. Since the language is iambic, a (LH) foot can be built and syncope is unnecessary.

In Tonkawa, a markedness explanation will not work, because shortened vowels fail to delete in the same environment where underlyingly short vowels do delete. This is a chain shift: long vowels map to short (VV → V), and short ones map to zero (V → ∅) in the same environment. Chain shifts are analyzed in OT using the idea of "relative faithfulness" (Gnanadesikan 1997, Kirchner 1996, McCarthy 2003, Prince 1998b): for the Tonkawa chain shift, the claim is that the mapping from a long vowel to zero is categorically less faithful than the deletion of a short vowel.[58],[59] Thus, long vowels do not delete because a faithfulness constraint requires long vowels to make it to the surface:

[58] McCarthy 2003 analyzes the Bedouin Arabic chain shift using faithfulness constraints that refer to a ternary duration scale a > i > ∅ (cf. Gnanadesikan 1997). Scales of this sort are prohibited in the theory of CON developed in chapter 2. Note also that the obvious solution of representing long vowels as sequences of two vowels is neither available nor illuminating in Tonkawa: long vowels are tolerated on the surface, but underlying sequences of short vowels undergo hiatus elision.

[59] Unlike feature change chain shifts (Beckman in press, Kirchner 1996), chain shifts that involve segmental deletion cannot be analyzed in terms of Local Conjunction. MAX

(110) MAX-LONG-V: "An input long vowel has a correspondent in the output."

MAX-LONG-V belongs to the MAX-POSITION family of constraints (Beckman 1998, ch.5), which protect a prominent element of the input.[60] Long vowels are one of Beckman's (1998) privileged positions, along with root-initial syllables, syllable onsets, and others.

MAX-LONG-V requires each underlying long vowel to have some correspondent on the surface but does not require that it be long: it is violated by the mapping VV → ∅ but not by V → ∅ or VV →V. This constraint is ranked above SWP, so light stressed syllables are tolerated when the alternative is wholesale deletion (rather than mere shortening) of a long vowel:

(111) Long vowels are not deleted even when this results in LL feet

| /we-naate-oʔ/ | MAX-LONG-V | SWP | MAXV |
|---|---|---|---|
| a. ☞(we.na)(toʔ) | | * | |
| b. (wen)(toʔ) | *! | | * |

Long vowels are never deleted in Tonkawa, so MAX-LONG-V is undominated. It is violated in other languages, however—we will see in §3.5 that long vowels are deleted in Southeastern Tepehuan.

The behavior of /LH.../ words shows that SWP is dominated not only by MAX-LONG-V. It would be possible to avoid the whole issue of deleting or shortening long vowels in #LH forms if only feet could be built around the long vowels themselves, as in

constraints cannot be locally conjoined in any domain because their joint violation is impossible to detect (Moreton and Smolensky 2002).

[60] MAX-LONG-V also bears some similarity to Kager's (1999) HEAD-MAX-BA "every segment in the base's *prosodic head* has a correspondent in the affixed form." This constraint does not require the correspondent to be a prosodic head, it only requires that the stressed vowel have a correspondent.

**we(nàa)(tóʔ)* or **ke(sòop)(kóʔ)*. That this doesn't happen suggests the ranking PARSE-σ>>SWP:

(112) Heavy heads not as high a priority as exhaustive parsing

| /we-naate-oʔ/ | PARSE-σ | SWP |
|---|---|---|
| a. ☞(wè.na)(tóʔ) | | * |
| b. we(nàa)(tóʔ) | *! | |

3.4.6.3 Apocope, hiatus elision and the root-final vowel

Root-final vowels are subject to a faithfulness constraint of the Anchor family (McCarthy and Prince 1995):

(113) ANCHOR-R(ROOT): "Every root-final segment in the input must have a corresponding segment in the output."[61]

ANCHOR-R must dominate SWP, because SWP is violated just in case the alternative requires the root-final vowel to delete:

(114) SWP violated to save the last vowel of the root

| /ya-seyak<u>e</u>-n-oʔ/ | ANCHOR-R | SWP |
|---|---|---|
| a. ☞(yas)(ya.ke)(noʔ) | | *(ya.ke) |
| b. (yas)(yak)(noʔ) | *! | |

The interesting twist is that ANCHOR-R can be violated under some circumstances in Tonkawa. When the last vowel of the root is either word final or ends up in a two-vowel sequence through morpheme concatenation, it apocopates or elides as required. The relevant facts are repeated in (115). The root-final vowel of *pile-* is preserved in the

61 An equally viable alternative is ANCHOR-EDGE (Nelson 1998), a constraint that protects segments at either edge from deletion.

environment for syncope (a), but the suffix vowel is the one that survives in the hiatus context (b). Examples (c) and (d) make the same point for apocope.

(115) Root-final vowel never syncopates but may elide or apocopate

| | | | | |
|---|---|---|---|---|
| a. | /pile-n-oʔ/ | (pi.le)(noʔ) | *(pil)(noʔ) | ‘he is rolling it’ |
| b. | /pil<u>e</u>-oʔ/ | (pi.loʔ) | *(pileʔ) | ‘he rolls it’ |
| c. | /we-notoxo-n-oʔ/ | (wen)(toxo)(noʔ) | *(wen)(tox)(noʔ) | ‘he is hoeing it’ |
| d. | /notoxo/ | (no.tox) | *(not.xo) | ‘hoe’ |

These facts suggest that apocope and syncope satisfy *different* constraints that must be transitively ranked through ANCHOR-R. This result is impossible to replicate using *STRUC(σ): it would have to be simultaneously ranked above and below ANCHOR-R. The argument is developed below.

Apocope and hiatus elision satisfy FINALC and ONSET, respectively. FINALC is defined as follows:

(116) FINALC: “Every prosodic word ends in a consonant” (McCarthy and Prince 1994a).
*Harmonic scale*: $[_{\text{PrWd}}...\text{C}] \succ [_{\text{PrWd}}...\text{V}]$

Independent motivation for FINALC comes from processes other than apocope. McCarthy and Prince (1994a:22) use FINALC in their analysis of consonant epenthesis in Makassarese words that violate CODACOND: /rantas/ → *rantas<u>aʔ</u>* ‘dirty.’ Since both consonant epenthesis and apocope result in a consonant-final word, FINALC is assumed to be responsible for both.[62]

---

[62] There may be a more interesting story to be told about apocope. It seems that in many languages prosodic words are required to end in *heavy syllables* (...VV or ...VC), not just in consonants (see Yapese (Jensen 1977, Wen Hsu 1969) and possibly Southeastern Tepehuan (§3.5), though Kager analyzes it using FINALC as well). There are also languages that have the opposite requirement, in which all words must end in vowels

FINALC and ONSET both dominate ANCHOR-R, as shown in (117). The suffix vowel is preserved in *piloʔ* because ANCHOR-L protects the morpheme-initial segment of the suffix *-oʔ* from deletion.[63] Candidate **pileʔ* loses because it keeps the root-final vowel and deletes the suffix-initial vowel:

(117) FINAL-C, ONSET >> ANCHOR-R

| | | FINALC | ONSET | ANCHOR-L | ANCHOR-R |
|---|---|---|---|---|---|
| /notox<u>o</u>/ | a. ☞notox | | | | * |
| | b. notoxo | *! | | | |
| /pile-oʔ/ | c. ☞pi.loʔ | | | | * |
| | d. pi.le.oʔ | | *! | | |
| | e. pi.leʔ | | | *! | |

We saw earlier from the behavior of words like *(pi.l<u>e</u>-)(n-oʔ)* that ANCHOR-R dominates SWP. Therefore FINALC transitively dominates SWP: although the two constraints do not inherently conflict, they are ranked in Tonkawa.

(118) FINALC, ONSET, ANCHOR-L>>ANCHOR-R>>SWP

The interplay of apocope and syncope can be seen directly in words like /notoxo/, where the normal application of syncope is disrupted and apocope applies instead, as in *no.tox* not **not.xo*. The prediction of the analysis presented so far is that such words should be footed as trochees with initial stress, so this is one of the situations where WSP must be violated to foot the initial syllable: (*nó.tox)*.

(e.g., Sidamo (Moreno 1940)). Since I cannot do this large and interesting topic justice here, I will assume that FINALC is the relevant constraint in Tonkawa.

[63] An alternative to ANCHOR-L is MAX-MI (Casali 1997), which prohibits the deletion of morpheme-initial segments.

Vowel deletion applies non-uniformly in Tonkawa: two processes can delete the root-final vowel, while the third is not allowed to. This is an important result that can only be obtained when vowel deletion is triggered by *different* markedness constraints. However attractive a uniform explanation for both apocope and syncope might be, languages like Tonkawa show that it is not attainable. A *STRUC analysis of apocope and syncope cannot explain why syncope fails to delete root-final vowels while apocope does so routinely. No single markedness constraint can favor both because no constraint can be simultaneously ranked below and above ANCHOR-R. Tableau (119) shows this: if *STRUC is ranked below ANCHOR-R, only medial deletion is possible. If *STRUC were ranked above ANCHOR-R, only final deletion is possible. The two patterns cannot coexist in the same language under any ranking:

(119) Apocope and syncope cannot be analyzed with a single M constraint

| | | ANCHOR-R | *STRUC(σ) |
|---|---|---|---|
| /ke-yamaxa-n-oʔ/ | a. ☞key.ma.xa.noʔ | | **** |
| | b. key.max.noʔ | *! | *** |
| /notoxo/ | c. ☞ not.xo | | ** |
| | d. 💣no.tox | *! | ** |

This is yet another piece of evidence for the claim that there is no inherent unity to the various vowel deletion processes—economy effects result from the interaction of diverse markedness constraints. This theme will be continued in chapter 4, where I examine deletion processes that affect only a subset of a language's vowel inventory.

### 3.4.7 Summary of the Tonkawa analysis

We are now ready to consider the global interaction of the vowel deletion and shortening processes in Tonkawa. I have presented arguments for the following rankings:

(120) *Feet are trochaic*: RHTYPE=TROCHEE>>RHTYPE=IAMB

(121) *Iterative footing*: Parse-σ, EndRule-R>>EndRule-L

(122) *No degenerate feet but uneven feet are okay*: FtBin, Parse-σ>>GrpHarm

(123) *Syncope, apocope, and shortening*:

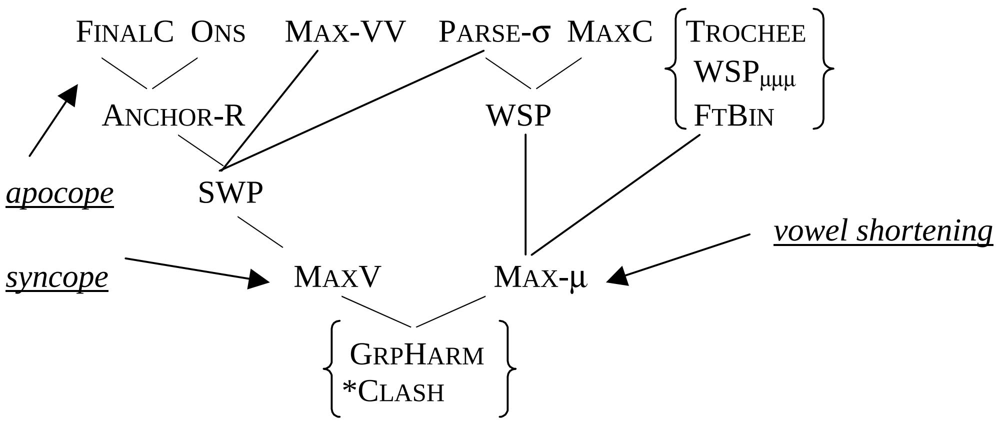



Tableau (124) illustrates the ranking in action. RHType=Trochee, FtBin, $\text{WSP}_{\mu\mu\mu}$ and Onset are left out to save space, as are all candidates that violate these constraints. To make the tableau easier to read, I have placed the winning output next to each input rather than next to the losers in the comparisons. The rows with inputs/winners are therefore grayed out to avoid confusion (the input is not being compared to the winner).

The first couple of comparisons in (124) show why syncope cannot delete the root-final vowel (Anchor-R) and why syncope targets the *second* vowel in many forms but not the third or fourth. The loser candidate that deletes the *third* vowel, **ya(sey.ke)(noʔ)*, is actually harmonically bounded within this constraint set: no constraint favors it. Next, the apocopating candidate *notox* is shown. Apocope words do not follow the usual syncope pattern because of FinalC, and in such words the deletion of word-final vowels is permitted and indeed required. The next three inputs show the distribution of long vowels and the non-triggering of syncope after long vowels. The winning output for */we-naate-oʔ/* shortens the second vowel but doesn't delete it; this is because of MAX-LONG-V, PARSE-σ and WSP. The winning output for */yaaloona-oʔ/* is faithful to vowel length and is exhaustively parsed into (H) feet. No shortening is required because faithful, iteratively footed outputs already satisfy SWP, GRPHARM, and WSP. The winning output for /xaa-yakew/ is also faithful to its underlying vowels—deletion is gratuitous because (HL) feet are acceptable (MAXV>>GRPHARM) and SWP is already satisfied. Next, shortening does not apply to uneven trochees either because either SWP or MAX-μ prevents it: /kaana-noʔ/ → *(kaa.na)(noʔ).* And, finally, the normal application of syncope in /notoxo-oʔ/ supports the ranking SWP>>MAXV, MAX-μ.

(124) Tonkawa, summary tableau

| /ya-seyake-n-oʔ/→ (yàs)(yà.ke)(nóʔ) | MxVV | FinC | Parse-σ | AncR | SWP | WSP | MxV | Mx-μ | ER-L | GrpHrm | *Clsh |
|---|---|---|---|---|---|---|---|---|---|---|---|
| a.~(yàs)(yàk)(nóʔ) | | | | W | L | | W | | | | W |
| b.~ya(sèy.ke)(nóʔ) | | | W | | L | | | | | W | L |
| /notoxo/→(nó.tox) | | | | | | | | | | | |
| c.~(nót.xo) | | W | | L | L | L | | | | W | |
| /we-naate-oʔ/→ (wé.na)(toʔ) | | | | | | | | | | | |
| d.~(wé.naa)(tóʔ) | | | | | | W | | L | | | |
| e.~we(náa)(tóʔ) | | | W | | L | | | L | | | W |
| f.~(wèn)(tóʔ) | W | | | | L | | W | | | | W |
| /yaaloona-oʔ/→ (yàa)(lòo)(nóʔ) | | | | | | | | | | | |
| g.~(yà.lo)(nóʔ) | | | | | W | | | W | | | L |
| h.~(yàl)(nóʔ) | W | | | | | | W | W | | | L |
| i.~(yáa)loo.noʔ | | | W | | | W | | | L | | L |
| j.~(yàa.lo)(nóʔ) | | | | | | | | W | | W | L |
| /xaa-yakew/ → (xàa.ya)(kéw) | | | | | | | | | | | |
| k.~(xàay)(kéw) | | | | | | | W | | | L | W |
| /kaana-noʔ/→ (kàa.na)(nóʔ) | | | | | | | | | | | |
| l.~(kà.na)(nóʔ) | | | | | W | | | W | | L | |
| /notoxo-oʔ/→ (nòt)(xóʔ) | | | | | | | | | | | |
| m.~(nò.to)(xóʔ) | | | | | W | | L | | | | L |

In short, Tonkawa syncope and vowel shortening result from the interaction of prosodic constraints on foot shape and parsing: there is a requirement for stressed syllables to be heavy, and it is enforced by syncope since neither vowel lengthening nor gemination are available. Syncope is iterative because footing is iterative; whenever there is an underlying /LL/ sequence neither of whose syllables can be incorporated into a foot with a heavy head, the second vowel is lost and a (H) foot surfaces. Likewise, vowel shortening applies in a very specific circumstance—when the long vowel cannot head its own foot, i.e., after an initial light syllable. There is no requirement for words to be shorter in Tonkawa and there is no dispreference for syllables, but there are various requirements on what feet and syllables in them must look like.

### 3.4.8 Comparison with economy analyses of Tonkawa

#### 3.4.8.1 Introduction: Kisseberth's analysis

Economy *is* the traditional analysis of Tonkawa (though obviously *STRUC(σ) hasn't always been its formal implementation). The idea behind Kisseberth's (1970b) original analysis is that syncope and vowel shortening are generalized processes—almost "delete vowel" or "delete mora." These processes are blocked by various constraints: Kisseberth discusses prohibitions on tautosyllabic consonant clusters, prohibitions on clusters of glottalized consonants with non-glottalized consonants, the impossibility of deleting the last vowel of the root (ANCHOR-R in the present analysis), and the prohibition on adjacent identical consonants (which McCarthy 1986 casts as the OCP, though see Rose 2000b and chapter 4). These various constraints limit the application of syncope.

This is the classic economy approach to syncope, which has been adopted in some form or another by Côté 2001, Hartkemeyer 2000, Taylor 1994, and others. Kisseberth notes that hiatus elision, apocope and syncope are three distinct processes (an assumption shared in the present analysis), and formulates three distinct rules for them. He does, however, observe that shortening and syncope seem to be related in a way that a rule-based analysis cannot capture: "...it is [...] clear that shortening of long vowels and deletion of short vowels [...] [are] the same phonological process" (Kisseberth 1970b:121). The reason they look like the same phonological process in Tonkawa is that both processes have to do with trochaic foot structure; shortening lightens the weak branch of a trochee and syncope removes what would be the weak branch to give weight to the head. Yet missing the connection between shortening and syncope is not the only problem of the "delete wherever you can" approach.

3.4.8.2 Directionality

Phelps 1975 argues that Kisseberth's approach misses another aspect of syncope in Tonkawa—its directionality. To capture it, she develops a directional, iterative vowel deletion rule, given here in somewhat simplified form:

(125) Vowel Elision (iterative, rightward)

$V \rightarrow \varnothing$ / VC(V) __CV

This rule attempts to collapse syncope, hiatus elision and shortening. A vowel is deleted following another vowel—this is shortening, assuming that long vowels are really sequences of two short vowels. A vowel is also deleted in a two-sided open syllable—this is syncope. The rule does correctly delete the first of two eligible vowels in words like */we-n$\underline{o}$t$\underline{o}$xo-oʔ/*, but it captures the directionality of syncope rather arbitrarily: it is not a feature-spreading rule or a metrical stress rule, so its "iterative, rightward" application seems ad hoc. The rule also encounters some empirical problems—it incorrectly applies to all non-initial long vowels that are preceded by CV syllables, e.g. */yaaloona-oʔ/* should shorten the second vowel to **yaa.lo.noʔ*. Furthermore, syncope is wrongly predicted by this rule to apply after long vowels in */xaa-yakew/*, yielding **xaay.kew*.

The problem is, of course, that the context for shortening is not determined by syllable structure but by *foot* structure. To prevent the rule from overapplying, the context must be restated and expanded to refer to the length, moraic weight or foot structure of both the surrounding syllables and of the target environment.

Interestingly, the success of this directional rule analysis of syncope cannot be replicated in terms of *STRUC without appealing either to prosodic constraints or to arbitrary directionality constraints (such as the syllable alignment constraints of Mester and Padgett 1994—see chapter 2). Under the *STRUC approach, the basic pattern of deletion results from *STRUC(σ) dominating MAXV. Overly enthusiastic deletion of vowels is prevented by *COMPLEX:

(126) Economy analysis of the basic pattern

| /we-notoxo-oʔ/ | *COMPLEX | *STRUC(σ) | MAXV |
|---|---|---|---|
| a. ☞wen.to.xoʔ | | *** | ** |
| b. ☞we.not.xoʔ | | *** | ** |
| c. went.xoʔ | *! | ** | *** |

As can be seen in (126), this rule brings back one of the problems of Kisseberth's original "delete-where-you-can" analysis. *STRUC(σ) cannot capture the directional application of syncope: (a) and (b) are tied, though (a) is the actual winner. The analysis cannot control directionality of deletion without some prosodic constraint, e.g., PARSE-σ1.

3.4.8.3 <u>Preventing syncope after long vowels in the economy analysis</u>

In my analysis, the problem of preventing syncope after long vowels in was already addressed in §3.4.5.2 and §3.4.5.3, where I argued that avoidance of superheavy syllables is not the right explanation for the non-application of syncope in words like

*/xaa-yakew/* → *xaa.ya.kew*. Let's see how *$\sigma_{\mu\mu\mu}$ works with the economy constraint analysis.

The result in (127) initially looks encouraging: syncope applies wherever possible but never creates superheavy syllables. Since MAX-μ prevents shortening all the way to **xay.kew*, the non-economical trisyllabic output is the winner.

(127) Blocking syncope after long vowels

| /xaa-yakew/ | MAX-μ | *$\sigma_{\mu\mu\mu}$ | *STRUC(σ) | MAXV |
|---|---|---|---|---|
| a. xaa.ya.kew~xay.kew | W | | L | W |
| b. xaa.ya.kew~xaay.kew | | W | L | W |

This success quickly diminishes, however, when the ranking in (127) is put in the larger perspective of Tonkawa shortening patterns.

#### 3.4.8.4 Controlling shortening

Metrical shortening is a general problem for economy principles, because long vowels are marked not generally but only in some environments. *STRUC(σ) cannot directly favor shortening, because a syllable with a long vowel incurs as many violations as a syllable with a short vowel.[64] The alternatives are *STRUC(μ) and *STRUC(FOOT).

MAX-μ must be dominated by *some* constraint that favors shortening. Suppose this constraint is *STRUC(μ). Shortening applies to superheavy syllables when they immediately follow an initial light syllable (e.g., */ke-soopka-oʔ/* → *ke.sop.koʔ*).

Therefore, *STRUC(μ) must dominate MAX-μ. Shortening might be prevented in the

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[64] One could imagine a situation where syllable economy is in conflict with avoidance of superheavy syllables, where every instance of deletion after a CVVC sequence will be accompanied by vowel shortening.

initial syllable by IDENT-σ1, which requires the first syllable to be faithful (Beckman 1998). (Shared violations of *STRUC(μ) are suppressed in the tableau):

(128) Shortening of peninitial CVVC

| | | IDENT-σ1 | *STRUC(μ) | MAX-μ |
|---|---|---|---|---|
| /ke-soopka-oʔ/ | a. ☞ke.sop.koʔ | | | * |
| | b. ke.soop.koʔ | | * | |
| /soopka-oʔ/ | c. ☞soop.koʔ | | * | |
| | d. sop.koʔ | *! | | |

However, superheavy syllables do appear in non-initial position in words like */ʔatsoo-k-laknoʔo/ (ʔat)(sook)(lak)(noʔo)* 'came to life, it is said.' Under the WSP analysis, shortening does not apply because the heavy syllable is a foot head and it is preceded by a footed syllable. For *STRUC(μ), the relative position of the superheavy syllable makes no difference—the ranking in (128) wrongly favors shortening in any non-initial syllable.

Both *STRUC(μ) and *STRUC(FOOT) are excellent drivers of shortening in the abstract, but they generally fail when applied to Tonkawa. The problem is that shortening occurs not generally but only in a special environment, i.e., after a light initial syllable. Long vowels appear faithfully in the initial syllable or following a heavy syllable. The relevant data are repeated below.

(129) Long vowels surface as long in the first syllable or following H

| | | | | |
|---|---|---|---|---|
| a. | /kaana-oʔ/ | (kaa)(noʔ) | 'he throws it away' | |
| b. | /kaana-n-oʔ/ | (kaa.na)(noʔ) | 'he is throwing it away' | |
| c. | /nes-kaana-oʔ/ | (nes)(kaa)(noʔ) | 'he causes him to throw it away' | |
| d. | /yaaloona-oʔ/ | (yaa)(loo)(noʔ) | 'he kills him' | *(yaa)lo..., *(yaa.lo)... |
| e. | /taa-notoso-oʔs/ | (taa)(not)(soʔs) | 'I stand with him' | |

(130) Vowel shortening after initial light syllable

| | | | | |
|---|---|---|---|---|
| a. | /xa-kaana-oʔ/ | (xa.ka)(noʔ) | 'he throws it far away' | *(xa.kaa)(noʔ) |
| b. | /ke-yaaloona-oʔ/ | (ke.ya)(loo)(noʔ) | 'he kills me' | *(ke.yaa)(loo)(noʔ) |
| c. | /ke-taa-notoso-oʔ/ | (ke.ta)(not)(soʔ) | 'he stands with me' | *(ke.taa)(not)(soʔ) |
| d. | /we-naate-oʔ/ | (we.na)(toʔ) | 'he steps on them' | *(we.naa)(toʔ) |

There are no morphological features unique to non-shortening environments that could single them out for special status with respect to positional faithfulness constraints. Thus we find that vowels fail to shorten in the first syllable of the word (*kaa.noʔ, yaa.loo.noʔ, taa.not.soʔs*) and in the second syllable (*nes.kaa.noʔ, yaa.loo.noʔ*); in the root (*kaa*...) and in the prefix (*taa*...). However, we also find that some of these environments allow shortening as long as they are preceded by a CV syllable, and even then not always: for example, /ke-yaaloona-oʔ/ does not map to **ke.ya.lo.noʔ*, which would be expected if shortening was about reducing the number of feet or moras. It seems impossible to correctly constrain shortening if *STRUC is driving it.

In short, both Phelps' iterative rule analysis and the *STRUC analysis run into problems because deletion and shortening are sensitive to metrical context in Tonkawa—there is no principle of syllable, mora, and foot economy, but there are accidental economy effects that arise when the words are massaged into their optimal metrical shape.

I have argued that Tonkawa vowel shortening and syncope apply in metrically determined environments. Among the constraints instrumental in Tonkawa were SWP, WSP, and PARSE-σ. Observe that these are also the constraints that were instrumental in Hopi, yet the outcome is very different. Hopi has non-iterative syncope, whereas in Tonkawa it is iterative. Conversely, in Hopi, long vowels shorten in several environments, while in Tonkawa they only shorten in one environment: the peninitial syllable following a light syllable.

These differences are baffling facts under the "delete/shorten where you can" approach, but they fall out straightforwardly if we abandon the idea that word length, syllable/mora/foot count, or other measures of structural economy play any role in grammars. If we look instead for explanations in terms of overall well-formedness, whether in terms of metrical constraints or other requirements (see chapter 4), we will find that there is nothing special to economy effects—deletion is just one among several ways to satisfy these requirements.

## 3.5 <u>Southeastern Tepehuan</u>

### 3.5.1 Introduction

The Hopi and Tonkawa patterns do not by any means exhaust the range of logical possibilities for metrically induced syncope. This section summarizes the analysis of Southeastern Tepehuan by Kager 1997. Kager's goal is different from the goals of the present study—he is concerned primarily with showing that superficially opaque metrical syncope patterns can be analyzed to great effect in OT by revising certain assumptions about these languages' prosodic systems. Nevertheless, his approach is very much in line with the one pursued here: he argues that syncope results from the interaction of metrical constraints with MAXV and that there is no syllable economy at work.

SE Tepehuan is both like and unlike Hopi and Tonkawa: its syncope is iterative as in Tonkawa, but its stress is iambic and non-iterative as in Hopi. Not surprisingly, this pattern involves the interaction of the same constraints that are active in Hopi and Tonkawa: WSP, PARSE-σ, NONFINALITY(σ), SWP, and FINALC.

Much of SE Tepehuan deletion *looks* like syllable economy, as Kager himself notes, but it is also clear that deletion fails to apply in some circumstances (e.g., inside a foot) although deletion there would reduce the overall number of syllables. This is because SE Tepehuan syncope reduces the number of *unfooted* syllables, not all syllables. This was already addressed in chapter 2: while syncope may minimize the number of unfooted syllables or maximize the weight of foot heads, no language deletes vowels to reduce the number of syllables inside well-formed feet. Patterns of syllable reduction that are agnostic of prosody cannot exist in the Lenient theory, yet syllable economy constraints predict that they should occur.

### 3.5.2 The patterns of deletion in Southeastern Tepehuan

According to Willett 1982 and Willett 1991, Southeastern Tepehuan (Uto-Aztecan, Mexico) has CV(V)(C) syllable structure, and consonant clusters are forbidden. Stress in Southeastern Tepehuan is much like that of its Uto-Aztecan relative, Hopi—Kager (1997:474) describes it as follows: "accent falls on the initial stem syllable when it is heavy (i.e. either long-voweled, diphthongal, or closed). It falls on the second stem syllable if this is heavy while the first syllable is light." There is no secondary stress, which Kager takes to be evidence of non-iterative footing.[65] Examples are given in (131) (I follow Kager's standardized transcriptions of the data from Willett 1982, Willett 1991).

(131) Southeastern Tepehuan stress

a. (vóo)hi 'bear'

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[65] Lack of reported surface secondary stress need not imply non-iterative footing. There is other evidence of the lack of secondary footing in Southeastern Tepehuan—for example, it has vowel shortening outside stressed syllables, just like Hopi. See also chapter 4 for discussion of Lebanese Arabic, which also lacks surface secondary stress but has other evidence of iterative feet (cf. Hayes 1995, McCarthy 1979 and others).

| | | |
|---|---|---|
| b. | (vát)vi.rak | ‘went to bathe’ |
| c. | (ta.káa)ruiʔ | ‘chicken’ |
| d. | (ta.pɨ́ɨʃ) | ‘flea’ |

The difference between Hopi and Tepehuan is that stress may fall on the last syllable, meaning that NONFINALITY(σ) is not active (unusually for iambic languages—see Hung 1994), and naturally this has consequences for the directionality of syncope and apocope.

Syncope deletes odd-numbered vowels following the stressed syllable. Deletion affects both short (a-e) and long vowels (f,g). Deleting vowels are underlined.

(132) Syncope

| | | | | |
|---|---|---|---|---|
| a. | /tɨɨ-t<u>ɨ</u>roviɲ/ | (tɨɨ́t).ro.piɲ | ‘ropes’ | cf. (b) |
| b. | /tɨr<u>o</u>viɲ/ | (tɨ́r).viɲ | ‘rope’ | cf. (a) |
| c. | /to-t<u>o</u>paa/ | (tót).pa | ‘pestles’ | cf. (topáa) |
| d. | /taa-t<u>a</u>kaaruiʔ/ | (táat).ka.ruiʔ | ‘chickens’ | cf. (ta.káa)ruiʔ |
| e. | /taa-t<u>a</u>pɨɨʃ/ | (táat).pɨʃ | ‘fleas’ | cf. (ta.pɨ́ɨʃ) |
| f. | /gaa-g<u>aa</u>gaʔ/ | (gáaʔŋ).gaʔ | ‘he will look around for it’<br>cf. (gáa)gim ‘he is looking for it’ | |
| g. | /tu# maa-m<u>a</u>tuʃ<u>i</u>dʒaʔ/ | tu# (máam).tuʃ.dʒaʔ | ‘will teach’ | |

These are all reduplicative examples—here, just as in Hopi, the reduplicant attracts stress, which entails that it also be heavy.[66]

As in Tonkawa, final vowels are subject to apocope, but an interesting twist is that although long vowels syncopate, they do not apocopate when they are in the strong position of an iamb—cf. (a-c) with (d,e):

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[66] Reduplicants are not always stressed in SE Tepehuan—sometimes the reduplicant is short and the base is stressed, e.g., /RED-huk/ is *hu.húk* ‘pines.’ Whether a stem takes the stressed or the short reduplicant is unpredictable—I assume that the difference between these stems are lexically encoded and that the base-stressed forms are lexically marked as subject to OO-DEP (see §2.3), which acts as a size-restrictor for the reduplicant.

(133) Apocope

| | | | | |
|---|---|---|---|---|
| a. | /tu# huana̲/ | tu# (huán) | ‘he is working’ | cf. tu# (huá).nat ‘he was working’ |
| b. | /hiɲ# novi̲/ | hiɲ# (ɲóv) | ‘my hand’ | cf. /novi-ʔn/ (no.víʔɲ) ‘his hand’ |
| c. | /novi/ | nóv | ‘hand’ | |
| d. | /ga-gaa/ | ga.gáa | ‘cornfields’ | *gaʔn, cf. (gáa) ‘cornfield’ |
| e. | /ʔaɽii/ | ʔa.ɽíi | ‘child’ | *ʔa.ɽí, ʔaɽ |

Deletion also exhibits a directionality effect of sorts: when either apocope or syncope is possible, apocope is preferred over syncope (this is also the case in Aguaruna (Payne 1990)—see (43)). Note the difference between Hopi and SE Tepehuan in this respect: /LLL/ words surface as (LH́), not as (H́)L. (This difference correlates with the ranking of NONFINALITY(σ) in the two languages, to which I will return shortly.)

(134) Apocope wins over syncope

| | | | | |
|---|---|---|---|---|
| a. | /hiɲ# noo-novi̲/ | hiɲ#(ɲóo)nov | ‘my hands’ | *hiɲ#(ɲóon)vi |
| b. | /ʃi#ʔomiɲi̲/ | ʃi#(ʔo.mín) | ‘break it!’ | *ʃi#(ʔóm)ni |
| c. | /naa-na̲kasɨɽi̲/ | (naan)ka.sɨɽ | ‘scorpions’ | *(naan)kas.ɽi |

Kager’s generalization is that “the output goal of apocope/syncope is *not* to minimize the number of syllables as such, but to minimize the number of syllables that stand *outside the foot*” (Kager 1997:475, emphasis in the original).

### 3.5.3 Kager’s analysis of Southeastern Tepehuan

Kager analyzes this pattern as serving “exhaustivity of metrical parsing.” (Kager 1997:479). In other words, PARSE-σ is the main motivating force behind both syncope and apocope in Southeastern Tepehuan. Since Kager goes into a fair amount of detail in his analysis, I will not do so here—instead I will focus on the comparison between Southeastern Tepehuan on the one hand and Hopi and Tonkawa on the other. I will also look at how economy principles deal (or, rather, do not deal) with these differences.

3.5.3.1 Footing and syncope

The Southeastern Tepehuan stress system is much like Hopi: an iambic foot is built at the left edge of the word, and no other feet are. The same ranking holds of both languages. (Kager (1997) uses gradient alignment—his analysis is recast in terms of categorical constraints here.)

(135) ENDRULE-L, ENDRULE-R>> PARSE-σ

However NONFINALITY(σ) is inactive in SE Tepehuan; disyllabic LH words like *topáa* 'pestle' surface with iambic rather than trochaic stress. This has consequences for syncope and apocope: in all the places where Hopi avoided deletion so as to obey NONFINALITY(σ), SE Tepehuan has it.

Just as in Hopi, PARSE-σ and SWP dominate MAXV in SE Tepehuan. Vowel deletion creates stressed heavy syllables and reduces the number of unfooted syllables. In (136), syncope creates a (H) foot, because (LL) crucially violates SWP. Note that the number of unfooted syllables is one in both the winner and the loser. Not so in (137), though: here, SWP is satisfied by both the winner and the loser, but syncope applies anyway, since the number of unfooted syllables can be reduced further.

(136) Syncope to make stressed syllables heavy

| / tɨroviɲ/ | SWP | MAXV |
|---|---|---|
| a. ☞(tɨ́r)viɲ | | * |
| b. (tɨró)viɲ | *! | |

(137) Syncope to get rid of unfooted syllables

| /taa-t̲a̲pɨɨʃ/ | PARSE-σ | MAXV |
|---|---|---|
| a. ☞(táat).pɨʃ | * | * |
| b. (táa)ta.pɨʃ | **! | |

In this respect SE Tepehuan and Hopi are almost identical—they only differ in their acceptance of superheavy syllables, which Hopi bans but SE Tepehuan doesn't.

#### 3.5.3.2 Apocope

Although SE Tepehuan resembles Hopi in its syncope patterns, it is more like Tonkawa when it comes to apocope. Both in Tonkawa and SE Tepehuan, FINALC (defined in (116)) dominates MAXV, favoring apocope. The only exception to apocope is canonically iambic LH words like *topaa*.[67] Kager attributes the behavior of LH words to the requirement for prosodic words to be minimally disyllabic (DISYLL).

(138) DISYLL: "The PrWd is minimally disyllabic" (Ito and Mester 1992, Kager 1997, McCarthy and Prince 1993b).
*Harmonic scale:* PrWd ≻ PrWd

| | | |
|---|---|---|
| PrWd | ≻ | PrWd |
| /\ | | \| |
| σ σ | | σ |

This constraint is violated by words like *nov*, but the alternative **(noví)* is ruled out by the higher-ranking SWP. This is summarized in the comparative tableau (139): the comparison in (a) supports the ranking ranking FINALC>>MAXV; comparison (b) shows that where an SWP violation is at stake, the disyllabic requirement is violated, and finally the (e)~(f) comparison supports the argument for DISYLL>>FINALC.

(139) Apocope satisfies FINALC

| | | SWP | DISYLL | FINALC | MAXV |
|---|---|---|---|---|---|
| /nakasɨɽi/ | a. (nák)sɨɽ~(nák)sɨ.ɽi | | | W | L |
| /novi/ | b. ☞(nóv)~(no.ví) | W | L | W | L |
| /topaa/ | c. ☞(to.páa)~(tóp) | | W | L | L |

[67] There are also phonotactic constraints that block apocope, such as the constraint against word-final *h* (witness *voohi*, **vooh* 'bear') and *COMPLEX(witness *hupna*, **hupn* 'pull out').

#### 3.5.3.3 Iterativity of syncope: WSP and FINALC

Apocope sets the direction for vowel deletion in SE Tepehuan (the relevant data are repeated in (140)).

(140) Apocope wins over syncope

| | | | | |
|---|---|---|---|---|
| a. | /hiɲ# noo-novi̲/ | hiɲ#(ɲóo)nov | 'my hands' | *hiɲ#(ɲóon)vi |
| b. | /ʃi#ʔomiɲi̲/ | ʃi#(ʔo.mín) | 'break it!' | *ʃi#(ʔóm)ni |
| c. | /naa-na̲kasɨɽi̲/ | (naan)ka.sɨɽ | 'scorpions' | *(naan)kas.ɽi |

Although footing is not iterative in SE Tepehuan, vowel deletion is, and it has a pseudo-directional character. Directionality in this case has two sources: the first is PARSE-σ, the second is FINALC.

In the case of /LLL/ words, the choice of deletion site is straightforward: the deletion of the third vowel creates a larger LH foot with no unparsed syllables, while the deletion of the second vowel makes an H foot with an unfooted syllable following it. Since SWP is satisfied by both candidates, the choice is handed down to PARSE-σ, which selects the larger foot (141). Recall that this option was not available in Hopi, where the equivalent of (b) is the winner. This difference arises because PARSE-σ and NONFINALITY (σ) are ranked in the opposite ways in Hopi and SE Tepehuan.

(141) Final stress tolerated for exhaustive footing

| /ʃi#ʔomiɲi/ | SWP | PARSE-σ | NONFINALITY(σ) |
|---|---|---|---|
| a. ☞ʃi#(ʔo.mín) | ✓ | | * |
| b. ʃi#(ʔóm)ni | ✓ | *! | |

NONFINALITY(σ) is never crucially active in SE Tepehuan—it is dominated by FINALC (142), since apocope routinely creates words with final stress (a~b). FINALC must also dominate WSP, because vowel deletion creates words with unstressed CVC syllables (c~d). In this too SE Tepehuan is the opposite of Hopi: there syncope was non-iterative because unstressed heavies were avoided.

(142) Apocope creates violations of WSP and NONFINALITY(σ)

| | | FINALC | WSP | NONFINALITY(σ) |
|---|---|---|---|---|
| /ʃi#ʔomiɲi/ | a. ☞ʃi#(ʔo.mín) | | | * |
| | b. ʃi#(ʔóm)ni | *! | | |
| /hiɲ# noo-novi̲/ | c. ☞hiɲ# (nóo)nov | | *(nov) | |
| | d. hiɲ# (nóon)vi | *! | | |

Kager ranks WSP below PARSE-σ, as well. Consider /tu# maa-ma̲tuʃi̲dʒaʔ/, where violations of FINALC or SWP are not an issue. Here syncope applies twice, creating the only output that has only two unfooted syllables (143). The alternatives invariably fail on PARSE-σ, although some (b,d) perform better than the winner on WSP.

(143) Iterative syncope creates maximally footed candidate

| /tu# maa-matuʃidʒaʔ/ | PARSE-σ | MAXV | WSP |
|---|---|---|---|
| a. ☞tu# (máam).tuʃ.dʒaʔ | ** | ** | ** |
| b. tu# (máa)ma.tu.ʃi.dʒaʔ | ***!* | | * |
| c. tu# (máa)mat.ʃi.dʒaʔ | ***! | * | ** |
| d. tu# (máam)tu.ʃi.dʒaʔ | ***! | * | * |

Note that WSP is not completely inactive in SE Tepehuan: there is a process of vowel shortening that affects unstressed long vowels */taa-ta̲kaaruiʔ/→ (táat).ka.ruiʔ* 'chickens,' so WSP must dominate MAX-μ. This fact supports Kager's claim that footing is non-iterative and suggests that a covert footing analysis (Hall 2001) is probably not the right analysis.

### 3.5.4 Summary of the analysis of Southeastern Tepehuan

Syncope is iterative in SE Tepehuan because exhaustivity of footing overrides WSP, not because footing is iterative (cf. Tonkawa). This brings up a more general implication of the present approach to rhythmic vowel deletion: iterative syncope need not correlate with iterative footing. Moreover, directionality of footing does not cement the options for syncope—other constraints can interfere. In Hopi, WSP prevents syncope from applying outside the main stress foot. In SE Tepehuan, the relative ranking of WSP and PARSE-σ is reversed and the pattern becomes iterative. In Tonkawa, the source of iterative syncope is iterative footing. We see consequences of these differences in the surface stress patterns: Hopi and SE Tepehuan lack secondary stress while Tonkawa has plenty.

Kager's results are summarized in the comparative tableau (144). The first group of comparisons shows why syncope and apocope must occur—the faithful *(naká)sɨɽi* violates both FINALC and SWP, while *(nakás)ɽi* and *(naká)sɨɽ* violate one of the two. The last loser, *(nák)sɨɽi*, is harmonically bounded by *(nakás)ɽi*: *(nakás)ɽi* could be a winner in Hopi but *(nák)sɨɽi* incurs a superset of its violations and could never win in an iambic language. The result is, generally, that given a choice between HLL and LHL, iambic languages should go for the latter—the distribution of weight is ideal in LHL because it maximizes the number of footed syllables while minimizing the number and weight of unfooted syllables. If other constraints intervene (e.g., FINALC), then HH may beat LHL, but HLL never can.

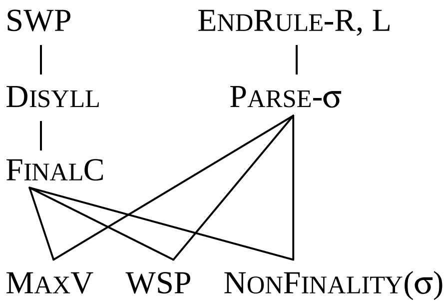
The next two comparisons, (e) and (f), demonstrate the role of PARSE-σ and FINALC in SE Tepehuan. The only thing preventing PARSE-σ from wiping out all the unfooted syllables is *COMPLEX, undominated in this language (not shown). Finally the last two comparisons show the workings of apocope in shorter words, demonstrating the violable preference for disyllabic prosodic words.

(144) SE Tepehuan apocope and syncope

| /nakasɨɽi/ | PARSEσ | SWP | Diσ | FINALC | MAXV | NONFIN | WSP |
|---|---|---|---|---|---|---|---|
| a. (nák)sɨɽ~(naká)sɨɽi | W | W | | W | L | | L |
| b. (nák)sɨɽ~(naká)sɨɽ | | W | | | L | | |
| d. (nák)sɨɽ~(nakás)ɽi | | | | W | L | | L |
| c. (nák)sɨɽ~(nák)sɨɽi | W | | | W | L | | L |
| /ʃi#ʔomiɲi/ | | | | | | | |
| e. ʃi#(ʔomíɲ)~ ʃi#(ʔóm)ɲi | W | | | W | | L | |
| /tu# maa-matuʃidʒaʔ/ | | | | | | | |
| f. tu# (máam)tuʃ.dʒaʔ~ tu# (máam)tu.ʃi.dʒaʔ | W | | | | L | | L |
| /novi/ | | | | | | | |
| g. (nóv)~(noví) | | W | L | W | L | | |
| /topaa/ | | | | | | | |
| h. (topáa)~(tóp) | | | W | L | L | | |

Some of Kager's crucial rankings are summarized below. The reader is referred to Kager's work for a more complete picture—he also analyzes vowel shortening and reduplication shapes, which are too complex to discuss here.

(145) Rankings for SE Tepehuan




To summarize, Kager's analysis accounts for a variety of economy effects in SE Tepehuan using the same core constraints that are active in Hopi and Tonkawa. The very presence of constraints like WSP, SWP, MaxV, Parse-σ, FinalC and NonFinality(σ) in CON predicts the existence of this syncope pattern. These constraints are by no means parochial—all were originally proposed to deal with processes other than syncope and vowel shortening.

### 3.5.5 An Economy analysis of Southeastern Tepehuan

Since SE Tepehuan is the opposite of Hopi when it comes to deletion outside the main stress foot, it looks like there may be a glimmer of hope for the economy principle analysis: deletion really does appear to apply wherever it is possible to reduce the number of syllables. In *tu# (maam)tuʃ.dʒaʔ*, the number of syllables is reduced from five in the underlying */tu# maa-matuʃidʒaʔ/* to three:

(146) *Struc favors syncope

| /tu# maa-matuʃidʒaʔ/ | *Complex | *Struc(σ) | MaxV |
|---|---|---|---|
| a. ☞tu# maam.tuʃ.dʒaʔ | | *** | ** |
| b. tu# maa.ma.tu.ʃi.dʒaʔ | | ****!* | |
| c. tu# maamtʃ.dʒaʔ | *! | ** | *** |

However, Kager is justified in his claim that vowels are not simply deleted for the sake of reducing the number of syllables—this pattern really reduces the number of *unfooted* syllables. In the following example, deletion fails to apply, although it could reduce the number of syllables in the word from two to one.

(147) No deletion after light syllables

| | | | | |
|---|---|---|---|---|
| a. | /takaaruiʔ/ | (ta.káa)ruiʔ | ‘chicken’ | *tak.ruiʔ |
| b. | /va-voohi/ | (vapóo)hi | ‘bears’ | *vavhi |
| c. | /va-vaiɲum/ | (vapái)ɲum | ‘metals’ | *vavɲum |

These forms cannot be explained away by appealing to MAX-LONG-V: recall that long vowels do delete after heavy syllables in forms like */gaa-gaagaʔ/ (gáaʔŋ).gaʔ* ‘he will look around for it’ (SE Tepehuan is unlike both Hopi and Tonkawa in this respect). Deletion does not apply after light syllables because it is gratuitous: the (LH) foot is already perfect; reduction to (H) serves no purpose and incurs additional violations of MAXV. Candidates with such deletion are locally harmonically bounded:

(148) Syllable reduction candidate harmonically bounded

| /va-voohi/ | SWP | PARSE-σ | MAXV |
|---|---|---|---|
| a. ☞(vapóo)hi | ✓ | * | |
| b. (váv)hi | ✓ | * | *! |

*STRUC(σ) cannot replicate this result: wherever deletion can apply, it should do so, whether it’s inside or outside the foot.

(149) Wrong prediction: deletion inside the foot

| /va-voohi/ | *STRUC(σ) | MAXV |
|---|---|---|
| a. 💣(vapóo)hi | ***! | |
| b. ☞ (váv)hi | ** | * |

This sort of pattern simply does not occur—there is no general preference between (H) and (LH) feet. In fact, if anything, (LH) feet may be preferred to (H) under some circumstances, e.g., if the prosodic word is required to be disyllabic. The preference never goes in the other direction—no language deletes a long vowel to opt for a (H) foot instead of a (LH) foot.

In order to avoid this outcome, *STRUC(σ) would have to be ranked *below* MAXV, and the syncope pattern would have to be attributed to the interaction of metrical constraints with MAXV. But this move amounts to admitting that *STRUC(σ) has nothing to do with syncope at all—which is what has been argued in this chapter.

One could argue that an economy principle analysis that is agnostic of prosodic constraints is unfairly oversimplified: of course other factors play a role in syllable economy; this has been known since the work of Kisseberth 1970b. Yet syllable economy not only fails to illuminate the patterns of vowel deletion in Hopi and Tonkawa—its very presence in UG predicts an unattested syncope pattern that is a mere variation on Southeastern Tepehuan.

### 3.6 Chapter summary

This chapter has presented three case studies of rather different syncope and shortening patterns in Hopi, Tonkawa, and Southeastern Tepehuan. I argued that independently motivated prosodic constraints achieve a great deal of success in accounting for the structure-reducing processes in these languages. The differences between the three languages are systematic. Syncope is iterative in Tonkawa because footing is iterative. Syncope is non-iterative in Hopi because unstressed heavy syllables are marked, while in Southeastern Tepehuan the opposite is true—unstressed heavy syllables are tolerated, so syncope is iterative. A simple re-ranking of the constraints WSP, SWP, PARSE-σ, ENDRULE, and MAXV produces these different patterns of syncope and shortening:

(150) Syncope is non-iterative, cannot create unstressed heavy syllables (Hopi):
WSP>>PARSE-σ>>MAXV

(151) Syncope is iterative, can create unstressed heavy syllables (SE Tepehuan):
PARSE-σ>>MAXV, WSP

(152) Syncope applies after long vowels (Hopi & SE Tepehuan):
ENDRULER, ENDRULE L>>PARSE-σ>>MAXV

(153) Syncope does not apply after long vowels (Tonkawa):
ENDRULE-R, PARSE-σ>>MAXV, ENDRULE-L

Vowel deletion processes are not uniform because constraints in CON are not uniform. The only thing that is common to all vowel deletion processes is that some markedness constraint dominates MAXV.

In other languages, the same markedness constraint will be satisfied in another way. SWP is satisfied by syncope in the three languages described here, which happens to make words shorter. Yet it can also be satisfied by making words longer through augmenting the stressed syllable. The same is true for PARSE-σ: in some languages, unfooted syllables are avoided through deletion, in others—through the addition of foot structure. Even in the same language, a single constraint can have both an economy effect and an anti-economy effect: in Hopi, WSP is satisfied by vowel shortening, but it also blocks unfooted syllable syncope. No constraint has only economy effects because no constraint is an economy constraint in the Lenient theory of CON. Economy effects are side effect, not a goal.

CHAPTER 4

# DIFFERENTIAL SYNCOPE AND EPENTHESIS

## 4.1 Introduction

Under the Leniency hypothesis, no constraint can ever refer to the least marked end of a harmonic scale. In chapter 3 I argued that there are no constraints that penalize *syllables* without reference to context: unfooted syllables are marked, light stressed syllables are marked, but syllables in general are not marked. This chapter is concerned with harmonic scales and constraints that refer to *vowels*. There are several phonological processes that shows evidence of scalar treatment of vowels: sonority-driven stress, the preference for sonorous syllable nuclei, and vowel reduction. Depending on the match of sonority with position, vowels may be marked or unmarked. This suggests that there are certain constraints that cannot exist in CON; for every harmonic scale, the least marked element escapes constraint violation under Lenient Constraint Alignment. This chapter will provide arguments that such constraints must indeed be excluded from CON.

The key ingredients for syncope are a markedness constraint and MAXV: if there is a markedness constraint against a particular structure that can be satisfied by deleting this structure, the prediction is that the structure should sometimes be deleted. Since certain vowels are marked in certain contexts, we expect to see them deleted where other vowels are not. This sort of pattern is called differential syncope.[68] Consider the pattern of Lebanese Arabic, where high vowels delete but low ones do not:

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[68] The terms “differential” and “non-differential” are due to Cantineau 1939, who applied them to Arabic dialects.

(1) Lebanese Arabic high vowel syncope (Haddad 1984)

| | | | | |
|---|---|---|---|---|
| a. | /nizi̲l-it/ | níz.lit | ‘she descended’ | cf. nízil |
| b. | /ni̲zil-t/ | nzílt | ‘I descended’ | |

(2) No syncope of /a/ in the same environment

| | | | | |
|---|---|---|---|---|
| a. | /saħab-it/ | sá.ħa.bit | ‘she withdrew (tr.)’ | *sáħ.bit |
| b. | /xazaʔ-t/ | xazáʔt | ‘I tore’ | *xzáʔt |

Which constraints in Con can favor differential deletion of vowels? The constraints on which I will focus in this chapter are those that ban prominent, sonorous vowels (e.g., *a*) from occupying non-prominent positions (e.g., weak branches of feet), and constraints that ban non-prominent vowels (e.g., *ə*) from prominent positions (e.g., syllabic nuclei and strong branches of feet). Syncope results when these marked configurations cannot be avoided by other means, e.g., vowel lowering or raising. These alternative solutions can coexist in a grammar: in Lushootseed, unstressed low vowels are preferentially deleted but sometimes they must reduce to schwa. There is no economy principle behind reduction of unstressed *a*: economy principles can only be satisfied by *deletion* of structure, not *change* of structure.[69]

In chapter 3 I argued that metrical syncope is not one process but many: diverse patterns result from the different rankings of SWP, Parse-σ, WSP and other constraints with respect to each other and MaxV. One can speak of unfooted syllable syncope, syllable weight-induced syncope, etc. Similarly, differential syncope is not one process but many. Some differential syncope patterns look remarkably like metrical syncope.

[69] It can be argued that *ə* is a featureless vowel, in which case reduction of *a* to *ə* does reduce the amount of structure in the output, because it removes purportedly marked features. For a discussion of this view, see §4.3.6.2.

Lebanese Arabic is one such case (see (1)-(2) and §4.4): syncopated forms often satisfy PARSE-σ and SWP better than the faithful alternatives do, and deletion is blocked by NONFINALITY, just as in Hopi. Yet this is not true of all differential syncope—some patterns are not metrical in any obvious sense. For example, deletion of schwa in Lillooet (discussed in detail in §4.3) is blocked only by phonotactic constraints. The one common thread among these patterns is that all involve the deletion of a vowel and the consequent reduction in structure.

As mentioned above, low-sonority vowels are penalized in some contexts and high-sonority vowels are penalized in other contexts. Can the constraints against these configurations "gang up" against all vowels and duplicate the effects of *STRUC(σ) or *V? In §4.2.2 I argue that this is impossible under the view that constraints in CON are lenient, i.e., no markedness constraint bans the least marked element of its markedness scale. On the other hand, such gang-up effects are not ruled out under the "everything-is-marked" view of CON.

Another issue raised by differential syncope has to do with its relationship to epenthesis. In some languages, the distribution of certain vowels is virtually entirely predictable: they surface only where phonotactic constraints require their presence. An example of this is the distribution of schwa in Lillooet. In this language, every word must contain at least one vowel, and tautosyllabic clusters of sonorants or sonority sequencing violations are prohibited. Schwa surfaces only when its presence is required by these constraints:

(3) Lillooet schwa (van Eijk 1997)

| | | | | | |
|---|---|---|---|---|---|
| a. | təq | ‘to touch’ | cf. | tq-alk’əm | ‘to drive, steer’ |
| b. | x̌ʷəm | ‘fast’ | cf. | x̌ʷm-akaʔ | ‘to do smt. fast’ |
| c. | s-nəm-nəm | ‘blind’ | cf. | nəm’ə-nm-’əp | ‘going blind’ |

In a sense, schwa is treated as a *cheap vowel*—it is readily inserted when phonotactic constraints require but deleted otherwise.[70] This is how this pattern must be analyzed under the OT assumption known as Richness of the Base: markedness constraints apply only to outputs, while inputs are unrestricted (Prince and Smolensky 1993). The grammar must work regardless of how many or how few schwas there are in the input: if the input contains too many schwas, the grammar must delete all but the ones necessary for phonotactic reasons, and if the input contains too few, the grammar must ensure that they are inserted in all the right places. As I will show, *STRUC(σ) alone cannot explain why only low-sonority vowels behave like this—once the *STRUC analysis is fortified to deal with rich inputs, it comes with undesirable typological predictions.

The rest of the chapter is organized as follows. In §4.2, I review the constraint hierarchies that relate vocalic prominence to designated positions, which form the basis for the subsequent discussion. I then highlight the differences between the constraints possible in the lenient model of CON and in the traditional model, and some consequences of these differences for factorial typology. The case studies are organized around the theoretical issues overviewed above. I start with an examination of cheap vowels in Lillooet (§4.3), where I also present a theory of epenthetic vowel quality. The next two

[70] A parallel pattern is cheap consonants, e.g., glottal stop in German, Dutch, Tagalog, and others. In these languages, glottal stops surface in the absence of another onset but not otherwise. Similarly, *do*-support in syntax may require this sort of analysis (see chapter 2 and Grimshaw 1997).

case studies examine syncope in Lebanese Arabic (§4.4) and Mekkan Arabic (§4.5). Lushootseed is discussed in §4.6, and §4.7 concludes.

## 4.2 Differential constraints in the Lenient model of CON

In this section, I discuss three hierarchies of constraints that relate vocalic sonority to prosodic positions: constraints that require nuclei to be as sonorous as possible (*NUC/x), constraints that require weak foot branches to have as little sonority as possible (*$\text{MAR}_{\text{FT}}$/x), and constraints that require strong foot branches to be as sonorous as possible (*$\text{PK}_{\text{FT}}$/x). These constraints play a central role in the case studies that follow.

### 4.2.1 Sonority constraints on nuclei and foot branches

It is well known that in general, the more sonorous the syllable nucleus, the better (Clements 1990). To capture this preference, Prince and Smolensky (1993) posit constraints on the sonority of syllable peaks (nuclei) and margins (onsets). The constraints on vocalic nuclei (shown in (4)) are most relevant to the discussion at hand.[71] The hierarchy in (4) is derived from the harmonic scale below, which is in turn derived by Harmonic alignment (discussed in Chapter 2). Note that by Lenient Constraint Alignment (also discussed in Chapter 2), no constraint refers to the least marked nucleus, *a*—there is no constraint *NUC/a in CON.

(4) *NUC/ə >> *NUC/i,u >> *NUC/e,o
*Nucleus harmony scale*: nuc/a ≻ nuc/e,o ≻ nuc/u,i ≻nuc/ə

These constraints have many effects. They control syllabification by determining which of several eligible segments ends up in the nucleus of the syllable (see Dell and

[71] It is possible for margins to be filled with vowels, as well, but I assume that when a vowel is parsed as a syllable margin (or onset), it surfaces as a glide: *i*, *e* → *j*, *u*, *o* → *w*, and *a* possibly as ɹ (Bakovic 1999, McCarthy 1993, Rosenthall 1994).

Elmedlaoui 1985, 1988 and Prince and Smolensky 1993 on Imdlawn Tashlhiyt Berber). They have also been argued to determine epenthetic vowel quality in languages that have epenthetic *a*, the most sonorous segment (de Lacy 2002a). Constraints on the sonority of syllable nuclei can favor the preservation of the more sonorous of two vowels in hiatus elision (see Casali 1996 and Pulleyblank 1998, although they use a hierarchy of MAX constraints based on the sonority scale). Vowel lowering (as in Sanskrit) is another effect (Beekes 1995:60). These processes are not economy effects, since they do not reduce the amount of structure in any sense.

Another set of constraints that relate sonority to positions are sonority-sensitive stress constraints, recently examined in the work of Crosswhite 1999a, Kenstowicz 1996b, and de Lacy 2002a. The hierarchy in (5) bans prominent, sonorous vowels from non-prominent positions such as the weak branch of a foot; the hierarchy in (6) bans vowels of low sonority (e.g., *ə*) from highly prominent positions such as the strong branch of a foot. These constraints are derived from the following harmonically aligned scales:[72]

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[72] The exact details of the formulation of these constraints vary somewhat by author. Kenstowicz 1996b and Urbanczyk 1996 use *P/x and *M/x to refer to peaks and margins of feet, as do I. Crosswhite 1999a uses *σ́/x and *σ̆/x for "stressed syllable" and "unstressed syllable." In de Lacy's (2002a) more elaborate theory, prominence constraints can refer to Designated Terminal Elements (DTEs or "Δ") and non-DTEs (basically, head segments) at every level of the prosodic hierarchy, so the constraints are called *$\Delta_{Ft}$/x and *-$\Delta_{Ft}$/x. For my purposes, reference to peaks and margins of feet is sufficient.

(5) Constraints on the sonority of vowels in strong branches of feet
*PK$_{FT}$/ə >> *PK$_{FT}$/i,u >> *PK$_{FT}$/e,o (cf. de Lacy 2002a, Kenstowicz 1996b)
*Foot Head (peak) scale*: Peak$_{Ft}$/a ≻ Peak$_{Ft}$/e,o ≻ Peak$_{Ft}$/u,i ≻ Peak$_{Ft}$/ə

(6) Constraints on the sonority vowels in weak branches of feet
*MAR$_{FT}$/a >> *MAR$_{FT}$/e,o>>*MAR$_{FT}$/i,u (de Lacy 2002a, Kenstowicz 1996b)
*FtNonHead (margin) scale*: Mar$_{Ft}$/ə ≻Mar$_{Ft}$/u,i ≻ Mar$_{Ft}$/e,o≻ Mar$_{Ft}$/a

By Lenient Constraint Alignment, CON does not contain the constraints *PK$_{FT}$/a and *MAR$_{FT}$/ə, because highly prominent foot peaks and minimally prominent foot margins are unmarked.

The diverse effects of these constraints are well known. Avoidance of unstressed sonorous vowels or stressed *ə* or *i* can force deviations from the default footing pattern if one of the constraints in (5) or (6) dominates a markedness constraint on foot placement (de Lacy 2002a, Kenstowicz 1996b). These constraints can also be satisfied by reducing/raising sonorous vowels in unstressed positions and by lowering vowels that lack prominence in stressed syllables (Crosswhite 1999a). They can also determine the quality of epenthetic vowels in particular contexts (de Lacy 2002a). Again, these are not economy effects—these processes do not make the output shorter.

Syncope is just another predicted effect of the constraints on nuclei and foot branches. If IDENT[F] and *NUC/ə dominate MAXV, schwa has no choice but to delete in at least some circumstances. Likewise, low vowels might delete if MAXV is dominated by IDENT[F] and *MAR$_{FT}$/a, though *MAR$_{FT}$/x constraints interact with a variety of other constraints that can potentially affect the outcome. The main point here is that these constraints have already received ample justification in work on processes that have little or nothing to do with economy or syncope, and their mere presence in the OT grammar together with MAXV *predicts* that deletion will occur.

### 4.2.2 No gang-up effect

It is not the goal of this study to explore all the possible differential syncope patterns predicted by these constraints. Rather, I will concentrate on showing that if the hierarchies are formulated leniently (i.e., excluding *NUC/a, *$\text{PK}_{\text{FT}}$/a and *$\text{MAR}_{\text{FT}}$/ə from CON), they cannot duplicate the effect of *STRUC(σ) (Zoll 1996) or its near-equivalent,[73] *V (Hartkemeyer 2000).

To begin, consider how syllable nuclei are evaluated in the traditional "everything-is-marked" theory of CON. If there is a constraint *NUC/a in CON, then the *NUC/x hierarchy assigns violations to the full range of possible nuclei, which duplicates the effect of *STRUC(σ) or *V.

(7) Purported constraint *NUC/a as an economy constraint

| | *NUC/ə | *NUC/i,u | *NUC/e,o | *NUC/a | *STRUC(σ) | *V |
|---|---|---|---|---|---|---|
| a. ...Cə... | * | | | | * | * |
| b. ...Ci... | | * | | | * | * |
| c. ...Ce... | | | * | | * | * |
| d. ...Ca... | | | | * | * | * |

The comparison is even plainer if the constraints are evaluated and formulated stringently, as in de Lacy's (2002a) theory (see also Prince 1997a, b). Stringently formulated constraints assign a violation mark to *x* and everything that is more marked

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[73] *V is not an exact equivalent of *STRUC(σ): they differ in evaluating syllabic sonorants. *STRUC(σ) assigns two violation marks to something like [di.mn̩], *V only one.

than *x*. *NUC/≤a in this approach is defined roughly as follows: “no nuclei with sonority equal or less than that of *a*.” Since all nuclei have sonority equal to or less than that of *a*, *NUC/≤a assigns a violation to every possible nucleus—equivalent to *STRUC(σ). The three most stringent constraints in (8) are shaded to highlight the similarity.

(8) Purported *NUC/a as an economy constraint, formulated stringently

| | *NUC/≤ə | *NUC/≤i,u | *NUC/≤e,o | *NUC/≤a | *STRUC(σ) | *V |
|---|---|---|---|---|---|---|
| a. ...Cə... | * | * | * | * | * | * |
| b. ...Ci... | | * | * | * | * | * |
| c. ...Ce... | | | * | * | * | * |
| d. ...Ca... | | | | * | * | * |

In the Lenient theory of CON, which does not admit *NUC/a, *STRUC(σ), or *V, the constraints in the *NUC/x hierarchy ban only the marked subset of syllable nuclei. The least marked nucleus, *a*, violates no constraints in this set:

(9) *NUC/x formulated leniently

| | *NUC/ə | *NUC/i,u | *NUC/e,o |
|---|---|---|---|
| a. ...Cə... | * | | |
| b. ...Ci... | | * | |
| c. ...Ce... | | | * |
| d. ☞...Ca... | | | |

Therefore, these constraints by themselves cannot duplicate the effects of *STRUC(σ). Yet *a* is not universally unmarked in all contexts—in fact, it is the most marked vowel in the weak branch of a foot, since it violates *MAR$_{FT}$/a (see (d)):

(10) Lenient *NUC/x and *MAR$_{FT}$/x

| | *NUC/ə | *NUC/i,u | *NUC/e,o | *MAR$_{FT}$/a | *MAR$_{FT}$/e,o | *MAR$_{FT}$/i,u |
|---|---|---|---|---|---|---|
| a. (CáCə) | * | | | | | |
| b. (CáCi) | | * | | | | * |
| c. (CáCe) | | | * | | * | |
| d. (CáCa) | | | | * | | |
| e. (CáCə)Ca | * | | | | | |
| f. (CáC)Ca | | | | | | |

This is the only context where *a* is marked with respect to any sonority constraint.[74] Unfooted syllables with low vowel nuclei do not violate *MAR$_{FT}$/a. As it is formulated, *MAR$_{FT}$/a doesn't even assign a mark to an unstressed, unfooted *a* in (e)-(f) above.[75] And since the *MAR$_{FT}$/x hierarchy is formulated leniently, *ə* is unmarked as a foot margin. (It is marked as a nucleus, of course.) GEN is able to provide at least some forms that do not violate any *MAR$_{FT}$/x constraints, and a subset of them does not even violate any sonority constraints at all. *MAR$_{FT}$/x and *NUC/x put together cannot match the power of *STRUC(σ) or *V.

Adding *PK$_{FT}$/x constraints to the mix does not change this picture. *PK$_{FT}$/x constraints are less stringent than the *NUC/x hierarchy: they penalize vowels of low sonority in a smaller set of environments. Just as was the case with syllable nuclei, *a* is unmarked as a foot head (see (e-f) in (11)):

---

[74] I am ignoring constraints on vowel harmony, agreement with adjacent consonants, and so on—these can assign violation marks to *a* in specific contexts as well.

[75] If the constraint were instead on unstressed syllables, the picture would be different—cf. *σ̆/x Crosswhite 1999a or Struijke's (2001) *UNSTRESSED VOWEL.

(11) *NUC/x, *MAR$_{FT}$/x and *PK$_{FT}$/x

| | *NUC/ə | *NUC/i,u | *NUC/e,o | *M/a | *M/e,o | *M/i,u | *P/ə | *P/i,u | *P/e,o |
|---|---|---|---|---|---|---|---|---|---|
| a. (Cə́Cə) | ** | | | | | | * | | |
| b. (CíCə) | * | * | | | | | | * | |
| c. (CéCə) | * | | * | | | | | | * |
| d. (CáCə) | * | | | | | | | | |
| e. (CáC)Ca | | | | | | | | | |
| f. (CáC) | | | | | | | | | |

Within this constraint set, a prediction emerges: the minimal vowel inventory of a language is {*á*}. Assuming that inputs are in no way restricted, *á* cannot fail to emerge in the surface forms of every language: none of the markedness constraints in (11) ban it. Such small inventories are unattested in adult languages, all of which have at least a height contrast (Ladefoged and Maddieson 1990). However, Jakobson 1941 hypothesizes that *a* is the earliest vowel to emerge in child speech because it is so sonorous, and my examination of three longitudinal databases of child speech (Compton and Streeter 1977, Pater 1997) confirms this—children's early vowel inventories are confined to stressed low vowels.

It appears that the sonority constraints in (11) cannot gang up against all vowels of a language—at least some of the forms slip through the filter. This suggests that even if all of these constraints dominated MAXV, the deletion pattern still would not look like the "delete-where-you-can" pattern produced by *STRUC(σ)>>MAXV (recall chapter 3). The conclusion is that in the Lenient model of CON, constraints relating sonority to positions cannot be used to indiscriminately count syllables or vowels, economy-style.

This brings up a question: if non-differential syncope (e.g., metrical syncope of the sort discussed in Chapter 3) can always be attributed to factors other than vowel or syllable economy, are there any "delete-where-you-can" syncope patterns at all? The answer is yes, but they are always differential. Moreover, such patterns always affect the less sonorous vowels, i.e., *ə* or *i* but never *a*. An archetypal example of this is examined in the next section.

## 4.3 Cheap vowels in Lillooet

### 4.3.1 Introduction: epenthesis, deletion, and Richness of the Base

Lillooet cheap schwa presents an interesting challenge for any theory of economy effects. The distribution of schwa in Lillooet is entirely predictable: it is absent unless the phonotactics of the language require its presence. On the other hand, the distribution of other vowels (*i*, *u*, *a*) is unpredictable. This is undoubtedly an economy effect; schwas are dispensed rather parsimoniously in the language. Is this a property peculiar to vowels of low sonority or can other vowels behave like this? As it turns out, the traditional rule-based analysis, economy, and the *NUC/ə analysis presented here differ on this. The *NUC/x analysis predicts that only low-sonority vowels can have this distribution, but under rule-based and economy OT analyses, other vowels can as well.

Lillooet raises another issue for economy: where in the grammar are economy effects obtained? The traditional analysis of this sort of pattern is to ban schwas from the input altogether—their predictable, economic distribution is the product of an epenthesis rule; there is no deletion. This is the gist of Brainard's (1994) analysis of predictable distribution of *ɨ* in Karao and Bobaljik's (1997) analysis of *ə* in Itelmen. An interesting consequence of this research strategy is that the epenthesis rule can insert any vowel. If any vowel can be banned from the input in the rule-based framework, this means that any vowel can have this predictable distribution—an odd prediction.

In OT, however, all economy effects have to follow from surface constraints. Inputs are not subject to constraints under the assumption known as Richness of the Base, or ROTB (Prince and Smolensky 1993, see also McCarthy 2002b:70-71). The OT grammar acts as a filter that is capable of dealing with any sort of input, whether it respects the output constraints of the language or not. Because inputs are unrestricted, an OT analyst cannot just ban schwas from the underlying representations in Lillooet and posit that all surface schwas are epenthetic. If an input happens to have all and only the necessary schwas, it will pass through the grammar filter unscathed, but if it has too many or too few, the grammar will need to fix the problem.

An ROTB-compliant analysis in terms of economy constraints shares some similarities with the rule-based analysis, with some important differences: e.g., there is no need to impose constraints on the input, because both epenthesis *and* deletion are the result of constraint interaction. The analysis must explain not only why schwa syncopates (while other vowels do not) but also why it is epenthetic. This turns out to be a problem, as I will show.

In the present framework, there are no economy constraints or restrictions on the input. The avoidance of schwa suggests that it is in some sense marked, but must also be unmarked in another sense to be selected as the epenthetic vowel. I claim that Lillooet schwa syncopates because it is the most marked vowel according to the *NUC/x hierarchy. On the other hand, schwa is the least marked *epenthetic* vowel. This follows from the theory of vowel epenthesis outlined in the next subsection.

This analysis predicts that only vowels on the less prominent end of the sonority scale can act as cheap vowels. The reason for this is that the constraints penalizing more sonorous vowels (e.g., *a*) are so context-specific that they can never favor general deletion of the sort that *NUC/x constraints favor. This prediction will be explored in §4.2.2. The rest of this section runs as follows. Section 4.3.2 outlines the prominence minimization theory of epenthesis. Then I lay out the Lillooet patterns (§4.3.3) and analysis (§4.3.4), which is followed by a discussion of the prediction that only the less prominent vowels can have predictable distribution (§4.3.5). Alternatives are discussed in (§4.3.6).

### 4.3.2 Prominence minimization and epenthetic vowel quality

It is well-known that, unlike epenthetic consonants,[76] epenthetic vowels are very diverse: while epenthesis of *ə* and *i* is very common, *e* and *a* can be epenthetic as well (for recent surveys of epenthetic vowel quality, see de Lacy 2002a, Lombardi 2003).

*NUC/x constraints penalize vowels of low sonority, so they select *a* as the vowel of epenthesis in languages like Coos, Takelma, Axininca Campa, and Mekkan Arabic. None of the markedness constraints discussed in §4.2, however, can favor the epenthesis of *ə* or *i* in *all contexts*. *$\text{PK}_{\text{FT}}$/x and *$\text{MAR}_{\text{FT}}$/x constraints are too sensitive to the prosodic context of the epenthetic vowel; there are plenty of languages (including Lillooet) that insert *ə* indiscriminately, even into the head of the prosodic word.

I propose that in languages like Lillooet, epenthetic vowel quality is determined by a different consideration: the prominence of epenthetic material should be minimized. Material that is prominent in the output should not be inserted; conversely, inserted

[76] Epenthetic consonants are usually confined to glottals, coronals, and glides formed off neighboring vowels. For some discussion, see de Lacy 2002a, Lombardi 1997, Paradis and Prunet 1991.

material should be minimally intrusive. The constraints that express this ban form a family of constraints I will call RECOVER, or REC for short:

(12) REC/a>>REC/e,o>>REC/i,u

REC/x: "A syllable nucleus with the prominence *x* must have a correspondent in the input."

The idea expressed by these constraints is related to Alderete's (1999) HEAD-DEP, which prohibits epenthesis into prosodic heads. Assuming that prominent positions/segments in the output are used as a crutch in reconstructing the input (Beckman 1998), it follows that they should not be epenthetic. Under (17), schwa is the ideal epenthetic vowel: it is the shortest and has the most negligible intensity among vowels (Lehiste 1970, Parker 2002), so its lack of an input correspondent is not a matter of concern for the RECOVER constraint hierarchy. Schwa epenthesis violates DEPV, of course, but it is the only vowel among the possible epenthetic vowels to incur no violations of RECOVER:

(13) Epenthetic vowel quality and RECOVER

| /CC/ | REC/a | REC/e,o | REC/i,u | DEPV |
|---|---|---|---|---|
| a. CaC | * | | | * |
| b. CeC | | * | | * |
| c. CiC | | | * | * |
| d. CəC | | | | * |

*NUC/x and the RECOVER hierarchy have partially conflicting demands: *NUC/x constraints disprefer nuclei of low sonority, be they epenthetic or not, while RECOVER constraints disprefer *epenthetic* nuclei of high sonority. Depending on the ranking of *NUC/x constraints with respect to RECOVER, then, any vowel can surface as epenthetic regardless of its prosodic context.

If ə is inserted in all contexts, all of the RECOVER constraints must dominate *NUC/ə (and therefore the other *NUC/x constraints, since they are in a fixed ranking). This is the ranking characteristic of Lillooet, Itelmen, and many others.

(14) Ranking for epenthetic ə

| /CC/ | REC/a | REC/e,o | REC/i,u | *NUC/ə | *NUC/i,u | *NUC/e,o |
|---|---|---|---|---|---|---|
| a. ☞CəC | | | | * | | |
| b. CiC | | | *! | | * | |
| c. CeC | | *! | | | | * |
| d. CaC | *! | | | | | |

For *i* to be epenthetic, either *NUC/ə or REC/a and REC/e,o must dominate *NUC/i,u or REC/i,u. The ideal epenthetic vowel ə is not available because it violates *NUC/ə, and better nuclei are not available because they violate REC/a and REC/e,o. This ranking is characteristic of most Arabic dialects, e.g. Lebanese, Palestinian, and Iraqi:

(15) Ranking for epenthetic *i*

| /CC/ | *NUC/ə | REC/a | REC/e,o | *NUC/i,u | *NUC/e,o | REC/i,u |
|---|---|---|---|---|---|---|
| a. ☞CiC | | | | * | | * |
| b. CəC | *! | | | | | |
| c. CeC | | | *! | | * | |
| d. CaC | | *! | | | | |

The ranking for epenthetic *e* is shown in (16). The mid vowel is the next best nucleus after *a*, but epenthetic *a* is ruled out by high-ranking REC/a. Although e is not the best *epenthetic* vowel, the epenthesis of ə is ruled out by high-ranking *NUC/ə, and the epenthesis of a high vowel is ruled out by *NUC/i,u. This ranking holds of Spanish.

(16) Ranking for epenthetic *e*

| /CC/ | REC/a | *NUC/ə | *NUC/i,u | *NUC/e,o | REC/e,o | REC/i,u |
|---|---|---|---|---|---|---|
| a. ☞CeC | | | | * | * | |
| b. CəC | | *! | | | | |
| c. CiC | | | *! | | | * |
| d. CaC | *! | | | | | |

Finally, for *a* to be epenthetic, all of the *NUC/x constraints must dominate all of the RECOVER constraints: *a* is the worst possible epenthetic segment but an ideal nucleus. This ranking obtains in Mekkan Arabic, Axininca Campa, and others.

(17) Ranking for epenthetic *a*

| /CC/ | *NUC/ə | *NUC/i,u | *NUC/e,o | REC/a | REC/e,o | REC/i,u |
|---|---|---|---|---|---|---|
| a. ☞CaC | | | | * | | |
| b. CəC | *! | | | | | |
| c. CiC | | *! | | | | * |
| d. CeC | | | *! | | * | |

Thus it is possible for a vowel of any height to be epenthetic *in any context* in this theory. Other constraints can affect the outcome; the epenthetic vowel may be subject to vowel harmony, context-sensitive agreement constraints, and so on (Kitto and de Lacy 2000, Shademan 2003). The theory of epenthetic vowel quality gives us the necessary tools to deal with Lillooet schwa.

### 4.3.3 Lillooet patterns

Lillooet (a.k.a. St'át'imcets; Interior North Salishan, British Columbia, Canada) has a four-vowel inventory: [i, u, a, ə].[77] Lillooet syllables may have onset or coda

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[77] Each vowel can be retracted (velarized) or not, though this contrast does not affect deletion/insertion. I will abstract away from retraction in the transcriptions.

clusters of two members but usually not more, with additional restrictions that will be discussed shortly. The generalizations over the distribution of schwa in Lillooet, extracted from the extremely thorough description of van Eijk 1997, can be stated as follows:

(18) Distribution of schwa in Lilooet

a. Every word must contain at least one vowel.
b. Sonorant consonants must be adjacent to a vowel.[78]
c. Tri-consonantal tautosyllabic clusters are banned.[79]
d. Schwa does not occur unless the above conditions are violated: it is never word-initial or word-final, and it does not occur in adjacent open syllables.

These generalizations are exemplified below. For exposition, I adopt van Eijk's URs, but it should be kept in mind that the distribution of schwa is so regular and predictable in Lillooet that the underlying representations of words with schwa are somewhat indeterminate.

In (19), schwa appears when there is no other vowel in the word, as in *təq*, but is readily elided when there is another vowel present and the resulting cluster consists of obstruents or has rising sonority:

(19) Schwa is the only vowel in the word

| | | | | | |
|---|---|---|---|---|---|
| a. | təq | 'to touch' | cf. | /təq-alk'-əm/ | tqalk'əm 'to drive, steer' |
| b. | x̌ʷəm | 'fast' | cf. | /x̌ʷəm-akaʔ/ | x̌ʷmakaʔ 'to do smt. fast' |
| c. | snəmnəm | 'blind' | cf. | /RED-nəm'-əp/ | nəm'ənm'əp 'going blind' |

[78] This generalization is violated by the prefixes *n̩*- '1S poss.' and *l̩*- 'in, on, at,' which are the only syllabic sonorant consonants in the language.

[79] This generalization holds of tautomorphemic clusters. Three-consonant clusters can emerge under morpheme concatenation, e.g., with the nominalizer prefix *s*-: *<u>s-k'ʷz</u>úsəm* 'work, job' (vE:20), *<u>s-kɬ</u>-akaʔ-mín-as=kʷuʔ* 'squeeze-tr.-3subj.=quot.' (vE:246).

Schwa must also break up consonants that would form a falling sonority cluster otherwise, as shown in (20). Whether it is inserted or simply fails to elide, it is always present in these environments:

(20) Syncope of schwa adjacent to sonorant blocked

| | | | | |
|---|---|---|---|---|
| a. | /nəq$^{w}$-alc/ | nəq$^{w}$alc | ‘warm in the house’ | *nq$^{w}$alc, cf. nəq$^{w}$ ‘warm’ |
| b. | /ləhac/ | ləhac | ‘otter’ | *lhac |

In (21), schwa seems to elide from one position only to appear in another. One schwa is inserted to break up the obstruent-obstruent clusters word-finally, while another (underlying) schwa elides. These data illustrate another aspect of Lillooet phonotactics: the position of the cluster matters; it seems that word-internal clusters are preferred to peripheral ones.

(21) Epenthesis and syncope

| | | | | |
|---|---|---|---|---|
| a. | /RED-łə̱sp/ | łəsłsə̱p | ‘rash all over’ | *łəsłə̱sp, łəsəłəsp |
| | | | cf. łə̱sp ‘rash on skin,’ | łə̱sp-akaʔ ‘rash on hand’ |
| b. | /RED-s-x̌ə̱tq/ | s-x̌ətx̌tə̱q | ‘holes’ | *s-x̌ətx̌ə̱tq, cf. s-x̌ə̱tq ‘hole’ |

Schwa is deleted whenever a proper cluster can be formed, but other vowels do not elide even when the resulting cluster is acceptable. In other words, the distribution of non-schwa vowels is unpredictable. Examples (a)-(d) in (22) make this point for vowels in the first syllable, and (e)-(f) show that non-schwa vowels do not elide in the last syllable. The last example shows that vowels also fail to elide medially.

(22) Non-schwa vowels are preserved

| | | | |
|---|---|---|---|
| a. | su̱tik | ‘winter’ | *stik, cf. stut ‘cricket’ |
| b. | sutik-ákaʔ | ‘north wind’ | *stikákaʔ, *sutkákaʔ |
| c. | ka̱-mays-c=a | ‘I will be able to’ | *kmays-c=a, cf. qmut ‘hat’ |
| d. | pa̱laʔ | ‘one’ | *plaʔ, cf. plan ‘already’ |
| e. | pun-tam-łkal’a̱p | ‘we find you folks’ | cf. ƛ̓’əl’q$^{w}$ ‘broken (rope)’ |

ƛ’əlp ‘lots of noise’

f. cuɬ-un’-tam-al’ap-a̲s ‘he points at you folks’ *...aps, cf. səps ‘door’

g. ɬap-ən-tu̲muɬ ‘hide us!’ cf. $tmix^w$ ‘land, weather’

To summarize, schwa appears to have a fully predictable distribution in Lillooet. It shows up to syllabify ill-formed sequences but not otherwise.[80]

### 4.3.4 Analysis of Lillooet

Two factors result in the cheap vowel pattern: schwa is the worst nucleus and the best epenthetic vowel. The ranking *NUC/ə >> MAXV results in economy of schwa. Meanwhile the equally high-ranking RECOVER constraints rule out epenthetic vowels other than schwa.

#### 4.3.4.1 Schwa epenthesis and syncope

Epenthesis is required and syncope blocked by phonotactic constraints. Among these are (i) the requirement that every syllable (and therefore word) have a nucleus/head (NUC: “syllables have nuclei,” Prince and Smolensky 1993:96), (ii) the prohibition on

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[80] One minor group of exceptions concerns words with the transitivizer suffix *-ən,* which appears to repel stress. Lillooet stress is fairly complex: it is generally lexical, but there are some elements of sonority-sensitivity (stress retracts from *ə* onto *i, u,* or *a*) and there is an initial default. The suffix *-ən* is odd in that schwa does not delete in roots that precede it even when the segmental conditions allow for schwa deletion, e.g., *tə́q-ən* ‘to touch, tr.’ (vE:20) is not **tq-ə́n*, cf. *tq-álk’əm* ‘to drive, steer’ (vE19). I assume that the reason for this is that the requirement for *-ən* to to be unstressed overrides the prohibition against schwa. This also explains why the schwa in *-ən* itself does syncopate when stress can fall elsewhere, e.g., *təq-n-ás* ‘he touches it’ (vE:20). Compare this to the stress-attracting suffix *-əm,* before which schwa does syncopate: */təq-ən-ə́m/ təqnə́m* ‘it is touched’ (vE:16), not * *tqənə́m*. Apart from examples like *təqən*, I have found no other examples of the shape $C_1əC_2əC_3$, where $C_1$ and $C_2$ are both obstruents. Note that similar suffix-induced peculiarities have been reported for Moroccan Arabic and Itelmen, where schwa also has a phonotactically determined distribution.

consonantal nuclei, which is expressed by the consonantal part of the *NUC/x hierarchy (Prince and Smolensky 1993); (iii) the prohibition on clusters of more than two consonants, *CCC; and (iv) sonority sequencing constraints that ban clusters of sonorants, falling sonority in onsets, and rising sonority in codas (Baertsch 1998, 2002, Clements 1990, Selkirk 1984a). In tableaux, I will conflate these requirements into a single cover constraint PHONOTACTICS, since they are all inviolable in Lillooet and do not interact with each other. I will identify the phonotactic transgressions of individual candidates for the reader's convenience.

PHONOTACTICS must dominate DEPV and *NUC/ə. When confronted with an input that contains no vowels at all, the grammar of Lillooet responds with schwa epenthesis. Something like *nəq^w^alc* 'warm in the house' will surface with a schwa even if the schwa is absent underlyingly:

(23) Epenthesis into illegal clusters

| /nq$^w$-alc/ | PHONOTACTICS | DEPV | *NUC/ə |
|---|---|---|---|
| a. ☞nəq$^w$alc | | * | * |
| b. nq$^w$alc | *!(sonority) | | |

Epenthesis will likewise apply to the hypothetical inputs /tq/ for *təq* 'to touch' or /nq$^w$/ *nəq$^w$* 'warm,' because faithful *ə*-less parses of these also violate PHONOTACTICS:

(24) Epenthesis for inputs without vowels

| | | PHONOTACTICS | DEPV | *NUC/ə |
|---|---|---|---|---|
| /nq$^w$/ | a. ☞nəq$^w$ | | * | * |
| | b. n̩q$^w$ | *!(cons. nucleus) | | |
| /tq/ | c. təq | | * | * |
| | d. tq | *!(no head) | | |

Why is schwa epenthesized rather than some other, less marked nucleus? The answer is provided by the theory of epenthesis outlined in §4.3.2: schwa may be the most marked nucleus in Lillooet, but it is the least marked epenthetic vowel, all other things being equal. The RECOVER constraints, which penalize all non-schwa epenthetic vowels, are ranked above all markedness constraints that might favor less marked nuclei, including *NUC/ə.

(25) Schwa is the least marked epenthetic vowel

| /nq$^{w}$-alc/ | REC/a | REC/e,o | REC/i,u | *NUC/ə | *NUC/i,u | *NUC/e,o |
|---|---|---|---|---|---|---|
| a. ☞nəq$^{w}$alc | | | | * | | |
| b. niq$^{w}$alc | | | *! | | * | |
| c. neq$^{w}$alc | | * | | | | * |
| d. naq$^{w}$alc | *! | | | | | |

If the input already contains a schwa and it is in the right place, it will be mapped to the output faithfully. If schwas can be deleted without violating PHONOTACTICS, they will be, because *NUC/ə dominates MAXV. Thus the form *təq* 'to touch' emerges with just one schwa in the middle even if it had three schwas underlyingly. The loser candidate that deletes all schwas and surfaces without a nucleus, **tq*, is ruled out by PHONOTACTICS.

(26) Deletion of schwas when not blocked by phonotactics

| /ətəqə/ | PHONOTACTICS | DEPV | *NUC/ə | MAXV |
|---|---|---|---|---|
| a. ☞ təq | | | * | ** |
| b. ətəqə | | | **!* | |
| c. tq | *!(no head) | | | *** |

It is not an accident that the middle schwa is preserved rather than, say, the last one. The clusters in the alternatives, **tqə* and **ətq*, are tolerated in Lillooet, so the fact that *təq* wins suggests the ranking *COMPLEX >>NOCODA. *COMPLEX itself is ranked below *NUC/ə, because clusters are generally permitted so long as they respect PHONOTACTICS. Despite its low ranking, *COMPLEX will select *təq* over **tqə* and **ətq*, since it dominates NOCODA.

This grammar is able to deal with inputs that have *too many* schwas as well as ones that have too few. The analysis is quite unlike Bobaljik's rule-based analysis of similar facts in Itelmen, which excludes schwa from underlying representations. The economy effect in the ROTB analysis arises because a violable output constraint (*NUC/ə) dominates MAXV; it is not a restriction on the input. Even if such a restriction existed, it is egregiously violated by output forms: schwas are abundant in the language, but their distribution is predictable and tied to phonotactics. The ROTB analysis directly captures this fact because schwa deletion is an active process that is blocked by phonotactics. On the other hand, in restricted input analyses, it is an accident that schwa is both the vowel banned from URs and inserted by rule—this point will be addressed again in §4.3.6.1.

One clarification is in order regarding the goals and assumptions of this analysis. Requiring the grammar to be able to map inputs like /ətəqə/ to *təq* does not amount to the claim that *təq* is underlyingly /ətəqə/. Richness of the Base is not a claim about underlying representations—it is an analytical assumption about how filter grammars work. The underlying representation for *təq* is a matter for the learner to sort out, and in Optimality Theory a strategy for that is called Lexicon Optimization (Prince and Smolensky 1993): the input should be such that it can be mapped to the output with a minimum of faithfulness violations. The input for *təq* could therefore be /təq/ or even /tq/; the important thing is that the grammar has a principled explanation for the why both **ətəqə* and **təqalk'əm* are absent in the output.

4.3.4.2 Other vowels

Consider now the other vowels of Lillooet. Neither *i*, *u*, nor *a* syncopate—their distribution is not predictable, nor are they ever epenthesized. For syncope, this means that MAXV dominates all constraints that might favor such deletion. These include *NUC/i,u, *MAR$_{FT}$/i,u, and *MAR$_{FT}$/a:

(27) The distribution of other vowels is unpredictable

| | | PHONO | *NUC/ə | MAXV | *NUC/i,u | *MAR/a | *MAR/i,u |
|---|---|---|---|---|---|---|---|
| /sutik/ | a. ☞sútik | | | | ** | | * |
| | b. stík | | | *! | * | | |
| /palaʔ/ | c. ☞pálaʔ | | | | | * | |
| | d. pláʔ | | | *! | | | |
| /sutik-ákaʔ/ | e. ☞sutikákaʔ | | | | ** | | ** |
| | f. stikákaʔ | | | *! | | | * |

Note that phonotactic constraints do not preclude deletion in these circumstances—clusters like #*st* and #*pl* are perfectly acceptable, as in *stut* 'cricket' and *plan* 'already.' There is no economy of vowels other than schwa because all the constraints that might favor such deletion are dominated by MAXV.

Something should be said about the effect of *NUC/x constraints on the vowel inventory of Lillooet. Peripheral mid vowels are not allowed in the language—recall that the core inventory contains schwa plus {i, u, a}. Mid vowels are marked with respect to the constraint *MID (Beckman 1998),[81] which can be seen as an entailment of Dispersion Theory of Flemming 1995. This constraint penalizes peripheral mid vowels but not high and low vowels or ə: mid vowels are insufficiently perceptually distinct from high and low vowels. With *MID undominated, the four vowels {i, u, a, ə} make it to the surface, and ə is permitted only when PHONOTACTICS require its presence.

Let us summarize the results. Schwa in Lillooet is "economized" (i.e., deleted) because it is a marked nucleus: *NUC/ə>>MAXV. It is also inserted wherever phonotactic constraints require: {PHONOTACTICS, REC/x}>>*NUC/ə. No other vowels are deleted because MAXV dominates other *NUC/x constraints, and no other vowels are inserted because REC/x constraints dominate *NUC/ə. These rankings are shown in the comparative tableau (28). The tableau shows how the grammar ensures that both inputs with a dearth (/tq/) and a profusion (/ətəqə/) of schwas are mapped to the appropriate winner, *təq*. Syncope applies when phonotactics permit, as in /təq-alk'-əm/ → *tqalk'əm*. In this grammar, there is also no such thing as too many full vowels: even though phonotactically possible, syncope does not apply to *sutik* and *palaʔ*. (I am ignoring hiatus here—hiatus is categorically banned in Lillooet, but it is unclear whether it is avoided through ʔ epenthesis or vowel deletion.)

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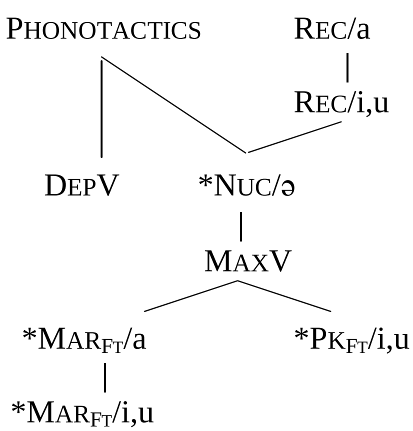
[81] This discussion entails that unlike *LOW and *NONLOW, *MID is not a *STRUC constraint—it is based on the harmonic scale *low, high ≻ mid*: "non-peripheral vowels are marked." It should be emphasized that context-free markedness constraints are not ruled out in the Lenient theory of CON—only constraints that penalize the least marked things on their harmonic scales are excluded. *LOW and *NONLOW are *STRUC constraints based on their relationship to the peripherality scale and the nucleus sonority scale.

(28) Cheap schwa in Lillooet

| /tq/ | PHONO | REC/x | *NUC/ə | MAXV | *NUC/i,u | *MAR$_{FT}$/a | *MAR/i,u |
|---|---|---|---|---|---|---|---|
| a. təq~tq | W | | L | | | | |
| b. təq~tiq | | W | L | | W | | |
| c. təq~taq | | W | L | | | | |
| /təq/ | | | | | | | |
| d. təq~tq | W | | L | W | | | |
| /ətəqə/ | | | | | | | |
| e. təq~ətəqə | | | W | L | | | |
| f. təq~tq | W | | L | W | | | |
| /təq-alk'əm/ | | | | | | | |
| g. tqalk'əm~təqalk'kəm | | | W | L | | | |
| /sutik/ | | | | | | | |
| h. sútik~stik | | | | W | L | | L |
| /palaʔ/ | | | | | | | |
| i. pálaʔ~plaʔ | | | | W | | L | |

The full ranking is diagrammed in (29).

(29)




This pattern might be described as "delete schwa where you can, insert schwa where you must." As stated earlier, however, not all vowels can have this distribution. This is discussed in the next section.

### 4.3.5 Some vowels never come cheap

The present analysis of schwa economy in Lillooet makes a prediction: only vowels on the less prominent end of the sonority scale can act as cheap vowels. It is impossible for *a* to be the only vowel of a language that behaves this way. The reason for this is that the very conditions necessary for *a*-epenthesis and syncope ensure that it cannot be the *only* syncopating vowel—as I show immediately below, no ranking of the sonority constraints is consistent with such a pattern.

The ranking necessary for *a*-epenthesis is shown in (30). Phonotactic constraints (e.g., sonority sequencing) require that the hypothetical /tikn/ map to *tikVn* rather than **tikn*. Epenthetic *a* is selected because it violates no *NUC/x constraints. *NUC/x constraints dominate the RECOVER constraints, which favor the losing candidates with epenthetic *ə* or *i*. Epenthesis in this context also violates *MAR$_{FT}$/a, because *a* is inserted into the weak branch of a foot. *MAR$_{FT}$/a is therefore ranked below *NUC/x.

(30) Insert *a* where required by phonotactics

| /tikn/ | PHONO | *NUC/ə | *NUC/i,u | *MAR$_{FT}$/a | REC/a | REC/i,u |
|---|---|---|---|---|---|---|
| a. tíkan~tikn | W | | | L | L | |
| b. tíkan~tíkən | | W | | L | L | |
| c. tíkan~tíkin | | | W | L | L | W |

The ranking necessary for differential syncope of just *a* cannot be consistent with (30). The only constraint that can favor differential syncope of *a* is *MAR$_{FT}$/a. For syncope, *MAR$_{FT}$/a (as well as IDENT[F] and the various constraints on footing) must dominate MAXV. But MAXV must also dominate all of the *NUC/x constraints, because they favor differential syncope of vowels other than *a*:

(31) Ranking for differential syncope of *a*

| | | PHONOTACTICS | $*\mathrm{MAR}_{FT}$/a | MAXV | *NUC/i |
|---|---|---|---|---|---|
| /takati/ | a. (tákti)~(táka)ti | | W | L | |
| /takiti/ | b. (táki)ti~(takti) | | | W | L |
| /takan/ | c. (tákan)~(takn) | W | L | | |

The ranking in (31) contradicts that of (30): *NUC/i must be ranked below $*\mathrm{MAR}_{FT}$/a for differential syncope of just *a* but above it for *a*-epenthesis. It is therefore impossible in this constraint system for *a* to be the a cheap vowel, i.e. the vowel that is epenthetic in all contexts as well as the sole vowel to syncopate.

It is possible for a language with *a*-epenthesis to have syncope, but syncope must affect either low sonority vowels only (as in Mekkan Arabic, §4.5) or all vowels (this is possibly the state of affairs in Coos—see Frachtenberg 1922).

### 4.3.6 Alternative analyses of schwa economy in Lillooet

The approach presented here differs from alternatives on several points: the source of economy effects, the expression of economy in the grammar, and predictions regarding the cross-linguistic inventories of cheap vowels.

#### 4.3.6.1 Constraints on the lexicon and economy

As was mentioned earlier, the traditional analysis of patterns like that of Lillooet is to exclude them from the inputs by imposing a restriction on the lexicon. The rule of vowel epenthesis then inserts the vowels in the necessary contexts. Bobaljik's (1997) analysis of an almost identical pattern of schwa distribution in Itelmen makes use of the following rule, which inserts schwa before a sonorant (R) that is separated from a vowel or a word boundary by any other consonant.

(32) $\varnothing \rightarrow \text{ə} / \left\{ \begin{array}{c} \mathrm{C} \\ \# \end{array} \right\} \_\_ \mathrm{R} \left\{ \begin{array}{c} \mathrm{C} \\ \# \end{array} \right\}$

Bobaljik's chief concern is different from the focus of this study—he is interested in explaining some peculiarities in the distribution of schwa in suffixes. Suffixation sometimes puts schwa in environments where its presence is not required by phonotactics. (He argues that only a cyclic approach can adequately account for the behavior of these suffixes.) Despite this difference in goals, the rule-based analysis can be compared with the ROTB analysis presented here.

Economy of schwa in the rule analysis is expressed in the lexicon: a constraint is imposed at that level of representation because the lexicon should not contain predictable information. Excluding predictable information from the lexicon is a reasonable goal, but the strategy of excluding schwa from underlying representations raises a question: is schwa the only vowel that can be thus excluded? As far as I know, there is no theoretical limit on such restrictions. Brainard 1994 proposes to exclude *ɨ* from the lexicon of Karao, since its distribution is entirely predictable. The vowel also predictably surfaces as *a* in some environments; yet *a* is not excluded from the lexicon in principle—only when it is "derived" from the banished *ɨ* by rule at some intermediate step. One could imagine the opposite situation, where *a* is banned from the lexicon and is inserted by rule where phonotactic constraints require:

(33) $\varnothing \rightarrow \mathrm{a} / \left\{ \begin{matrix} \mathrm{C} \\ \# \end{matrix} \right\} \_\_\_ \mathrm{R} \left\{ \begin{matrix} \mathrm{C} \\ \# \end{matrix} \right\}$

Something very much like this epenthesis process operates in Coos (de Lacy 2002a, Frachtenberg 1922), but the distribution of *a* in Coos is not otherwise predictable—i.e., underlying /a/ maps to surface [a] faithfully and is not deleted "wherever possible." If *a* can be banished from the lexicon, though, we would find a situation that is most likely unattested: *ə*, *i*, and *u* have an unpredictable distribution, whereas *a* is readily inserted and deleted whenever required by phonotactics.

Any restricted input analysis of cheap vowel patterns requires an adequate theory of markedness that delineates the range of things that can be banned from the input. As Lillooet shows, this theory must be separate and different from the theory of markedness that governs rules (Chomsky and Halle 1968:ch. 9). Since there is no theory of what can be excluded from the lexicon and what can be inserted by rule, restricted input analyses make overly rich predictions regarding cheap vowels. The present analysis argues that the real source of schwa economy is its markedness as a syllable nucleus, not a ban on the lexicon—from this it follows that the cheap vowel pattern can only be restricted to the least prominent vowels.

4.3.6.2 Featurelessness, markedness, and economy

Closely related to restricted input analyses is another approach to the behavior of schwa—the view that schwa is a special featureless vowel (see for example Browman and Goldstein 1992, van Oostendorp 1997, and many others). Under this view, one could claim that schwa is banned from the lexicon because input vowels must be specified for features, and it is inserted for the same reasons. The problem with this particular approach towards Lillooet is again the dual status of schwa in the language—it is both marked and unmarked. If the features that schwa is purported to lack are marked, then why do full vowels not lose them? Conversely, if they are unmarked, then why are they not inserted? Furthermore, there is plenty of evidence that schwa is not marked in all contexts—in the Salish language Lushootseed (see §4.6), schwa is actually both marked and unmarked depending on whether it is stressed. If featurelessness is equated with markedness (or unmarkedness), then the grammar requires an additional non-representational mechanism for dealing with the chameleonic markedness of schwa within and between languages.

Another well-known issue for featureless vowel theories is contrast. Several kinds of vowels have been claimed to be featureless: *ə, ɛ* (see Spaelti 1997), *ɨ*, and so on. Yet some languages contrast two or even all three of these vowels with each other—a feat impossible to achieve without some featural marking. Furthermore, claiming that unmarked segments are featureless can have broad and often undesirable consequences for the rest of the phonology, especially with regards to assimilation, spreading, and so on (see McCarthy and Taub 1992, Prince and Smolensky 1993, Pulleyblank 1998, Steriade 1995 and others for review and criticism).

Most relevant to the concern of this thesis is the claim inherent in the featureless schwa approach: that features are somehow marked while their absence is not. If features were indeed marked, then their removal is a kind of economy effect, since economy effects target only marked structure. This cannot be true in Lillooet—schwa is the only target of deletion, which means that it is the only vowel that violates a markedness constraint ranked above MAXV in the language. If features themselves were marked (rather than entire vowels in certain contexts), then their removal would be optimal—in other words, *a*, *i*, *u*, and other "full" vowels should reduce to schwa before anything deletes. The fact that *only* schwa deletes in Lillooet signals that this approach is inadequate.

#### 4.3.6.3 Economy constraints and differential syncope

The analysis of Lillooet in terms of *NUC/x and Recover constraints is not the only possible ROTB-compliant OT analysis of the Lillooet pattern. In this section, I review an economy constraint theory of differential syncope (Hartkemeyer 2000, Tranel 1999) and an economy constraint theory of epenthetic vowel quality (Lombardi 2003). The two theories must join forces to deal with the Lillooet pattern; neither is rich enough by itself. Once they are combined, however, their predictions are overly rich—the cheap vowel pattern is no longer limited to low-sonority vowels.

Hartkemeyer 2000 sketches out a theory of differential syncope that makes use of the economy constraint *V and a hierarchy of MAX constraints that protect vowels of different height:

(34) MAX-A>>MAX-E,O>>MAX-I,U

Tranel 1999 independently proposes a similar approach to schwa deletion in French, except that his hierarchy also includes a fourth constraint at the low-ranked end, MAX-SCHWA. Tranel even explicitly ties the hierarchy to Prince and Smolensky's ideas about syllable peak and margin markedness, and both authors argue that the ranking of these MAX constraints is fixed (see §4.4.5 for some arguments against such sonority-sensitive MAX constraints). Similar fixed hierarchies have been used by Casali 1996, Davis and Zawaydeh 1996, Pulleyblank 1998 and others. According to Hartkemeyer and Tranel, the quality of syncopating vowels in differential patterns depends on the ranking of the *STRUC constraint in (35). The language will have either non-differential syncope (1), differential syncope of {*ə, i, u, e, o*} (2), differential syncope of {*ə, i, u*} (3), differential syncope of *ə*, as in Lillooet (4), or no syncope at all, with the ranking in (5).

(35) MAX-A >> MAX-E,O >> MAX-I,U >> MAX-SCHWA

↑ ↑ ↑ ↑ ↑

(1) (2) (3) (4) (5)

This theory of differential syncope is insufficiently rich. There are languages where only low vowels delete (Lushootseed, §4.6) or only low and mid (Estonian, Georgian), which is the opposite of what is predicted by (35). If syncope in these latter grammars is also a response to economy principles, then the constraints in (35) must be freely permutable—otherwise additional mechanisms are needed.

This is only half the story, however, because schwa is not only the syncopating vowel but also the epenthetic vowel in Lillooet. Tranel and Hartkemeyer do not focus on the connection between epenthesis and syncope, so their theory of differential syncope needs to be supplemented with a theory of epenthesis.

4.3.6.4 Epenthesis and syncope in the “everything-is-marked” theory

Such a theory of epenthesis comes from a different implementation of economy in OT—the “everything-is-marked” theory. A recent exposition of this view of vowel markedness is Lombardi 2003. Lombardi’s concern is not with syncope but with epenthesis, but as Lillooet shows, the two are inextricably connected.

The theory of epenthesis Lombardi presents might be seen as an application of an approach to markedness and epenthesis developed by McCarthy and Prince 1994a in their analysis of Makassarese final consonant epenthesis. They note that of the two consonants permitted in coda position in Makassarese, *ʔ* and *ŋ*, *ʔ* is selected by *NASAL. *NASAL is low-ranked in the language but exerts its effects whenever faithfulness constraints cannot break the tie between two candidates, as is the case when the consonants are epenthetic. McCarthy and Prince propose that the identity of epenthetic material is determined by segmental markedness constraints. This is a development of an idea put forth by Prince and Smolensky (1993/2002:Chs 8,9) and Smolensky 1993: "...segmental markedness is defined by a family of constraints barring *every* feature. Their ranking with respect to each other may be universally fixed" (McCarthy and Prince 1994a:32, fn. 32, emphasis in the original). If the quality of epenthetic vowels is determined by markedness constraints, it follows that the markedness constraints must ban almost the entire range of vowel qualities, since practically any vowel can be epenthetic—moreover, some of these constraints must be freely rankable with respect to each other.

Under Lombardi's theory of epenthetic vowel quality, every vowel violates at least some constraint. The ranking of some of these constraints is universally fixed: *ROUND>>*NONROUND, *FRONT>>*BACK. Others are freely rankable, e.g. *LOW, *MID, and *NONLOW (Beckman 1998 similarly has *LOW and *HIGH freely ranked). The factorial typology of these constraints is supposed to derive the connection between the structure of vowel inventories and the choice of epenthetic vowel, though it is not obvious (and Lombardi does not show) how the inventories themselves are derived. In (36), I apply Lombardi's ranking to epenthetic schwa in Lillooet. Lombardi assumes that schwa is a back, nonlow vowel:

(36) Economy alternative: epenthetic schwa in the "everything-is-marked" theory

| /tq/ | *LOW | *NONLOW | *FRONT | *BACK |
|---|---|---|---|---|
| a. ☞təq | | * | | * |
| b. tiq | | * | *! | |
| c. taq | *! | | | * |

It is clear that these constraints cannot dominate MAXV in Lillooet. If they did, underlying *i* and *a* would syncopate just as *ə* does. As shown in (37), *NONLOW or

*BACK force the deletion of schwa by dominating MAXV, but they also incorrectly compel the deletion of a full vowel, *u* in *sutik*.

(37) Economy alterenative: Context-free markedness cannot dominate MAXV in Lillooet

| | | *LOW | *NONLOW | *FRONT | *BACK | MAXV |
|---|---|---|---|---|---|---|
| /sutik/ | a. ☞stik | | * | * | | * |
| | b. 💣sutik (actual) | | **! | * | *! | |
| /təq-alk'-əm/ | c. ☞tqalk'əm | | * | | * | * |
| | d. təqalk'əm | | **! | | **! | |

To maintain this theory of epenthesis, it is necessary to incorporate high-ranking constraints that offer special protection to the "marked" vowels, as in the *STRUC theory of Tranel and Harkemeyer. Tableau (38) presents this alternative in the comparative format. Ranking MAX-A and MAX-I,U above the context-free markedness constraints is a way to ensure that only schwa is undergoes deletion. Adding MAX to the analysis does not affect the evaluation of epenthetic vowels, so the results of (36) still stand unchanged.

(38) Economy alternative: context-free markedness plus faith to the marked; schwa syncope

| /sutik/ | MAX-A | MAX-I,U | *LO | *NLO | *FRNT | *BCK | MAX-ə |
|---|---|---|---|---|---|---|---|
| a. sutik~stik | | W | | L | | L | |
| /palaʔ/ | | | | | | | |
| b. palaʔ~plaʔ | W | | L | | | L | |
| /təq-alk'-əm/ | | | | | | | |
| c. tqalk'əm~təqalk'əm | | | | W | | W | L |

This analysis works for Lillooet: schwa is correctly selected as epenthetic and is the only vowel to syncopate. Nevertheless, breaking *STRUC(σ) up into *LOW, *NONLOW, *FRONT and *BACK destroys the predictions of Hartkemeyer's and Tranels' fixed hierarchy in (35). This constraint set is too rich—with *LOW and *NONLOW freely rankable, it is possible to produce some unattested patterns. One of these is depicted in

(39). This is the ranking for a language where *a* and *ə* syncopate *in all contexts* (as in (a) and (c)), *i* does not syncopate in any context (see (a)), and schwa is the epenthetic vowel (see (d) and (e)).

(39) Economy alternative: differential syncope of low vowels and schwa

| | | *LO | MAX-A | MAX-I,U | *NLO | *FRNT | *BCK | MAX-ə |
|---|---|---|---|---|---|---|---|---|
| /pitiki/ | a. pi.ti.ki~pit.ki | | | W | L | L | | |
| /pitaki/ | b. pit.ki~pi.ta.ki | W | L | | L | | | |
| /pitəki/ | c. pit.ki~pi.tə.ki | | | | W | | W | L |
| /pt/ | d. pət~pit | | | | | W | L | |
| | e. pət~pat | W | | | | | | |

The only difference between (39) and (38) is the permuted ranking of *LOW and MAX-A. *LOW assigns the same violations as the banished constraint *NUC/a, so its presence in CON would make the same predictions (see §4.2.2). Note that this result is unobtainable if the constraints against *a* are context-sensitive (e.g., *$\text{MAR}_{\text{FT}}$/a): they never favor deletion in all contexts, which is a hallmark of cheap vowels. This is a testable point of difference between the Lenient CON theory and the "everything-is-marked" theory: if patterns like (39) exist, the theory presented here will be shown to be insufficient.

Examining this constraint set further reveals another pattern that the "everything-is-marked" theory can produce but the Lenient CON theory cannot. The pattern is depicted in (40). Here, *i* and *a* syncopate in all contexts, while *ə* does not. Schwa is also the epenthetic vowel. This is a pattern where *ə* is the only vowel whose distribution is unpredictable from the phonotactics, since it never syncopates.

(40) Economy alternative: differential syncope of everything but schwa

| | | *FRNT | *LO | MAX-A | MAX-I,U | MAX-ə | *NLO | *BCK |
|---|---|---|---|---|---|---|---|---|
| /pitiki/ | a. pit.ki~pi.ti.ki | W | | | L | | W | |
| /pitaki/ | b. pit.ki~pi.ta.ki | | W | L | | | | W |
| /pitəki/ | c. pi.tə.ki~pit.ki | | | | | W | L | W |
| /pt/ | d. pət~pat | | W | | | | L | |
| | e. pət~pit | W | | | | | | L |

This pattern is impossible in the theory with Lenient *NUC/x, *MAR$_{FT}$/x and *PK$_{FT}$/x constraints: there are no constraints that assign violation marks to *i* and *a* in all contexts. Low vowels are only marked in the margin of a foot, and all rankings that imply markedness of *i* also imply the markedness of *ə*.

Let us summarize the argument. Differential syncope and epenthesis in Lillooet are two sides of the same coin, so any theory of differential vowel behavior must be rich enough to account for this pattern. The unadulterated *STRUC(σ) theory with sonority-specific MAXV constraints (Hartkemeyer 2000, Tranel 1999) can account for the differential syncope of schwa, but it requires additional mechanisms to explain *ə*-epenthesis. Theories of epenthetic vowel quality, however, need to be quite rich to match the wide range of epenthetic vowels observed cross-linguistically. Sonority-specific MAXV constraints must be supplemented with something like Lombardi's (2003) theory, which is also very much in the spirit of economy: every structure violates at least one constraint. While this combined approach offers a workable analysis of Lillooet, its typological predictions are too rich.

The "everything-is-marked" analysis shares a property with the rule-based analyses that impose restrictions on the lexicon. Both approaches lack a principled theory of what it means for a vowel to be marked. While the "everything-is-marked" analysis relies on markedness, it is so arbitrary as to almost reject the very notion. Restrictions on the lexicon also have a somewhat arbitrary flavor—if any vowel of the set {ə, i, e, a} can be epenthetic cross-linguistically, then why is it that only *ə* can be excluded from underlying representations? If *ə* is not the only vowel, then any vowel can be cheap in the rule-based account, and this is not what we find cross-linguistically.

### 4.3.7 Summary

To conclude, this section examined a pattern of syncope/epenthesis that can be described as "delete where you can, insert where you must." This behavior is characteristic of low-sonority vowels only: while *ə, ɨ,* and *i* are treated as cheap vowels by some languages, *a* never is. Nor is this pattern equivalent to syllable economy—if anything, this is economy of schwa. CON does not contain any economy constraints such as *STRUC(σ), *NUC/a, or context-free markedness constraints such as *LOW, and *NONLOW. There are constraints that may favor the deletion of low-sonority vowels in all contexts (e.g., *NUC/ə) but there are no constraints that favor context-free deletion of low vowels or all vowels.

It should be emphasized that the prediction does not go in the other direction: it is not the case that deletion of low-sonority vowels is always pervasive and blocked only by phonotactic constraints. Schwa deletion need not look like the Lillooet pattern at all. A much-discussed example of schwa deletion that is clearly not motivated by avoidance of schwa in all contexts is found in Central Alaskan Yupik (Gordon 2001, Hayes 1995, Jacobson 1985, McCarthy 1986, Miyaoka 1985, Woodbury 1987).

In Central Alaskan Yupik, schwa is banned from open stressed syllables, but it is allowed to surface faithfully in closed stressed syllables or in unstressed ones (see (41)). In the language's iambic stress system, stressed syllables are required to be heavy, and this requirement is normally satisfied by vowel lengthening (see (a)). When schwa occurs in the same position where other vowels lengthen, it deletes instead (cf. (a) and (a) or (c)). An interesting twist is that deletion is blocked between identical consonants (this is known as "antigemination"—see McCarthy 1986). In these cases, the consonant following schwa geminates instead (see (d)). All of these processes conspire to ensure that the stressed syllable is heavy while long schwa never emerges in the language.

(41) Central Alaskan Yupik schwa syncope (data from Miyaoka 1985)

| | | | | |
|---|---|---|---|---|
| a. | /jaquləcuaχ/ | (ja.qúː)(lə.cúaχ) | 'small bird' | *(jaqúl)(cúaχ) |
| b. | /qanʁutəkaː/ | (qán)(ʁút)kaː | 'he talks about it' | *(qán)(ʁu.tə́ː)kaː |
| c. | /atə-pik/ | (át)pik | 'real name' | *(atə́p)pik |
| d. | /atə-təŋ/ | (atə́t)təŋ | 'their own names' | *(át)təŋ |

Gordon 2001 analyzes this pattern as an interplay of SWP and the prohibition on long schwa, both generally obeyed in Central Alaskan Yupik. The context for schwa deletion is clearly metrical: schwa does not delete if it can head the weak branch of a foot (cf. (ja.qúː)(lə.cúaχ) ~*(ja.qúl)(cúaχ)), only when it must be in the strong branch. Schwa cannot lengthen, nor can consonant gemination be used unless compelled by the OCP. This is not economy of syllables or schwa: in fact, most of the time the requirement for stressed syllables to be heavy is satisfied by augmentation (vowel lengthening or gemination) rather than deletion. Economy effects are not in any way special—they are just one way out of several to satisfy the language's markedness constraints.

The next section examines a pattern that resembles metrical syncope—the combined effect of *NUC/i and metrical constraints.

## 4.4 Lebanese Arabic: a differential/metrical hybrid

High vowel nuclei are marked in all contexts with respect to *NUC/i,u, but this doesn't mean that their distribution is always determined by phonotactic constraints. Thus in the grammar of Lebanese Arabic, the constraint ranking selects only those forms that satisfy its foot structure requirements while containing a minimal number of marked high vowel nuclei. The resulting pattern seems to be governed by avoidance of short high vowels in open syllables, but as we will see, this is just a superficial impression. No special constraint against short high vowels in open syllables is necessary—the pattern emerges from the interaction of *NUC/x with prosodic constraints PARSE-σ, SWP, and NONFINALITY. The same general constraints that were seen to be active in Hopi, Tonkawa, and Lillooet account for the pattern of high vowel deletion in Lebanese. To put it another way, constraints need not be *too* context-specific for their interaction to produce intricate patterns.

The next subsection presents the stress pattern of Lebanese Arabic—stress crucially interacts with high vowel syncope, so I will look at stress first. The interaction of syncope and prosody is analyzed in §4.4.2 and §4.4.3, and epenthesis is addressed in §4.4.4.

### 4.4.1 The patterns

The following descriptions of Lebanese Arabic and data are drawn from Haddad 1984. Lebanese Arabic has three short [i, u, a] and three long [ii, uu, aa] vowels. Mid vowels also surface in a few restricted contexts, such as word-finally in nouns and adjectives after non-emphatic consonants (*maktabe* ‘library’). Medial syllables can be CVV, CVVC, CVC, or CV. Initial and final syllables can also be CCV... and ...VCC, respectively. CVC and CVV syllables count as heavy in the assignment of stress, which is described and exemplified in the next section.

#### 4.4.1.1 Stress

Stress in Lebanese Arabic is similar to that of Latin (Mester 1994), with the added complication involving the behavior of trimoraic, or “superheavy” syllables. Superheavy syllables (CVVC or CVCC) are special in that they bear main stress in final position, which other syllables cannot do. Stress is on the penult if the penult is heavy (CVV or CVC) and on the antepenult otherwise.[82]

(42) Stress final superheavy

| | | |
|---|---|---|
| a. | ʔa.kált | ‘I ate’ |
| b. | naz.zált | ‘I brought down’ |
| c. | naa.zált | ‘I encountered’ |
| d. | sa.ʔa.lúuk | ‘they asked you’ |
| e. | bi.xal.líik | ‘he lets you’ |
| f. | mak.ta.báat | ‘libraries’ |
| g. | ʕal.lam.náak | ‘we taught you’ |

(43) Otherwise stress penult if heavy

| | | |
|---|---|---|
| a. | náz.zal | ‘he brought down’ |
| b. | náa.zal | ‘he encountered’ |
| c. | ma.ʕáa.rik | ‘battles’ |
| d. | mak.táb.ti | ‘my library’ |

[82] I ignore emphasis in the transcriptions; Haddad’s spelling conventions are modified as follows: his “c” is replaced by “š,” “9” is replaced by “ʕ,” “ɦ” is replaced by “ħ.”

(44) If penult is light, stress antepenult except in disyllables

a. ʔá.ka.lit 'she ate'
b. sá.ħa.bit 'she withdrew (tr.)'
c. mák.ta.be 'library'
d. sá.ħab 'he withdrew'
e. ʔá.kal 'he ate'

Lebanese Arabic words never have more than three light syllables in a row at the end (for reasons having to do with syncope, discussed in the next section). In the Lebanese pronunciations of Classical Arabic words, though, main stress tends toward the antepenult (Haddad 1984):

(45) Antepenultimate stress in Lebanese pronunciations of Classical words

a. da.rá.ba.na 'he hit us'
b. ša.já.ra.tun 'a tree'
c. saw.má.ʕa.tun 'a hermitage'
d. yuz.ʕí.ju.na 'he annoys us'

These patterns can be summarized as in (46). A trochaic foot (LL, HL or H) is built that encompasses the penult, except when the ultima is superheavy (S).

(46) Stress assignment in Lebanese Arabic

a. ...(Ĺ L)σ#, (H́ L)σ# antepenult
b. ...(H́)σ# penult
c. ...(Ś)# ultima

Although secondary stress has not been reported for Lebanese Arabic, the indications are that footing is iterative. I will return to this in §4.4.2.1.

#### 4.4.1.2 <u>Syncope</u>

High vowels delete in several environments. First, as in all modern Arabic dialects, deletion applies to medial vowels flanked by single consonants. Deletion does not apply to low vowels here—compare (47) and (48).

(47) Syncope in the two-sided open syllable environment

| | | | | |
|---|---|---|---|---|
| a. | /nizi̲l-it/ | níz.lit | ‘she descended’ | cf. ní.zil ‘he descended’ |
| b. | /saaħib-i̲t-uu/ | saa.ħíb.tu | ‘his friend’ | cf. sáa.ħib ‘friend’ |
| c. | /saaħib-it-na/ | saaħ.bít.na | ‘our friend’ | cf. sáa.ħib ‘friend’ |
| d. | /ʔibi̲n-ii/ | ʔíb.ni | ‘my son’ | cf. ʔí.bin ‘son’ |
| e. | /bagi̲l-ii/ | bág.li | ‘my mule’ | cf. bá.gil ‘mule’ |

(48) No syncope of /a/ in the same environment

| | | | | |
|---|---|---|---|---|
| a. | /ʔakal-it/ | ʔá.ka.lit | ‘she ate’ | *ʔák.lit |
| b. | /saħab-it/ | sá.ħa.bit | ‘she withdrew (tr.)’ | *saħ.bit |

High vowels delete not only in the environment shown in (47)—the first vowel of the word can also syncopate, as shown in (49). Despite this, there is a restriction on the application of syncope to the first vowel of the word—deletion cannot result in stress on the last syllable (unless the last syllable is already superheavy), so if there are only two vowels underlyingly, they must both surface.

(49) Limits on syncope of /i/ in open initial syllables

| | | | | |
|---|---|---|---|---|
| a. | /ni̲zil-t/ | nzílt | ‘I descended’ | |
| b. | /nizil/ | nízil | ‘he descended’ | *nzíl |
| c. | /fi̲him-na/ | fhímna | ‘we understood’ | |
| d. | /fihim/ | fíhim | ‘he understood | *fhím |
| e. | /nisi/ | nísi | ‘he forgot’ | *nís, *nsí |

The low vowel does not syncopate in this environment, as shown in (50).

(50) No syncope of /a/ in open initial syllables

| | | | | |
|---|---|---|---|---|
| a. | /xazaʔ-t/ | xazáʔt | ‘I tore’ | *xzáʔt |
| b. | /katab-t/ | katábt | ‘I wrote’ | *ktábt |

Syncope also never deletes long high vowels, which may occur in positions from which short high vowels are prohibited, such as medial open syllables.

(51) No deletion of long high vowels

| | | |
|---|---|---|
| a. jaríide | 'paper' | *jar.de |
| b. ʕaríida | 'wide' | *ʕar.da |

To summarize, high vowel syncope deletes short high vowels in open syllables, as long as deletion does not result in final stress.

### 4.4.2 Analysis of stress pattern

I claim that high vowels delete in Lebanese Arabic for non-metrical reasons—deletion reduces the number of marked high vowel syllable nuclei. Whether deletion does or does not apply depends on metrical factors, as Haddad (1984) rightly notes. I will start therefore by analyzing the stress system and then showing how various aspects of high vowel deletion follow from it.

#### 4.4.2.1 <u>Stress assignment and iterative footing</u>

Stress in Lebanese Arabic is assigned on the basis of the trochaic foot. I will assume that footing is iterative, despite the absence of secondary stress. First of all, it is frequently assumed that secondary stress is not a necessary correlate of footing; thus McCarthy 1979 assumes iterative feet in his analysis of main stress placement in Cairene Arabic and Hayes 1995 does the same for tone in Seminole Creek. (See also Hall 2001 for a covert footing analysis of Southeastern Tepehuan.)

Second, there is evidence for iterative footing in Lebanese Arabic that comes from the distribution of long vowels. According to Haddad 1984, they may occur in stressed or unstressed syllables but they never occur in word-final open syllables. Since word-final open syllables are never stressed, this is the only environment where long vowels cannot be foot heads:

(52) Long vowels barred from final syllables

| | | | | | |
|---|---|---|---|---|---|
| a. | /darab-uu/ | dá.ra.bu | ‘they hit’ | cf. darab-úu-hun | ‘they hit them’ |
| b. | /ħamal-na/ | ħá.ma.lna | ‘we neglected’ | cf. ħamal-náa-š | ‘we didn’t neglect’ |
| c. | /saʔal-t-uu/ | sá.ʔal.tu | ‘you asked’ | cf. saʔal-t-úu-hun | ‘you asked them’ |

Haddad 1984 considers some arguments for the underlying representation of these suffixes and chooses to analyze these vowels as underlyingly short, assuming that they lengthen when followed by clitics like *–hun* and *–š* (Broselow 1976 also assumes this for Cairene Arabic, though Abu-Mansour 1987 takes the opposite stand for Mekkan—see §4.5). For an OT analyst, the absence of long vowels in final syllables (regardless of any alternations) points to a real generalization about the phonology of Lebanese Arabic: long vowels cannot occur word-finally. A final open syllable is never stressed or long, so whether it shortens in the last syllable or lengthens before clitics should follow from the analysis. If iterative footing is assumed, then the environment for shortening in this dialect is straightforward—any non-final long vowel can be parsed into a foot of its own except for the last one, which must undergo shortening. (See the analysis of Tonkawa in chapter 3 for a similar argument for iterative footing from the distribution of long vowels.)

4.4.2.2 Foot shape and placement

Foot shape is determined by the interaction of the following constraints:

(53) RHTYPE=TROCHEE: “Feet do not begin in unstressed syllables.”

(54) RHTYPE=IAMB: “Feet do not end in unstressed syllables.”

(55) FTBIN: “Feet are binary at the moraic or syllabic level.” (Prince and Smolensky 1993)

*Harmonic scale*: $\begin{array}{c}\text{Ft}\\ /\backslash\\ \sigma\ \sigma\end{array}, \begin{array}{c}\text{Ft}\\ |\\ \sigma_{\mu\mu}\end{array} \succ \begin{array}{c}\text{Ft}\\ |\\ \sigma_{\mu}\end{array}$

Foot placement is determined by the ENDRULE constraints, PARSE-σ, the NONFINALITY constraints, and $\text{WSP}_{\mu\mu\mu}$, which are defined as follows:

(56) $\text{WSP}_{\mu\mu\mu}$: “No unstressed trimoraic syllables.”
*Harmonic scale*: $\breve{\sigma}_{\mu} \succ \breve{\sigma}_{\mu\mu} \succ \breve{\sigma}_{\mu\mu\mu}$

(57) NONFINALITY(FT): “The head foot of the PrWd is not word-final.” (P&S:45)

(58) NONFINALITY(σ): “The head of the PrWd does not fall on the word-final syllable.” (P&S:42)

*Harmonic scale*: $\sigma\#/\overset{\overset{\text{PrWd}}{|}}{\underline{\quad\ }} \succ \sigma\#/\overset{\overset{\text{HdFt}}{|}}{\underline{\quad\ }} \succ \acute{\sigma}\#$ (“/” = directly dominated by)

As can be seen from the definitions in (57) and (58), the NONFINALITY constraints are in a stringency relationship. Whenever NONFIN(σ) is violated, so is NONFIN(FT): if the head of the prosodic word falls on the word-final syllable, that syllable is footed. A form can violate NONFINALITY(FT) without violating NONFINALITY(σ), however:

(59) NONFINALITY constraints

| | NONFINALITY(σ) | NONFINALITY(FT) |
|---|---|---|
| a. ...(σσ́) | * | * |
| b. ...(σ́σ) | | * |
| c. ...(σ́σ)σ | | |

Feet in Lebanese Arabic are prominence-initial (trochaic), which indicates that RHTYPE=TROCHEE dominates RHTYPE=IAMB:

(60) Feet are trochaic

| /ʔakal-it/ | RHTYPE=TROCHEE | RHTYPE=IAMB |
|---|---|---|
| a. ☞(ʔá.ka)lit | | * |
| b. (ʔa.ká)lit | *! | |

Feet are built iteratively, with main stress falling on the rightmost foot. This is the result of high-ranking PARSE-σ, which dominates ENDRULE-L (ENDRULE constraints are discussed in chapter 3). ENDRULE-L demands that the main stress foot be the first foot of the word (even if it does not encompass the first syllable), and the main stress foot is not the first foot of the word in the winner *(màk)(táb)ti*. ENDRULE-L is also ranked below ENDRULE-R, which requires that the main stress foot be the last foot of the word. This can be seen from the failure of **(mák)(tàb)ti*.

(61) Footing is iterative; main stress is on the rightmost foot

| | ENDRULE-R | PARSE-σ | ENDRULE-L |
|---|---|---|---|
| a. ☞(màk)(táb)ti | | * | * |
| b. mak(tàb)ti | | **! | |
| c. (mák)(tàb)ti | *! | * | |

So, footing is iterative and trochaic, with the main stress falling on the rightmost foot.

#### 4.4.2.3 The role of NONFINALITY

The NONFINALITY constraints play a central role in the phonology of Lebanese Arabic. As a result of their high ranking, the last syllable is left unfooted, which also sometimes leads to stress lapses, as in *(sáħa)bit*. NONFINALITY(FT) must therefore dominate all the constraints that might favor final footing, such as *LAPSE, $\mathrm{WSP}_{\mu\mu}$, and

PARSE-$\sigma_{FINAL}$ (not shown). Its less stringent cousin NONFINALITY(σ) must also be ranked at least above $WSP_{\mu\mu}$.

(62) The foot and the stressed syllable cannot be word-final

| | NONFINALITY(σ) | NONFINALITY(FT) | *LAPSE | $WSP_{\mu\mu}$ |
|---|---|---|---|---|
| a. ☞(sáħa)bit | | | * | * |
| b. sa(ħábit) | | *! | | * |
| c. (sáħa)(bít) | *! | * | | |

In words with four light syllables, as in the Lebanese pronunciation of the Classical Arabic word *da(rá.ba)na*, it is only possible to build a single foot without violating NONFINALITY(FT); **(dára)(bána)* is impossible. I'll assume that the placement of the single foot is determined by *LAPSE, which must be ranked above all the constraints that might favor initial footing, e.g., PARSE-σ1 (a.k.a. ALIGN-L(Wd, Ft). See Chapter 3 and McCarthy to appear).

(63) Antepenultimate stress as avoidance of lapses

| | *LAPSE | PARSE-σ1 |
|---|---|---|
| a. ☞da(rá.ba)na | * | * |
| b. (dá.ra)ba.na | ** | |

The prohibitions against footing and stressing the last vowel of the word are violated under some circumstances, e.g., when the last syllable is superheavy. The undominated $WSP_{\mu\mu\mu}$ requires that such syllables be stressed even if final.[83]

[83] $WSP_{\mu\mu\mu}$ does not insist that every superheavy syllable bear *main* stress—only that it be the head of a foot. Words with non-final superheavy syllables can have main stress on other syllables, as long as the superheavy is footed: *(saaħ)(bít)na* 'our friend.'

(64) Trimoraic syllables are stressed even when final

| | $WSP_{\mu\mu\mu}$ | NONFINALITY(σ) | NONFINALITY(FT) |
|---|---|---|---|
| a. ☞(ʕal)(lam)(náak) | | * | * |
| b. ʕal(lám)naak | *! | | |

The last syllable must also be footed if the word is only two syllables long, where violation of NONFINALITY(FT) is required by the constraint FTBIN, which disallows feet of the shape (CV).

(65) Disyllables are exhaustively footed

| | FTBIN | NONFINALITY(FT) |
|---|---|---|
| a. (ʔá.kal) | | * |
| b. (ʔá)kal | *! | |

Thus the NONFINALITY constraints are obeyed except when there is a danger of leaving a superheavy syllable unfooted or having to build a monadic foot.

4.4.2.4 <u>Summary of the analysis of stress</u>

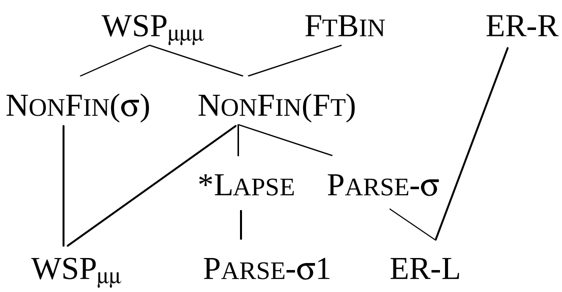
To summarize, consider the tableau below, which shows the entire stress system. Only trochaic candidates are included in the tableau, so RHTYPE=TROCHEE and RHTYPE=IAMB are left out. $WSP_{\mu\mu}$ has also been left out to save space—keep in mind that it is violated in cases where the last syllable of the word is a closed heavy (e.g., *ʔá.kal* or *(sáħa)bit*).

NONFINALITY(σ) is also left out of (66)—it agrees with the more stringent NONFINALITY(FT) on most of the comparisons.

(66) Stress in Lebanese Arabic

| | FtBin | $WSP_{\mu\mu\mu}$ | ER-R | NFin(Ft) | *Lapse | Parse-σ | ER-L |
|---|---|---|---|---|---|---|---|
| a. (màk)(táb)ti~(mák)(tàb)ti | | | W | | | | L |
| b. (màk)(táb)ti~mak(táb)ti | | | | | | W | L |
| c. (màk)(táb)ti~(mák)tab.ti | | | | | W | W | L |
| d. (sáħa)bit~sa(ħá.bit) | | | | W | L | | |
| e. (sáħa)bit~(sàħa)(bít) | | | | W | L | L | L |
| f. da(rába)na~(dára)ba.na | | | | | W | | |
| g. da(rába)na~(dàra)(bá.na) | | | | W | | L | W |
| h. ʔa(kált)~(ʔá.kalt) | | W | | L | | L | |
| i. (ʔá.kal)~(ʔá)kal | W | | | L | | | |

(67) Rankings for stress




NonFinality constraints play a key role in the ranking in (67): they are obeyed at the expense of less-than-exhaustive footing and stress lapses and violated only in a few select circumstances. We will see more evidence of their activity in the analysis of syncope.

### 4.4.3 Analysis of syncope: prosodically constrained economy of marked nuclei

#### 4.4.3.1 <u>The basic pattern: deletion as avoidance of high vowel nuclei</u>

High vowels have the lowest sonority in the vowel inventory of Lebanese Arabic. Recall that the vowel inventory of Lebanese does not even contain schwa—this indicates that *Nuc/ə is undominated. In the absence of alternations, it is not possible to say whether input schwas map to ∅, *i*, *u*, or *a*—schwas are avoided in one way or another.

This means among other things that epenthetic vowels cannot surface as schwa; I will return to this in §4.4.4.

High vowels are allowed to surface sometimes, so *NUC/i,u must be dominated by other constraints. The fact that high vowels syncopate at all suggests that *NUC/i,u dominates MAXV. *NUC/i,u cannot wipe out all high vowels because it is crucially dominated by other constraints. The most important of these is NONFINALITY(FT), but SWP and PARSE-σ play a role in determining the site of deletion as well. This is a hybrid syncope system: high vowels are deleted because they are marked nuclei, but the output respects higher-order prosodic constraints.

The ranking *NUC/i,u>>MAXV is shown in (68). The deletion candidate *niz.lit* in (68) violates *NUC/i,u only twice, i.e., to a lesser extent than the faithful loser **ni.zi.lit*.

(68) High vowel syncope reduces the number of marked nuclei

| /nizil-it/ | *NUC/i,u | MAXV |
|---|---|---|
| a. ☞niz.lit | ** | * |
| b. ni.zi.lit | ***! | |

The winner in (68) still violates *NUC/i,u twice. The alternatives such as *nzilt* are phonotactically legal in Lebanese Arabic, and yet *nzilt* loses. The reason for this is NONFINALITY, discussed in the next section.

Low vowels do not undergo syncope. They do not violate any *NUC constraints, and all the constraints that might favor their deletion are ranked too low to matter (see § 4.4.3.3).

(69) No deletion of high-sonority nuclei

| /ʔakal-it/ | *NUC/i,u | *NUC/e,o | MAXV |
|---|---|---|---|
| a. ☞ʔá.ka.lit | * | | |
| b. ʔá.k.lit | * | | *! |

Long high vowels are immune to deletion as well (the relevant facts are repeated in (70).

(70) No deletion of long high vowels

a. ja(ríi)de ‘paper’ *(jár)de
b. ʕa(ríi)da ‘wide’ *(ʕár)da

Long high vowels violate *NUC/i,u just as short high vowels do, but their deletion is blocked by the undominated MAXLONGV, just as in Tonkawa. I will return to the behavior of long vowels in §4.4.3.3.

This story is incomplete, of course, because it does not explain why any short high vowels at all manage to surface in Lebanese Arabic. The next section addresses this.

4.4.3.2 Prosodic constraints and the locus of deletion

*NUC/i,u differs from other constraints that have economy effects, e.g., SWP and PARSE-σ, in that it is completely indifferent to the site of deletion. In this it is somewhat like *STRUC(σ), since it even has a limited ability to count syllables. The ability is limited because only syllables with high vowel nuclei are counted—*NUC/i,u is particular in a way that *STRUC(σ) is not. In Lebanese Arabic, the relatively context-free demands of *NUC/i,u are curtailed by prosodic constraints.

The first of these requirements is a central one in Lebanese Arabic—NONFINALITY. When the choice is between high vowel nuclei or footing the last syllable, high vowel nuclei are tolerated. For example, /nizil-it/ maps to *níz.lit*, not **nzilt*, even though *nzilt* is a legal form of the language—it is the output for the input */nizil-t/*. This is because deletion of more than one vowel in the former case must result in final stress:

(71) Deletion does not result in final stress

| /nizil-it/ | NONFINALITY(FT) | *NUC/I,U | MAXV |
|---|---|---|---|
| a. ☞(níz)lit | | ** | * |
| b. (nzílt) | *! | * | ** |

A third candidate not included in (71) is one that deletes the first vowel, *nzí.lit*. It is also in principle a possible word in Lebanese Arabic, both in terms of syllable and foot structure—cf. *ʔá.kal* and *nzílt*. It fails because there are better options in terms of foot structure. Recall that penultimate stress is tolerated only when FTBIN requires it. Because FTBIN dominates NONFINALITY(FT), the last syllable be footed in disyllables that begin in L, ruling out **(nzí)lit*, and *(nzí.lit)* performs worse on NONFINALITY(FT) than the candidate that deletes the second vowel. All three candidates are tied on *NUC/i,u and MAXV.

(72) Deleting the second vowel creates optimal foot structure

| /nizil-it/ | FTBIN | NONFIN(FT) | PARSE-σ |
|---|---|---|---|
| a. ☞(níz)lit | | | * |
| b. (nzí.lit) | | *! | |
| c. (nzí)lit | *! | | |

Forms with two underlying vowels, e.g. /nizil/, do not undergo syncope. Syncope in such words turns things from bad to worse: the faithful parse *(ní.zil)* already violates

NONFINALITY(FT) by footing the last syllable, while the syncope candidate[84] *(nzíl)* not only foots but stresses the last syllable, incurring violations of both NONFINALITY(FT) and NONFINALITY(σ). NONFINALITY(σ) must therefore also dominate *NUC/i,u: deletion of high vowels does not result in final stress.

(73) Deletion cannot create final stress

| /nizil/ | NONFINALITY(σ) | NONFINALITY(FT) | *NUC/i,u | MAXV |
|---|---|---|---|---|
| a. ☞(ní.zil) | | * | ** | |
| b. (nzíl) | *! | * | * | * |

This analysis predicts that given an input that ends in a superheavy sequence (VVC# or VCC#), syncope should proceed—the violation of NONFINALITY(FT) is unavoidable even in a faithful parse, so it is possible to remove additional high vowels. The winner *(nzílt)* and the faithful loser **ni(zílt)* both violate NONFINALITY(FT) and so the decision between them is passed on to *NUC/i,u, which selects the monosyllabic candidate.

(74) If the superheavy syllable is already there, deletion proceeds

| /nizil-t/ | NONFINALITY(σ) | NONFINALITY(FT) | *NUC/I,U | MAXV |
|---|---|---|---|---|
| a. ☞(nzílt) | * | * | * | * |
| b. ni(zílt) | * | * | **! | |

The same ranking selects syncope in situations where both the syncopating and the faithful candidates satisfy NONFINALITY; thus /fihim-na/ → *(fhím)na*, not **fi(hím)na*.

[84] A candidate like **nizl* is as ill-formed as **nzil* with respect to NONFINALITY, and it incurs an additional violation of sonority sequencing constraints, which are high-ranked in Lebanese Arabic (Haddad 1983, 1984).

Thus the NONFINALITY constraints impose a limit on high vowel deletion, but deletion is allowed to proceed when it does not worsen the performance on the constraints. This result is summarized in the comparative tableau in (75).

(75) NONFINALITY and high vowel syncope

| | | WSP$_{\mu\mu\mu}$ | FTBIN | NF(σ) | NF(FT) | *NUC/i,u | MAXV |
|---|---|---|---|---|---|---|---|
| /nizil-t/ | a. (nzílt)~ni(zílt) | | | | | W | L |
| | b. (nzílt)~(ní)zilt | W | W | L | L | W | L |
| /nizil-it/ | c. (níz)lit~(ní.zi)lit | | | | | W | L |
| | d. (níz)lit~(nzílt) | | | W | W | L | W |
| /nizil/ | e. (nízil)~(nzíl) | | | W | | L | W |
| | f. (nízil)~(ní)zil | | W | L | | | |

This intricate pattern is due to the interaction between *NUC/i,u and the prosodic constraints, all of which have independent effects in the language. NONFINALITY not only determines the outcome of syncope in /nizil-it/; it also affects stress and footing. WSP$_{\mu\mu\mu}$ and FTBIN likewise have effects on more than the syncope process. Economy effects do not exist in a vacuum—they are the result of complex constraint interaction.

4.4.3.3 <u>The role of PARSE-σ and SWP</u>

There is an alternative to the *NUC/i,u analysis, of course. Comparing the syncope forms with their more faithful competitors reveals that the winners often satisfy the familiar metrical constraints SWP and PARSE-σ better: *(nzílt)* improves on *ni(zílt)* in terms of exhaustive footing, and *(níz)lit* improves on *(ní.zi)lit* in having a heavy stressed syllable. This alternative is sketched in the following tableau.

(76) The metrical alternative

| | | SWP | NONFIN(FT) | PARSE-σ | MAXV |
|---|---|---|---|---|---|
| /nizil-t/ | a. (nzílt)~ni(zílt) | | | W | L |
| /nizil-it/ | b. (níz)lit~(ní.zi)lit | W | | | L |
| | c. (níz)lit~(nzílt) | | W | L | W |

The problem with this story is that it is only half true. If SWP and PARSE-σ dominated MAXV, we would expect to see the low vowel deletion in these contexts, and such deletion is patently absent—witness /ʔakal-it/ → *(ʔá.ka)lit*, not **(ʔák)lit*, and /katab-t/ → *ka(tábt)*, not **(ktábt)*. PARSE-σ and SWP must be ranked below MAXV in Lebanese Arabic, as shown in the following two tableaux:

(77) Light stressed syllables tolerated

| /ʔakal-it/ | MAXV | SWP |
|---|---|---|
| a. ☞(ʔáka)lit | | * |
| b. (ʔák)lit | *! | |

(78) Unfooted syllables tolerated

| /katab-t/ | MAXV | PARSE-σ |
|---|---|---|
| a. ☞ka(tábt) | | * |
| b. (ktábt) | *! | |

The failure of *a* to syncopate in these cases is not necessarily a devastating criticism of the PARSE-σ/SWP analysis of Lebanese Arabic—it could be the case that MAX-V is a hierarchy of constraints sensitive to sonority, where more sonorous vowels receive special protection from deletion (see §4.3.6.3). In §4.4.5 I provide some arguments against such constraints.

The output of high vowel syncope sometimes satisfies SWP and PARSE-σ better than the faithful alternatives might, but this is just an accident. High vowel syncope in Lebanese Arabic only looks metrical because some metrical constraints are ranked above *NUC/i,u.

Despite being dominated by MAXV, PARSE-σ has an effect on the outcome of syncope. In some words, more than one high vowel can be deleted without any risk of violating NONFINALITY(FT): consider /saaħib-it-uu/ → *(saa)(ħíb)tu* 'his friend,' not *(sáaħ)bi.tu*. This outcome is consistent with the ranking already established in section §4.4.2.2: there is no foot economy in the language, but there is economy of unfooted syllables. The winner *(saa)(ħíb)tu* satisfies PARSE-σ better than *(sáaħ)bi.tu*, but it violates ENDRULE-L, which disfavors multiple feet.

(79) Economy of unfooted syllables

| /saaħib-i̱t-uu/ | *NUC/i,u | MAXV | PARSE-σ | ER-L |
|---|---|---|---|---|
| a. ☞(saa)(ħíb)tu | ** | * | * | * |
| b. (sáaħ)bi.tu | ** | * | **! | |

The third option is to delete the first and the last high vowels of the input, yielding *(sáaħ)bit*. This candidate beats its competitors on *NUC/i,u, but it violates the undominated constraint against deleting word-final segments, ANCHOR-EDGE (see the

Tonkawa section of Chapter 3). This constraint also explains the lack of deletion in /nisi/ → *nísi* 'forget,' **nís*. Final vowels do not delete in any of the Arabic dialects.[85]

PARSE-σ's lack of impact is consistent also with the behavior of long vowels in syncope. Recall that medial long vowels do not shorten or syncopate; hence *ja(ríi)de* not **(jár)de* 'paper.' Syncope in such words could yield a more exhaustive foot parse, but it is not allowed to apply because MAXLONGV dominates PARSE-σ.

The pattern in (79) follows a generalization that is frequently made about differential Arabic dialects: short high vowels in open syllables are avoided[86] (Broselow 1992a, Farwaneh 1995). The winner in (79), *(saa)(ħíb)tu*, has fewer open high vowel syllables, but this does not mean that there is a constraint against such syllables. The dispreference is an epiphenomenon of the interaction of the constraints on footing.

The fact that high vowels delete but low ones do not does not necessarily imply that high vowels are more marked—it could also be the case that low vowels are specially protected by high-ranking faithfulness constraints (these were discussed in the context of Lillooet in §4.3.6.3). There is no real need for such constraints even for Lebanese Arabic—the interaction of *NUC/i,u with metrical constraints accounts for the

[85] The alternative to this account is that syncope of high vowels is blocked when the result might violate $*\sigma_{\mu\mu\mu}$. This is incorrect, however—outputs of syncope do sometimes violate $*\sigma_{\mu\mu\mu}$, as in /saaħib-it-na/ → *saaħ.bít.na* 'our friend,' not **(saa.ħi)(bít)na*.

[86] This generalization is also meant to account for some aspects of epenthesis. In some dialects, /CCC/ clusters are broken up by epenthesis between the first two consonants, which creates a closed syllable: /kitab-t-la/ → *ki.ta.bit.la*, **ki.tab.ti.la* (Iraqi). In others, the epenthetic vowel is inserted between the second and the third: /katab-t-lu/→ *ka.tab.ti.lu* (Cairene, Mekkan—see Broselow 1992a).

pattern quite adequately. There are additional reasons to believe that MAXV is not differentiated for vowels at various sonority levels—see §4.4.5.

#### 4.4.3.4 Summary of the analysis of syncope

Let us summarize the main points of this section. I argued that Lebanese Arabic syncope results because the constraint against high vowel nuclei, *NUC/i,u, dominates MAXV: marked high vowel nuclei are deleted. While *NUC/i,u itself is indifferent to the site of deletion, constraints on the placement and shape of feet are not: the output of high vowel syncope must comply with the general prosodic requirements of the language. This is a pseudo-metrical pattern: high vowels delete for essentially non-metrical reasons, but the result is as metrically well-formed as possible because *NUC/i,u is dominated by certain prosodic constraints.

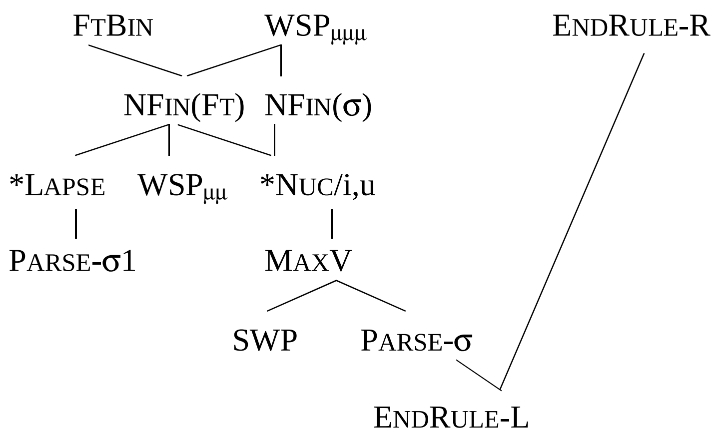
The summary tableau in (80) shows how the prosodic constraints interact with *NUC/i,u and MAXV. The first two comparisons show that there is no non-differential, metrical syncope in Lebanese Arabic because MAXV dominates SWP and PARSE-σ. The next two comparisons show how NONFINALITY(FT) guides and limits high vowel deletion in *(níz)lit.* NONFINALITY(FT) is not decisive in the case of *(nzílt)* and *(fhím)na* since they perform just as well or poorly on the constraint as their competitors; the decision is passed down to *NUC/i,u. Finally, the ranking PARSE-σ >> ENDRULE-L favors the deletion of the second high vowel in /saaħib-i̲t-uu/: the number of feet is not limited to one, so the winner has two feet and just one unfooted syllable rather than one foot and two unfooted syllables.

(80) Stress and syncope

| | | NF(FT) | *NUC/i,u | MAXV | SWP | PARSE-σ | ER-L |
|---|---|---|---|---|---|---|---|
| /saħab-it/ | a. (sáħa)bit~(sáħ)bit | | | W | L | | |
| /katab-t/ | b. ka(tábt)~(ktábt) | | | W | | L | |
| /nizil-it/ | c. (níz)lit~(nízi)lit | | W | L | W | | |
| | d. (níz)lit~(nzílt) | W | L | L | | L | |
| /nizil-t/ | e. (nzílt)~ni(zílt) | | W | L | | W | |
| /fihim-na/ | f. (fhím)na~fi(hím)na | | W | L | | W | |
| /saaħib-i̱t-uu/ | g. (saa)(ħíb)tu~(sáaħ)bi.tu | | | | | W | L |

The following is the complete ranking for Lebanese Arabic stress and syncope.

(81) Rankings for stress and syncope




In both Lebanese Arabic and Lillooet, vowels of low sonority are avoided. Nevertheless, this avoidance plays out very differently in the two languages. In Lillooet, *NUC/ə is dominated by phonotactic constraints but does not interact in a visible way with constraints on foot structure, while in Lebanese Arabic, the pattern is largely controlled by prosodic considerations.

### 4.4.4 Epenthetic vowel quality

Apart from demonstrating that it is possible for a differential syncope pattern to have metrical properties, Lebanese Arabic syncope raises the important issue of epenthetic vowel quality. Lebanese Arabic is like Lillooet in that its syncope vowel is also its epenthetic vowel. The theory of epenthetic vowel quality outlined earlier in this chapter (§4.3.2) suggests an explanation: while high vowels are marked as syllable nuclei, they are unmarked as epenthetic vowels, because they are the least marked vowels with respect to the epenthesis prominence constraints of the RECOVER hierarchy.

The contexts for epenthesis in Lebanese Arabic include coda clusters with flat or rising sonority and triconsonantal clusters.[87] If sonority falls, as in *kalb* 'dog,' then *i* is optional.

(82) Epenthesis into rising sonority clusters

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| a. | /nasl/ | nasil | 'progeny' | *nasl | cf. | kalb~kalib | 'dog' |
| b. | /ʔasr/ | ʔasir | 'palace' | *ʔasr | | nasp~nasib | 'fraud' |
| c. | /ʔidm/ | ʔidim | 'old (pl.)' | *ʔidm | | wizg~wizik | 'victory' |

A full analysis of epenthesis raises issues too tangential to the main topic of economy effects, so I will provide an account of epenthetic vowel quality only. For some discussion of epenthetic vowel placement in Arabic dialects, see Abu-Mansour 1995, Broselow 1992a, b, Davis and Zawaydeh 1996, Farwaneh 1995 and the references cited within those works.

In languages where epenthetic vowel quality is constant across contexts, the quality of epenthetic vowels is determined by the relative ranking of *NUC/x and RECOVER. RECOVER constraints favor epenthetic vowels of low sonority, and the *NUC/X

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[87] Unfortunately, Hassad does not give any examples of epenthesis into medial triconsonantal clusters, but he states that the epenthetic vowel is positioned "after the first consonant in a sequence of three consonants or a sequence of two consonants at the end of the word." (Haddad 1984) This makes Lebanese a "coda dialect" in Broselow's (1992a) classification: the epenthetic vowel heads a closed rather than an open syllable. See also fn. 86.

hierarchy favors vowels of high sonority regardless of source or stress. Since epenthetic vowels are always high in Lebanese Arabic regardless of context, epenthetic vowels are high because REC/a, REC/e,o and *NUC/ə dominate REC/i,u and *NUC/i,u:

(83) Epenthetic vowels are high

| /nasl/ | *NUC/ə | REC/a | REC/e,o | REC/i,u | *NUC/i,u | *NUC/e,o |
|---|---|---|---|---|---|---|
| a. ☞nasil | | | | * | * | |
| b. nasəl | *! | | | | | |
| c. nasel | | | *! | | | * |
| d. nasal | | *! | | | | |

*NUC/ə is undominated in Lebanese Arabic, so the ideal epenthetic vowel schwa (which violates no RECOVER constraints) is not available. The next best option is a high vowel—the less marked, sonorous nuclei *e*, *o*, and *a* are ruled out by high-ranked REC/a and REC/e,o.

The REC constraints do not interact with any of the constraints in (81) apart from *NUC/i,u, so this concludes the analysis of Lebanese Arabic.

### 4.4.5 Excursus: an argument against the differentiated MAXV hierarchy

The analyses of Lillooet and Lebanese Arabic do not *require* a differentiated hierarchy of MAXV constraints, but this does not by itself prove that there are no such constraints in CON. In this subsection, I argue that these constraints are not only unnecessary but potentially dangerous.

The theory of differential vowel behavior presented here assumes that there are two kinds of constraints that refer to sonority. First, there are markedness constraints governing the relation of sonority and positional prominence (cf. Crosswhite 1999a, de Lacy 2002a, Kenstowicz 1996b, Prince and Smolensky 1993). Second, there are faithfulness constraints that require prominent vowels to have input correspondents (cf. Alderete 1999, Steriade 1995). Thus, constraints that refer to sonority are necessarily surface-oriented—either because they are markedness constraints or because they are quasi-positional faithfulness constraints of the DEP family. There are no constraints that offer special protection for highly sonorous input vowels—in other words, MAXV is not differentiated. The reason for this is that sonority and prominence are viewed here to be properties of the output. Being prominent by itself does not merit special protection (though being marked may—see de Lacy 2002a, Kiparsky 1994), but it does come with certain “responsibilities”: if *x* is prominent, it must occur in a prominent position and not be epenthetic. There are no other privileges associated with prominence, because it is not equal to markedness.

Apart from such theoretical considerations, there is a typological reason for excluding differentiated MAXV constraints from CON. The argument builds on another syncope pattern: anti-antigemination. Anti-antigemination (Odden 1988) is a pattern whereby vowels delete only between identical or homorganic consonants, as in Mussau:

(84) Mussau anti-antigemination (Blust 2001)

| | | | | | |
|---|---|---|---|---|---|
| a. | /pa̲pasa/ | ppása | ‘outrigger poles’ | cf. | papása (older generation) |
| b. | /ŋaŋa̲ŋala/ | ŋaŋŋála | ‘to weep’ | cf. | ŋaŋaŋála (older generation) |
| c. | /gagaga/ | gágga | ‘tidal wave’ | cf. | gagága (older generation) |
| d. | bilíki | ‘skin’ | *bilki, *bliki | | |
| e. | karása | ‘whet, grind a blade’ | *karsa, *krasa | | |

The pattern is widely attested—Odden discusses anti-antigemination in Koya (Taylor 1969), Telugu (Krishnamurti 1957), Yapese (Jensen 1977), and Nukuoro (Carroll and Soulik 1973); to this we can add Blust’s (1990) Trukese, Tuvaluan, and Iban of Sarawak, and Blevins’ (2003) Dobel. The curious thing about this pattern of deletion is that of the many cases reported in the literature, not one is differential—i.e., no language deletes only a subset of its vowels between identical consonants.[88]

Rose 2000b argues for a specific prohibition against sequences of identical consonants; a variety of an OCP constraint (see also Fukazawa 1999, McCarthy 1986, Myers 1997, Suzuki 1998, Yip 1988, 1998).

(85) OCP: "No $C_1VC_2$, where $C_1 = C_2$." (adapted from Rose 2000b[89])

When this constraint dominates MAXV, the vowel deletes and the consonants automatically merge into a geminate (Keer 1999):

(86) Anti-antigemination syncope

| /papasa/ | OCP | MAXV |
|---|---|---|
| a. ☞ppasa | ✓(pp=geminate) | * |
| b. papasa | *!(p..p) | |

Under this assumption, syncope is blocked between identical consonants not by the OCP but by constraints against geminates, as in Tonkawa, Afar and Yupik (cf. McCarthy 1986). Rose's analysis thus explains how it is possible for there to be two opposite syncope patterns: one where syncope applies only between identical consonants, and one where syncope applies except between identical consonants (Yip 1988, Zoll 1996).

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[88] Odden also cites Maliseet-Passamaquoddy (Sherwood 1983) as an example of anti-antigemination. Maliseet-Passamaquoddy is said to delete only short *a* and *ə* between identical consonants, which seems like a potential counterexample to this generalization. According to Sherwood, schwa deletes in other contexts, as well—not just medially, as in the example Odden cites (/tep-ă̲pi-w/ → *teppo*'he sits inside,' /məkwət-ă̲pi-w/ → *kw'ətə̲po* 'he sits alone.') Overall, though, Sherwood's description is strongly influenced by his rather abstract analysis, which make it difficult to assess the value of this evidence.

[89] Rose assumes that two consonants are adjacent irrespective of intervening vowels, and that any surface identical CC sequence is a geminate. The definition in (85) is a close approximation of her OCP.

The patterns do not exactly mirror each other, though: while antigemination syncope can be differential (Yupik schwa deletion is—see §4.3.7), anti-antigemination syncope never is. This asymmetry can only exist if MAXV is a single constraint rather than the hiearchy MAX-A>>MAX-E,O>>MAX-I,U>>MAX-SCHWA. The reason is that no ranking of *NUC/x constraints, MAXV, and the OCP can produce a differential anti-antigemination pattern.

*NUC/x and the OCP do not really conflict—the OCP is violated when a vowel of any kind separates two identical consonants, while *NUC/x constraints are violated by vowels of a particular kind in all contexts. Their demands do not conflict—they overlap. Thus even if both the OCP and *NUC/x dominated MAXV, the result is not differential syncope between identical consonants—it's differential syncope everywhere plus non-differential syncope between identical consonants:

(87) Factorial typology without differentiated MAXV constraints

| | |
|---|---|
| OCP>>MAXV>>*NUC/x | syncope between identical consonants only |
| MAXV>>{OCP,*NUC/x} | No syncope |
| {OCP,*NUC/x}>>MAXV | differential syncope in all contexts, plus non-differential syncope between identical consonants |

Consider the last ranking in (87), which is expanded in the tableau below. Under this ranking, syncope will apply to a low vowel between identical consonants, as in the first input. It will also apply to a high vowel between identical consonants, as in /pipasa/. Moreover, high vowels also syncopate between non-identical consonants. This pattern is like a hybrid between Lebanese Arabic and Mussau:

(88) Differential syncope plus anti-antigemination

| | | OCP | *Nuc/i,u | MaxV |
|---|---|---|---|---|
| /papasa/ | a. ☞ppasa | | | * |
| | b. papasa | *! | | |
| /pitasa/ | c. ☞ptasa | | | * |
| | d. pitasa | | *! | |
| /pipasa/ | e. ☞ppasa | | | * |
| | f. pipasa | *! | *! | |

The only possible differentiation in this theory comes from the ranking of MaxLongV: if these constraints dominate the OCP, long vowels will not delete between identical consonants but short ones will (as in Afar—see Bliese 1981).

In the differentiated MaxV theory, the prediction does not pan out. If the OCP is ranked somewhere within the hierarchy rather than above or below it, as in (89), the anti-antigemination pattern can be differential.

(89) Max-A>>Max-E,O>>Max-I,U>>Max-Schwa

OCP

For example, the tableau below shows a ranking under which high vowels syncopate only between identical consonants. This is an unattested pattern:

(90) Wrong prediction of differentiated MaxV theory: differential anti-antigemination

| | | Max-A | Max-E,O | OCP | Max-I,U |
|---|---|---|---|---|---|
| /papasa/ | a. ☞papasa | | | * | |
| | b. ppasa | *! | | | |
| /pipasa/ | c. ☞ppasa | | | | * |
| | d. pipasa | | | *! | |

The differentiated MaxV theory predicts that deletion between identical consonants can affect only vowels of a particular height, but this prediction does not follow if MAX constraints do not refer to vocalic height or sonority. For this reason, the hierarchy in (89) should be excluded from CON.[90]

For cases like Lebanese, this means that differential *has to be* the effect of some markedness constraint against low sonority vowels rather than of SWP or PARSE-σ. Once the constraints in (89) are excluded from CON, then MAX-A cannot protect *a* from deletion in metrically determined contexts while allowing *i* to delete there. Nevertheless, differential syncope can appear metrical without being a differential clone of a true metrical pattern, e.g., Hopi or Tonkawa—the richness of constraint interaction allows for this possibility.

### 4.4.6 Section summary

Lebanese Arabic high vowel syncope is a metrical/differential hybrid pattern: only marked high vowel nuclei are deleted, yet the locus of deletion is determined by prosodic constraints. The output must obey the same prosodic requirements that hold of words with low vowels: stress cannot be final in *ʔá.ka.lit*, so high vowel syncope cannot apply to more than one vowel in /nizil-it/ → *niz.lit*, **nzílt*. The prosodic character of this pattern was noted by Haddad 1984, who casts his syncope rule in metrical terms. In his account, vowels are deleted after foot structure is assigned, but they must be high, non-final and not dominated by strong foot branches. The analysis presented here does not assume an intermediate level at which foot structure is assigned but high vowels are not deleted; the

[90] Pulleyblank argues that these constraints are necessary to analyze *r*-deletion in Yoruba (Akinlabi 1993, Pulleyblank 1998) because *r* sometimes deletes together with neighboring high vowels but non-high vowels never delete. This pattern could be analyzed in other ways, though—e.g., by using context-specific constraints against *r* next to vowels of a specific height rather than a general **r*.

entire output is evaluated at once for its foot structure and the quality of its syllable nuclei. This allows for rather intricate interaction of diverse constraints, the outcome of which is the optimal and often most economical output.

We have now seen two grammars where economy effects are a response to the markedness of low sonority vowel nuclei. In these grammars, low sonority vowels have a dual status: they are marked as nuclei but unmarked as epenthetic vowels. I next turn to a case where *NUC/i,u does more than require syncope of high vowels—it also determines the quality of epenthetic vowels.

### 4.5 Avoidance of marked nuclei in Mekkan Arabic

No constraints have only economy effects. For example, SWP, which under some circumstances can favor syncope, can also be satisfied by syllable augmentation. Likewise, PARSE-σ can be satisfied either by removing unfootable vowels or by footing them, i.e., by adding structure. The sonority constraints on syllable nuclei are no different. In Lillooet and Lebanese Arabic, deletion of low sonority nuclei is the only option for satisfying *NUC/x constraints, but in Mekkan Arabic, they have an additional effect: they determine the choice of epenthetic vowel. The pattern is all the more interesting because high vowel syncope and low vowel epenthesis coexist in this dialect of Arabic, so *NUC/x constraints do double duty.

#### 4.5.1 The patterns

The following generalizations about Mekkan Arabic phonology are based on the work of Abu-Mansour 1987. Mekkan Arabic has the same vowel inventory as Lebanese, but it differs somewhat in syllable structure. Its syllables can be light (CV), heavy (CVC, CVV), or superheavy (CVVC). Tautosyllabic two-consonant clusters are permitted word-initially and word-finally but not medially; in other words, there are generally no CCC sequences (except in fast speech; see fn. 93).

4.5.1.1 High vowel deletion

High vowels only rarely occur in open syllables in Mekkan. Underlying high vowels syncopate wherever it is possible to do so without creating a tautosyllabic CC cluster, as shown in (91). A verb with two low vowels (e.g., *katab* 'write') never loses its vowels throughout its paradigm. A verb with two high vowels (e.g., *kibir* 'grow up') loses its second vowel in the two-sided open syllable environment (VC__CV).

(91) High vowel deletion (Abu-Mansour 1987:129-130)

| | | | | | | |
|---|---|---|---|---|---|---|
| a. | /kibir/ | ki.bir | 'he grew up' | cf. | ka.tab | 'he wrote' |
| b. | /kibir-t/ | ki.birt | 'I, you (m.) grew up' | | ka.tabt | 'I, you (m.) wrote' |
| c. | /kibir-at/ | kib.rat | 'she grew up' | | ka.ta.bat | 'she wrote' |
| d. | /kibir-na/ | ki.bir.na | 'we wrote' | | ka.tab.na | 'we wrote' |
| e. | /kibir-uu/ | kib.ru | 'they grew up' | | ka.ta.bu | 'they wrote' |

Syncope is blocked by high-ranking syllable structure constraints (Abu-Mansour 1995). For example, there is no syncope after geminates or after CC sequences, as shown in (92) and (93).

(92) No syncope after geminates (Abu-Mansour 1987:136-137)

| | | | |
|---|---|---|---|
| a. | ti.dár.ris | 'she teaches' | *ti.da<u>rrs</u> |
| b. | ti.dár.ri.si | 'you (f) teach' | *ti.dá<u>rr</u>.si |
| c. | mu.dár.ris | 'a male teacher' | *mu.da<u>rr</u>.s |
| d. | mu.dár.ri.sa | 'a female teacher' | *mu.dá<u>rr</u>.sa |

(93) No syncope in CC__C (Abu-Mansour 1987:136)

| | | | |
|---|---|---|---|
| a. | ʔák.tu.bu | 'I write it (m.)' | *ʔakt.bu |
| b. | yík.si.ru | 'they break' | *yiks.ru |
| c. | ʔák.ri.mi | 'you (f.) honor!' | *ʔakr.mi |

Likewise, although word-initial two-consonant clusters are tolerated, high vowels are not deleted in initial syllables—syncope there is blocked by *COMPLEX. Recall that Lebanese

Arabic does have syncope in this environment, e.g. /fihim-na/ → *fhim.na*. This option is not available in Mekkan because syllable structure constraints take precedence over *NUC/x (in fact, as we will see shortly, underlying initial clusters must undergo epenthesis).

(94) No deletion in the word-initial syllable

| | | | |
|---|---|---|---|
| a. | mu̲.dar.ris | 'a male teacher' | *m̲d̲ar.ris |
| b. | ti̲.raa.sil | 'you (m.) correspond' | *t̲r̲aa.sil |

Another constraint on high vowel syncope is that it does not apply between identical consonants in the verbal morphology—it is blocked by a constraint against geminates (Rose 2000b; see also §4.4.5).[91] This is shown in (95); compare (a) with (b-c), where syncope fails to apply.

(95) No high vowel syncope between identical consonants (Abu-Mansour 1987:151)

| | | | | |
|---|---|---|---|---|
| a. | /ʔa-kaati̲b-u/ | ʔa.kaat.bu | 'I write to him' | cf. ʔa.kaa.tib.ha 'I write to her' |
| b. | /yi-ʃaari̲r-u/ | yi.ʃaa.ri.ru | 'he fights with him always' | *yi.ʃaar.ru |
| c. | /ʔa-ħaaʒi̲ʒ-u/ | ʔa.ħaa.ʒi.ʒu | 'I argue with him' | *ʔa.ħaa.ʒ.ʒu |

To summarize, high vowels delete in Mekkan Arabic in two-sided open syllables, which happen to be the only environment where syllable structure constraints permit deletion.

4.5.1.2 Low vowel epenthesis

Vowels are inserted for reasons of syllable structure: to avoid medial superheavy syllables and tautosyllabic consonant clusters. When a consonant-initial suffix is added after a geminate (96), a sequence of two consonants (97), or a VVC sequence (98), *a* is

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[91] Syncope does apply in non-verbal forms, /daabi̲b-at/ → *daabba* 'animal' (see Abu-Mansour 1987, Bakalla 1979, McCarthy 1986 and Rose 2000a for related discussion).

inserted before the suffix.[92] This vowel is absent otherwise, thus /ʔa-kaatib-ha/ surfaces as *ʔa.kaa.tib.ha* 'I write to her,' not as **ʔa.kaa.ti.ba.ha*.

(96) Epenthesis after geminates (Abu-Mansour 1987:165)

| | | | |
|---|---|---|---|
| a. | /ʔumm-na/ | ʔum.ma.na | 'our mother' |
| b. | /ʕadd-hum/ | ʕad.da.hum | 'he counted them' |

(97) Epenthesis into medial consonant clusters (Abu-Mansour 1987:163-171)

| | | | | |
|---|---|---|---|---|
| a. | /ʕumr-ha/ | ʕum.ra.ha | 'her age' | *ʕu<u>mr</u>.ha: no clusters |
| b. | /kalb-kum/ | kal.ba.kum | 'your (pl.) dog' | |
| c. | /katab-t-ha/ | ka.tab.ta.ha | 'I wrote it (f.)' | |
| d. | /katab-t-l-kum/ | ka.tab.tal.kum | 'I wrote to you (pl.)' | |
| e. | /ʔaʃtaree-t-l-hum/ | ʔaʃ.ta.ree.tal.hum | 'I bought for them' | |
| f. | /ʔaddeet-l-ha/ | ʔad.dee.tal.ha | 'I counted for her' | |

(98) Epenthesis after long vowels (Abu-Mansour 1987:163-164)

| | | | | |
|---|---|---|---|---|
| a. | /muftaaħ-kum/ | muf.taa.ħa.kum | 'your (p.) key' | *muf.<u>taaħ</u>.kum: $*\sigma_{\mu\mu\mu}$ |
| b. | /saab-hum/ | saa.ba.hum | 'he left them' | |
| c. | /naay-ha/ | naa.ya.ha | 'her flute' | |

Epenthesis also applies to words that have two consonants initially. Mekkan is unusual among onset dialects in having prothesis in such situations rather than epenthesis; this will be analyzed as a contiguity effect.

(99) Word-initial epenthesis (Abu-Mansour 1991, Abu-Mansour 1987)

| | | | | |
|---|---|---|---|---|
| a. | /t-rafaz/ | ʔat.ra.faz | 'to be kicked' | |
| b. | /ktub/ | ʔak.tub | 'Write!/I write' | cf. ni-ktub 'we write' |
| c. | /n-katab/ | ʔan.ka.tab | 'was written' | |

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[92] I am ignoring the pattern of "prepausal" epenthesis, where the epenthetic vowel is not [a] but usually a copy of the preceding vowel: /kusr/→ *kusur* 'break,' /kizb/→*kizib* 'lying,' /ʃiʕr/→*ʃiʕir* 'poetry,' /ʃahr/ →*ʃahar* 'mouth.' This pattern is not entirely regular; the quality of the epenthetic vowel sometimes depends on the preceding consonant, as in /ʔamr/ → *ʔamur* 'command' (Jastrow 1980:107-108) and sometimes is unpredictable.

To sum up, high vowels syncopate but low vowels are epenthesized. High vowels are marked as syllable nuclei in all contexts, whether they are epenthetic or not.

### 4.5.2 Analysis

High vowels make poor syllabic nuclei because they are low in sonority, so syncope is used to get rid of them wherever possible. These nuclei are avoided in epenthetic contexts for the same reason. *NUC/i,u has two effects in the grammar of Mekkan Arabic. The first is an economy effect: it causes syncope by dominating MAXV. The second is not an economy effect: it determines the quality of epenthetic vowels by dominating the RECOVER constraints. I start with the analysis of syncope.

#### 4.5.2.1 Syncope

Syncope is the result of *NUC/i,u dominating MAXV. High vowels are deleted in /kibir-at/ →*kibrat* 'she grew up,' but low ones are not /katab-at/ → *katabat* 'she wrote.' IDENT[high] must also dominate MAXV, because lowering of *i* to *a* is impossible (candidate (c) shows this):

(100) No low-sonority nuclei

| /naajiɦ-a/ | *NUC/i,u | IDENT[hi] | MAXV |
|---|---|---|---|
| a. ☞ naaj.ħa | | | * |
| b. naa.ji.ħa | *! | | |
| c. naa.ja.ħa | | *! | |

Low vowels do not delete under any circumstances, so MAXV must dominate all other constraints that favor syncope: PARSE-σ, SWP, *MAR$_{FT}$/x, etc. Thus there is no syncope of *a* in the weak branch of a foot in *ká.ta.bu*, which means that MAXV dominates *MAR$_{FT}$/a. By transitivity, MAXV also dominates all the other *MAR$_{FT}$/x constraints, which are universally ranked below it.

(101) No deletion of *a* in the weak branch of a foot

| /katab-u/ | MAXV | *MAR$_{FT}$/a | SWP |
|---|---|---|---|
| a. ☞(ká.ta)bu | | * | * |
| b. (kát)bu | *! | | |

Lebanese Arabic syncope is primarily blocked by metrical constraints, but in Mekkan Arabic syllable structure constraints take precedence over *NUC/i,u. As shown in (102),*COMPLEX prevents the deletion of the first vowel in *ki.birt*. This is in contrast to Lebanese, where *COMPLEX is ranked below *NUC/i,u—initial clusters are created by syncope in such words.[93] This same ranking explains the lack of syncope after two-consonant sequences in *ʔák.tu.bu (*ʔákt.bu)* and in the first syllable in /mudarris/ → **mdarris*.[94]

(102) Syncope cannot create a cluster

| /kibir-t/ | *COMPLEX | *NUC/i,u |
|---|---|---|
| a. ☞ki.birt | | * |
| b. kbirt | *! | |

Just as in Lebanese, high vowel deletion does not apply word-finally in Mekkan Arabic in words like *nísi* and *kátabu*, which is due to the high-ranking positional

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[93] This explanation is incomplete, because the ranking *NUC/i,u>>*COMPLEX predicts that syncope will create medial clusters in Lebanese Arabic, which is not the case. It is possible that in Lebanese Arabic, initial two-consonant sequences are actually not monosyllabic—the first consonant could be a minor syllable or an appendix to PrWd.

[94] In fast speech, the opposite ranking applies. Vowel deletion applies optionally in *yistaɦgiru ~ yistaɦgru* 'they despise,' *tigarbiʕu ~ tigarbʕu* 'you (pl.) make noises,' *tinʃulu ~ tinʃlu* 'you (pl.) steal' (Abu-Mansour 1987:142). The resulting consonant clusters must obey sonority sequencing; the first consonant in the coda cluster must be more sonorant than the second (cf. *tiʕrifi, *tiʕr.fi* 'you (f.) know,' *tis.li.mi* not **tisl.mi* 'you (f) become a muslim.'

faithfulness constraint ANCHOR-EDGE. Abu-Mansour (1995) uses FTBIN to block deletion in *nísi*, observing that words are always binary, but there is no apocope in longer words either.

To summarize, high vowels never lower in Mekkan Arabic but they syncopate whenever possible to do so without violating high-ranking syllable structure and faithfulness constraints. The following rankings are crucial to this interaction:

(103) *COMPLEX IDENT[Hi] ANCHOR-EDGE

*NUC/i,u

MAXV

$*\text{MAR}_{\text{FT}}$/a PARSE-σ SWP

This analysis does not address the locus of deletion in longer words. Abu-Mansour does not discuss longer words, but it is likely that syncope in longer words is controlled to a large extent by prosodic constraints, just as in Lebanese or Cairene Arabic (Kenstowicz 1980, though cf. Davis and Zawaydeh 1996, Mester and Padgett 1994).

Deletion is an economy effect of *NUC/i,u: because it dominates MAXV, deletion is preferred to the faithful and less economical parsing of marked high vowel nuclei. The next section addresses another effect of *NUC/i,u that is not related to economy: its influence on the selection of the epenthetic vowel.

4.5.2.2 A-epenthesis

Mekkan Arabic epenthesizes vowels into consonant clusters and after superheavy syllables, i.e., epenthesis is a way to satisfy *COMPLEX and $*\sigma_{\mu\mu\mu}$. While most dialects of Arabic are like Lebanese in that they choose *i* as their epenthetic vowel (Farwaneh 1995), Mekkan and Sudanese have epenthetic *a*. The quality of the epenthetic vowel in these dialects is determined by the same constraints that favor high vowel syncope. From the standpoint of markedness (not faithfulness), *a* is the best epenthetic vowel, since it alone violates no *NUC/x constraints. The tableau below shows the markedness violations of various epenthetic vowels with respect to *NUC/x and *MID, which bans mid vowels from the core vowel inventory of Mekkan Arabic.

(104) Low vowel epenthesis favored by the *NUC hierarchy

| /katab-t-ha/ | *NUC/ə | *MID | *NUC/i,u | *NUC/e,o |
|---|---|---|---|---|
| a. ☞katabt<u>a</u>ha | | | | |
| b. katabt<u>e</u>ha | | *! | | * |
| c. katabt<u>i</u>ha | | | *! | |
| d. katabt<u>ə</u>ha | *! | | | |

The difference between Mekkan Arabic and *i*-dialects, then, is the relative ranking of *NUC/x and RECOVER. In *i*-dialects, REC/a dominates *NUC/i,u, while in Mekkan the opposite ranking holds.

This effect of *NUC/i,u is not structural economy—the winner in (104) does not contain any fewer syllables or vowels than its competitors. Indeed, under a certain definition of economy, *a* is less economical than *i*, *ə*, or *e*, since it is phonetically longer and therefore requires more articulatory effort. In his discussion of vowel reduction, Lindblom claims that "...speech production appears to operate as if physiological processes were governed by a *power constraint* limiting energy expenditure per unit of time" (Lindblom 1983:231). This "power constraint," however it is formally expressed, cannot apply in Mekkan, since its least "effortful" short high vowels are clearly avoided in favor of the longer-winded low vowels. The reason for this is markedness—high vowels are doubly marked in that they are deleted and not epenthesized.

Why not simply delete all the marked high vowel nuclei and replace them with the unmarked low ones? The answer is faithfulness. Epenthetic vowels can only appear between morphemes in Mekkan Arabic (/naay-ha/ → *naa.ya.ha* ‘her flute’), which drastically limits the possibilities for such vowel swapping.

Morpheme-internal epenthesis is blocked by a morphologically sensitive version of the correspondence constraint O-CONTIG (see (105)). This epenthesis pattern is similar to that of Chukchee, where CC+C → CCəC but C+CC → CəCC (Kenstowicz 1994).

(105) O-CONTIG$_M$ (No Intrusion into morphemes): “If $S_2$ stands in correspondence with $S_1$, where $S_1$ is a morpheme, $S_2$ forms a contiguous string” (adapted from Kenstowicz 1994, McCarthy and Prince 1995).

Deleting high vowels and replacing them with low ones violates O-CONTIG$_M$ whenever epenthesis has to intrude into a morpheme. In /kibir/, high vowel deletion is blocked by *COMPLEX and lowering is ruled out by IDENT. Deleting and epenthesizing to *kabar* instead of lowering to *kabar* is not prohibited by either *COMPLEX or IDENT; instead, O-CONTIG$_M$ must rule out this type of unfaithfulness. Violating *NUC/i,u ends up being the least of four evils:

(106) Deleted high vowels are not replaced by inserted low ones

| /kibir/ | IDENT[hi] | O-CONTIG$_M$ | *COMPLEX | *NUC/i,u | DEPV | MAXV |
|---|---|---|---|---|---|---|
| a. ☞kibir | | | | ** | | |
| b. kabar | | *! | | | ** | ** |
| c. kbir | | | *! | * | | * |
| d. kabar | *!* | | | | | |

One environment in particular shows the effect of O-CONTIG$_M$. Although surface medial superheavy syllables can be created by high vowel syncope, underlying /VVC+C/ sequences undergo epenthesis:

(107) Superheavy syllables, epenthesis and syncope

a. /naajiħ-a/ → naaǰ.ħa *naa.ji.ħa
b. /naay-ha/ → naa.y$\underline{\text{a}}$.ha *naay.ha

Contiguity allows epenthesis only in the second case. O-CONTIG assigns a violation mark to the mapping /naajiħ-a/ → **naa.j$\underline{a}$.ħ-a* but not to /naay-ha/ → *naay-$\underline{a}$-ha*. In **naa.j$\underline{a}$.ħ-a*, the output segments of the root morpheme do not form a contiguous string because the epenthetic *a* intervenes. It does not matter that these segments are not adjacent in the input because O-CONTIG only evaluates the contiguity of output strings of correspondents. (Syncope violates I-CONTIG, but it is ranked low in Mekkan.) Conversely, in *naay-$\underline{a}$-ha*, all of the tautomorphemic correspondents form contiguous strings, because the epenthetic vowel is between them.

The non-concatenative morphology of Mekkan Arabic never gives rise to monomorphemeic CVVCC strings (Abu-Mansour 1987:155), so syncope is the only source of surface medial superheavy syllables. This means that $*\sigma_{\mu\mu\mu}$ must be dominated by O-CONTIG and by *NUC/i,u: output superheavy syllables are tolerated (see (a)) when the alternative is epenthesis into a morpheme (see (b)) or a marked high vowel nucleus (see (c)). On the other hand epenthesis between morphemes is acceptable (see (d-e)).

(108) Contiguity prevents morpheme-internal epenthesis in -CVVC- strings

| | | O-CONTIG$_M$ | *NUC/i,u | $*\sigma_{\mu\mu\mu}$ | DEPV | MAXV |
|---|---|---|---|---|---|---|
| /n$_1$aa$_2$j$_3$i$_4$ħ$_5$-a$_6$/ | a. ☞ n$_1$aa$_2$j$_3$.ħ$_5$-a$_6$ | | | * | | * |
| | b. n$_1$aa$_2$.j$_3$i$_4$.ħ$_5$-a$_6$ | | *! | | | |
| | c. n$_1$aa$_2$.j$_3$$\underline{\text{a}}$.ħ$_5$-a$_6$ | *! | | | * | * |
| /n$_1$aa$_2$y$_3$-h$_4$a$_5$/ | d. ☞ n$_1$aa$_2$y$_3$$\underline{\text{a}}$-h$_4$a$_5$ | | | | * | |
| | e. n$_1$aa$_2$y$_3$-h$_4$a$_5$ | | | *! | | |

There is evidence that the non-morpheme-specific version of O-CONTIG is active in Mekkan, as well: recall that in words with initial consonant clusters, the epenthetic vowel is positioned to the left of the cluster even when the cluster is heteromorphemic: /t-rafaz/ → *ʔ̲a̲t.ra.faz* 'to be kicked' not **ta̲.ra.faz*. Prothesis here is accompanied by *ʔ*-epenthesis, since onsetless syllables are categorically prohibited in the language. Only *ʔ̲a̲t.ra.faz* satisfies O-CONTIG *and* ONSET, which suggests that O-CONTIG dominates DEP-C: inserting the consonant would not be necessary if epenthesis could break up the output consonant sequence.

Other factors contribute to the positioning of the epenthetic vowel as well. As is well-known, epenthesis in the so-called onset dialects is generally between the second and the third consonant in a cluster, regardless of morphological structure: alongside *kal.ba̲.kum*, we get /katab-t-ha/ → *ka.tab.ta̲.ha* 'I wrote it (f.).' The simplest analysis of this is metrical: epenthesis between the first and the second consonant here creates an open light syllable in unstressed position (as in *(ʕúm)ra̲.ha*,), which is better than the alternative where the epenthetic vowel is in an unstressed heavy syllable (as in *(ʕú.ma̲r)ha*) or is itself the head of the prosodic word, violating Alderete's HEAD-DEP constraint (see §4.3.2): **(ʕu.má̲r)ha*. But this sort of analysis cannot be readily extended to coda dialects, where epenthetic vowels head unstressed closed syllables (Broselow 1992a). A full analysis of epenthetic vowel positioning would take me too far off the topic of economy—the reader is referred to the works cited in this section.

*NUC/i,u is implicated in two separate processes in Mekkan Arabic. The first of these, syncope, results in structural economy. The second, however, does not: epenthetic vowel quality and economy are not directly related. If anything, low vowel epenthesis results in *increasing* articulatory effort, since low vowels arguably take more energy to produce. The result could be argued to be anti-economy—high, shorter vowels are deleted but low, longer vowels are inserted. This pattern is consistent with a markedness analysis but not with this sort of economy reasoning.

### 4.5.3 Summary of the analysis of Mekkan Arabic

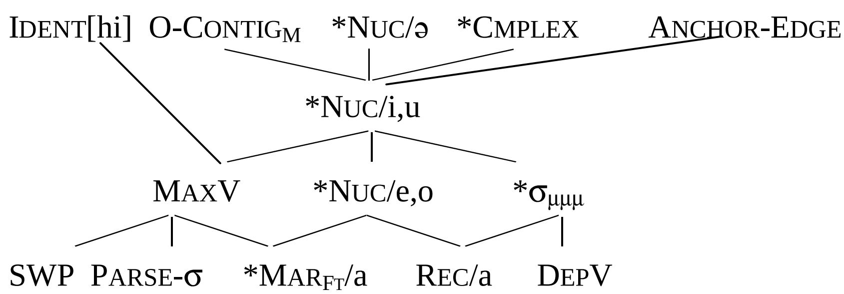
Mekkan Arabic shows that *NUC/i,u is not just an economy constraint, even though it can have economy effects. Because of its high ranking in Mekkan Arabic, high vowels are doubly marked: they are removed by syncope and they are avoided in epenthesis. Nevertheless, various faithfulness and markedness constraints prevent wholesale deletion of high vowels and their replacement with low ones.

The grammar is shown in action in the comparative tableau (109). The first two candidates show why deletion is impossible in CVCVC words—such candidates violate either *COMPLEX or O-CONTIG$_M$. (IDENT and all the candidates that violate it have been left out from the tableau for reasons of space—only the syncope/epenthesis candidate is considered.) Next, the grammar's output for the input /naay-ha/, *naa.ya̲.ha*, is selected because it satisfies *$\sigma_{\mu\mu\mu}$ at the expense of violating DEPV: underlying morpheme-final CVVC- sequences must surface with epenthesis. The candidates for the input /tiraasil-u/ show that -CVVC- syllables derived by syncope are acceptable because the alternative, epenthesis, violates the undominated O-CONTIG$_M$. Finally, the last group of candidates shows why the epenthetic vowel is low: the constraints that favor a less prominent epenthetic vowel (i.e., *MAR$_{FT}$/a (not shown) and REC/a) are ranked below the *NUC/x constraints, which uniformly disfavor everything but *a*.

(109) Mekkan epenthesis and syncope

| /kibir/ | OCONTIG$_{M}$ | *CMPLX | *NUC/i,u | *$\sigma_{\mu\mu\mu}$ | DEPV | MAXV | REC/a |
|---|---|---|---|---|---|---|---|
| a. ki.bir~kbir | | W | L | | | W | |
| b. kibir~k<u>a</u>b<u>a</u>r | W | | L | | W | W | W |
| /naay-ha/ | | | | | | | |
| c. naa.y<u>a</u>.ha~naay.ha | | | | W | L | | L |
| /tiraasil-u/ | | | | | | | |
| d. ti.raas.lu~ti.raa.si.lu | | | W | L | | L | |
| e. ti.raas.lu~ti.raa.s<u>a</u>.lu | W | | | L | W | | L |
| /ʕumr-ha/ | | | | | | | |
| f. ʕum.r<u>a</u>.ha~ʕumr.ha | | W | | W | L | | L |
| g. ʕum.r<u>a</u>.ha~ʕum.r<u>i</u>.ha | | | W | | | | L |

(110) Ranking for Mekkan Arabic




Avoidance of high vowel nuclei is so pervasive in Mekkan Arabic that syncope is used to remove them and epenthesis never creates them. Syncope, an economy effect, is just one aspect of this tendency—not an end goal in itself.

### 4.5.4 Alternative analysis: no short [i] in open syllables

High vowel syncope has received a lot of attention in the phonological literature—there are many rule-based and OT analyses of the Mekkan pattern as well as of other Arabic dialects. I do not know of any analyses that have focused specifically on the quality of the syncopating and epenthetic vowel, so this is the chief contribution of this analysis to that body of work. In this section, I will consider the differences between the predictions of the *NUC/x analysis and of other analyses.

The traditional practice in the literature is to assume that deletion obeys the fairly specific prohibition on short high vowels in open syllables, $*\breve{\imath}_\sigma]$ (Kager 1999, Kenstowicz 1996a and others). Most analysts simply adopt the constraint for convenience, but Farwaneh 1995 offers some justification for it—she argues that high vowels in open syllables are not prominent enough and that closing off the syllable by syncope to $[\mathrm{CiC}_\sigma]$ makes it as prominent as a $[\mathrm{Ca}_\sigma]$. She notes that *a*-epenthesis is only found in onset dialects, and argues that even those dialects have *i*-epenthesis in closed syllables in prepausal epenthesis (e.g., /kizb/→*kizib* 'lying,' see fn. 92). Abu-Mansour 1987 and Jastrow 1980 make it clear that this is not the case, however—the epenthetic vowel in prepausal epenthesis sometimes is *a*. More importantly, in the productive epenthesis pattern of the kind discussed in this section, *a* is inserted throughout, whether the resulting syllable is open or closed (e.g., /katab-t-l-kum/ → *katabta̲lkum* 'I wrote to you (pl.).' If $*\breve{\imath}_\sigma]$ were active in the process, we would expect high vowels to be inserted in closed syllables. Only a fairly general constraint like *NUC/x can explain this, since it favors low vowels in open or closed syllables.

I argue that *i* is avoided in Mekkan not just in open syllables but throughout—its marked status derives from its being a low-sonority nucleus, not from its being in a closed or open syllable. The seeming markedness of i in open syllables is just an artifact of the overall grammar.

The usefulness of $*\breve{\imath}_\sigma]$ is put further into question when we look to other dialects of Arabic. The *NUC/i,u analysis of high vowel syncope matches the success of the $*\breve{\imath}_\sigma]$ analysis in all the relevant ways without the undesirable predictions that come with introducing $*\breve{\imath}_\sigma]$ into CON. This constraint is somewhat odd in its formulation; for one thing, it predicts the lowering of /i/ in open syllables but not in closed ones under the ranking *ĭ$_\sigma$]>>IDENT[hi]. In fact the opposite happens in Bedouin Arabic: low vowels raise in open syllables but not in closed ones. In Bedouin Arabic, /katabat/ maps to *ktíbat*. If high vowels are marked in open syllables, why not go to *katbat* or *kitbat*? The pattern cannot be explained in terms of *NUC constraints, either, but at least *NUC constraints do not prefer the losers *katbat* and *kitbat* to the winner *ktibat*, unlike *ĭ$_\sigma$]. (The reader is referred to McCarthy 2003 for further discussion of this complex pattern).

The *NUC/x hierarchy gives the quality of the epenthetic vowel for free, without additional mechanisms. Abu-Mansour 1995 does not discuss this issue, but it is clear that the constraint *ĭ$_\sigma$] cannot explain why the epenthetic vowel is *a* generally, not just in open syllables (recall *katabtalkum*). In short, the *NUC/x hierarchy offers a more general account without the need to resort to constraints like *ĭ$_\sigma$].

The constraint *ĭ$_\sigma$] also predicts consonant gemination after high vowels but not elsewhere. Patterns where consonants geminate after vowels of a particular height are attested: one famous example comes from Central Alaskan Yupik, where consonants geminate following a stressed [ə] (see §4.3.7). But the Yupik pattern is really the result of avoidance of long schwa, not of schwa in an open syllable[95] (Gordon 2001). In other

[95] Brainard 1994 describes a similar pattern in Karao: [ɨ] must be followed by a geminate consonant (unless it is the last syllable, where a non-geminate coda is required): /man-saxɛt/ → *mansaxɛt*, /mɨn-saxɛt/ → *mɨnnaxɛt*, /ʔɨ-saxɛt-an/ → *ʔɨssaxɛtan*, cf. *saxɛt* ‘to get sick.’ This is the only environment where geminates occur in the language. This is a curious pattern, but it does not provide evidence for *ĭ$_\sigma$]. There is clearly something odd about this environment for gemination but there is no reason to think that it is driven by the requirement on [ɨ] to be in a closed syllable—a non-geminated coda would satisfy this requirement just as well, /mɨn-saxɛt/ → **mɨnsaxɛt*. I leave this for future research.

words, this is not a general post-schwa gemination pattern. The constraint $*\breve{\imath}_{\sigma}]$ can favor a post-*i* gemination pattern and indeed predicts it; *NUC/x constraints do not.

An even stranger prediction of $*\breve{\imath}_{\sigma}]$ is non-differential syncope of any vowel after an *i* in an open syllable: e.g., /pataka/→ *pa.ta.ka* but /pitaka/→ *pit.ka*. While the quality of neighboring vowels can sometimes affect whether syncope applies or not (Sorvacheva 1977 argues that it does in the Lower Vychegda dialect of Komi-Zyrian), what matters in such patterns is the sonority of foot heads and margins, not whether the syncopating vowel is preceded by a high vowel in an open syllable. The problem here is that the markedness constraint $*\breve{\imath}_{\sigma}]$ does not give any instructions on how to remove the marked structure—both gemination of the following consonant and syncope of the following vowel are options available to GEN. The constraint $*\breve{\imath}_{\sigma}]$ is not equivalent to the rule /i/ → ∅ /C__CV, and it should be kept in mind that in OT there is a wealth of alternatives for any marked structure.

Generality is a virtue for a constraint—constraints should not be *too* context-specific in OT because constraint interaction produces much of the needed complexity. The various factors involved in high vowel syncope conspire to create the illusion that a high vowel in an open syllable is somehow more marked than a high vowel in a closed syllable or a low vowel in any syllable, but this markedness relationship does not necessarily imply that this preference is encoded in a harmonic scale in CON: *{Ca, CaC, CiC}* ≻ *Ci*. Mekkan Arabic shows that constraint interaction can derive this harmonic relationship without overly context-specific constraints.

## 4.6 Avoidance of marked foot heads in Lushootseed

This case study continues the theme of the previous section: no constraint has just economy effects; the same output goal can be met through a variety of means, even in a single grammar. Mekkan Arabic showed that apart from having economy effects, *NUC/i,u also affects the quality of the epenthetic vowel. Lushootseed shows a similar complexity in its pattern of low vowel syncope. In one sense, Lushootseed is the opposite of Mekkan Arabic: in Lushootseed, low vowels syncopate but high ones do not, and the epenthetic vowel in Lushootseed is high, not low. Yet in another sense, Lushootseed is just like Mekkan Arabic: in both languages, vowels in marked contexts are avoided through a variety of means; economy effects are part of a larger system.

Lushootseed also raises an issue for theories of differential vowel behavior. Low vowel syncope in the absence of high vowel syncope puts in question fixed rankings of MAX constraints of the sort proposed by Hartkemeyer 2000 and Tranel 1999 (see §4.3.6.3). At the very least, the fixed MAX hierarchy theory is insufficient: without further adjustments of some sort, differential syncope of low vowels simply is not possible in this approach. Adding context-free markedness constraints (Lombardi 2003, see §4.3.6.4) expands the power of the *STRUC/MAX hierarchy theory, but it expands it a bit too far: *LOW, for example, favors the deletion *a* in all contexts, which is not what we find in Lushootseed. To correctly analyze its pattern, *$\text{PK}_{\text{FT}}$/x and *$\text{MAR}_{\text{FT}}$/x need to be introduced, while context-free markedness constraints are demoted to the point where they pay no role in the analysis. This variety of economy constraints thus proves to be as unnecessary as *STRUC(σ) was in analyzing metrical syncope (chapter 3).

### 4.6.1 The patterns

The discussion of Lushootseed (Central Salish, Puget Sound, Washington State) presented in this section closely follows the description and analysis of Urbanczyk 1996, supplemented by data from Bates et al. 1994 and Hess 1998. Lushootseed has a four-vowel system [i, u, a, ə] with a length distinction. The syllable structure of Lushootseed is somewhat controversial (see Urbanczyk 1996, ch. 3), but not in ways that are crucially relevant to syncope or stress. The stress system is sonority-sensitive. The generalizations can be stated as follows:

(111) Lushootseed stress and syncope generalizations:

a. Default leftmost stress moves onto the next full vowel to avoid stressed *ə*.
b. When *a* cannot be stressed, it syncopates.
c. If the resulting cluster has rising sonority, *a* reduces to *ə* instead of deleting.

The patterns are exemplified in (112)-(116) (the data are from Urbanczyk 1996 unless otherwise indicated). As shown in (112), default stress is leftmost when all vowels in the word are of equal sonority or when the first is more sonorous than the second.

(112) Stress pattern: default left

| | | |
|---|---|---|
| a. | jə́səd | 'foot' |
| b. | ʔítut | 'sleep' |
| c. | sáliʔ | 'two' |
| d. | sáx̌ʷil | 'grass, hay' |

When the first vowel is schwa, stress moves onto the leftmost non-schwa vowel (113).

(113) Avoid stressed *ə*

| | | |
|---|---|---|
| a. | təyíl | 'to go upstream' |
| b. | čəgʷás | 'wife' |
| c. | k'ədáyu | 'rat' |
| d. | čəláq | 'ask permission' (Bates et al. 1994: 63) |

In about 50% of the cases, stress also moves to avoid unstressed *a*, as shown in (114). This suggests that high and low vowels are not fully conflated in the sonority-sensitive stress system of Lushootseed (see de Lacy 2001, 2002a and Prince 1997a, b on conflation).

(114) Avoid unstressed *a*

a. biɬáʔ ‘have more than enough’ *bíɬaʔ
b. yuwáɬ ‘the very’ *yúwaɬ
c. q$^{w}$uwádbəč ‘an owl of unidentified species’ *q$^{w}$úwadbəč (Bates et al. 1994:194)

Relatively rare are words that have more than one *a*, especially in a row. CV-reduplication is one morphological context where such words are expected, but here the second of two low vowels syncopates, as shown in (115). High vowels generally do not syncopate in this position.[96] In (116) syncope is impossible because the resulting sequence of a voiceless obstruent followed by a voiced obstruent is illegal. Instead of syncopating, *a* reduces to *ə* there:

(115) Delete *a* from unstressed positions, keep *i*

| | | | |
|---|---|---|---|
| a. | /RED-caq’/ | cácq’ | ‘to spear big game on salt water’ |
| b. | /RED-walis/ | wáwlis | ‘little frog’ *wáwălis |
| c. | /RED-laq-il/ | láʔlqil | ‘be a little late’ *laʔlaqil |
| d. | /s-RED-tiqiw/ | stítiqiw | ‘pony, foal’ *títqiw (Bates et al. 1994:226) |
| e. | /RED-hiqəb/ | híhiʔəb | ‘too, excessively’ (Bates et al. 1994:110) |
| f. | /RED-wiliq’$^{w}$id/ | wíwiliq’$^{w}$id | ‘quiz someone’ (Hess 1998:5/Bates et al. 1994:248) |

[96] There are some exceptions to this, most of which involve high vowels syncopating in unstressed positions. E.g., *kupi* ‘coffee’ → *kukpi*, **kukupi*, and *pišpiš* ‘cat’ → *pipšpiš*, **pipišpiš*. Urbanczyk tests the generalization with chi-square tests on dictionary word counts, which show that the higher propensity of *a* to syncopate is non-accidental. Possibly relevant is the fact that *kupi* is a loan from English, while *pišpiš* is from Chinook Jargon (Adam Werle, p.c.).

(116) When syncope is blocked by cluster condition, reduce *a* to *ə*

| | | | | |
|---|---|---|---|---|
| a. | /s-RED-łag$^{w}$id/ | s-łáłəg$^{w}$id | *s-łałg$^{w}$id | ‘little mat’ |
| b. | /RED-tabəc/ | táʔtəbəc | *taʔtbəc | ‘slowly, softly’ |
| c. | /RED-čaləs/ | čáčələs | *čačləs | ‘little hand’ |
| d. | /RED-saliʔ/ | sáʔsəliʔ | *saʔsliʔ | ‘two little items’ (Hess 1998:7) |

There is a further twist in the reduplication pattern. When the base contains a low vowel or a short non-schwa vowel, it appears in the reduplicant without alternations, as in (115) and (116). When the base contains a *ə*, a consonant cluster, or a long vowel (not shown), the reduplicant “overwrites” the base vowel with *i*:

(117) C*i* reduplication with schwa (Alderete et al. 1999:340)

| | | | |
|---|---|---|---|
| a. | təláw-il | tí-təlaw’-il | ‘run’/ ‘jog’[97] |
| b. | g$^{w}$ədíl | g$^{w}$í-g$^{w}$ədil | ‘sit down’/ ‘sit down briefly’ |

To summarize, the distribution of vowels in Lushootseed is to a large extent determined by the sonority-sensitive stress system: low and high vowels are preferred in stressed positions, while *ə* is preferred in unstressed positions. Syncope, reduction, and overwriting are the strategies used to ensure these output goals.

[97] According to the transcription in the *Lushootseed Dictionary*, the third vowel in *tí-təlaw’-il* does not syncopate or reduce to schwa, contrary to Urbanczyk’s generalizations. It may be that this is an exceptional form, but it is even more likely that there is a secondary stress on the *a*. Secondary stresses (or primary stresses, for that matter) are not consistently transcribed in the dictionary, but forms like *ʔá-ʔəgwàləb* ‘yawn-LG’ (cf. *ʔágwələb* ‘yawn’) indicate that non-initial *a* does sometimes bear secondary stress.

### 4.6.2 Analysis

4.6.2.1 Stress

I follow Urbanczyk 1996 in assuming that Lushootseed feet are trochaic—the language has initial default stress. Departures from the default pattern (ignoring lexically stressed suffixes, etc.) arise as a result of the conflict between PARSE-σ1 "the first syllable is footed"[98] and the *$\text{PK}_{\text{FT}}$/x constraints. When all vowels in the word are of the same sonority, as in *(jə́səd)*, stress is initial—*$\text{PK}_{\text{FT}}$/ə is violated whether stress is moved or not, so PARSE-σ1 breaks the tie. PARSE-σ1 is violated when the first syllable contains a schwa but the second contains a more sonorous vowel, as in *k'ə(dáyu)*. Finally, in about half of the cases, *a* pulls the stress away from high vowels, as in *bi(ɬáʔ)*.

(118) Stress low vowel, else leftmost

| | *$\text{PK}_{\text{FT}}$/ə | *$\text{PK}_{\text{FT}}$/i,u | PARSE-σ1 |
|---|---|---|---|
| a. ☞(jə́səd) | * | | |
| b. jə(sə́d) | * | | *! |
| c. ☞k'ə(dáyu) | | | * |
| d. (k'ə́da)yu | *! | | |
| e. ☞bi(ɬáʔ) | | | * |
| f. (bíɬaʔ) | | *! | |

Stress retraction is the first effect of sonority-sensitive stress constraints in Lushootseed: foot placement deviates from the normal pattern so that high sonority matches the stressed position. There are other ways to achieve the same goal, e.g., reduction and deletion. It is in principle possible to place the foot at the left edge of the word while

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[98] Urbanczyk uses the gradient alignment constraint ALIGN-L (FT, PRWD).

avoiding stress on schwa by deleting one of the vowels. In a word like *čəláq* ‘ask permission,’ the low vowel could be reduced to schwa without moving stress from the preferred initial position, as in **čə́ləq*. It could also be deleted yielding **čə́lq* without violating high-ranking constraints on resulting clusters—*lq#* is a possible cluster; cf. , *łučədálq* ‘where will I take this game.’ (This is true in general, although as we will see in the next section, *a* does reduce to schwa or delete when it cannot be stressed.) The lack of reduction and deletion indicates that MAXV and IDENT dominate PARSE-σ1:

(119) No reduction and deletion in general

| /čəlaq/ | IDENT | MAXV | PARSE-σ1 |
|---|---|---|---|
| a. ☞čə(láq) | | | * |
| b. (čə́ləq) | *! | | |
| c. (čə́lq) | | *! | |

Reduction and deletion are not available regardless of the direction of change: underlying *a* cannot become schwa, and underlying schwa does not lower to *a* in the first syllable, as in /jəsəd/ → **jásəd*. IDENT must dominate *$\mathrm{PK_{FT}}$/ə to select the marked *jə́səd* over the unfaithful **jásəd*:

(120) No stressed schwa lowering

| /jəsəd/ | IDENT | *$\mathrm{PK_{FT}}$/ə | PARSE-σ1 |
|---|---|---|---|
| a. ☞(jə́səd) | | * | |
| b. (jásəd) | *! | | |

In short, the preferred fix for situations where prominence and position are mismatched is to move the foot away from the default left edge rather than to be unfaithful to the input.

#### 4.6.2.2 Syncope and reduction of *a* to schwa

A mismatch of prominence and position occurs not only when schwa is a foot peak but also when a low vowel is a foot margin—this violates *MAR$_{\text{FT}}$/x constraints. Low vowels syncopate and reduce to schwa when simply changing the footing is not an option.

Such situations arise when bases with low vowels in the first syllable are reduplicated. It is impossible to build a foot around both low vowels, as in **(wá)(wális)*, so the second vowel deletes instead. Words with *a* in the first syllable of the base exhibit syncope in the second syllable, but words with high vowels generally do not. The reason for this lies in the ranking of the *MAR$_{\text{FT}}$/x constraints, as shown in (121). *MAR$_{\text{FT}}$/a dominates MAXV but *MAR$_{\text{FT}}$/i,u does not. Furthermore, IDENT dominates MAXV, so deletion is preferred to reduction, all else equal:

(121) Syncope of unstressed *a* but not of unstressed *i*

| | | *MAR$_{\text{FT}}$/a | IDENT | MAXV | *MAR$_{\text{FT}}$/i,u |
|---|---|---|---|---|---|
| /RED-walis/ | a. (wáw.lis)~(wá.wa)lis | W | | L | L |
| | b. (wáw.lis)~(wá.wə)lis | | W | L | L |
| /s-RED-tiqiw/ | c. (stí.ti)qiw~(stít.qiw) | | | W | L |
| | d. (stí.ti)qiw~(stí.tə)qiw | | W | | L |

Urbanczyk 1996 does not discuss what rules out parses like **(wá)(wális)*, but reasons are not hard to find: this sort of parse violates *CLASH. The *CLASH hypothesis was confirmed by my own search of the *Lushootseed Dictionary*, which did not unearth any words with clashing stresses.[99]

[99] Another possible reason for the unavailability of **(wá)(wális)* is that its first foot is not binary, although the FTBIN hypothesis is harder to verify in the absence of evidence for

There are situations when neither syncope nor refooting are available. If syncope would produce a cluster with rising sonority (i.e., one with a voiceless obstruent followed by a voiced one or with an obstruent followed by a sonorant), syncope is blocked and the vowel reduces to *ə* instead. The instrumental constraint here is SYLLCON: "sonority cannot rise between a coda and the following onset."[100] Schwa in unstressed position does not violate any *MAR$_{FT}$/x constraints, so it is the ideal choice for that position, though this particular way of being unfaithful is not ideal in Lushootseed.

(122) Reduction of unstressed *a* where syncope is impossible

| /RED-čaləs/ | *MAR$_{FT}$/a | SYLLCON | IDENT | MAXV |
|---|---|---|---|---|
| a. ☞ (čá.čə)ləs | | | * | |
| b. (čá.ča)ləs | *! | | | |
| c. (čáč.ləs) | | *!(č.l) | | * |

Reduction to schwa and syncope are both used only in very specific circumstances: when identical vowels are found in neighboring syllables. Low vowels do not generally reduce to schwa or delete, as might be expected if they were inherently marked with respect to the economy constraint *LOW (Beckman 1998, Lombardi 2003). Lushootseed provides the relevant evidence (see (115)). In *sáx̌$^{w}$il*, the low vowel does not delete because it is stressable. Forms like *sx̌$^{w}$aʔ* indicate that deletion is not blocked by a

consonant weight. It does appear that most Lushootseed words meet a minimum size requirement of CVC or CVV, so the FTBIN analysis may also be right.

[100] The formulation given here is simplified—for more elaborate theories of Syllable Contact and the harmonic scale that it is based on, see Baertsch 2002, Davis 1998, Davis and Shin 1999, Gouskova 2002a, b, Rose 2000c.

cluster condition. Furthermore, where it is possible to assign secondary stress to *a*, this is done—compare *ʔá-ʔəgwàləb* and *ʔágwələb*.

(123) No general deletion of low vowels (all forms from Bates et al. 1994)

| | | | | |
|---|---|---|---|---|
| a. | /sax̌ʷ-il/ | (sá.x̌ʷil) not **sx̌ʷíl* | 'grass, hay' | cf. sx̌ʷaʔ 'urinate'[101] |
| b. | /ʔá-ʔagʷaləb/ | (ʔá-ʔə)(gʷàləb) | 'yawn-LG' | |
| c. | /ʔagʷaləb/ | (ʔá.gʷə)ləb | 'yawn' | (reduction is optional) |

This behavior is predicted by the analysis. In non-reduplicated forms like *sáx̌ʷ-il* 'grass, hay,' deletion does not apply because nothing of value is gained: stress in the faithful candidate is already leftmost, and deleting the vowel removes a violation of the low-ranked constraint $*\text{M}\textsc{ar}_{\text{FT}}$/i,u at the expense of high-ranked MAXV:

(124) No deletion of *a* from stressable position

| /sax̌ʷ-il/ | $*\text{M}\textsc{ar}_{\text{FT}}$/a | MAXV | $*\text{M}\textsc{ar}_{\text{FT}}$/i,u |
|---|---|---|---|
| a. ☞(sá.x̌ʷil) | ✓ | | * |
| b. (sx̌ʷíl) | ✓ | *! | |

In derivational terms, this pattern may be described as deleting *a* from unstressed position: "assign stress to the most sonorous vowel on the left, and then delete unstressed *a*." In parallel terms this kind of description is nonsensical: the choice is really between having an unstressed *i* or not, and since unstressed *i* is no great evil in Lushootseed, syncope does not apply.

So far, we have seen three effects of the foot peak and margin constraints in the same grammar: departure from the default footing pattern, syncope, and reduction to

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[101] This word itself may be derived by schwa deletion; the Lushootseed dictionary gives *sx̌ʷaʔ* as an alternate form of *sʔəx̌ʷaʔ*. Schwa is somewhat elusive in Lushootseed in voiceless obstruent clusters—see Urbanczyk 1996, ch. 3 for discussion (also Hess 1998).

schwa. The next section is concerned with the fourth effect of these constraints, selection of the default vowel in reduplication.

4.6.2.3 <u>Default vowel in the reduplicant is *i*</u>

Although *a* is copied into the reduplicant faithfully, some vowels are not: *ə* and long vowels are replaced with *i*. Since the diminutive reduplicant is stressed and there is a strong preference in Lushootseed for stressed vowels to be low (recall *biɬáʔ~*bíɬaʔ*), the question arises why the default vowel is *i* and not *a*. The reason is that this vowel has no correspondent in the reduplicant, and therefore it is subject to REC/x constraints: inserted vowels should not be highly prominent. Schwa, the least sonorous epenthetic vowel, is ruled out by *PK$_{FT}$/ə, so *i* is the next best thing. This is a variation on the analysis developed by Alderete et al. 1999.

Alderete et al. argue that the faithful copying of the base schwa is prohibited by the constraint against stressed schwa, *PK$_{FT}$/ə, which dominates MAX-BR and DEP-BR. The base vowel is deleted in the reduplicant, and an *i* is inserted instead:

(125) Schwa cannot be reduplicated faithfully

| /RED-gʷədil/ | *PK$_{FT}$/ə | MAX-BR | DEP-BR |
|---|---|---|---|
| a. ☞gʷí-gʷədil | | **** | * |
| b. gʷə́-gʷədil | *! | *** | |

To this, we can add that the choice of epenthetic vowel is a matter for the BR versions of the REC constraints. Epenthetic *i* is the next best choice after epenthetic schwa. REC/a must dominate *PK$_{FT}$/i,u, because Lushootseed settles for a less-than perfect stressed *i* so as to avoid an overly prominent epenthetic *a*. The winner in (126) satisfies REC/a *and* *PK$_{FT}$/ə, which offsets its poor performance on *PK$_{FT}$/i,u and REC/i,u.

(126) Choosing the vowel for the reduplicant

| /RED-$g^w$ədil/ | REC/a | *$PK_{FT}$/ə | *$PK_{FT}$/i,u | REC/i,u |
|---|---|---|---|---|
| a. ☞($g^w$í.$g^w$ə)dil | | | * | * |
| b. ($g^w$á.$g^w$ə)dil | *! | | | |
| c. ($g^w$ə́.$g^w$ə)dil | | *! | | |

This analysis also explains why high vowels reduplicate faithfully (*s-duk*$^w$ ~ *s-dú-ʔ-duk*$^w$)—there simply isn't a way to improve on a stressed high vowel without violating REC/a.

(127) High vowels reduplicate faithfully

| /s-RED-$duk^w$/ | REC/a | *$PK_{FT}$/ə | *$PK_{FT}$/i,u | REC/i,u |
|---|---|---|---|---|
| a. ☞ s-dú-ʔ-$duk^w$ | | | * | |
| b. s-dá-ʔ-$duk^w$ | *! | | | |

4.6.2.4 Alternatives to the RECOVER analysis for Lushootseed

Alderete et al. use the constraint REDUCE ("Minimize the duration of short vowels," Kirchner 1996) to select *i* over *a*. While REDUCE is useful in Emergence-of-the-Unmarked situations as in Lushootseed, it cannot be used to determine epenthetic vowel quality in languages like Lillooet, where the shortest vowel is the only vowel to syncopate or be epenthesized.

The reason REDUCE cannot be used to determine epenthetic vowel quality generally is the following. For *ə* or *i* to be selected as epenthetic, all the relevant *NUC constraints must be dominated by REDUCE, because *NUC constraints favor low nuclei. But if this is the case, then schwa or *i* cannot be the only vowel to syncopate: REDUCE prefers *i* and *ə* to *a*, and it is ranked higher than *NUC. For the cheap vowel pattern, it is necessary that the constraints determining epenthetic vowel quality be faithfulness constraints. REC constraints are that, but REDUCE isn't.

REC constraints can also subsume the function of REDUCE in Yoruba reduplication, where *i* is the default in reduplication and the epenthetic vowel (e.g., *gírámà* 'grammar,' Pulleyblank 1988). It may not be possible to eliminate REDUCE from the grammar altogether, though. Kirchner 1996 and McCarthy 2003 use REDUCE to motivate raising in Bedouin Hijazi Arabic, where underlying /a/ maps to *i* in all open syllables, even when stressed: /katab-at/ → *ktíbat* 'she wrote,' /samiʕ/ → *símiʕ* 'he heard,' but /samiʕ-at/ → *sámʕat* 'she heard.' None of the markedness constraints discussed here can produce such raising, and the REC hierarchy is irrelevant since the vowels are underlying.

Urbanczyk 1996 analyzes default vowel quality in Lushootseed using the Place Markedness hierarchy:

(128) *PL/LAB, *PL/DORS>>*PL/COR (Smolensky 1993)

If one assumes a specific version of vowel feature theory under which *a* is dorsal, *u* is labial, and *i* is coronal, *i* is selected as the default vowel in the reduplicant. As Urbanczyk herself notes, though, it could be argued that *a* is actually less marked than coronals because it is pharyngeal. This issue is avoided in the REC hierarchy analysis.

### 4.6.3 Summary of the Lushootseed analysis

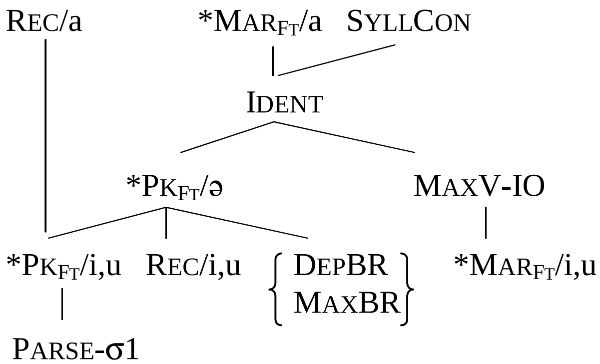
The phonology of Lushootseed vowels is to a large extent controlled by the constraints on foot heads and non-heads: they determine the placement of stress, require the deletion and reduction of unstressed *a*, and prevent faithful reduplication. The rankings for Lushootseed are as follows:

(129) *Ranking for stress*: IDENT >>*PK$_{FT}$/ə>>*PK$_{FT}$/i,u>>PARSE-σ1

(130) *Ranking for syncope/reduction*: *MAR$_{FT}$/a, SYLLCON>>IDENT>>MAXV

(131) *Rankings for reduplication*: *PK$_{FT}$/ə>>MAX-BR, DEP-BR, *PK$_{FT}$/i,u, REC/i,u

REC/a>>*PK$_{FT}$/i,u, REC/i,u




(132) Lushootseed stress, syncope, reduction, and reduplication

| | | R/a | *M/a | SC | ID | *PK/ə | MXV | R/ i,u | *PK/ i,u | *M/ i,u | P-σ1 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| /k'ədayu/ | a. k'ə(dá.yu)~(k'ə́.da)yu | | W | | | W | | | | | L |
| /təyil/ | b. tə(yíl)~(tə́yil) | | | | | W | | | L | W | L |
| /biłaʔ/ | c. bi(łáʔ)~(bí.łaʔ) | | W | | | | | | W | | L |
| /jəsəd/ | d. (jə́səd)~(jásəd) | | | | W | L | | | | | |
| /čəlaq/ | e. čə(láq)~(čə́.ləq) | | | | W | | | | | | L |
| /RED-walis/ | f. (wáw.lis)~(wá.wa)lis | | W | | | | L | | | L | |
| | g. (wáw.lis)~(wá.wə)lis | | | | W | | L | | | L | |
| /s-RED-tiqiw/ | h. (stí.ti)qiw~(stí.tə)qiw | | | | W | | | | | L | |
| | i. (stí.ti)qiw~(stít.qiw) | | | | | | W | | | | |
| /RED-čaləs/ | j. (čáčə)ləs~(čáč.ləs) | | | W | L | | W | | | | |
| /saxʷ-il/ | k. (sá.xʷil)~(sxʷíl) | | | | | | W | | W | W | |
| /RED-gʷədil/ | l. (gʷí.gʷə)dil~(gʷə́.gʷə)dil | | | | | W | L | | L | | |
| | m. (gʷí.gʷə)dil~(gʷá.gʷə)dil | W | | | | | L | L | L | | |

Tableau (132) summarizes the analysis. The first three candidate comparisons demonstrate the workings of the sonority-sensitive stress system: stress retracts away from *ə* onto *a* and *i* and from *i* onto *a*. The crucial ranking here is $*\text{PK}_{\text{FT}}$/ə>>PARSE-σ1, although $*\text{MAR}_{\text{FT}}$/a also plays a role. The candidates for /jəsəd/ and /čəlaq/ show that neither stressed schwa lowering nor unstressed reduction to schwa are available options if default footing or stress retraction are possible. When dealing with an input like /RED-walis/, it is impossible to avoid violations of $*\text{PK}_{\text{FT}}$/x and $*\text{MAR}_{\text{FT}}$/x without some kind of unfaithfulness (recall that footing every low vowel, as in **(wá)(wá.lis)*, is ruled out by *CLASH). Syncope is the preferred way of avoiding a violation of $*\text{MAR}_{\text{FT}}$/a here—reduction is deployed only when SYLLCON blocks deletion (witness **čá<u>č.l</u>əs*). High vowels do not undergo deletion in the weak branches of feet, as shown by *(stí.ti)qiw*. The form *(sá.x̌ʷil)* shows that there is no deletion of low vowels when they can head their own feet—in other words, deletion is not general avoidance of *a* but avoidance of *a* in the weak branches of feet. Finally, in diminutive reduplicants, schwa is not copied faithfully but replaced by *i*—again because of $*\text{PK}_{\text{FT}}$/ə. Schwa is not replaced with the the least marked peak, *a*, because REC/a prevents this. The high vowel is a compromise between avoiding stressed schwa and avoiding epenthetic *a*.

The effects of $*\text{MAR}_{\text{FT}}$/x and $*\text{PK}_{\text{FT}}$/x constraints are so varied that syncope is but a minor player in the grammar of Lushootseed. Most of the time, no structural economy results from the interaction of the constraints: feet are moved around, vowel quality changes, and only in some circumstances is syncope allowed to apply. Economy is an epiphenomenon of the sonority-sensitive stress system, it is not in any sense an output goal.

The Lushootseed pattern clearly points to a need for rethinking the context-free markedness theory: *a* is not marked in all contexts but only when there is no other way to avoid placing it in the weak branch of a foot. Differential low vowel syncope patterns are (arguably) all context-sensitive in this way. For example, in Estonian verbal morphology, low and mid vowels are deleted only when preceded by a long or "overlong" syllable, but not when preceded by a short syllable. High vowels are not deleted in any environments:

(133) Estonian low/mid syncope (Tauli 1973:99-100, Silvet 1965, Kiparsky 1994)

a. Low and mid vowels delete after a long or "overlong" syllable

| | | | |
|---|---|---|---|
| /saatta-ma/ | (saátt)ma | 'send' | cf. sáa.tan |
| /tappa-ma/ | (tápp)ma | 'kill' | cf. táp.pan |
| /jookse-ma/ | (jóoks)ma | 'run' | cf. jóok.sen |

b. High vowels do not delete after a long or "overlong" syllable

| | | | |
|---|---|---|---|
| /kaalu-ma/ | (káa)(lùma) | 'weigh' | cf. káa.lun |
| /salli-ma/ | (sál)(lìma) | 'tolerate' | cf. sál.lin |
| /rentti-ma/ | (rént)(tìma) | 'rent' | cf. rén.tin |

c. No deletion of anything after a short syllable

| | | | |
|---|---|---|---|
| /teke-ma/ | (téke)ma | 'do, make' | not ték.ma |
| /sata-ma/ | (sáta)ma | 'fall (rain, snow)' | not sát.ma |
| /latu-ma/ | (látu)ma | 'pile up' | not lát.ma |
| /küsi-ma/ | (kǘsi)ma | 'ask' | not kǘs.ma |

The environment for syncope is clearly related to foot structure and stress—the vowel deletes only in the position where it can bear secondary stress (Prince 1980). This is not avoidance of *a* in the margin of a foot, as in Lushootseed, but it is also not context-free deletion blocked by syllable structure constraints. It can only be so—no constraint assigns violations to *a* in all contexts in the Lenient theory of Con.

The next section continues the discussion of prosodic hierarchy-referring constraints and context-free markedness constraints that was started in §§4.3.6.3-4.3.6.4.

### 4.6.4 Alternative analysis of Lushootseed: context-free markedness

The biggest challenge presented by Lushootseed lies in explaining why the markedness status of *ə*, *i*, and *a* is so apparently inconsistent—they appear to be marked in some contexts but unmarked in others. This directly suggests a context-sensitive markedness analysis: without some reference to context, how else to explain the fact that schwa is marked in reduplicants (**gʷə́-gʷədil*) and stressed syllables (*tə.yíl* ≻ **tə́.yil*) but unmarked in unstressed syllables (*čá.čə.ləs*)? High vowels are relatively unmarked in reduplicants (*s-dú-ʔ-dukʷ*), in unstressed syllables (*stí.ti.qiw*), and in stressed syllables (*tə.yíl*), but when a low vowel comes along later in the word, high vowels lose stress to it as though they are marked (*biɬáʔ~ *bíɬaʔ*). Low vowels are unmarked in reduplicants (*čáčələs*), but clearly are the most marked vowels in unstressed syllables, where they are the only vowels to syncopate or reduce to *ə*.

A pure economy analysis of Lushootseed in terms of *STRUC constraints cannot capture these nuances because economy principles disregard context. To an economy principle, any structure is going to be marked, and the only way to aid the situation is to remove the structure, not to move feet around or change the quality of vowels. If deletion happens to be differential, it is not because one vowel is somehow more marked than another—they are *all* marked. Deletion is differential because faithfulness constraints protect certain vowels more than others.

The Lushootseed pattern of low vowel deletion in the absence of high vowel deletion goes against the predictions of the Hartkemeyer-Tranel MAX hierarchy, which can only deal with patterns of low-sonority vowel deletion. Recall that in this theory, the extent of differential syncope depends on the ranking of the *STRUC constraint in (134). Non-differential syncope corresponds to the ranking in (1), differential syncope of {*ə*, *i*, *u*, *e*, *o*} is (2), differential syncope of {*ə*, *i*, *u*} is (3), differential syncope of *ə* is (4), and (5) is no syncope at all.

(134) MAX-A >> MAX-E,O >> MAX-I,U >> MAX-SCHWA

↑ ↑ ↑ ↑ ↑

(1) (2) (3) (4) (5)

Under (134), syncope of *a* entails the syncope of all other vowels. So, if this ranking is to be maintained, (134) needs to be augmented with other mechanisms to deal with Lushootseed, such as an articulated theory of context-free markedness discussed in §4.3.6.4.

The ranking for differential deletion of *a* under context-free markedness is given in (135). *LOW dominates MAX-A, and because *LOW does not assign violation marks to either *i* or *ə*, its high ranking does not prevent other vowels from surfacing. The articulated MAX hierarchy is ranked above the rest of the markedness constraints so that *i* does not undergo deletion.

(135) Economy alternative: differential syncope of low vowels with context-free markedness

| | | *LO | MAX-A | MAX-I,U | MAX-ə | *NLO | *FRNT | *BCK |
|---|---|---|---|---|---|---|---|---|
| /s-RED-tiqiw/ | a. stí.ti.qiw~stít.qiw | | | W | | L | L | |
| /RED-walis/ | b. wáw.lis~wá.wa.lis | W | L | | | | | |

This analysis cannot be extended to default segmentism in reduplication. In Lushootseed diminutive reduplication, *a, i* and *u* are copied faithfully but *ə* is replaced with *i*. This means that *i* is the least marked vowel in the reduplicant, and this conclusion is inconsistent with the ranking in (135).

In Lombardi's theory, the ranking of *FRONT>>*BACK is universally fixed to capture the universal that in languages with both *i* and *ə*, *ə* is always the epenthetic vowel (assuming, as Lombardi does, that *ə* is [back]). This clearly does not hold of Lushootseed reduplicants, where *i* is less marked than *ə*. The reason for this is that this position is obligatorily stressed and stressed *ə* is marked in Lushootseed in general. To capture this connection, it would be necessary to include *PK$_{\mathrm{FT}}$/ə in the analysis, because only *PK$_{\mathrm{FT}}$/ə prefers the winning candidate in the comparisons *g$^w$í-g$^w$ədil~*g$^w$ə́-g$^w$ədil* and *wáw.lis~*wə́w.lis*. The latter was not an issue in the contextual markedness analysis, because substituting *a* with *ə* in this particular context is not favored by *any* constraint.

(136) Economy alternative: default segmentism in reduplication; *PK$_{\mathrm{FT}}$/ə required

| | | *PK/ə | *LO | MX-A | MX-I,U | MX-ə | *NLO | *FRNT | *BCK |
|---|---|---|---|---|---|---|---|---|---|
| /s-RED-tiqiw/ | a. stí.ti.qiw~stít.qiw | | | | W | | L | L | |
| | b. stí.ti.qiw~stə́t.qiw | W | | | W | | | L | W |
| /RED-walis/ | c. wáw.lis~wá.wa.lis | | W | L | | | | | |
| | d. wáw.lis~wə́w.lis | W | L | L | | | W | | |
| /RED-g$^w$ədil/ | e. g$^w$í-g$^w$ədil~ g$^w$ə́-g$^w$ədil | W | | | | L | | L | W |

*PK$_{\mathrm{FT}}$/ə explains why *a* is not replaced with *ə*, but the ranking above still predicts that *a* should be replaced with *i*: *PK$_{\mathrm{FT}}$/ə does not distinguish *wáw.lis* and **wíw.lis*, while the high-ranking *LOW favors the loser **wíw.lis*. To help *a* beat *i* in reduplicants (but not in bases, where *a* does syncopate), *PK$_{\mathrm{FT}}$/i,u must be added:

(137) Economy alternative: default segmentism in reduplication; *PK$_{FT}$/i,u required

| | | *PK/ə | *PK/i,u | *LO | MAX-A | MAX-I,U | MAX-ə | *NLO |
|---|---|---|---|---|---|---|---|---|
| /RED-walis/ | a. wáw.lis~wá.wa.lis | | W | W | L | | | |
| | b. wáw.lis~wə́w.lis | W | L | L | L | | | W |
| | c. wáw.lis~wíw.lis | | W | L | W | | | W |

There is yet another hole to plug. The ranking in (137) predicts that low vowels should delete whenever the phonotactic constraints permit, because they are marked regardless of context. This is wrong: if *a* occurs in a position where it can head its own foot, as in *sáx̌ʷil*, deletion does not apply. To prevent deletion here, *LOW must be *replaced* with a constraint that penalizes *a* only in the correct contexts, or else supplemented with such a constraint while being demoted below MAXV. It is impossible to block deletion here—clusters like *#sx̌ʷ* are not illegal in Lushootseed (witness *sx̌ʷaʔ* ‘urinate’), and since *a* is not initial in the word, it cannot be protected by a positional faithfulness constraint like ANCHOR-LEFT.[102]

(138) Blocking deletion of stressable *a*

| | | *PK/ə | *PK/i,u | *MAR/a | MAX-A | *LO |
|---|---|---|---|---|---|---|
| /sax̌ʷ-il/ | a. sáx̌ʷil~sx̌ʷil | | W | | L | W |
| /RED-walis/ | b. wáw.lis~wá.wa.lis | | | W | L | W |

Once these complexities are dealt with, it appears that the crucial choices between losers and winners in the analysis are made not by the context-free markedness

[102] A hypothetical constraint MAX-σ1 might seem like an intuitively attractive analysis, but it is impossible to formalize. The constraint cannot look to the output position since the thing it refers to is not present in the output (it’s been deleted), and it cannot be input-oriented since *a* is not necessarily the nucleus of the first syllable there (=Richness of the Base).

constraints but by *PK$_{FT}$/ə, *PK$_{FT}$/i,u and *MAR$_{FT}$/a. The context-free markedness constraints are no longer doing any work in the analysis. This is without even attempting to analyze another aspect of the Lushootseed system, stress assignment, where context-sensitive markedness constraints are irreplaceable.

Can context-free markedness constraints simply stay at the bottom of the hierarchy? The answer is no, because they are anything but harmless. Recall that their free ranking comes with some dangerous predictions for differential syncope and epenthesis (these were discussed in §4.3.6.4). These predictions will not go away unless these constraints are excluded from CON altogether.

Excluding *LOW and *NONLOW from CON is a fairly trivial matter—there are no legitimate scales for these constraints to be grounded in. Until a substantial markedness relationship can be established between low and nonlow vowels, membership in CON is closed to these constraints.

### 4.7 <u>Chapter summary</u>

This chapter was mainly concerned with situations where certain vowels are marked in certain contexts. For example, low sonority vowels (such as *ə*) are marked as syllabic nuclei and as heads of feet, while high sonority vowels (such as *a*) are marked when they occur in weak branches of feet. The constraints that encode these markedness relationships appear in hierarchies:

(139) Constraints on syllabic nuclei

*NUC/ə >> *NUC/i,u >> *NUC/e,o
*Nucleus harmony scale*: nuc/a ≻ nuc/e,o ≻ nuc/u,i ≻nuc/ə

(140) Constraints on the sonority of vowels in strong branches of feet

*PK$_{FT}$/ə >> *PK$_{FT}$/i,u >> *PK$_{FT}$/e,o
*Foot Head (peak) scale*: Peak$_{Ft}$/a ≻ Peak$_{Ft}$/e,o ≻ Peak$_{Ft}$/u,i ≻ Peak$_{Ft}$/ə

(141) Constraints on the sonority of vowels in weak branches of feet

*MAR$_{FT}$/a >> *MAR$_{FT}$/e,o>>*MAR$_{FT}$/i,u
*FtNonHead (margin) scale*: Mar$_{Ft}$/ə ≻Mar$_{Ft}$/u,i ≻ Mar$_{Ft}$/e,o≻ Mar$_{Ft}$/a

The *NUC/x hierarchy is of particular interest because in its original, non-lenient form it has the potential to duplicate the effect of *STRUC(σ): if there is a constraint against every kind of syllable nucleus, altogether these constraints ban *all* nuclei and therefore all syllables. Without the constraint *NUC/a, this gang-up effect of the *NUC/x hierarchy is diminished: only the less sonorous vowels violate *NUC/x constraints. Even with the addition of *PK$_{FT}$/x and *MAR$_{FT}$/x constraints, the effects of *STRUC(σ) cannot be duplicated: GEN can always supply at least some forms that do not violate any of the sonority constraints on vowels.

Another issue addressed in this chapter was the so-called *cheap vowel pattern*, where vowels of low sonority are inserted wherever required by phonotactic constraints and deleted otherwise. I presented a detailed OT analysis of such a pattern in Lillooet (§4.3): regardless of what the input looks like, underlying schwa must be deleted wherever phonotactic constraints permit, but if there are no underlying vowels, they must be supplied by the grammar in all the right environments. This economical pattern of schwa distribution and the relative ease with which it is epenthesized stem from its dual status: it is the most marked nucleus but the least marked epenthetic vowel. The latter property was attributed to a universally fixed hierarchy of positional faithfulness constraints that prohibit overly prominent epenthetic material, related to HEAD-DEP of Alderete 1999:

(142) REC/a>>REC/e,o>>REC/i,u

REC/x: "A syllable nucleus with the prominence *x* it must have a correspondent in the input."

Just like metrical syncope of Chapter 3, differential syncope is not one process but many. Depending on what is ranked above *NUC/x, the pattern may look essentially phontactically driven (as in Lillooet) or it may resemble metrical syncope (as in Lebanese Arabic, §4.4). This range of variation is expected when constraints of different kinds are allowed to interact freely.

Syncope is by no means the only effect of *NUC/x constraints: in Mekkan Arabic (§4.5), syncope of marked high vowel nuclei goes hand in hand with epenthesis of unmarked low vowel nuclei. The same point was explored in Lushootseed (§4.6). Lushootseed displays not one but four different effects of vocalic sonority constraints: foot placement, reduction of unstressed *a* to *ə*, default segmentism in reduplicants, and syncope. The fact that syncope is an economy effect is in in no way special here: it is just one of four ways to meet the demands of the constraints on foot peaks and margins.

Finally, I argued against economy analyses of differential syncope. The classic economy constraint *STRUC(σ) is too general for differential syncope since it penalizes nuclei of all sorts. For cases like Lillooet, it must be supplemented with a theory of epenthetic vowel quality that is consistent with *ə*-epenthesis and *ə*-syncope. Yet when this component is added, the theory becomes too rich; patterns are predicted that are neither observed nor plausible. Once the theory is applied to Lushootseed, where additional markedness considerations are clearly at play, it becomes redundant—the context-specific markedness constraints do all the work. Nihilistic markedness, whether expressed as a single constraint *STRUC(σ) or as *LOW, *NONLOW, *FRONT, *BACK, and so on, once again has failed to shed light on economy.

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