SIZE RESTRICTIONS IN PROSODIC MORPHOLOGY

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ABSTRACT

This dissertation proposes a theory of conditions on prosodic constituents and how they relate to morphological categories. A significant effect of such conditions is that they can impose minimal and maximal size limits on roots and words. A good deal of research has established that there are minimality restrictions on words (McCarthy & Prince 1986, Hayes 1995); this dissertation shows how minimal restrictions on roots and maximal size restrictions on both roots and words can be characterized through Prosodic Morphology.

Prosodically-based minimal and maximal size restrictions on a morphological category (MCat) are achieved indirectly through independently motivated concepts such as the Prosodic Hierarchy (Selkirk 1984) and Generalized Alignment (McCarthy and Prince 1993). A prosodically-based root size restriction follows from restrictions on prosodic categories. A language may require all prosodic words to be at *least* one binary foot through Headedness and Foot Binarity (McCarthy and Prince's (1986) "Minimal Word"), or to be at *most* one binary foot (plus optional unfooted syllables) through a ban on non-head feet (de Lacy 2003). A size restriction is then transferred to a root morpheme through *outputs* in which the PCat and the MCat are linked, a process dubbed Concurrence here. One example is a bare root, which is coextensive with a prosodic word: any size restriction on the PrWd is directly translated to the root morpheme in this environment. Equally important to the indirect approach advocated in this dissertation is Output Faithfulness, which can spread size restrictions derived through Concurrence to all outputs in the language (Benua 1997).

The introduction presents an overview of the proposals. Chapter 2 illustrates how they are integrated into the overall phonology of a language by examining the complex case of Czech maximal root size. Subsequent chapters explicate different aspects of the theory. Chapter 3 identifies the mechanisms behind minimal and maximal size restrictions, their predicted typologies and the strategies available for obtaining these sizes. The ways in which a root may acquire a prosodically-based size restriction are discussed in Chapter 4, which describes environments of Concurrence and explores the role played by Output Faithfulness. Chapter 5 discusses broader implications of the theory, such as a refinement of constraints on constituent alignment. Chapter 6 presents conclusions.

To my family

DECLARATION

This dissertation is the result of my own work and includes nothing which is the outcome of work done in collaboration except where specifically indicated in the text. No part of this thesis has already or is currently being submitted for any other qualification than the degree of Doctor of Philosophy at the University of Cambridge. This dissertation contains approximately 65,000 words.

Katherine H. Ketner
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1 INTRODUCTION

Generalized Template Theory seeks to account for size restrictions on morphological and prosodic constituents indirectly (McCarthy and Prince 1986 *et seq*.). A restriction that every word be at least disyllabic is due to the interaction of constraints on prosodic form and prosody-morphology alignment. There are no constraints that directly state that words should be minimally disyllabic. Size restrictions are an epiphenomenon of constraint interaction.

This dissertation systematically examines predicted size restrictions and leads to several novel discoveries. It shows that conditions on constituents other than feet can influence size restrictions (also see Hayes 1995). It shows that constraints can also impose size restrictions on roots, which may be different from restrictions on the prosodic word, even within the same language (e.g. Steriade 1988, Kager 1995). It builds on work by Ussishkin (2000) and de Lacy (2003) in identifying *upper* bounds on both root and word size. It also details how size restrictions can persist in morphologically complex wordforms because they exist in morphologically simplex (i.e. base) forms (Benua 1997, McCarthy 2005).

This dissertation also focuses on unattested size patterns. Such unattested patterns are argued to follow from two theoretical proposals. One is that alignment constraints cannot refer to the right edge, building on work by Nelson (1998, 2003) and Bye & de Lacy (2000). The other is that the inventory of alignment constraints referring to prosodic and morphological categories must be restricted to refer to head and non-head categories and to exclude constraints forcing every prosodic category to align with a certain morphological category.

These insights all stem from the initial observation that in some languages, the phonological content of words and roots is subject to size restrictions based on a prosodic unit. "Minimal Word" requirements are the most well-known: many languages require prosodic words to be at least a binary foot in size (McCarthy and Prince 1986 *et seq.*). For example, Māori prosodic words and roots must be at least one bimoraic foot long, a common minimal size restriction. At the same time, they may be at *most* one binary foot plus two non-adjacent unfooted light syllables. Therefore, Māori imposes both a minimal and a maximal size restriction on prosodic words and root morphemes, which is evident in the data below (roots are double-underlined throught this work; de Lacy 2003).

(1) *Māori has a minimal and maximal PrWd size*

Ft	[(ˈpaː)]	'fortified village'	[(ˈho.ka)]	'to run out'
Ftσ	[(ˈk͡au)ɾi]	*type of tree*	[(ˈa.ɾi)hi]	'to chop'
σFt	[ku(ˈɾiː)]	'dog'	[ko(ˈp͡ou)]	'to appoint'
σFtσ	[ta(ˈm͡ai)ti]	'child'	[ma(ˈnaː)ki]	'to show kindness'

*[(σ_μ)], *[(□Ft)(□Ft)], *[Ftσσ]

The prosodically-based minimal and maximal size restrictions in Māori are also observable in the process of affixation. The data below shows that the language adopts three different strategies for incorporating the passive suffix /-ia/ while observing the maximal size restriction. When possible, the root plus suffix will surface faithfully (a). When a fully faithful output would prove too long, then the suffix will undergo minor deletion (b). An even longer root reveals that deletion from the root and total deletion of the suffix are banned; therefore, the best option becomes fracture of the morphological word into separate prosodic words (c).

(2) *Māori maximal PrWd size and suffixation*

a) *Output surfaces faithfully*

[(□ho.ka)]	‘to run out’-ACT	[ho(□ka□-i)a]	PASS
[(□ti.a)]	‘to paddle vigorously’-ACT	[ti(□a□-i)a]	PASS

b) *Deletion from suffix*

[ko(□po□u)]	‘to appoint’-ACT	[ko(□po□u)-a]	PASS
[ta(□pa□e)]	‘to present’-ACT	[ta(□pa□e)-a]	PASS

c) *Fracture into multiple prosodic words*

[(ˈa.ɾi)hi]	‘to chop’-ACT	[{ˈa.ɾi)hi}{(-ˈti.a)}]	PASS
[(ˈma.hu)e]	‘to put off’-ACT	[{(ˈma.hu)e}{(-ˈti.a)}]	PASS

*[(ˈma.hu)(ˌe.i)a], *[(ˈma.hu)e.i.a], [(ˈma.hu)a]

These restrictions on prosodic word size form the basis for similar restrictions on the root morpheme, through a process which will be discussed in greater depth in §4.

Prosodic size restrictions, such as those in Māori, are characterized through a highly restrictive theory of minimal and maximal size restrictions in this dissertation. It is argued that such restrictions are due to independently motivated phonological considerations, such as ALIGNment (McCarthy & Prince 1993b) and the Prosodic Hierarchy (Selkirk 1984). Restrictions on the size of the root are shown to be an extension of prosodic word size restrictions, which become universal within a language through transderivational and intraparadigmatic faithfulness.

Interactions between prosody and morphology, such as a prosodic size restriction on a root, are captured in the theory of Prosodic Morphology and Generalized Template Theory, which form the basis of the analysis presented here (McCarthy and Prince 1986, 1990a, 1990b, 1993a, 1993b, 1994a, 1994b, 1995a, 1995b, 1997, 1999). Under the Generalized Prosodic Morphology hypothesis, size restrictions emerge from constraints on prosodic constituents and the way these constituents are related to morphological structure. This dissertation aims to do two things: (1) systematically explore predictions of the theory for minimal *and* maximal size restrictions, and (2) propose conditions on size-influencing constraints.

The Prosodic Morphology program began with the identification of prosodic restrictions on morphological categories, which were initially characterized by templates (McCarthy and Prince 1986). This insight developed into the Generalized Template Theory, which replaced templates as such with more universal constraints on prosody, morphology and the interaction of the two (McCarthy and Prince 1994a,b). This dissertation represents an extension of this approach, as minimal and maximal prosodically-based size restrictions, and their application to root morphemes, are characterized through universal, independently motivated constraints.

The tools provided by Prosodic Morphology predict that similar size restrictions should be found in many different environments, not just the prosodic words and roots explored here. Prosodic size restrictions are also attested in reduplicants, truncations (both e.g. McCarthy and Prince 1994b), child language acquisition (e.g., Demuth 1996), language disorders (e.g., Kessler and Piggott 1999) and language games (e.g., Hammond 1990, Bagemihl 1995). These size restrictions are achieved through similar means to those described here for prosodic words and roots.

The following sections outline the theory of minimal and maximal word and root size restrictions. First, Section 2 examines the theoretical mechanisms behind PrWd size requirements. Section 3 identifies the different shapes which may satisfy a prosodic size restriction, along with the tools available for a language to obtain its target size. Section 4 explores how a prosodic size restriction may be imposed on a morphological category through Concurrence and Output Faithfulness. Section 5 identifies the theoretical implications for the ALIGN family of constraints – I show that ALIGN must be substantially limited in order to avoid unattested size restrictions. Section 6 presents a brief outline of the theoretical framework, Optimality Theory, and Section 7 summarizes and provides a more detailed outline of the remainder of this dissertation.

2 PROSODIC WORD SIZE RESTRICTIONS

The relationship between different prosodic units is characterized by the Prosodic Hierarchy (Selkirk 1980a, 1980b, 1984, McCarthy and Prince 1990a, 1995b). At the sub-PrWd levels, a prosodic word (PrWd) is composed of feet (Ft) which are composed of syllables (σ), represented graphically below. There is a universal restriction on the Prosodic Hierarchy which is crucially important to the arguments in this dissertation, Headedness, which stipulates that every node of level *n* dominates one and only one head of *n-1* (Selkirk 1995). Prosodic structure must not be strictly layered (i.e., a node on level *n* may dominate a node lower than *n-1*).

(3) *Prosodic Hierarchy*

PrWd
|
Ft
|
σ

Moras do not play any role in prosodic size requirements. McCarthy and Prince's work on alignment (1993b) concluded that moras may be a syllabic property rather than an independent prosodic unit. (See also Clements 1990 and discussion in Ch5§1.)

Prosodic size restrictions are derived through constraints on the Prosodic Hierarchy and its constituents. The cases considered in this dissertation require a prosodic word to be at least one binary foot long – i.e., a minimal word restriction – or at most one binary foot long, with optional unfooted syllables – i.e., a maximal word restriction. (In many cases, this size restriction is also imposed on a root, a process which will be addressed in Section 4.) For example, a minimal size restriction is straightforwardly characterized through the Prosodic Hierarchy. Headedness requires each prosodic unit to dominate a head of the immediately subordinate unit (Selkirk 1984, Nespor and Vogel 1986, Itô and Mester 1993, Selkirk 1995). In other words, each prosodic word must have at least one (head) foot. When this foot must be binary, then each prosodic word will be at least the size of one binary foot in size (Prince 1980, esp. McCarthy and Prince 1986 *et seq.*).

On the other hand, a maximal size restriction is derived from the requirement that each prosodic word have one head foot, but no secondary feet. When non-head feet are banned, then each prosodic word dominates a single, head foot (de Lacy 2003). Therefore, a ban on non-head feet results in each prosodic word being at most one foot long. Other considerations, such as the status of unfooted syllables, may also affect the maximal size restriction. This was seen in the Māori data above, where the maximal PrWd and root size is a single binary foot plus non-adjacent unparsed syllables, [σFtσ]. The following sections will discuss the formal mechanisms behind minimal and maximal PrWd size in §2.1 and 2.2.

2.1 Minimal word size

Many languages have a minimal word size, including Māori above and German. The data in (4) shows that German words may have many different shapes but all are at least one binary foot in length (Clark and Thyen 1998, Golston and Wiese 1998). German will be discussed in depth in Chapter 4§2.1.

(4) *Minimal word size in German*

[($\sigma_{\mu\mu}$)]	[(ˈt͡sɛː)]	'tough'	[(ˈba͡u)]	'building'
[(σσ)]	[(ˈʔaː.təm)]	'breath'	[(ˈzɛ.t͡s-n̩)]	'to put'
[Ft…]	[(ˈʔaː.təm)(ˌ-loːs)]		'breathless'	
	[(ˌyː.bɐ-)(ˈzɛ.t͡s-ʊŋ)]		'translation'	
*[(σ_{μ})]				

The mechanisms behind minimal word size have been prominently discussed, notably within McCarthy and Prince's work on Prosodic Morphology (1986 *et seq.*, also see Hayes 1995, Garrett 2002). The relationships expressed through the Prosodic Hierarchy in (1) play a central role through the principle of Headedness (Selkirk 1984, Nespor and Vogel 1986, Itô and Mester 1993, Selkirk 1995). Headedness requires each prosodic category to dominate at least one member of the immediate subordinate category: all feet must dominate at least one syllable and all prosodic words must dominate at least one foot. Headedness is taken to be an inviolable property after

Selkirk (1995; cf. Crowhurst 1996). Feet prefer to be binary – i.e., bimoraic or disyllabic (Prince 1980, Hayes 1985, McCarthy and Prince 1986) –, which is expressed through the OT constraint FT-BIN (Prince & Smolensky 1993; see Ch3§2 for further discussion of foot binarity).

(5) FT-BIN: Feet are binary at some level of analysis (σ, μ).

Combining foot binarity with Headedness translates into a system where all prosodic words must be at least one binary foot in size. This is the definition of the traditional "Minimal Word" (McCarthy and Prince 1986 *et seq.*) and the source of other prosodically-based minimal size restrictions, such as the restrictions on root size to be discussed in Section 4.

If a foot (and so, the PrWd) must be binary – bimoraic or disyllabic – then a shorter input will be augmented in order to achieve this minimal size. This is illustrated in the following tableau, where a hypothetical subminimal input is lengthened in order to obtain the minimal size. Hypothetical inputs (i.e., those which are not determined by alternations but are predicted to be possible by Richness of the Base), are marked with 'ʔ'. An output less than one binary foot in length is rejected.

(6) *Minimal size in German words*

Feet are binary » Don't change segment weight

ʔ/kɛ/	FT-BIN	IDENT(weight)
Λ a) [(ˈkɛː)]		*
b) [(ˈkɛ)]	*!	

Therefore, when FT-BIN outranks faithfulness to the input – given that Headedness is inviolable – then every PrWd will have at least one binary foot in the output. Minimal word size is therefore captured in the following constraint schema.

(7) *Minimal word size*

FT-BIN » Faith

The factors determining whether the minimal word size is a bimoraic or disyllabic foot, as well as the various strategies for obtaining this size, will be introduced in Section 3. The next section examines the constraint interaction behind a maximal word size.

2.2 Maximal word size

A "maximal word" size is found in Māori above and is also evident in Czech, where words may be up to one binary foot in length in their simplest inflections. Longer words are not permitted (except in morphologically complex words, which will be discussed directly). In the data below, each PrWd may be up to one binary foot in length, while longer words are banned (Fronek 1999).

(8) *Maximal size in Czech words*

[(σ_μ)]	[(ˈdn-o)]	'bottom'	[(ˈmst-a)]	'revenge'
[($\sigma_{\mu\mu}$)]	[(ˈluːj)]	'suet'	[(ˈd-aː-t)]	'to give'
[(σσ)]	[(ˈja.zɪk)]	'language'	[(ˈmo.ř-ɛ)]	'ocean'

*[(ˈFt)(ˌFt)…], *[Ftσ…]

The maximal word size in Czech is due to a ban on non-head feet and a requirement for exhaustive parsing. (This will become even more evident in §3.2, where the full typology of maximal size restrictions is discussed.) After de Lacy (2003), a maximal prosodic size restriction is expressed through the following economy constraint, part of the *STRUC family of constraints (Zoll 1993, 1996).[1]

(9) *FT-: Incur a violation for each non-head foot

The maximal word size in Czech is achieved through the ban on non-head feet forcing a potentially over-long input to be pared down to an acceptable size. Czech does not provide an overt example of reduction to achieve this maximal word size: the size restriction is a phonotactic generalization found in simple words. However, all inputs

[1] Gouskova (2003) argues that *STRUC constraints should not be included in CON because they indiscriminately ban all structure, including unmarked structure. The constraint *FT- acknowledges this insight by only banning a marked structure, a non-head foot (Beckman 1998).

must be considered under Richness of the Base (§6), so an over-long input – even if there is no evidence for it on the surface – must also be accounted for. This interaction is illustrated below with a hypothetical input. Analysis of other areas of Czech phonology reveals deletion to be the preferred repair method (Ketner 2003). A $^{+}$ marks a foot as a head, and a $^{-}$ marks it as a non-head.

(10) *Maximal size in Czech words*

Don't have non-head feet, Parse all syllables into feet » Don't delete

ˀ/jazɪkatat/	*FT-	PARSE-σ	MAX
a) [(ˈja.zɪ)$^{+}$(ˌka.tat)$^{-}$]	*!		
b) [(ˈja.zɪ)$^{+}$ka.tat]		**!	
Λ c) [(ˈja.zɪk)$^{+}$]			*

Czech reveals that a maximal word size may be represented through the following constraint schema, where the ban on non-head feet forces the output to be unfaithful to the input. The predictions of this ranking and the different responses which can be employed to achieve a maximal size will be introduced in §3 and discussed in depth in Ch3§3.

(11) *Maximal word size*

*FT- » Faith

In Czech, this maximal size is only upheld by PrWds in their simplest inflections and by extension, in roots (§4; Ch2§4.2). Morphologically complex words may be much longer. Although they still have a single foot, any number of additional syllables may remain unfooted. Some of the roots from the simple words in (8) are shown in more complex words below, which illustrate the longer outputs tolerated in polymorphemic words.

(12) *Maximal size blocked in complex words*

[(□do.-d-a)-va-.t-ɛl] P-give-TH-CONT-E1-NOM	'supplier'	cf. [(ˈd-aː-t)] 'to give'
[(□bɛ.zɛ)-dn-iː] P-bottom-AdjNomSg	'bottomless'	cf. [(ˈdn-o)] 'bottom'
[(□pro.-baː)d-aː.-ɲ-iː] P-research-TH-E4-GER	'exploration'	cf. [(ˈbaː.d-a-t)] 'to research'
[(ˈmo.ř-ɛ)-pla.v-ɛt͡s.-tv-iː] ocean-TH-swim-NOM-ABS-AdjNomSg	'nautical'	cf. [(ˈmo.ř-ɛ)] 'ocean'
[(□ɲɛ.-k-o)l-ɪ.k-a.-ja.zɪt͡ʃ.-n-iː] INDEF-Q-NUM-NOM-PL-language-e4-AdjNomSg	'multilingual'	cf. [(ˈja.zɪk)] 'language'

In more complex outputs, deletion to obtain a maximal PrWd size of one foot is blocked to preserve the morphological integrity of the input. For example, total deletion of a morpheme is prevented through the constraint REALIZEMORPH (Samek-Lodovici 1993). Both candidates in the following tableau satisfy the ban on non-head feet, but reducing the input so that it is one foot or shorter fatally violates pressure for each morpheme to have an overt expression in the output.

(13) *All morphemes must be overtly realized*

Don't have non-head feet, Morphemes overtly realized

/ɲɛ-k-ol-ɪk-a-jazɪk-n-iː/	*FT-	REALIZEMORPH
a) [(ˈɲɛk.jan)]		*!
Λ b) [(□ɲɛ.ko)lɪ.ka.ja.zɪt͡ʃ.niː]		

Instead of deletion, the ban on non-head feet is satisfied by permitting additional syllables to surface unfooted. The constraint PARSE-σ militates against unfooted syllables (Liberman and Prince 1977, Prince and Smolensky 1993), but here it is crucially dominated by the pressure for every morpheme to be overtly realized. PARSE-σ must also outrank MAX, since deletion is the first choice of repair and non-exhaustive parsing is only resorted to as necessary.

(14) *Morpheme preservation causes non-exhaustive parsing*

Morphemes overtly realized » Parse all syllables into feet » Don't delete

	/ɲɛ-k-ol-ɪk-a-jazɪk-n-iː/	REALIZEM	PARSE-σ	MAX
	a) [(ˈɲɛk.jan)]	*!		*
Λ	b) [(▯ɲɛ.ko)lɪ.ka.ja.zɪt͡ʃ.niː]		*	

In sum, a maximal word size is the product of a ban on non-head feet. This size restriction may be blocked by other phonological factors, so that as in Czech, it only emerges in morphologically simple outputs and in root morphemes. Languages with absolute maximal PrWd sizes include Māori (Ch3§3; de Lacy 2003) and isolating languages like Lao (Morev, Moskalev and Plam 1979).

The following section takes a closer look at how a minimal or maximal size is implemented; specifically, which output shapes may satisfy a size restriction and the tools a language may use in order to obtain this size.

3 TYPOLOGY OF SIZE RESTRICTIONS

The factors producing a minimal or maximal size restriction can lead to several different outcomes, not only in the size of the output but also in how this size is obtained. Simply put, a minimal or maximal PrWd size is produced wherever foot binarity or a ban on non-head feet restricts the size of the output, and this limitation may be satisfied through any response sufficiently augmenting or constraining an offending input. This section examines the typologies of minimal size (§3.1) and maximal size (§3.2), before examining the strategies for obtaining a size restriction, such as epenthesis or deletion, in §3.3. Finally, the influence extraprosodicity may have on a size restrictions is discussed in §3.4.

3.1 Typology of minimal size

A minimal size restriction is a by-product of foot binarity (Prince 1980) and Headedness, a prediction first articulated by McCarthy and Prince (1986 *et seq.*). Feet may be binary on the level of the mora or the syllable, which leads to the following typology of minimal size.

(15) *Typology of minimal size*

a) Quantity-sensitive minimum: $(\sigma_{\mu\mu})_{Ft}$

b) Quantity-insensitive minimum: $(\sigma\sigma)_{Ft}$

The mechanisms producing to each type of minimal size will be identified in the discussion of Shipibo in Ch3§2.1. Shipibo words must be at least one bimoraic foot long, which can be seen in the following data (Elias-Ulloa 2006). The language is standardly quantity-insensitive, but a bimoraic, quantity-sensitive foot is permitted when doing so would satisfy the minimal PrWd size restriction. This change in footing shows that the pressure to meet a minimal size restriction may override a language's general phonotactic requirements.

(16) *Minimal size in Shipibo*

$[(\sigma_{\mu\mu})]$	[(□t□i□)]	'fire'	[(□tɨ□)]	'work'
$[(\sigma\sigma)]$	[(□ba.kɨ)]	'child'	[(□pi.-ti)]	'food'
[Ft…]	[(□a.ta)pa]	'hen'	[(a.□in)bu]	'woman'
$*[(\sigma_{\mu})]$				

The difference between binary feet – bimoraic or disyllabic – is determined through two constraints, one banning monomoraic feet and the other banning monosyllabic feet (Elias-Ulloa 2006, see Ch3§2 for discussion). This formulation captures the distinction that disyllabic feet also satisfy the requirement for feet to be bimoraic, even though disyllabic feet may have more than two moras. A bimoraic minimal size, as in Shipibo, is produced when the impetus for feet to be bimoraic (represented by the constraint *FOOT(μ)) outranks faithfulness to the input, which outranks pressure for feet to be disyllabic (*FOOT(σ)). Shipibo's bimoraic minimal size is illustrated in the tableau below, where a subminimal input is augmented through vowel lengthening so that the PrWd satisfies the minimal size.

(17) *Bimoraic minimal size in Shipibo*

Feet are bimoraic » Don't epenthesize » Don't lengthen V, Feet are disyllabic

‽/ti/	*FOOT(μ)	DEP	IDENT(weight)	*FOOT(σ)
a) [(ti)]	*!			*
b) [(titi)]		*!		
Λ c) [(ti□)]			*	*

The opposite situation, a disyllabic minimal size, is obtained any time the ban on monosyllabic feet outranks faithfulness to the input. The stringency relationship between *FOOT(σ) and *FOOT(μ), in which a disyllabic output satisfies both constraints but a monosyllabic bimoraic output only satisfies the latter, makes the ranking of the ban on monomoraic feet irrelevant. The two tableaux below show that no matter the role played by *FOOT(μ), the PrWd will have a minimal size of a disyllabic foot any time *FOOT(σ) can force a faithfulness violation.

(18) *Disyllabic minimal size: Ranking of* *FOOT(μ) *irrelevant*

a) No monosyllabic feet » Faithfulness to input » No monomoraic feet

‽/CV/	*FOOT(σ)	Faith	*FOOT(μ)
a) [(σ_{μ})]	*!		*
b) [($\sigma_{\mu\mu}$)]	*!	*	
Λ c) [(σσ)]		**	

b) No monosyllabic feet, No monomoraic feet » Faithfulness to input

‽/CV/	*FOOT(σ)	*FOOT(μ)	Faith
a) [(σ_{μ})]	*!	*	
b) [($\sigma_{\mu\mu}$)]	*!		*
Λ c) [(σσ)]			**

The two types of minimal size restriction are therefore characterized by the following constraint rankings.

(19) a) *Bimoraic minimal size:*
*FOOT(μ) » Faith » *FOOT(σ)
b) *Disyllabic minimal size:*
*FOOT(σ) » Faith

Chapter 3§2.1 provides a full analysis of the typology of minimal size, and the following section looks at the different expressions of a maximal size restriction.

3.2 Typology of maximal size

A maximal size is produced through a ban on non-head feet, as argued in §2.2. This prosodic restriction leads to four possible maximal sizes, each with a single foot limiting the output size. Which maximal size a language employs depends on the interaction with faithfulness, non-exhaustive parsing and ALIGNment.

(20) *Typology of maximal size*
a) Minimal maximal PrWd: Ft
b) Loose maximal PrWd: σ Ft σ
c) Right-loose maximal PrWd: Ft σ
d) Left-loose maximal PrWd: σ Ft

All languages allow outputs of size (a). If a language has a maximal size restriction, it may choose to *only* allow size (a). Only three other maximal size restrictions are possible. A language may allow forms of size {Ft, Ftσ} or {Ft, σFt}. Or it may allow outputs of {Ft, σFt, Ftσ, σFtσ}. No language has any other maximal size restrictions except in one very specific instance: *roots* may be maximally smaller than a foot in size but only if they are "bound," i.e., always accompanied by an affix – see §4.1. Whether the language permits outputs shorter than one foot in size is determined by its relationship with the minimal size restriction, as outlined in §3.1 above, which is independent from the maximal size restriction discussed here.

The largest maximal size, a 'loose' PrWd consisting of a binary foot plus non-adjacent unfooted syllables, comes about when non-head feet are banned but non-exhaustive parsing is permitted. A second foot would violate *FT-, and a sequence of unfooted syllables (e.g., Ftσσ…) is prevented by a ban on lapses (Prince 1983, Green and Kenstowicz 1995). The output is as faithful as possible to a longer input while avoiding a second foot or a potentially foot-able sequence. This maximal size is found in Māori words and roots, illustrated below and with a full analysis provided in Ch3§3 (de Lacy 2003).

(21) *Maximal size in Māori*

Ft	[(ˈpaː)]	'fortified village'	[(ˈho.ka)]	'to run out'
Ftσ	[(ˈka͡u)ɾi]	*type of tree*	[(ˈa.ɾi)hi]	'to chop'
σFt	[ku(ˈɾiː)]	'dog'	[ko(ˈpo͡u)]	'to appoint'
σFtσ	[ta(ˈma͡i)ti]	'child'	[ma(ˈnaː)ki]	'to show kindness'

*[(σ_μ)], *[(□Ft)(□Ft)], *[Ftσσ]

The Māori maximal size can also be seen in alternations. For example, suffixes are reduced in size when they would create a prosodic word that is too large: e.g., /kopou-ia/ → [ko(ˈpou)a], *[ko(ˈpou)(ˌi.a)], *[ko(ˈpou)i.a] 'to appoint'-PASS.

The ban on lapses is necessary for the output to have a maximal size. Systems with a single foot and any number of unfooted syllables are a predicted response to a ban on non-head feet and are attested in languages such as Czech (Ch2§4.2). However, this does not result in a maximal size: the output size is not restricted, but is featurally fully faithful to the input. The ban on non-head feet is reflected in the prosodic structure but does not lead to a maximal size restriction.

A maximal size of a single binary foot is due to the same restriction on non-head feet, with an additional ban on unfooted syllables. That is, only one foot is permitted, and every syllable must be parsed into a foot. A maximal word size of Ft is found in isolating languages, such as Vientiane Lao (Morev, Moskalev and Plam 1979) or Ancient Thai (Brown 1965). Czech PrWds also have a maximal size of one foot in the first instance, although this restriction is obscured in morphologically complex prosodic words (Ch2§4.2).

The other types of maximal size, Ftσ and σFt, are similar to Māori's loose maximal size but are additionally influenced by alignment constraints. In the former, the left edge of the prosodic word must coincide with the left edge of the foot, or potentially with the left edge of the head syllable (in a trochaic system). Unfooted syllables are still permitted, but left-edge alignment may not be compromised. The result is a left-aligned foot and a single unparsed syllable.

The complementary maximal size, σFt, is also attributable to alignment between two prosodic categories but is somewhat more complex. This dissertation argues against right-edge alignment (Ch5), so foot-word alignment at the right edge corresponding to that accounting for a maximal size of Ftσ is dismissed. Instead, apparent right-edge head effects are argued to be better accounted for through left-edge alignment of non-heads. This maximal size is therefore due to alignment of the left edge of the word with a non-head syllable: $[\sigma^{-}(\sigma^{+}\sigma^{-})]$ or $[\sigma^{-}(\sigma_{\mu\mu}{}^{+})]$. The implications of (non-)head alignment are discussed in further detail in §5 and Ch5§4.1.

The constraint rankings leading to each of these maximal sizes are outlined below.

(22) *Maximal size constraint schemas*

a) Ft : *FT-, PARSE-σ » Faith

b) σFtσ : *FT-, *LAPSE » Faith » PARSE-σ

c) i. Ftσ : *FT-, *LAPSE, ALIGN-L(Ft^{+}, PrWd) » Faith » PARSE-σ

ii. $Ft_{TROCHEE}\sigma$: *FT-, *LAPSE, ALIGN-L(σ^{+}, PrWd) » Faith » PARSE-σ

d) $\sigma Ft_{TROCHEE}$: *FT-, *LAPSE, ALIGN-L(σ^{-}, PrWd), TROCHEE » PARSE-σ » Faith

Full discussion of the typology of maximal size and the constraint rankings leading to each is provided in Ch3§3. The following section looks at the strategies a language may employ in order to obtain a minimal or maximal size.

3.3 Typology of responses

A minimal or maximal size restriction may provoke several different responses, so long as the output has an appropriate size. Essentially, a minimal size restriction requires a subminimal input to be augmented, while a maximal size restriction requires a supermaximal input to the pared down. The repairs leading to a prosodic size restriction may be broken down into three main strategies, as below.

(23) *Strategies for obtaining a size restriction*

- a) Faithfulness violation
- b) Exceptional prosodification
- c) Null parse (i.e., ineffability)

The first approach for obtaining a size restriction is for the output to be unfaithful to the featural content of the input. A minimal size restriction may lead to an output segment having no correspondent in the input (i.e., epenthesis), while a maximal size may be reached when an input segment has no correspondent in the output (i.e., deletion). A similar response involves multiple segments having a single correspondent, either when a single input segment has multiple correspondents in the output (i.e., segment splitting) or when multiple input segments are realized in a single output segment to reduce the size of the output (i.e., coalescence). Finally, a change in segment length may achieve a minimal size (i.e., vowel lengthening or consonant gemination) or a maximal size (i.e., vowel shortening or consonant degemination). The use of a faithfulness violation to reach a prosodic size restriction arises several times in this dissertation, including deletion in Czech (Ch2§3) and in Māori (Ch3§3), epenthesis in Lardil (Ch4§3.2), segment splitting in Tagalog (Ch3§2.2.2), vowel lengthening in Shipibo (Ch3§2.2.1) and consonant gemination in Yup'ik (Ch4§2.1.3).

Another strategy for meeting the prosodic size restriction is for the language to employ a different prosodic structure from standard, an approach dubbed here "exceptional prosodification." For example, Māori prosodic words are restricted to a maximal size of a single foot plus non-adjacent unparsed syllables. When the passive suffix /-ia/ is added to shorter words (a), they surface faithfully. However, a longer root cannot incorporate the suffix into an acceptable prosodic word, so the input is split into two prosodic words (b; de Lacy 2003). (Epenthesis of [t] is a standard process to ensure that each affix-initial prosodic word starts with an onset.) The data below shows that PrWd-splitting is preferable to the other options, such as allowing a secondary foot or a sequence of unfooted syllables.

(24) *Exceptional prosodification in Māori*

a) *Suffix* [-ia] *surfaces faithfully when possible*

[{(ˈho.ka)}]	‘to run out’-ACT	[{ho(ˈka͡-i)a}]	PASS
[{(ˈti.a)}]	‘to paddle vigorously’-ACT	[{ti(ˈa͡-i)a}]	PASS

b) *MWd fractured into separate PrWds as necessary*

[{(ˈa.ɾi)hi}]	‘to chop’-ACT	[{ˈa.ɾi)hi}{(-ˈti.a)}]	PASS
[{(ˈma.hu)e}]	‘to put off’-ACT	[{(ˈma.hu)e}{(-ˈti.a)}]	PASS

*[{(ˈma.hu)(ˌe.i)a}], *[{(ˈmahu)e.i.a}]

Māori, like all languages, prefers a morphological word to be parsed into a single prosodic word. However, this exceptional prosodification is undertaken so that the output may remain faithful to the input while observing the maximal word size. Because a minimal or maximal word size is a prosodic target, it may also be met by suitably altering the prosodic structure. A full analysis of Māori is provided in Ch3§3.2, while the case of exceptional prosodification in Manam is examined in Ch3§2.2.3.

Finally, the best response to a prosodic size restriction may be no output whatsoever, or a null parse (“⊙”). The Bantu language Tiene has a maximal word size of [Ftσ], and a longer output never surfaces (Hyman and Inkelas 1997, Orgun and Sprouse 1999). The definitive aspect is realized through reduplication of the final syllable, which is evident in shorter words (a). However, reduplication of a trisyllabic word would force the output to be longer than the maximal word size, and so the optimal output is a null parse (b).

(25) *Null parse in Tiene*

a) *Disyllabic bases*

BASE		REDUPLICATED FORM	
[(ˈjɔ.bɔ)]	'bathe'	[(ˈjɔ.bɔ)bɔ]	'bathe thoroughly'
[(ˈma.ta)]	'go away'	[(ˈma.ta)ta]	'go away once and for all'

b) *Trisyllabic bases*

[(ˈko.to)ba]	'chase'	⊙,	i.e *[(ˈko.to)(ˌba.ba)], *[(ˈko.to)ba.ba], *[ko(ˈto.ba)ba]
[(ˈvu.te)kɛ	'come back'	⊙	

*[(ˈσσ)(ˌσσ)], *[(ˈσσ)σσ], *[σ(ˈσσ)σ]

Rather than violating the maximal size, it is preferable for there to be no output at all. A full analysis of ineffability in Tiene is provided in Ch3§3.2.2.

In summary, there are several different strategies that a language may use to obtain a minimal or maximal size restriction. Each of these responses helps prevent outputs that are too long or too short. The next section identifies a final influence on the shape of a minimal or maximal size restriction, extraprosodicity.

3.4 Extraprosodicity and size restrictions

Another consideration which may affect the minimal or maximal size is extraprosodicity, a phenomenon in which the word-final prosodic constituent is prevented from being prominent. That is, an extraprosodic word-final syllable is prevented from bearing stress, or an extraprosodic word-final consonant is prevented from being heavy (Prince and Smolensky 1993, Hyde 2002, 2003). When the word-final element is thus excluded from the prosodic structure, then a minimal or maximal size restriction – which is itself based on the prosody – may have a different surface realization.

The role of extraprosodicity in a prosodic size restriction is exemplified by Modern Standard Arabic. Every Arabic PrWd must end in a consonant (through the constraint FINAL-C; McCarthy & Prince 1993a). However, that consonant cannot contribute to the moraic weight of the final syllable – it is necessarily extraprosodic. Consequently, CVC form does not form a bimoraic foot: it would be [(CV$_\mu$<C>)].

The minimal word size in Arabic is therefore [(CV$_{\mu}$C$_{\mu}$<C>)] or [(CVː$_{\mu\mu}$<C>)], so that the foot may be binary and the final consonant may remain extraprosodic (McCarthy and Prince 1990a: 7).

Extraprosodicity may also influence minimal word size in the absence of the schema for prosodic size restrictions proposed here. For example, Hixkaryana does not permit the final syllable of the word to bear stress. Closed syllables are treated as heavy, and there is compulsory lengthening in stressed open syllables (Derbyshire 1979, Garrett 2002). The result is that all words must be at least trimoraic: the final syllable cannot bear stress, so there must be at least one other syllable which has 1) a closed, heavy syllable, [(ˈnɨ$_{\mu}$m$_{\mu}$<no$_{\mu}$>)] ‘house’, or 2) an open syllable which is stressed and so lengthened, /kwæjæ/ → [(ˈkwæː$_{\mu\mu}$<jæ$_{\mu}$>)] ‘red and green macaw’. This minimal word size is not the product of FT-BIN but of other phonological factors. The role of extraprosodicity in size restrictions is discussed in Ch3§4.

3.5 Summary

There are many factors which influence a language’s minimal or maximal size restriction. The shape of the restriction is determined by considerations such as the status of unfooted syllables, extraprosodicity and even the preferential method of repair. A language may choose from several strategies for adapting an unsatisfactory input to comply with a minimal or maximal size restriction in the output. The following section examines how a prosodic size restriction may be imposed on a morphological category, the roo.

4 ROOT SIZE RESTRICTIONS

Roots may also be subject to a prosodically-based minimal and/or maximal size restriction. However, a root morpheme is not directly related to the prosodic structure, in contrast to a foot and a prosodic word which are directly linked to each other through constraints on the Prosodic Hierarchy. Instead, root size restrictions are obtained indirectly. When the output of the root coincides with an independently motivated size in the output, as through the minimal and maximal PrWd size restrictions described in §2 above, then it inherits this size. For example, when the prosodic word must be at least one binary foot, and the root is the only morpheme in a word (i.e., a "bare root"), then the output will be one binary foot in length and the root may be reanalyzed as upholding a minimal prosodic size. This process is dubbed here "Concurrence".

Concurrence only produces a minimal or maximal root size in limited environments. In order for *all* root outputs to share a prosodically-based size restriction, there must be high-level faithfulness between a concurrent output subject to a size restriction and other outputs of the root. Concurrence necessarily takes place in a morphologically simple output, such as a bare root; in a more complex output, the presence of other morphemes may encourage the root to be smaller or larger while still satisfying the PrWd size restriction. When a root in a complex word must be faithful to a simple, size-restricted root output, a process characterized by Output Faithfulness, then the prosodically-based size restriction is effectively spread to all outputs of the root (Benua 1997, McCarthy 2001, 2005). Therefore, a universal root size restriction is the product of two independent processes.

(26) *Criteria for universal root size restriction*

a) *Concurrence*: The root is in an environment where it acquires a prosodic size restriction.

b) *Output Faithfulness*: All roots have the same output shape, and so share the same size restriction acquired through Concurrence.

This indirect approach predicts that root size restrictions fall out from independently motivated phenomena, such as the word size restrictions in §2, ALIGNment and positional markedness. Turning the argument on its head, there should *not* be a root size restriction where 1) the root size cannot be derived from a case of Concurrence, or 2) Output Faithfulness does not ensure that the size restriction persists in all outputs. The crucial role of Concurrence and Output Faithfulness in obtaining a universal root size restriction will now be explored.

4.1 Concurrence

"Concurrence" refers to an environment in which a root acquires a minimal or maximal size restriction through independent prosodic factors. A prime example of a concurrent environment is a bare root in a language with a prosodic word size restriction. A bare root is coextensive with the prosodic word, and so any restriction on the word is transferred directly to the root morpheme. Many of the words subject to a minimal size restriction in German (§2.1) or a maximal size restriction in Czech (§2.2) above are bare roots. The effects of a maximal word restriction on the size of a bare root can be seen in the following Czech data (Fronek 1999). Just as simple PrWds were limited to a maximal size of one binary foot, so are roots.

(27) *Bare roots in Czech*

[(σ)]	[(pr̩st)]	'finger'	[(ˈluːj)]	'suet'
[(σσ)]	[(ˈja.zɪk)]	'language'	[(ˈjɛřaːp)]	'crane'

*[(ˈFt)(ˌFt)…], *[Ftσ…]

Czech words are encouraged to be one binary foot or shorter, and so this size restriction is directly transferred to a bare root. The prosodic word has a maximal size, and so a bare root – which is coextensive with the prosodic word – inherits this maximal size.

The relevance of this approach is supported by the behavior of bound roots, or those roots which may not surface as a bare morpheme. Some Czech roots require each output to have a syllabic inflectional suffix. The simplest inflection of a bound root (i.e., a root + minimal affixation) will be dubbed a "near-bare" root here, because it interacts with the prosodic word size restriction in the same manner as a bare root but must also accommodate an inflectional suffix. Below is an example of the inflectional paradigm of a near-bare root in Czech. The root may never surface as a bare morpheme, but requires an overt, syllabic inflection in every output.

(28) *Inflectional paradigm of the noun* [(mo.ř-ɛ)]

‘ocean’	*Singular*	*Plural*
Nominative	[(ˈmo.ř-ɛ)]	[(ˈmo.ř-ɛ)]
Genitive	[(ˈmo.ř-ɛ)]	[(ˈmo.ř-iː)]
Dative	[(ˈmo.ř-ɪ)]	[(ˈmo.ř-iːm)]
Accusative	[(ˈmo.ř-ɛ)]	[(ˈmo.ř-ɛ)]
Vocative	[(ˈmo.ř-ɛ)]	[(ˈmo.ř-ɛ)]
Locative	[(ˈmo.ř-ɪ)]	[(ˈmo.ř-iːx)]
Instrumental	[(ˈmo.ř-ɛm)]	[(ˈmo.ř-ɪ)]

The root derives a size restriction from the maximal PrWd size, which bans non-head feet (§2.2). Therefore, near-bare roots like [(mo.ř-ɛ)] are restricted to a maximal size of one syllable, not one foot as for bare roots. One syllable is consumed by the inflectional suffix, so the root may itself only be up to one syllable long for the prosodic word to satisfy the maximal size restriction. A similar phenomenon for minimal size may be seen in Shipibo near-bare roots (Ch4§2.1.4).

Thus far, two concurrent environments have been identified. All told, this dissertation discusses four different cases of Concurrence.

(29) *Factors producing Concurrence*

a) Bare root
b) Near-bare root
c) Root-foot alignment
d) Positional markedness

The final two types of Concurrence can lead to a minimal size restriction, but not a maximal size. When the left edge of every root must align with a binary foot, then the root will obtain a minimal size in certain situations, such as word-finally or within a compound word. The root must align at its left edge with a binary foot, while the right edge of the root coincides with another prosodic boundary (e.g., the end of the prosodic word, or the edge of a second root in a compound which must align with its own foot). The root morpheme is isolated within the foot with which it is aligned. The only way to achieve foot binarity is for the root to augment. Root-foot alignment only leads to a minimal size restriction when the right edge of the root also coincides with a prosodic boundary. If the right edge is unbounded, then the material occurring to the right of the root (e.g., a suffix) will count towards the minimal word size, potentially eliminating the pressure for the root to augment. Minimal root size as a product of root-foot alignment will be discussed in German in Ch4§2.1.2.

Finally, positional markedness – specifically, the requirement that a root receive stress – can also lead to a minimal root size (Smith 2002). This requires a complex set of conditions, as in Yup'ik (Ch4§2.1.3). Roots always occur word-initially, and a syllable nucleus dominated by a root segment must be stressed through positional markedness. The stress pattern is strongly iambic, so the root must be at least long enough to attract stress. When the root would otherwise dominate a single, word-initial light syllable – and so be skipped for stress by the language's iambic system – then the onset of the following syllable is geminated: /aŋ-uq/ 'it is big' → [(ˈaŋ)(ˌŋuq)], *[(a.ˈŋuq)], *[(ˈa.ŋuq)]. Positional markedness produces a unique size restriction in that it does not rely on Output Faithfulness to ensure that every output of the root observes the size restriction. Instead, the minimal root size can be independently derived for every output.

In conclusion, a root size restriction may only arise when the root obtains a prosodic size restriction through Concurrence. A bare or near-bare root may acquire a minimal or maximal size restriction, while a minimal root size restriction may also be obtained through root-foot alignment or positional markedness. The next section examines the importance of Output Faithfulness, which determines whether or not a root size restriction persists throughout the language.

4.2 Output Faithfulness

A root obtains a size restriction in certain environments of Concurrence, as discussed above. However, other outputs may not demand a given minimal or maximal prosodic size restriction. For instance, a bare root may share the minimal size restriction of the prosodic word. But when the root occurs in a more complex word, then the presence of other morphemes would also count towards the minimal PrWd size. In some languages, like German, the root shape is consistent, even where the output does not explicitly demand a minimal size. In other languages, like Lardil, a bare root is augmented to reach a minimal size, but a smaller root surfaces when other morphemes contribute to the minimal prosodic word size. Whether the root size is consistent is determined by Output Faithfulness, which requires output forms to be faithful to one another and so effectively results in a uniform root shape (Benua 1997, McCarthy 2001, 2005).

The importance of Output Faithfulness is most clearly seen by comparing two languages which begin with the same initial size restriction. Both German and Lardil require each prosodic word to be at least one binary foot in length. In German, roots have the same shape in all outputs, equivalent to the minimal PrWd size of binary foot. The consistent form of German roots is shown in the data below, where a bare root (i) understandably shares the minimal word size restriction, but a more complex word (ii) would permit a smaller root while still satisfying the minimal word restriction. Nonetheless, root size is consistent.

(30) *German: Minimal PrWd and minimal root size*

i)	[(ˈt͡sɛː)]	‘tough’	ii)	[(ˈt͡sɛː-.ə)]	‘tough’-F
	[(ˈʔaː.təm)]	‘breath’		[(ˈʔaː.təm)(ˌ-loːs)]	‘breathless’
	[(ˈba͡u)]	‘building’		[(ˌfɛɐ̯)(-ˈba͡u-.ən)]	‘to obstruct’

There is no independent prosodic motivation for a minimal root size in the complex outputs (ii). For example, a hypothetical word with a shorter root, e.g., *[(ˈt͡sɛ-.ə)], would still satisfy the minimal PrWd restriction. As argued above, the only way for a morpheme to acquire a prosodic size restriction is for it to be linked to the prosodic structure through Concurrence. When there is no environment demanding a minimal or maximal size but the root still exhibits a prosodic size restriction, then that shape must be retained from a legitimate case of Concurrence, such as the bare roots in (i).

Output Faithfulness encourages all outputs to have the same shape through a correspondence relationship from a morphologically simple output to a morphologically related, more complex one (Benua 1997). In the case of a universal root size restriction, a complex output (ii) observes faithfulness to a simpler one, like a bare root (i), called the “base”. When the base is subject to a prosodic size restriction, as is a German bare root, then the size restriction will be spread to all outputs.

The role of Output Faithfulness in a universal root size restriction is illustrated below. In (A), a subminimal bare root is augmented to obtain the language's minimal prosodic word size. The winning candidate is unfaithful to the input (i.e., it violates Input-Output (IO) Faithfulness) in order to satisfy foot binarity. In the second interaction (B), the bare root is taken as a base form to which more complex outputs must be faithful in order to satisfy Output Faithfulness. The polymorphemic input does not independently require the root to obtain a minimal size, as FT-BIN is satisfied even with a smaller root (a). However, faithfulness to the base – which does require a minimal prosodic size – causes the root to have a minimal size in all outputs (b).

(31) *Output Faithfulness leads to universal minimum root size*

Recursion A: Foot are binary » Don't change segment weight from input

‽/kɛ/	IDENT(weight) -Output	FT-BIN	IDENT(weight) -IO	>>
a) [(kɛ)]		*!		
Λ b) [(kɛː)]			*	

Recursion B: Faithfulness to base » Faithfulness to input

‽/kɛ-ən/	IDENT(weight) -Output: [kɛː]	FT-BIN	IDENT(weight) -IO
a) [(kɛ.ən)]	*!		
Λ b) [(kɛː.ən)]			*

The role of Output Faithfulness in ensuring a universal root size restriction, rather than a constraint directly requiring a root to obtain a certain size, is reinforced in cases of resyllabification. For instance, in the related German words [(ˈflɛk)] 'stain' and [(ˈflɛ.k-ɪç)] 'stained', the latter root does not dominate a full foot; the root segments are parsed into the initial light syllable and the onset of the second syllable, but not a binary foot. The segmental content could potentially dominate a foot, as in the bare root, but it would not satisfy a constraint forcing all roots to be at least one foot in size. However, an output where the segmental content is the same even though the prosodic structure may vary is fully predicted through Output Faithfulness.

The complementary situation, a language with a minimal PrWd size but no minimal root size, is found in Lardil (Wilkinson 1988, Prince and Smolensky 1993). A bare root undergoes [a] epenthesis to satisfy the minimal word restriction (a). These words can be compared to the roots in (b), which independently satisfy the minimal word restriction and are not subject to epenthesis. In Lardil the epenthetic segment allowing a bare root to meet the minimal word size is not retained in more complex outputs (ii). The root is augmented as necessary to obtain a minimal PrWd size, but this change is not preserved in outputs of the root where the PrWd size is independently satisfied. That is, Lardil has a minimal word size, but it does not translate into a minimal root size.

(32) *Lardil: Minimal PrWd but no minimal root size*

a) i)	*Subminimal bare roots subject to epenthesis*				
	[(ˈwi.k-a)]	‘shade’-Nom	ii)	[(ˈwi.k-in)]	Acc
	[(ˈte.r-a)]	‘thigh’-Nom		[(ˈte.r-in)]	Acc
	[(ˈja.k-a)]	‘fish’-Nom		[(ˈja.k-in)]	Acc
b) i)	*Minimal bare roots surface faithfully*				
	[(ˈwi.ʈe)]	‘inside’-Nom	ii)	[(ˈwi.ʈe-n)]	Acc
	[(ˈmaːn)]	‘spear’-Nom		[(ˈmaː.n-in)]	Acc

Lardil has the same initial state as German: all prosodic words must be at least one binary foot. However, while German carries this minimal size over to all outputs of the root, Lardil allows a subminimal root to remain so, provided FT-BIN is satisfied. The role of Output Faithfulness is deemphasized; it is more important for the output to be faithful to the input than to the base, the bare root. As illustrated in the following tableaux, the output is faithful to the input except where augmentation is necessary to meet the minimal word requirement.

(33) *Input-Output Faithfulness prevents universal minimal root size*

Recursion A: Feet are binary » Don't epenthesize to input

/wik/	FT-BIN	DEP-IO	MAX-Output	>>
a) [(ˈwik)]	*!			
Λ c) [(ˈwi.ka)]		*		

Recursion B: Faithfulness to input » Faithfulness to base

/wik-in/	FT-BIN	DEP-IO	MAX-Output: [wika]
Λ a) [(ˈwi.kin)]			*
b) [(ˈwi.kan)]		*!	

To conclude, Output Faithfulness determines whether or not the root size restriction required in a simple output is retained throughout the language. Output Faithfulness must occur in tandem with a concurrent environment, which obliges the root to achieve a minimal or maximal size in the first place. Therefore, a universal root size restriction follows when the ranking producing a prosodic size restriction is combined with highly-ranked Output Faithfulness.

(34) *Universal root size restriction*

a) *Minimal size*: FT-BIN, Output Faith » IO-Faith

b) *Maximal size*: *FT-, Output Faith » IO-Faith

The analysis of intraparadigmatic faithfulness in Czech bound roots will discuss the crucial role played by Optimal Paradigms Faithfulness (McCarthy 2001, 2005), in addition to offering some new insights. The following section discusses the theoretical implications of the current proposals, which point to a new set of restrictions on constituent alignment.

5 THEORETICAL IMPLICATIONS

The investigation of size restrictions leads to necessary modifications of the constraints that regulate constituent alignment. Generalized Alignment Theory proposes that morphological and prosodic categories may be aligned with one another at an edge (McCarthy and Prince 1993b). ALIGNment is employed in this dissertation, but it is argued that the theory must be significantly restricted in order to make more accurate typological predictions.

The original schema for ALIGNment theory is given in (36). Any M(orphological) Cat(egory) or P(rosodic) Cat(egory) may align with any other MCat or PCat at the left or right edge. The ordering of the elements being aligned also affects the definition, such that *every* Cat1 must align with the edge of *some* Cat2. For example, ALIGN-L(root, foot) states that the left edge of *every* root should align with the left edge of *some* foot.

(35) *Classical Generalized Alignment Theory (M&P 1993b)*

ALIGN(Cat1, Edge1, Cat2, Edge2) $=_{\text{def}}$

$\forall$ Cat1 $\exists$ Cat2 such that Edge1 of Cat1 and Edge2 of Cat2 coincide

Where

Cat1, Cat2 $\in$ PCat $\cup$ MCat

Edge1, Edge2 $\in$ {Right, Left}

The fundamental value of constraints on constituent alignment is affirmed in this dissertation, but it is argued that alignment theory must be more restrictive in order to make accurate typological predictions. Chapter 5 will propose that ALIGNment be restricted in the following ways.

(36) *Restricted Alignment Theory (RAT)*

ALIGN-Left(Cat_1, Cat_2) $=_{def}$

For all Cat1 and some Cat2, the left edge of Cat_1 and Cat_2 coincide

Where

(i) Cat1 ∈ {Root}, Cat2 ∈{σ, Ft, PrWd};

(ii) Cat1 ∈ {(non-)head of $PCat_1$} and Cat2 ∈ {$PCat_2$}; or

(iii) Cat1 ∈ {$PCat_2$} and Cat2 ∈ {(non-)head of $PCat_1$}.

- There are no ALIGN-L(PCat, MCat) constraints in CON.
- There is no right-alignment (also see Nelson 1998, 2003, Bye & de Lacy 2000, Alber 2002).

Restricted Alignment Theory generates several concrete predictions, including a family of constraints requiring the left edge of *every* MCat to align with *some* PCat. A prime example of this is root-foot alignment, which helps produce some cases of Concurrence (§4.1, Ch4§2.1.2). For instance, the left edge of every German root must be aligned with a binary foot. Root-foot alignment is evident in the following data from Clark and Thyen (1998) in two respects: 1) the initial syllable of the root always receives stress, regardless of the presence of other morphemes; 2) there is no resyllabification between a prefix and root, seen through root-initial glottal stop epenthesis and vocalization of /ʀ/ to [ɐ]: /ɛʀ-aʀbai͡t-ən/ → [(ˌʔɛɐ̯)(ˈʔaɐ̯.bai͡)t̠n̩] 'to work for', *[(ˌɛ.ʀaɐ̯)(ˈbai͡.tn̩)]. The lack of resyllabification represents a crisp edge produced through constituent alignment (Itô and Mester 1999).

(37) *Root-foot alignment in German*

/høːʀ/	'hear'	[(ˈhøː.ʀ-ɐ)]	'listener'
		[gə-(ˈhøːɐ̯)]	'[sense of] hearing'
		[(ˌfɛ□□-)(ˈhøː.ʀ-ən)]	'to interrogate'
/a□bait/	'work'	[(ˈʔaɐ̯.bai͡t-s-)(ˌloːs)]	'unemployed'
		[(ˌʔɛɐ̯-)(ˈʔaɐ̯.bai͡)t̠-n̩]	'to work for'
		[(ˌʔyːbɐ)(ˈʔaɐ̯.bai͡)(ˌt̠-ʊŋ)]	'revision'

A full analysis as well as discussion of other types of MCat-PCat alignment, such as root-syllable alignment in Northern Italian and root-PrWd alignment in Korean, is found in Ch5§2.

The inverse relationship, in which *every* PCat must align with *some* MCat, is argued to be pathological. For instance, if every syllable must align with a root, then each PrWd will consist of a single root at most one syllable long. This superficially resembles a maximal size restriction. But if this is combined with a ban on heavy syllables (e.g., long vowels and codas are not permitted), then a language with a maximal PrWd size of a single light syllable is predicted. Such a language is unattested, and other types of PCat-MCat alignment do not actively contribute to CON, either. Therefore, this type of alignment is rejected.

Chapter 5 also points out several implications of PCat-PCat and MCat-MCat alignment, although these are discussed in less depth because they do not lead to prosodic size restrictions on morphemes. Alignment of two prosodic categories is affirmed, with the additional specification that the higher-order PCat (on the Prosodic Hierarchy) is aligned with the head or non-head of the lesser PCat. For example, a foot may be aligned with a head or non-head syllable. Without head specification, PCat-PCat alignment makes some unwarranted predictions; e.g., if *every* syllable must align with the left edge of a foot, the result is a language where all feet are monosyllabic. Such a language is unattested, and this prediction is avoided through head specification.

The (non-)head PCat approach also leads to some felicitous characterizations with respect to prosodic typologies. The constraint ALIGN-L(σ^+, PrWd) predicts a system where a head syllable must be aligned with the left edge of the prosodic word – a left-to-right trochaic system $[(\sigma^+\sigma^-)\sigma^-]$. The opposite formulation, ALIGN-L(σ^-, PrWd), requires a non-head foot to be leftmost in the prosodic word, resulting in a right-to-left trochaic system $[\sigma^-(\sigma^+\sigma^-)]$ or an iambic system $[(\sigma^-\sigma^+)]$. The famously absent stress pattern of right-to-left iambs $[\sigma^-(\sigma^-\sigma^+)]$ follows from the current proposal. These and other results are discussed in Ch5§4.1.

Alignment of two morphological categories is only briefly touched on, principally because the inventory of MCat participants is not fully defined. This dissertation has illustrated the ALIGNment of root morphemes several times over, but other categories – such as morphological words, stems, or specific roots such as a noun or verb – are not as well understood. Ch5§4.2 discusses these issues and lays out several diagnostics for determining the morphological participants, but definitive claims on the status of MCat-MCat alignment are left for future research.

Finally, the current investigation leads to the conclusion that right-edge alignment is not valid, following on from proposals by Nelson (1998, 2003), Bye and de Lacy (2000) and Alber (2002). Many of the phenomena observed in this dissertation are attested at left edges but never at the right. For example, alignment of a root with a PCat can create a crisp edge at the root onset (German, Ch4§2.1.2; Northern Italian, Ch5§2.2) or militate at the left edge of the root against prefixes (Yup'ik, Ch4§2.1.3; Korean, Ch5§2.3), but complementary phenomena do not occur at the right edge of the root, such as a root-final crisp edge or a process attacking suffixes.

To summarize, Generalized Alignment Theory plays an important role in prosodic size restrictions, but several additional restrictions improve the theory's predictive power. Finally, the following section lays out the fundamental tenets of Optimality Theory, the theoretical framework employed in this dissertation.

6 OPTIMALITY THEORY

Optimality Theory (OT) is a theoretical framework which employs ranked and violable constraints in parallelist computation. It contrasts with serialist, rule-based theories such as *SPE*, which employ a series of ordered rules (Chomsky and Halle 1968). As it is set within OT, the central concern of this analysis is to determine the form and ranking of the constraints that are responsible for generating the attested patterns while preventing unattested ones from occurring.

This dissertation adopts the Correspondence Theory (CT) of faithfulness as proposed by McCarthy and Prince (1995a). CT posits a relationship called "correspondence" between segments or features, for example from input segments to output ones (i.e., IO-Faithfulness) or between a less complex and more complex output (i.e., Transderivational "Output-Output" Faithfulness). Correspondence relationships are constrained by "faithfulness" constraints, which urge the output to be identical to the input (or in the case of Output Faithfulness, the base; cf. "anti-faithfulness", Alderete 2001). Examples of faithfulness constraints used in this dissertation are listed below (McCarthy & Prince 1995a).

(38) *Faithfulness constraints*

MAX: Every segment in S_1 has a correspondent in S_2. ("Don't delete")

DEP: Every segment in S_2 has a correspondent in S_1. ("Don't epenthesize")

IDENT(F): Correspondent segments in S_1 and S_2 have identical values for some feature F. ("Don't change features")

INTEGRITY: No element of S_1 has multiple correspondents in S_2. ("Don't split segments")

UNIFORMITY: No element of S_2 has multiple correspondents in S_1. ("Don't coalesce")

While faithfulness constraints encourage the output to remain true to the input, markedness constraints evaluate the well-formedness of outputs. Significant markedness constraints used in this dissertation are given below.

(39) *Markedness constraints*

*FT-: Incur a violation for each non-head foot (de Lacy 2003).

FT-BIN: Feet are binary at some level of analysis (σ, μ; Prince 1980).

PARSE-σ: All syllables must be parsed by feet (Liberman and Prince 1977).

*LAPSE: Adjacent unstressed moras must be separated by a foot boundary (Prince 1983, Green and Kenstowicz 1995).

ONSET: $*_{\sigma}[V$ ("Every syllable has an onset"; Prince & Smolensky 1993).

REALIZEMORPH: Every morpheme in S_1 has some correspondent in S_2 ("Every morpheme is realized overtly"; Samek-Lodovici 1993).

PRESERVECONTRAST: For each pair of contrasting inputs that map onto the same output in a scenario, assign a violation mark (Łubowicz 2003).

STRESS-TO-ROOT: Some segment contained in the root must be parsed into a nucleus of the head syllable of a foot (Smith 2002).

The ALIGNment family of constraints, which requires certain PCats and MCats to align with one another at their left edges, is also important to the analysis. This dissertation proposes that alignment is more restricted than commonly assumed, an argument outlined in §5 above and discussed in greater detail in Chapter 5.

Given an input, an in-principle infinite number of output candidates is assessed based on how "well" they satisfy the constraints of a given language. The final output is the candidate which incurs minimal violation, determined by the ranking of faithfulness and markedness constraints. The process of deciding the optimal candidate is formally depicted by tableaux comparing possible outputs against a constraint ranking. Tableaux are presented in the usual manner (e.g., McCarthy 2002a). Root morphemes are denoted through a double underline, with additional notation discussed when it arises.

Finally, Richness of the Base proposes that there are no constraints on inputs. A practical consequence of this is that the absence of a feature, segment or structure in a language must follow from the constraint ranking – it is not enough to assume that it simply does not exist or can never be an input. For example, the maximal root size in Czech must be due to predictable phonological conditions, rather than a rule stipulating that each root must be one foot or less. Although there is not direct evidence for an over-long native root input in Czech, this possibility must be considered through Richness of the Base, and the constraint ranking must reflect how any input is shaped by the constraint ranking to produce a well-formed output. Many size restrictions discussed in this dissertation do not provide alternations to show how this size is obtained. In these cases, a hypothetical subminimal or supermaximal input (denoted by the symbol "‽") will be employed to show how the size restriction is enforced.

7 Summary

Prosodic size restrictions are all related, be they on a prosodic category, such as a prosodic word, or a morphological category, such as a root. Minimal PrWd size has received much attention in the literature, and this size restriction may be straightforwardly transferred to a root morpheme through a concurrent environment. Maximal size restrictions are less well known, although close examination reveals such phenomena to be well-attested, both for prosodic words and roots. This dissertation aims to provide a theory of the motivations and cross-linguistic expression of minimal and maximal size restrictions in prosodic words and, transitively, in roots.

In this sense, this dissertation develops the theory of Prosodic Morphology and extends its applications to previously neglected areas. At the same time, several theoretical uncertainties a PrWd-based prosodic size restrition on reduplicants into question (e.g. Downing 1999) – may be explained by recursive prosodic words (McCarthy and Prince 1994a) or may be found to form a separate domain creating an independent size restriction, similar to the discussion of root-foot alignment to obtain a minimal root size in German in Ch4§2.1.2. Observations that derived words may be subject to a minimal size restriction while underived words are exempt warrant a case-by-case examination; for instance, the much-discussed case of minimal word size in derived words in Turkish (e.g. Inkelas and Orgun 1995) is restricted to loanwords, which are shown here and elsewhere to frequently require separate phonological constraints from the native inventory (e.g. Itô and Mester 1995). In other words, this dissertation addresses many concerns pertaining to the theory of Prosodic Morphology, but there is still much work to be done.

This dissertation is organized as follows. Chapter 2 provides an in-depth case study of maximal size in Czech, where the mechanisms behind maximal size and a universal root size restriction are first introduced. Chapter 3 analyzes the phenomena of minimal and maximal prosodic size restrictions in greater detail, identifying the predicted systems and the strategies through which a size restriction may be obtained. Chapter 4 looks at how a prosodic size restriction may be spread to the root morpheme, through an environment of Concurrence and universal enforcement through Output Faithfulness. Chapter 5 examines the theoretical implications of these proposals, investigating the different combinations of constituent alignment. Finally, Chapter 6 presents conclusions.

CHAPTER 2

A COMPLEX CASE: MAXIMAL ROOT SIZE IN CZECH

1 INTRODUCTION

This chapter examines the complex case of maximal root size restrictions in the Czech language. There are three principal goals: 1) to illustrate the theory responsible for maximal size restrictions; 2) to demonstrate how a prosodic size can be transferred to a morphological unit, specifically, a root; and 3) to show that root size restrictions are fully integrated into the broader phonology of a language, rather than an observation which bears out in the simplest instance but breaks down when compared with the language as a whole. Czech provides an introduction to the theory of MCat size as it incorporates many crucial proposals of the theory. In short, this chapter aims to illustrate the key aspects of the theory through a case study; later chapters will focus on specific elements of the theory and identify the broader typology of minimal and maximal size restrictions.

Native Czech roots are subject to a maximal size restriction: all roots are maximally disyllabic, while smaller root shapes are freely tolerated. Roots can contain zero, one, or two vowels and any number of flanking consonants permitted by the language's phonotactics; there are no larger roots (e.g. never [CVCVCVC]). There are no alternations that show longer roots being shortened, and the maximal root size is therefore a static phonotactic generalization. The data in (1) from Fronek (1999) give a sampling of the common root shapes in Czech. (See §2.2 for a more complete data set.)

(1) *Czech roots may be up to two syllables in length*

[(ˈd-aː-t)]	'to give'	[(ˈdo.-d-a)-va.-t-ɛl]	'supplier'
[(ˈdn-o)]	'bottom'	[(ˈbɛ.z-ɛ)-dn-iː]	'bottomless'
[(ˈstřɛt)]	'center'	[(ˈu.-pro)-střɛt]	'in the middle'
[(ˈbaː.d-a-t)]	'to research'	[(ˈpro.-baː)d-aː.-ɲ-iː]	'exploration'
[(ˈja.zɪk)]	'language'	[(ˈɲɛ.-k-o)l-ɪ.k-a.-ja.zɪt͡ʃ.-n-iː]	'multilingual'

Several important observations about root size can be seen in the data.

1) Czech roots cannot be larger than two syllables.
2) Czech roots have the same shape in all outputs, even when the root segments remain unfooted or straddle a foot or syllable boundary (excluding feature-changing processes like palatalization of /k/ to [t͡ʃ], which do not change the size of the root).
3) Czech roots can be as short as a single segment, showing there is no minimum root size.

Each of these points will be addressed in this chapter, in addition to other factors not immediately evident from the data. Even though there are no alternations in Czech that show the fate of overly long roots, it is essential to have a theory that restricts root size. Optimality Theory's principle of Richness of the Base allows unrestricted inputs, so one is forced to ask questions for Czech such as, "How is a root input /CVCVCVCV/ prevented from surfacing faithfully?"

This chapter proposes that the maximal root size limit is achieved through a maximal prosodic word size, although this PrWd size restriction is otherwise obscured in Czech. For a morphological category like a root to be limited to a maximal prosodic size (such as a foot), the root must be linked to prosodic structure which in turn has restrictions placed upon it. For example, if the prosodic word has a maximal size restriction, then any root contained in this PrWd will also be subject to this size restriction. This indirect approach is confirmed by Czech, where the size of the root is determined by its morphology. Roots which may appear as a bare morpheme – and so coexistent with the PrWd – may also be up to one foot long, while bound roots, which may not surface without an inflectional suffix, have a smaller size restriction so that the root plus suffix together satisfy the maximal prosodic word size.

The relationship between prosodic units is expressed in the Prosodic Hierarchy (Selkirk 1984) and a ban on non-head feet (de Lacy 2003). The Prosodic Hierarchy maintains that prosodic units are organized in an ordered relationship, such that a prosodic word (PrWd) is composed of feet (Ft), which is composed of syllables (σ; see Ch1(3) for a graphical representation).

The theory presented here attributes maximal size to a ban on non-head feet. In other words, each PrWd has one head foot, but additional, non-head feet are not permitted. This is represented through the constraint *FT-, after de Lacy (2003; Ch1(9)).

As mentioned above, no alternations show what happens to overly long inputs in Czech. There are several possible strategies that can be employed to ban non-head feet /CVCVCVCV/ → *[$(\sigma\sigma)^{+}(\sigma\sigma)^{-}$]. Any repair which limits the length of the output may result in a maximal size restriction. An obvious example of this is deletion /CVCVCVCV/ → [$(\sigma\sigma)^{+}$], where segments are deleted until the output is one foot or shorter, although other strategies are also available. The theory of maximal size is presented in greater depth in Ch3§3.1, and a full typology of responses to *FT- will be discussed in Ch3§3.2.

Czech employs deletion to limit the size of simple prosodic words, an insight gained through study of other aspects of the phonology of Czech (Ketner 2003). Thus, a hypothetical input which is longer than two syllables would be reduced until the output does not exceed the length of one foot, resulting in a maximum PrWd size. The maximal PrWd size in turn leads to a restriction on the size of a bare, or uninflected, root. A bare root is coextensive with a prosodic word, so any restriction on the size of the PrWd is directly transferred to a bare root. The process by which Czech simple PrWds, and so bare roots, are limited to one foot or less is analyzed in §3.1.

In contrast to bare roots, bound roots can never surface alone, but require an overt affix in all outputs. In their simplest inflections (i.e., the closest a bound root may come to surfacing bare), they are referred to as "near-bare" roots in this dissertation. Near-bare roots in Czech have a maximal size of one syllable – instead of the disyllabic maxima seen for bare roots – because each inflectional suffix is itself at least one syllable (§3.2; Fronek 1999). One syllable is consumed by the obligatory suffix, so for the prosodic word to be one foot or smaller, the size of the root is restricted to a maximum length of one syllable. The behavior of these near-bare roots verifies an important prediction of the theory at hand, which asserts that maximal root size effects are an indirect effect of a restriction on the size of the PrWd, rather than a direct restriction on the root. A near-bare root must share the prosodic word with an inflection. The maximal size restriction on the PrWd stays the same, one binary foot, so the root must be shorter to accommodate the inflectional suffix.

Prosodic size restrictions cannot be placed directly on the root, as there is no inherent link between the morphology and the prosody. Instead, a root size restriction must be derived indirectly from the PrWd size restriction. A bare or near-bare root is linked to the Prosodic Hierarchy through its association with the prosodic word, which also accounts for the different size restrictions in the two classes of roots. Environments in which a root may derive a prosodic size restriction are dubbed here Concurrence, and will be addressed in greater detail in Ch4§2.

Once the root size has been restricted as a bare or near-bare root, a second operation is required to ensure that the root has this same prosodically-determined size in all outputs. The maximal PrWd size, which also accounts for the maximal root size, encourages *all* words to be one foot or shorter. In a polymorphemic word, the root may be tempted to have a shorter output to better satisfy the maximal PrWd size. Yet all outputs of the root maintain the same prosodically-determined shape, even when the word is complex or the connection with the Prosodic Hierarchy is not otherwise apparent. For example, many of the roots in the longer words in (1), such as [(ˈɲɛ.-k-o)l-ɪ.k-a.-<u>ja.zɪt͡ʃ</u>.-n-iː], are not even parsed into a foot in the output. How can the root be restricted to a certain prosodic size in these longer words, when there is no evidence of its relationship to the Prosodic Hierarchy?

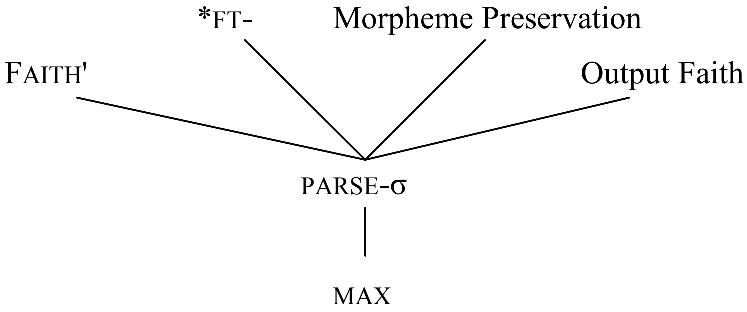
The answer lies in Output Faithfulness, which limits differences between output forms. Output Faith requires the root shape to remain constant in all outputs. In this way, a size restriction imposed on one output, such as a bare or near-bare root as argued above, will be spread to all other outputs of the root. The term "Output Faithfulness" is used in this dissertation to refer to the complementary proposals of Transderivational Correspondence Theory for base-output faithfulness (Benua 1997) and Optimal Paradigms for intraparadigmatic faithfulness (McCarthy 2005). The interaction of these two systems will be explored in §4, with the end effect that Output Faithfulness encourages every output of the root to have the same exponence, so spreading a prosodic size restriction. Any deviation among forms would incur a violation of Output Faithfulness.

The theories behind root size restrictions and Output Faith are synthesized in the discussion of complex words in §4.2, which are frequently longer than the disyllabic maximum seen for simple PrWds and roots above. These polymorphemic words are still subject to *FT-, which encourages words to have a single foot, but are under additional pressure to keep the root shapes consistent with simpler outputs and to preserve the morphological material encoded in the different morphemes making up the word. The result is that the prosodic word has a single foot, but instead of deleting segments outside this foot, they are left unparsed. Deletion is blocked by constraints preserving the morphological material of the input and Output Faith, and so a violation of PARSE-σ becomes the best option. In order to minimize violations of PARSE-σ, each morpheme is as short as it can be while still satisfying Output Faith and morpheme preservation constraints.

Finally, Section 5 looks at the special status of borrowed roots in Czech, which are not subject to a maximal size restriction like native roots. Instead, loanword roots can be any length, suggesting the presence of loanword-specific faithfulness constraints which can block processes leading to a maximal size in native words (Itô and Mester 1995). Loanword Faith blocks deletion, leaving non-exhaustive parsing as the optimal repair.

In summary, the Czech maximal root restriction is derived from a maximal PrWd size, which is motivated by the cumulative effect of the markedness constraints *FT- and PARSE-σ. These constraints along with other faithfulness constraints crucially outrank MAX, so causing deletion in simple outputs. In complex outputs, deletion can be blocked, leaving non-exhaustive parsing as the optimal solution. The end effect is that simple outputs – and the root shapes derived from them – have a maximal size, while the maximal PrWd size may be obscured in complex words. The ranking below provides an overview of the constraints responsible for the maximal root size in Czech. The mechanisms behind most of these rankings will be discussed in greater depth in §3, with Output Faithfulness addressed in §4.

(2) *Czech maximal root constraint ranking*



The rest of this chapter is organized as follows: Section 2 gives preliminary information about the Czech language (§2.1) and provides the data relevant to the discussion of maximal root size in the language (§2.2). Section 3 examines the mechanics of maximal size and presents an analysis of maximal root size in bare roots (§3.1) and in near-bare roots (§3.2). Output Faith is addressed in Section 4, examining bare and near-bare roots (§4.1) before turning complex words and the use of multiple responses to *FT- (§4.2). Finally, Section 5 looks at the special status of loanwords in Czech, and Section 6 offers up conclusions.

2 PRELIMINARY INFORMATION ON CZECH

2.0 Introduction

This section provides critical background information on Czech phonology. Section 2.1 provides general information on the phonology of Czech, including its segmental inventory and stress pattern. Section 2.2 presents a relatively large body of linguistic data relevant to the discussion of PrWd and root size maxima, which will also be summarized later in the course of the analysis.

2.1 About Czech

Czech is a Western Slavic language spoken by approximately 11.5 million people, 10 million of whom live in the Czech Republic (Gordon 2005). The language enjoys official language status and is supported by a strong national media and literary community. This section aims to provide an understanding of the basic mechanisms of the language before moving on to the analysis of maximal size in §3.

The following chart outlines the consonantal inventory of Czech, adapted from Dankovičová (1999: 70).

(3) *Czech consonant inventory*

	Bilabial		Labio-dental		Alveolar		Post-alveolar		Palatal		Velar		Glottal	
Plosive	p	b			t	d			c	ɟ	k	g		
Nasal		m				n				ɲ				
Fricative			f	v	s	z	ʃ	ʒ			x			ɦ
Affricate					t͡s		t͡ʃ	d͡ʒ						
Trill						r ř								
Approx.									j					
Lateral					l									

The segment [ř] merits special discussion.[2] [ř] is a voiced strident laminal trill, fully contrastive with the apical trill [r] – [křovɪ] 'shrubbery' vs. [krovɪ] 'roof timbers' – and the voiced stridents [z ʒ] – [koři: (sɛ)] 'worship'-3Sg vs. [kozi:] 'goat'-MaAdjNomSg vs. [koʒi:] 'skin'-InstSg (Trávníček 1935, Kučera 1961, Ladefoged and Maddieson 1996, Dankovičová 1999). Only in Czech is [ř] known to be contrastive, although similar segments are contrastive in other languages: Nivkh/Gilyak has the voiceless strident trill [ř̥] (Comrie 1981, Gruzdeva 1997, Shiraishi 2004), Tacana has the voiced strident tap/flap [ɾ̌] (Key 1968, Maddieson 1984) and Etsako has the voiceless strident tap/flap [ɾ̥̌] (Laver 1994 citing Laver 1969). Moreover, strident trills can occur as allophones in Cois Fhairrge Irish (de

[2] There is no IPA symbol for the Czech strident trill since the removal of the long-tailed 'r' at the 1989 Kiel IPA convention (IPA 1989). Since then, Ladefoged and Maddieson (1996) use the 'laminal' diacritic [r̻], while Dankovičová (1999) employs the 'raised' diacritic [r̝]. I have chosen to use the r-háček [ř] (the Czech orthographic symbol) in the Slavist tradition and in an effort to facilitate reading.

Bhaldraithe 1966), Dutch (Verstraeten and Van de Velde 2001, Sebregts 2004), East Sutherland Gaelic (Dorian 1978), Erris Irish (Mhac an Fhailigh 1968), Fulani (Taylor 1921), Guaraní (loanwords from Paraguayan Spanish; Gregores and Suárez 1967, Maddieson 1984), Guémené-sur-Scorff Breton (McKenna 1988), KiVunjo KiChaka (Davey, Moshi and Maddieson 1982), Macedonian (Hála 1962), Paraguayan Spanish (Granda 1988), Skyrian Greek (Thumb 1910), Toda (Spajić *et al.* 1996) and Tsakonian Greek (Deffner 1881).

Czech obstruents (including [ř]) are subject to devoicing in coda position and participate in regressive voicing assimilation. The language allows consonants to form many combinations in onset clusters, although the inventory of permissible coda clusters is highly restricted in native words (chiefly strident plus homorganic stop sequences).

Another important consideration is that Czech onset clusters do not strictly adhere to the Sonority Sequencing Generalization (SSG), which states that the relative sonority of segments in a consonant cluster rises closer to the syllable nucleus (Selkirk 1984 and references cited therein). The sonority scale characterizes this relationship between segments, proposing that obstruents are less sonorant than nasals, which are less sonorant than liquids, etc. The following sonority scale adapted from Selkirk (1984) and Clements (1990) shows only the most relevant categories to the argument at hand, although it can also be broken down into finer divisions.

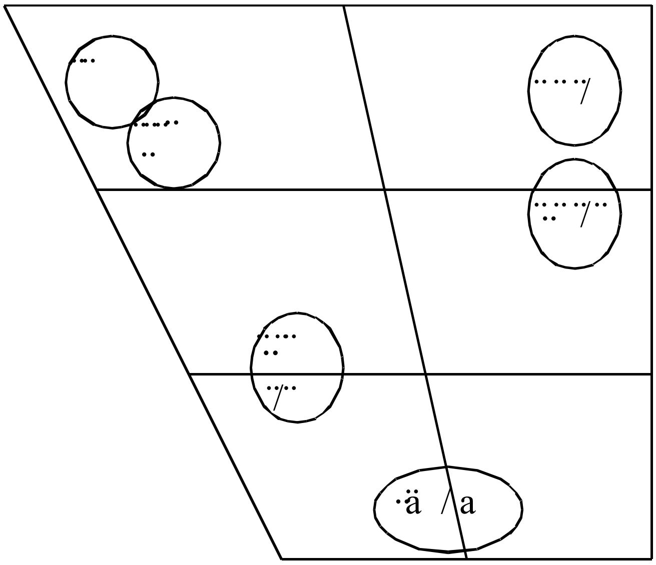
(4) *Sonority scale*

Obstruent < Nasal < Liquid < Vowel

The SSG posits that a higher sonority segment, such as a liquid or a nasal, should not occur farther away from the nucleus than a lower sonority segment, like an obstruent, in a consonant cluster. Czech defies this generalization, by permitting words such as [.msta.] 'revenge' and [.lpjɛt.] 'to adhere'. These words are both a single syllable (*[.m̩.sta.], *[.l̩.pjɛt.]), indicating that the consonants all share onset position (Kučera 1961).

Vowels in Czech are limited to a few cardinal positions, as illustrated below (adapted from Dankovičová (1999: 72). Vowel quantity is also contrastive, as seen in minimal pairs such as [rada] 'advice' vs. [raːda] 'gladly'-F.

(5) *Czech vowel parallelogram*



There is only one native diphthong [ou]; [au] and [eu] are found exclusively in loanwords, as is the long vowel [oː] (de Bray 1951).

The syllable nucleus can be filled by any vowel, diphthong or the syllabic liquids [r l]. (The strident trill [ř] cannot serve as a syllable nucleus because it is an obstruent (Kučera 1961).) Examples of each are included below.

(6) *Czech syllabic nuclei*

(a) *Long vowels*

[biː.d-aːk]	'villain'	[beː.r-ɛ͡ts]	'shin'
[baː.d-a-t]	'to research'	[boː.j-ɛ]	'buoy'
[buː.ʒ-ɛ-k]	'idol'		

(b) *Short vowels*

[bɪ.d-l-o]	'pole'	[bɛ.dr-a]	'shoulder'
[ba.b-a]	'granny'	[bɔ.d-aːk]	'bayonet'
[but.-k-a]	'box'		

(c) *Diphthongs*

[bo͡u.d-a]	'booth'	[ba͡uk.sɪt]	'bauxite'
[pnɛ͡u.ma.ti.ka]	'tire'		

(d) *Liquids*

[bl̩.b-ɛ͡ts]	'idiot'	[br̩.lox]	'den'

Turning now to morphology, Czech is a synthetic language with a rich system of inflectional and derivational affixes. Nouns and adjectives express gender (masculine animate, masculine inanimate, feminine, neuter), case (nominative, genitive, dative, accusative, vocative, locative, instrumental) and number (singular, plural) in a single fusional suffix.[3]

Verbs are inflected for tense (present, past), person (1,2,3) and number (singular, plural). Tense, person, and number are expressed through portmanteau morphemes; there are no separate tense morphemes, person morphemes, and so on. For example, in regular -at verbs (traditionally called 5th Class), the morpheme [-m] marks present 1st person singular, while [-jiː] marks present 3rd person plural (Naughton 1987). Each verb is accompanied by an obligatory thematic morpheme which falls between the root and the inflectional suffix. The thematic morphemes are mono-vocalic, and one of /a/, /ɛ/, /ɪ/, /aː/, /eː/, /iː/. These morphemes are separate from the root; if they were instead part of the underlying form of the root, a fuller range of vowels would be expected, such as stems with a thematic [u], and [o], and so on.

Thematic morphemes are semantically empty (e.g. Shields 1992). Halle and Nevins (in prep.) suggest on the strength of Russian data that all Slavic verbal theme vowels in fact express present tense. However, this analysis fails for Czech as the theme vowels are also found in the past tense: [baːd-aː-m] study-*a*-1SG 'I study', [baːd-a-l sɛm] study-*a*-past + copula-1SG 'I (m./n.) studied'.[4] The change in vowel length may be attributed to the traditional yer-analysis (e.g. Jakobson 1948) or may be reanalyzed as a mora associated with the inflectional suffix; either way, the vowel occurs in both present and past tenses of regular verbs and clearly cannot be a tense marker.

Stress always falls on the first syllable of the prosodic word in Czech (Kučera 1961, Palková 1994, Dankovičová 1999). The placement of stress is not affected by

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[3] A small number of nouns retain dual forms, as in [oko] 'eye'-Sg, [otʃɪ] 'eye'-Dual, [oka] 'eye'-Pl. To my knowledge, dual forms are now restricted to paired body parts, such as eyes, ears, shoulders, hands/arms, feet/legs and knees.

[4] The verbs cited by Halle and Nevins as lacking the theme vowel all take irregular conjugations and so do not bear on the present discussion (e.g. Naughton 1987).

attributes such as the length or relative sonority of the syllable nuclei; the first syllable is simply always stressed.[5]

The fact that there is only one stress per prosodic word, regardless of the length of the word, indicates that each word has a single foot (as every foot must have a head syllable, realized as stress (Hayes 1995)). Although vowel length is contrastive in Czech, it is one of a small number of languages which disregards this contrastive length with respect to stress and treats all syllables – open or closed, long or short – as the same (Hayes 1995). Subminimal words consisting of a single light syllable (as [(ˈps-ɪ)] below) are still parsed into a foot, although this foot is not binary. The stress and footing system is illustrated in the following data.

(7) *Czech has a single leftmost quantity-insensitive trochee*

[(ˈps-ɪ)]	'dog'-AccPl	[(ˈpu.s-u)]	'mouth'-AccSg
[(ˈpaː.s-ɛk)]	'belt'-NomSg	[(ˈpa.s-aːk)]	'shepherd'-NomSg
[(ˈpr̩.s-a)]	'breast'-NomSg	[(ˈpl̩.n-aː)]	'full'-FemNomSg
[(ˈpa.z-our)-k-o.v-ɪ.-t-iː]		'flinty'-MaNomSg	
[(ˈpo-.sto)n-a.v-a.-jiː.-t͡s-iː]		'ailing'-MaNomSg	

Affixes and prepositions are included within the PrWd, which can be seen by the fact that these morphemes are treated as a single unit with respect to stress and voicing assimilation (Trávníček 1952, Kučera 1961, Palková 1994).

(8) *Prepositions and affixes part of PrWd*

[(ˈʃko.l-a)]	'school'	[(ˈvɛ ʃko)l-ɛ]	'in school'
[(ˈba.l-ɪ-t)]	'to wrap'	[(ˈvɪ-.ba)l-ɪ-t]	'to unwrap'
[(ˈmɲɛ.st-o)]	'city'	[(ˈna přɛd-)mɲɛ.sc-ɛ]	'in the suburbs'

As the remainder of this chapter will explore, Czech roots have a maximal size (Slavičková 1975). Roots can be up to two syllables in length – which is equivalent to a binary foot in this quantity-insensitive language – and are frequently much shorter.

[5] Some dialects also give secondary stress to every other syllable following the primary stress on the first syllable, again regardless or length or quality of the syllable nuclei (Chlumský 1928). However, the Literary Czech dialect described here has only a single stress on the initial syllable of each PrWd.

This aspect of Czech will be explored in greater length in the following section dealing with maximal root size data (§2.2).

A final note concerns the Czech “mobile e”, a segment which occurs in some outputs of a root and is absent from others. Ketner (2003) argues that this segment is epenthetic and triggered by different factors, such as providing a suitable syllable nucleus ([dɛn] ‘bottom’-GenPl, *[dn̩]; cf. [dn-o] NomSg) or providing an onset ([lɛv] ‘lion’-NomSg, *[l̩v]; cf. [lv-a] GenSg). However, epenthesis never occurs for the purpose of creating a minimal size. Words consisting of a single light syllable surface faithfully in Czech, as in [(ˈdn-o)] ‘bottom’-NomSg, *[(ˈdɛ.n-o)], or [(ˈlv-a)] ‘lion’-GenSg, *[(ˈlɛ.v-a)]. So, Czech words have no minimal size restriction.

The next section looks more closely at the types of roots permitted in Czech, before moving on to an analysis of this maximal size restriction.

2.2 Czech maximal root size data

Czech roots can be as short as a single segment or up to two syllables in length. As a language with quantity-insensitive trochees (Hayes 1995), this maximal size restriction is equal to one binary foot. This section presents data showing that Czech roots do indeed have this maximal size, before providing an analysis of the factors producing it in §3.

Czech roots have the same size and shape in all output forms, regardless of whether they appear as a bare root or as part of a long, morphologically complex word. The following data, based on Slavičková (1975) and Fronek (1999), illustrates that Czech roots are the same in various outputs, and all roots dominate at most two syllable nuclei.

(9) *Roots maximally disyllabic in all outputs*

[(ˈd-aː-t)] give-TH-INF	‘to give’	[(ˈdo.-d-a)-va.-t-ɛl] P-give-TH-CONT-E1-NOM	‘supplier’
[(ˈp-iː-t)] drink-TH-INF	‘to drink’	[(ˈna.-p-a)-jɛ.-dl-o)] P-drink-TH-E2-NOM-NomSg	‘watering place’
[(ˈdn-o)] bottom-NomSg	‘bottom’	[(ˈbɛ.z-ɛ)-dn-iː] P-EP-bottom-AdjNomSg	‘bottomless’
[(ˈmst-a)] revenge-NomSg	‘revenge’	[(ˈpo.-mst-ɪ)-xc-ɪ-.v-ost] P-revenge-GenSg-want-TH-E3-NOM	‘vindictiveness’
[(ˈxc-iː-t)] want-TH-INF	‘to want’		
[(ˈstřɛt)] center-NomSg	‘center’	[(ˈu.-pro)-střɛt] P-P-center	‘in the middle’
[(ˈbaː.d-a-t)] research-TH-INF	‘to research’	[(ˈpro.-baː)d-aː.-ɲ-iː] P-research-TH-E4-GER	‘exploration’
[(ˈmo.ř-ɛ)] ocean-NomSg	‘ocean’	[(ˈmo.ř-ɛ)-pla.v-ɛt͡s.-tv-iː] ocean-TH-swim-NOM-ABS-AdjNomSg	‘nautical’
[(ˈja.zɪk)] language-NomSg	‘language’	[(ˈɲɛ.-k-o)l-ɪ.k-a.-ja.zɪt͡ʃ.-n-iː] INDEF-Q-NUM-NOM-PL-language-E4-AdjNomSg	‘multilingual’
[(ˈko.lɛ)n-o] knee-NomSg	‘knee’	[(ˈnaː.-ko)lɛ.ɲ-iːk)] P-knee-NOM	‘knee pad’

Roots can have many different shapes, but all comply with the maximal size restriction. (Palatalization, e.g., from /k/ to [t͡ʃ], is a standard process in Czech and does not affect the size of the root.) The maximal root size in Czech is referred to as disyllabic, even though some of the outputs above appear to be longer due to resyllabification (e.g., [(ˈko.lɛ)n-o] ‘knee’-NomSg). However, such roots *always* have an output as a bare morpheme, which is uncontentiously the size of one foot or less (e.g., [(ˈko.lɛn)] 'knee'-GenPl). The bare root output is the true source of the maximal size restriction, an insight which will be fully discussed in §3.1.

The data below specifies the possible root sizes in Czech, which are not only constrained by the maximal size, but also by the requirement that roots have onsets and end in a consonant (Ketner 2003). In other words, onsetless syllables and roots ending with a vowel or syllabic liquid are banned in the language.

(10) *Czech root shapes*

C	[(ˈd-aː-t)]	'to give'
CC	[(ˈdn-o)]	'bottom'
CCC	[(ˈmst-a)]	'revenge'
CVC	[(ˈbaː.d-a-t)]	'to research'
CVCC	[(ˈpr̩st)]	'finger'
CCVC	[(ˈzviː.ř-ɛ)]	'animal'
CCCVC	[(ˈstřɛt)]	'center'
CCVCC	[(ˈplaːʃc)]	'cloak'
CCCVCC	*no data (accidental gap)*	
CV.CVC	[(ˈja.zɪk)]	'language'
CV.CCVC	[(ˈko.přɪ)v-a]	'nettle'
CV.CCCVC	[(ˈjɛ.střaːp)]	'hawk'
CCV.CVC	[(ˈɦro.ma)d-a]	'pile'
CCV.CVCC	[(ˈɦlɛ.mɪʃc)]	'snail'

To summarize, Czech exhibits great variety in the shapes roots can take, so long as they conform to certain guidelines. The root cannot be longer than two syllables and cannot end in a vowel or syllabic liquid. Roots are also subject to the same restrictions on syllabic structure as all other morphemes, such as the onset requirement and well-formedness considerations of consonant clusters.

The fact that roots are confined to a maximal size requires explanation. OT posits that there are no constraints on the input, only on the output. The next section begins the analysis of Czech maximal root size. It is argued that this maximal root size in fact stems from a maximal PrWd size, which is otherwise latent in the language as it is dominated in longer, polymorphemic words. Output Faithfulness ensures that all outputs of the root are identical, which leads to a language-wide restriction on the maximal size of roots.

3 MAXIMAL ROOT SIZE IN CZECH

3.0 Introduction

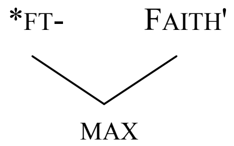
Czech presents a complex and compelling case of prosodic size maxima, both in terms of the process itself and in the way in which it interacts with other morphophonological phenomena in the language. Native Czech roots are maximally disyllabic in length, and they are frequently much shorter. The root size restriction is derived from a maximal PrWd size, leading to different maximal sizes based on the morphological characteristics of the root. The prosodic word is encouraged to be one foot or less, so a bare root (which is coextensive with the PrWd) may be up to a full foot in size. A bound root, which requires an overt inflectional suffix in all outputs, must be shorter so that the root plus suffix together (i.e., the PrWd) are one foot or less. This section presents an overview of the theoretical mechanisms behind maximal root size in Czech, arguing that it is created as an epiphenomenon of a maximal PrWd size. This size is then carried over to all outputs of the root – even ones which may not independently demand this shape – through Output Faithfulness (§4).

The most straightforward case of maximal size is found in the bare root, where the root and a prosodic word are coextensive, which will be addressed in §3.1. Any restrictions on the PrWd must also affect the root size when the root and the PrWd are one and the same. Maximal word size is achieved by limiting the PrWd to at most one foot, brought about through a ban on non-head feet represented by the constraint *FT- (de Lacy 2003; also see Ch3§3 for discussion of the theory of maximal size). In Czech, the ban on secondary feet is satisfied by deleting all material outside the foot. This results in an output of a single binary foot or less. The system of constraints leading to Czech maximal root size will now be outlined before the full analysis begins in §3.1.

The schematic constraint ranking below illustrates the mechanisms behind maximal word/root size for bare roots in Czech. The ban on non-head feet (*FT-) is repaired with deletion, which limits the size of the output. Other repairs which are less optimal (FAITH') must necessarily be higher ranked.

(11) *Maximal size: Bare roots*

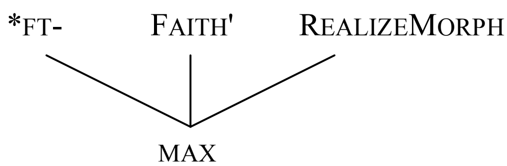
/CVCVCVCVC/ → [(ˈCV.CVC)]



The restriction on non-head feet has slightly different implications for bound roots, which must surface with an affix. Since the *prosodic word* must be at most one foot, the bound root and its affix must be *in total* one foot or less in length. As affixes are typically one syllable in size, bound roots only have enough room to be maximally mono-syllabic in order to satisfy the maximal PrWd size. For example, members of the [(ˈmo.ř-ɛ)] inflectional paradigm (see 24) demand a monosyllabic suffix in all inflections, so they are themselves at most one syllable in length. The inflectional suffix may not be wholly deleted because of the constraint REALIZEMORPH, which requires each morpheme to have an overt realization in the output (Samek-Lodovici 1993); therefore, the best option is to restrict the size of the root. The near-bare root must comply with a smaller maximal size restriction than bare roots, in order to accommodate the inflectional suffix.

(12) *Maximal size: Bound roots I*

/CVCVCVCVC-V/ → [(ˈCV.CV)]

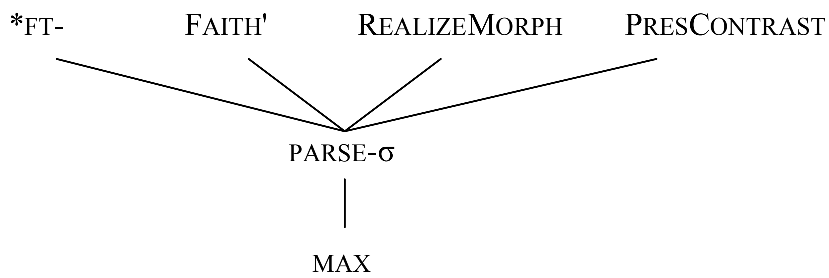


In other classes of bound roots, the inflectional material may reach two syllables in length. In order for the PrWd to be one foot or less, given the size of the inflectional suffix(es), the root needs to be less than one syllable, or non-syllabic. This is the case for many roots, as in [(ˈd-aː.-mɛ)] 'to give'-1Pl.

However, other roots with disyllabic inflections can be a full syllable in length, like [(ˈbaː.d-aː)-mɛ] ‘to research’-1Pl. Deletion is blocked when the morpheme would be pared down to such an extent that distinctive meaning is lost. This morphological preservation is represented here with the constraint PRESERVECONTRAST (Łubowicz 2003). The stress pattern of Czech indicates the word still has a single foot (Palková 1994), so non-exhaustive parsing, or a violation of PARSE-σ (Prince and Smolensky 1993), is the recourse when deletion is blocked. Each of the actions not pursued – the construction of non-head feet, a different faithfulness violation, or the loss of morphological data or contrastiveness (REALIZEMORPH, PRESCONTRAST) – must outrank the ban on non-exhaustive parsing so that it can emerge as the optimal repair.

(13) *Maximal size: Bound roots II*

/CVCVCVCVC-VCV/ → [(ˈC̲V.CV)] *or* [(ˈCV.CV)CV]



A bound root can still never be longer than one syllable in length, even with the protection provided by PRESERVECONTRAST. This is attributed to a ban on adjacent unfooted syllables, represented by the constraint *LAPSE (Green and Kenstowicz 1995). PRESCONTRAST allows a root to avoid reducing to a non-syllabic form in the interest of morphological contrast; *LAPSE balances this constraint by only allowing deletion to be blocked up to the point where the output would have a series of unparsed syllables. Therefore, this ranking would permit an output such as [(σ-σ)σ], but not [(σσ)-σσ]. When these two restrictions are brought to bear on the size of a bound root, then the result is a maximal root size of one syllable, plus a disyllabic inflectional suffix (§3.2.2). (All Czech words must have stress on the initial syllable, so an output like [σ(ˈσσ)σ], which also satisfies *LAPSE, is excluded, but see Ch3§3 for an analysis of a similar construction in Māori.)

However, the other highly ranked constraints – the ban on non-head feet, other potential faithfulness violations, and the requirement that each morpheme have an overt realization in the output – can lead to a sequence of unparsed syllables in longer words, or a violation of *LAPSE. For example, a word like [(ˈɲɛ.-k-o)l-ɪ.k-a.-ja.zɪt͡ʃ.-n-iː] violates *LAPSE several times, and does not attempt to repair it by having additional (non-head) feet or incurring additional faithfulness violations, e.g., through coalescence or by deleting one or more morphemes. Therefore, constraints against such actions must be higher ranked than the ban on a sequence of unparsed syllables.

(14) *Maximal size: Bound roots III*

/CVCVCVCVC-VCV/ → [(ˈCV.CV)], [(ˈCV.CV)CV], *not* [(ˈCV.CV)CV.CV]

*FT- FAITH' REALIZEMORPH

*LAPSE

PRESCONTRAST

PARSE-σ

MAX

Now that the theory and constraints behind maximal root size have been introduced, the following sections will illustrate their implementation. Section 3.1 looks at maximal size in bare roots, while §3.2 provides an analysis for bound (near-bare) roots. Subsequent sections will extend the theory of maximal size to look at Output Faithfulness and morphologically complex words (§4), as well as loanwords (§5).

3.1 Bare roots

The Czech maximal root size is created as an epiphenomenon of a latent maximal PrWd size. The language bans non-head feet, which means each word has a single, head foot. This ban is satisfied through deletion in the first instance, encouraging the word to be at most one foot in length. Therefore a bare root – where a root and a PrWd are coextensive – will be subject to this same maximal size. This section explores the maximal size restrictions on bare roots, attributing this phenomenon to an emergent maximal PrWd size. A "bare root" is only bare on the phonological level; morphologically, it is accompanied by a null inflectional suffix or an underlying yer which is subject to deletion (in contrast to overtly inflected outputs; Halle and Nevins in prep.).

A bare root is coextensive with the prosodic word; there are no other morphemes overtly present. Therefore, any restrictions on the PrWd are translated directly to the root, as they are essentially one and the same. The PrWd is encouraged to be at most one foot in length due to a ban on non-head feet, so the root incurs the same restriction. This maximal size is achieved through a ban on non-head feet, which in turn must be repaired by some constraint limiting the size of the output. A prime example of this is deletion, which is the repair of choice in Czech. The constraint *FT- limits the output to a single foot, and deletion ensures that any material outside that foot does not surface. The prosodic word, and the bare root which makes up the PrWd, is limited to a maximal size of a single binary foot. A longer, hypothetical input is reduced in size.

(15) *Maximal PrWd size through deletion*

Don't have non-head feet » Don't delete

‽/jazıkatat-Ø/	*FT-	MAX
a) [(ˈja.zı)$^{+}$(ˌka.tat)$^{-}$]	*!	
Λ b) [(ˈja.zık)$^{+}$]		*

Other potential repairs, such as coalescence, non-exhaustive parsing and fracture of the Morphological Word (MWd) into separate PrWds are also available, but not pursued in Czech. Each of these strategies will now be briefly explored. The reader is also referred to the discussion of possible responses to a maximal size restriction in Ch3§3.2.

One strategy for obtaining a maximal size restriction is for two or more input segments to map onto a single output segment, or coalesce, in order to prevent the word from exceeding one foot in length. The markedness constraint working against such an outcome is UNIFORMITY (McCarthy and Prince 1995a).

(16) UNIFORMITY: No element of S_2 has multiple correspondents in S_1. ("Don't coalesce")

The subscript numbers below show how more than one segment in the input can be combined into one in the output (17a).

(17) *Other responses I: Coalescence*

Don't have non-head feet, Don't coalesce » Don't delete

	‽/$j_1a_2z_3I_4k_5a_6t_7a_8t_9$-Ø/	*FT-	UNIFORMITY	MAX
	a) [(ˈ$c_{1,7}a_{2,6,8}.d_{3,9}I_4k_5$)$^+$]		*!	
Λ	b) [(ˈ$j_1a_2.z_3I_4k_5$)$^+$]			*

Based on the Czech root size data alone (§2.2), it cannot be determined if the maximal root size is achieved through deletion or coalescence of extraneous segments. The root size is a phonotactic generalization and so does not give any insight into the processes creating it. However, examination of other aspects of the phonology of Czech suggests that deletion (MAX) is lower ranked than UNIFORMITY, and so the maximal root size must be reached through deletion (Ketner 2003).

Another possible response triggered by a ban on non-head feet is non-exhaustive parsing. A single foot occurs in each word, and any additional syllables (i.e., those which would fall outside of a binary foot) are present in the output, but remain unfooted. The force militating against non-exhaustive parsing is the constraint PARSE-σ (Liberman and Prince 1977, Prince 1980, Halle and Vergnaud 1987, Prince and Smolensky 1993).

(18) PARSE-σ: All syllables must be parsed by feet.

As §4.2 will explore, non-exhaustive parsing is found in many Czech outputs, but only where the initial response, deletion, is blocked. In a simple input, as below, there is no motivation for blocking deletion, and so the PrWd is restricted to a maximal size of one foot.

(19) *Other responses II: Non-exhaustive parsing*

Don't have non-head feet, Parse all syllables into feet » Don't delete

ʔ/jazɪkatat-Ø/	*FT-	PARSE-σ	MAX
a) [(ˈja.zɪ)$^{+}$ka.tat]		*!	
Λ b) [(ˈja.zɪk)$^{+}$]			*

A fourth repair would break the input into more than one prosodic word, each with a single binary foot. This satisfies *FT-, as each PrWd would have exactly one foot, but it would destroy the integrity of the input, which is a single Morphological Word (MWd). This outcome can be prevented by a version of Truckenbrodt's WRAP constraint, requiring each MWd to be organized into a single PrWd (1999, 2006; see also discussion in Peperkamp 1997).

(20) WRAP(MWd, PrWd): Each morphological word is contained in a prosodic word.

The effects of WRAP can be seen in the following tableau, where an output which is broken into multiple PrWds (21a) is fatally dominated by the candidate undergoing deletion (21b).

(21) *Other responses III: Multiple PrWds*

Don't have non-head feet, Wrap each MWd in a single PrWd » Don't delete

ʔ/jazɪkatat-Ø$_{NP}$/	*FT-	WRAP(MWd, PrWd)	MAX
a) [{(ˈja.zɪ)$^{+}$}{(ˈka.tat)$^{+}$}]		*!	
Λ b) [{(ˈja.zɪk)$^{+}$}]			*

In summary, Czech employs deletion such that a PrWd (and by extension, a bare root) consists of a single foot, resulting in a maximum size restriction.

There are other factors that affect the shape of Czech roots. All words must have an onset, which is repaired through onset glide [j] epenthesis before non-back vowels, and through glottal stop epenthesis for back vowels and loanwords (Ketner 2003). The same Output Faithfulness (§4) which spreads the maximal root size to all outputs will also spread epenthetic segments, with the result that all roots – in addition to all prosodic words – must have an onset.[6] Another generalization is that all roots must end in a consonant, either as a syllable coda [(ˈja.zɪk)] 'language' or onset [(ˈmo.ř-ɛ)] 'ocean' (Ketner 2003). This is achieved through a root-specific version of McCarthy and Prince's (1993a) constraint FINAL-C (Golston 1996). ONSET and FINAL-C(root) affect the shape of the root, but not the size. Roots must not only comply with these well-formedness constraints, but also the maximal size restriction outlined in this section.

The next section deals with near-bare roots, which require a more complicated account but in doing so substantiate a major claim of the current theory. Maximal root size is based on a maximal PrWd size, so a change in the morphological constituency of the word may be reflected in a change in root shape. Czech roots which demand an overt, syllabic inflectional suffix in all outputs must have shorter roots so that together, the root plus inflection can best satisfy the maximal size restriction.

3.2 Near-bare roots

3.2.0 Introduction

The maximal root size is based on restrictions on the length of the prosodic word, not on the root itself. Maximal size limits on roots are simply a side effect of these PrWd size restrictions. This approach predicts that different maximal root size restrictions should emerge based on whether or not the root necessarily occurs with an affix, as an

[6] Speakers differ as to whether the glottal stop surfaces after a non-syllabic prefix or preposition. For example, all speakers say [ʔa͡u.t-o] 'car', with some speakers saying [s-ʔa͡u.t-ɛm] 'with (the) car' and other (typically, younger) speakers saying [s-a͡u.t-ɛm] (Čulík 1981). This disparity is not due to a change in Output Faithfulness, since other root outputs are unaffected (e.g., [jɛt-.ʔa͡u.t-ɛm] 'to go by car' or [na-.ʔa͡u.t-o] 'onto the car'). Instead, the difference hinges on the acceptability of [Cʔ] onset clusters.

affix would also take up space inside the PrWd. This is precisely the case in Czech: roots which can occur without an overt suffix, as in §3.1 above, can be up to two syllables (i.e., root ≤ one foot) in length. In comparison, roots requiring an overt suffix must be shorter, so that together the root plus suffix do not exceed the maximal word size (i.e., root + inflection ≤ one foot).

Czech verbal roots, adjectival roots and those of two nominal paradigms require each inflection to have an overt suffix, constituting at least one syllable in the output. These bound roots may be at most one syllable, and are frequently as short as a single segment (Slavičková 1975). These two phenomena are related: a longer inflectional suffix requires a shorter root so that together, these two do not exceed the length of one foot. The suffix contributes toward the maximal PrWd size, so longer (obligatory) inflectional suffixes lead to a shorter root. Together, the root plus suffix stay within the disyllabic maximal PrWd size restriction. This type of inflectional paradigm will be addressed in Section 3.2.1.

Similarly, inflections which call for a disyllabic inflectional suffix – Czech verbs and adjectives – will lead to roots which are non-syllabic, consisting of a consonant or cluster of consonants. In this way, the root plus the inflection are equal to one binary foot, and so within the word maximum. However, these roots can also be a single syllable in length, which pushes certain inflections over the maximal size. Section 3.2.2 argues that this is because reducing all verbal and adjectival roots to non-syllabic sequences would lead to an impractical root inventory, incapable of expressing the semantic or morphological range required by the language. In these cases, deletion down to a non-syllabic sequence can be blocked by constraints preserving the expression of morphological material.

Morpheme preservation may only block deletion up to a point. A ban on adjacent unfooted syllables (or lapses) still enforces a maximal size, so that the entire word is maximally one foot plus one unfooted syllable. In this way, morphological preservation prevents too much deletion, but the ban on lapses prevents too much faithfulness, too. The end result is that roots with disyllabic inflectional suffixes can be non-syllabic (root + inflection ≤ foot) or monosyllabic (root + inflection ≤ foot + one syllable), but not longer. Like the bare roots before them, the outputs of near-bare roots are also spread to other forms through Output Faithfulness, which will be discussed in §4.

3.2.1 Root size in near-bare roots I: Monosyllabic inflectional suffixes

Two Czech nominal paradigms, represented by nouns like [(ˈmo.ř-ɛ)] 'ocean' and [(ˈnuː.ʃ-ɛ)] 'pack basket' (Fronek's paradigms 34 and 49 (1999)), require a monosyllabic suffix in every inflection. Because of this, these roots are limited to a maximum length of one syllable, so that together the root (up to one syllable) and the inflectional ending (always one syllable) are equal to one foot or less. Consider the following nominal inflectional paradigm representing the noun [(ˈmoř-ɛ)]. (The paradigm for nouns like [(ˈnuːʃ-ɛ)] is nearly identical and so omitted here.)

(22) *Inflectional paradigm of the noun* [(ˈmo.ř-ɛ)]

'ocean'	*Singular*	*Plural*
Nominative	[(ˈmo.ř-ɛ)]	[(ˈmo.ř-ɛ)]
Genitive	[(ˈmo.ř-ɛ)]	[(ˈmo.ř-iː)]
Dative	[(ˈmo.ř-ɪ)]	[(ˈmo.ř-iːm)]
Accusative	[(ˈmo.ř-ɛ)]	[(ˈmo.ř-ɛ)]
Vocative	[(ˈmo.ř-ɛ)]	[(ˈmo.ř-ɛ)]
Locative	[(ˈmo.ř-ɪ)]	[(ˈmo.ř-iːx)]
Instrumental	[(ˈmo.ř-ɛm)]	[(ˈmo.ř-ɪ)]

In this case, the cause of a monosyllabic maximal size is fairly straightforward, based on what has already been established for bare roots in §3.1 above. Czech PrWds want to have a single binary foot, with any extra syllables subject to deletion. Thus, in a paradigm in which all suffixes consist of a single syllable, the root can be at most one syllable so that the entire word has an output of one foot or less. A hypothetical input exceeding this binary foot maximum would be shortened to satisfy *FT-, comparable to the analysis of deletion to form a maximal size in a bare root (§3.1). The only difference is that here the morphology does not allow an output where this root occurs as a bare morpheme.

(23) *Paradigm with monosyllabic suffixes creates monosyllabic root maximum*

Don’t have non-head feet » Don’t delete

	/mořat-ɛ/	*FT-	MAX
	a) [(mo.řa)+(t-ɛ)-]	*!	
Λ	b) [(mo.ř-ɛ)+]		*

The use of *FT- to create a maximal PrWd size predicts that a root which always requires a suffix will be shorter in order to avoid exceeding a binary foot in length, and this is borne out by Czech nouns following the paradigm in (22) above. Of course, other repairs, like non-exhaustive parsing, are less preferable to deletion, as in the analysis of bare roots in §3.1.

Deleting the suffix in order to accommodate the maximal word size would result in the loss of valuable morphological material. The nominal suffixes in Czech are fusional, encoding information on both the case and number of the inflection. This morphological material is protected by a constraint requiring all morphemes to have an overt realization in the output, REALIZEMORPH (Samek-Lodovici 1993, Walker 1998).

(24) REALIZEMORPH: Every morpheme in S_1 has some correspondent in S_2. (“Every morpheme is realized overtly”)

REALIZEMORPH blocks complete deletion of a morpheme. For the discussion at hand, this means that the inflectional endings must be preserved in the output at the expense of root material. This point is illustrated in the tableau below, which has a hypothetical disyllabic root and an obligatory inflectional suffix in the input. Deleting the suffix (25a) would allow the word to be one foot or less, but it loses the valuable morphological information contained in the inflection. Instead, it is preferable to delete part of the root (25b), so that both morphemes are represented in the output, satisfying REALIZEMORPH while keeping the output within the maximum size.

(25) *Deletion of a morpheme blocked to preserve morphological data*

Morphemes overtly realized » Don't delete

‽/mořat-ɛ/	REALIZEMORPH	MAX
a) [(ˈmo.řat)]	*!	*
Λ b) [(ˈmo.ř-ɛ)]		**

This analysis succinctly accounts for the maximal root size in nouns like [(ˈmo.ř-ɛ)]. All suffixes are one syllable in length, so all roots are one syllable or less in order to satisfy constraints on the maximum PrWd length. The next section will look at the inflectional paradigms of verbs and adjectives, whose suffixes can be two syllables in length.

3.2.2 Root size in near-bare roots II: Disyllabic inflectional suffixes

The paradigms of verbs and adjectives are somewhat more complex, as the inflectional suffixes are both mono- and disyllabic. Cases with a disyllabic inflection would suggest that a non-syllabic root is the optimal shape, so that together the root (no syllables) plus the suffix (two syllables) add up to one binary foot. Indeed, many root morphemes consist of a single consonant or sequence of consonants, completely lacking a viable syllable nucleus. Non-syllabic roots are exemplified in the data below, where each output is one binary foot or shorter (Fronek 1999; paradigms 119 and 69).

(26) *Paradigms of non-syllabic roots*

a) *Inflectional paradigm of the verb* [(ˈd-aː-t)]

‘to give’ INF: [(ˈd-aː-t)]	*Singular*	*Plural*
1	[(ˈd-aː-m)]	[(ˈd-aː.-mɛ)]
2	[(ˈd-aː-ʃ)]	[(ˈd-aː.-tɛ)]
3	[(ˈd-aː)]	[(ˈd-a.-jiː)]
IMP	[(ˈd-ɛj)]	[(ˈd-ɛj.-tɛ)]

b) *Inflectional paradigm of the adjective* [(ˈzl-iː)]

‘bad’ (Ma.)	*Singular*	*Plural*
Nominative	[(ˈzl-iː)]	[(ˈzl-iː)]
Genitive	[(ˈzl-eː.ɦo)]	[(ˈzl-iːx)]
Dative	[(ˈzl-eː.mu)]	[(ˈzl-iːm)]
Accusative	[(ˈzl-eː.ɦo)]	[(ˈzl-eː)]
Locative	[(ˈzl-eːm)]	[(ˈzl-iːx)]
Instrumental	[(ˈzl-iːm)]	[(ˈzl-iː.mɪ)]

The fact that non-syllabic roots provide the most satisfactory response to disyllabic inflectional suffixes is illustrated below. This conclusion follows directly from the analysis of bare roots in §3.1 and of the near-bare roots in §3.2.1. In order to accommodate a disyllabic suffix, the root must be non-syllabic (27b) to avoid exceeding the maximal word size (a). (The example is based on a hypothetical verbal root input inflected for 1Pl.)

(27) *Paradigm with disyllabic suffixes creates non-syllabic maximum root*

Don’t have non-head feet » Don’t delete

ʔ/ban-aː-mɛ/	*FT-	MAX
a) [(ˈba.naː)(ˌmɛ)]	*!	
Λ b) [(ˈbaː.mɛ)]		*

Yet in other cases, the root consists of sequences which do form a full syllable in the output, e.g., CVC. These roots will push the word over the disyllabic maximum in certain inflections, like [(ˈbaː.d-aː)-mɛ] ‘to research’-1Pl. This section will argue that deletion is blocked in these cases by a constraint preserving the distinct morphological meanings of the morphemes. Severe deletion, which would pare each root down to an “acceptable” non-syllabic output, would reduce the morphological and semantic capabilities of the language to an impractical level. The loss of meaning is countered by constraints preserving morphemes and their distinctiveness.

Below are two representative inflectional paradigms of a Czech verb and adjective, following the same inflectional paradigms as the non-syllabic roots in (26) above (Fronek 1999). Although there can be quite a lot of variance between paradigms, they all have some monosyllabic and some disyllabic suffixes, excluding a few irregular roots. Monosyllabic inflections remain unshaded while disyllabic inflections are shaded gray.

(28) *Paradigms of monosyllabic roots*

a) *Inflectional paradigm of the verb* [(ˈbaː.d-a-t)]

‘to research’ INF: [(ˈbaː.d-a-t)]	*Singular*	*Plural*
1	[(ˈbaː.d-aː-m)]	[(ˈbaː.d-aː)-mɛ]
2	[(ˈbaː.d-aː-ʃ)]	[(ˈbaː.d-aː)-tɛ]
3	[(ˈbaː.d-aː)]	[(ˈbaː.d-a)-jiː]
IMP	[(ˈbaː.d-ɛj)]	[(ˈbaː.d-ɛj)-tɛ]

b) *Inflectional paradigm of the adjective* [(ˈmla.d-iː)]

‘young’ (Ma.)	*Singular*	*Plural*
Nominative	[(ˈmla.d-iː)]	[(ˈmla.ɟ-iː)]
Genitive	[(ˈmla.d-eː)ɦo]	[(ˈmla.d-iːx)]
Dative	[(ˈmla.d-eː)mu]	[(ˈmla.d-iːm)]
Accusative	[(ˈmla.d-eː)ɦo]	[(ˈmla.d-eː)]
Locative	[(ˈmla.d-eːm)]	[(ˈmla.d-iːx)]
Instrumental	[(ˈmla.d-iːm)]	[(ˈmla.d-iː)mɪ]

A syllabic verbal root exceeds the length of a single binary foot in the plural conjugations (e.g., [(ˈbaː.daː)mɛ] 1Pl) but not in the singular (e.g., [(ˈbaː.daːm)] 1Sg). Monosyllabic adjectival roots can also lead to outputs longer than one foot, as in the masculine animate [(ˈmla.d-eː)ɦo)] ‘young’-GenSg or [(ˈmla.d-eː)mu)] DatSg in (28b) above. Yet these roots are clearly not subject to deletion down to a non-syllabic form, the only size capable of fully satisfying the maximal PrWd size.

Limiting verbal and adjectival roots to non-syllabic sequences would provide an unworkably small inventory of roots, and so severe deletion is blocked in order to maintain morphological distinctiveness.[7] For example, if the [baːd] root were shortened, it would no longer carry distinct meaning from roots such as [baːt (sɛ)] ‘to fear’, [biːt] ‘to beat’, [daːt] ‘to give’ and [bɟiːt] ‘to be awake’. This intuitive preservation is represented through a constraint ensuring that distinct inputs remain distinct in the output, PRESERVECONTRAST (Łubowicz 2003), slightly paraphrased here from the original.

[7] Alternatively, monosyllabic maximum root size could be an effect of intraparadigmatic faithfulness. McCarthy argues that the Optimal Paradigms model selects the root shape which incurs the least overall markedness violation (2001, 2005). Limiting the verbal roots to a maximum of one syllable allows the singular and infinitive inflections (i.e., 5 out of 9 outputs) to be one foot or less. If Optimal Paradigms’ tenet of “Majority Rules” is interpreted to mean that a root which satisfies any majority of paradigm members is acceptable, then this would also explain the monosyllabic roots here. Currently, Majority Rules only comes into play when no output can satisfy the restrictions on every member of the paradigm (as a non-syllabic root does in Czech).

(29) PRESERVECONTRAST: For each pair of contrasting inputs that map onto the same output in a scenario, assign a violation mark. ("If inputs are distinct, their outputs must remain distinct.")

Admittedly, PRESERVECONTRAST is a troublesome constraint. For one, the extent of its scope is undefined and so can lead to overprediction. When highly ranked, this constraint would create a language with no homophones, a scenario which the author is unaware of. It is also uncertain how this constraint may apply to individual roots, but not to a morphologically complete input/output. For example, if a highly inflected language (like Czech) has a nominal root /b-/ and a verbal root /b-/, and the morphology ensures that these roots can never be used to form identical output PrWds, can PRESERVECONTRAST force dissimilation of the root morpheme alone?

However, there does not appear to be a more suitable alternative available at present. The constraint MORPHREAL merely requires that the morpheme have *some* overt expression, but it must not obtain a larger than minimal size, as reflected in the Czech data.

Another alternative would be to analyze the outputs cyclically, with the size restriction imposed on the level of a *stem* instead of the prosodic word. For instance, the root plus theme vowel (e.g. [baː.d-aː-]) or root plus theme vowel plus person (e.g. [baː.d-aː-m-]) would serve as the stem, which has a maximal size of a foot, while the plural marker is excluded for the purposes of size restrictions (e.g. [{ˈbaː.d-aː-}mɛ]). The input would be analyzed once up to the level of the stem, where prosodic structure must be assigned and any material larger than a foot deleted, and then the output as a whole would be analyzed a second time and prosodic structure reassigned, this time without a size restriction.

This approach is not only rejected on theory-internal grounds, but also fails when expanded to other inflectional paradigms. Although it appears to hold for the [(ˈbaː.d-a-t)] inflectional paradigm in (28a), where the outputs can more or less be decomposed along the lines of singular stems (lacking a number marker) and plural stems (with an additional morpheme -ɛ/-iː/-tɛ). However, Czech adjectives, as in (28b), lack theme vowels (and so the basis for a stem as described above), but are still limited to a maximal size of a single syllable. This becomes clear when looking at inflectional paradigms for all four genders, as below.

(30) *Inflectional paradigms of the adjective* [(ˈmla.d-iː)] ‘young’

M-animate	*Singular*	*Plural*
Nominative	[(ˈmla.d-iː)]	[(ˈmla.ɟ-iː)]
Genitive	[(ˈmla.d-eː)ɦo]	[(ˈmla.d-iːx)]
Dative	[(ˈmla.d-eː)mu]	[(ˈmla.d-iːm)]
Accusative	[(ˈmla.d-eː)ɦo]	[(ˈmla.d-eː)]
Locative	[(ˈmla.d-eːm)]	[(ˈmla.d-iːx)]
Instrumental	[(ˈmla.d-iːm)]	[(ˈmla.d-iː)mɪ]

M-inanimate	*Singular*	*Plural*
Nominative	[(ˈmla.d-iː)]	[(ˈmla.d-eː)]
Genitive	[(ˈmla.d-eː)ɦo)]	[(ˈmla.d-iːx)]
Dative	[(ˈmla.d-eː)mu)]	[(ˈmla.d-iːm)]
Accusative	[(ˈmla.d-iː)]	[(ˈmla.d-eː)]
Locative	[(ˈmla.d-eːm)]	[(ˈmla.d-iːx)]
Instrumental	[(ˈmla.d-iːm)]	[(ˈmla.d-iː)mɪ]

F	*Singular*	*Plural*
Nominative	[(ˈmla.d-aː)]	[(ˈmla.d-eː)]
Genitive	[(ˈmla.d-eː)]	[(ˈmla.d-iːx)]
Dative	[(ˈmla.d-eː)]	[(ˈmla.d-iːm)]
Accusative	[(ˈmla.d-ou)]	[(ˈmla.d-eː)]
Locative	[(ˈmla.d-eː)]	[(ˈmla.d-iːx)]
Instrumental	[(ˈmla.d-ou)]	[(ˈmla.d-iː)mɪ]

N	*Singular*	*Plural*
Nominative	[(ˈmla.d-eː)]	[(ˈmla.d-aː)]
Genitive	[(ˈmla.d-eː)ɦo]	[(ˈmla.d-iːx)]
Dative	[(ˈmla.d-eː)mu]	[(ˈmla.d-iːm)]
Accusative	[(ˈmla.d-eː)]	[(ˈmla.d-aː)]
Locative	[(ˈmla.d-eːm)]	[(ˈmla.d-iːx)]
Instrumental	[(ˈmla.d-iːm)]	[(ˈmla.d-iː)mɪ]

The wide variations in features, along with the fact that these suffixes are obviously not semantically empty, indicates that the vowel following the root cannot be a theme vowel. Yet the root is still limited to a maximal size of one syllable. Accounting for this maximal size restriction through a cyclical account would require the stem to be defined here as root plus inflection, rather than root plus theme vowel (and excluding additional inflection) for the nouns above. Additionally, it would require the unusual stipulation that the stem be defined as the root plus *only the first syllable of the inflection*, militating exclusively against the Ma-GEN-SG, Ma-DAT-SG, Ma-ACC-SG, Mi-GEN-SG, Mi-DAT-SG, N-GEN-SG, N-DAT-SG and the instrumental plural of all genders, since the "too long" suffixes are not logically ordered as in the singular/plural dichotomy of nominal inflectional paradigms. Therefore, a cyclical analysis does not resolve the problem presented by Czech, either.

In short, the difficulties are recognized here and deserve further consideration, but for the purposes at hand, the constraint PRESERVECONTRAST is employed as a counterbalance to excessive deletion. Intuitively, it is not in a language's interest for distinct inputs to devolve into identical, and so indistinguishable, outputs, and it is in this spirit that PRESERVECONTRAST is used here. So in the following example, for the /baːd/ morpheme to retain its morphological distinctiveness, deletion is blocked and the input is preserved despite a violation of PARSE-σ.

(31) *Too much deletion causes morphemes to be non-distinctive I: Root*

Morphemes are distinct » Parse all syllables into feet » Don't delete

/baːd-aː-mɛ/	PRESCON: [b]	PARSE-σ	MAX
Λ a) [(ˈbaː.daː)mɛ]		*	
b) [(ˈbaː.mɛ)]	*!		*

By the same token, PRESERVECONTRAST also prevents reduction of the suffix, so that e.g., the plural [(ˈbaː.daː)mɛ] and the singular [(ˈbaː.daːm)] are distinctive.

(32) *Too much deletion causes morphemes to be non-distinctive II: Suffix*

Morphemes are distinct » Parse all syllables into feet » Don't delete

/baːd-aː-mɛ/	PRESCON: [m]	PARSE-σ	MAX
Λ a) [(ˈbaː.daː)mɛ]		*	
b) [(ˈbaː.daːm)]	*!		*

And as argued above for the bound nominal roots, completely deleting one or more of the input morphemes would lead to the loss of the morphological data it carried, which is prevented by REALIZEMORPH.

(33) *Deletion of a morpheme causes loss of morphological data*

Morphemes overtly realized » Parse all syllables into feet » Don't delete

/baːd-aː-mɛ/	REALIZEMORPH	PARSE-σ	MAX
Λ a) [(ˈbaː.daː)mɛ]		*	
b) [(ˈbaː.dmɛ)]	*!		*

Thus for Czech verbal paradigms, which require monosyllabic or disyllabic suffixes, a non-consonantal root is ideal because the output is one foot or less in all inflections. When reduction of an over-long input would lead to a loss of morphological data or distinctiveness, then a monosyllabic root is accepted instead.

Even so, roots are again limited to a maximal size of one syllable. Monosyllabic roots may force words to be longer than a foot, but it still may not be longer than a foot plus a single unparsed syllable. This reveals a ban on adjacent unparsed syllables, characterized by the constraint *LAPSE (Prince 1983, Selkirk 1984, Green and Kenstowicz 1995).

(34) *LAPSE: Adjacent unstressed moras must be separated by a foot boundary.

Coupled with the language's undominated requirement that stress fall on the initial syllable of the word, minimally inflected PrWds can be up to three syllables long [(ˈσ-σ)σ]. Even when a hypothetical input would require an output identical to that of a separate word, the preservation of morphological distinctness is blocked in these cases so that a sequence of unparsed syllables may be avoided. (The outputs [σ(ˈσ-σ)σ] and [σ(-ˈσσ)] would equally satisfy *LAPSE, but they are omitted due to that language's requirement that stress fall on the initial syllable of the word. For more on foot-PrWd alignment, see discussion in Ch5§4.1.)

(35) *Morpheme preservation blocked by ban on lapses*

Don't have lapses » Morphemes are distinct » Parse all syllables into feet

‽/baːdad-aː-mɛ/	*LAPSE	PRESCON: [bad]	PARSE-σ
Λ a) [(ˈbaː.daː)mɛ]		*	*
b) [(ˈbaː.da)daː.mɛ]	*!		**

The ban on lapses never prevents the overt realization of a morpheme, but can only restrict the size of the root; this point will be returned to in the discussion on longer words in §4.2. A similar case of root size accommodating a PrWd size restriction – but dealing with minimal size instead – is found in the Panoan language Shipibo (Ch4§2.1.4; Elias-Ulloa 2006).

Now that the size maxima of bare and near-bare roots have been accounted for, the next section addresses the observation that Czech roots have the same shape in all outputs, including complex words which far exceed the size of one foot. This consistency is accounted for through Output Faithfulness, which encourages all outputs to have the same exponence.

4 OUTPUT FAITHFULNESS AND COMPLEX WORDS

4.0 Introduction

Czech has a rich inflectional system, so roots are found in bare and near-bare outputs like those examined in the preceding section, but can also occur in longer, more complex words. Yet roots have the same shape in all outputs, regardless of the complexity of the word. The constraints accounting for the maximal size in Czech also put pressure on complex words to be as short as possible. Conceivably, a root might alternate forms between, e.g., a disyllabic form in the bare root and a monosyllabic form in complex outputs in order to reduce the overall number of unparsed syllables. As this is never the outcome in Czech, this section examines how root consistency is maintained through Output Faithfulness, which carries the prosodically-based size as determined in §3 over to more complex outputs.

A Czech root can be up to two syllables as a bare root, or up to one syllable as a near-bare root, as demonstrated in the previous section. That is, the prosodic word aims to have at most a single foot, so a bare or near-bare root is shaped accordingly, creating a maximal root size. This pressure to limit the size of the word is not put aside simply because the input is morphologically more complex; yet Czech roots have the same size and constituency in all outputs.[8] The data from (11), which illustrates this consistency, is partially reproduced here to facilitate the reader (Fronek 1999).

(36) *Czech roots have same shape in all outputs*

[(ˈd-aː-t)]	‘to give’	[(ˈdo.-d-a)-va.-t-ɛl]	‘supplier’
[(ˈstřɛt)]	‘center’	[(ˈu.-pro)-střɛt]	‘in the middle’
[(ˈbaː.d-a-t)]	‘to research’	[(ˈpro.-baː)d-aː.-ɲ-iː]	‘exploration’
[(ˈmo.ř-ɛ)]	‘ocean’	[(ˈmo.ř-ɛ)-pla.v-ɛt͡s.-tviː]	‘nautical’
[(ˈja.zɪk)]	‘language’	[(ˈɲɛ.-k-o)l-ɪ.k-a.-ja.zɪt͡ʃ.-n-iː]	‘multilingual’
[(ˈko.lɛ)n-o]	‘knee’	[(ˈnaː.-ko)lɛ.ɲ-iːk)]	‘knee pad’

[8] Excluding palatalization (e.g., /k/ → [t͡ʃ]) and epenthetic [ɛ], which is conditioned by factors such as syllable structure rather than the length of word (Ketner 2003). In these cases, the triggering conditions must outrank Output Faith in order to allow variance in root shapes.

Pressure to eliminate material outside the foot predicts that the word will always be as short as possible. Potentially, the root could reduce in longer words to satisfy this, but be larger in simple outputs, where a shorter inflection gives the root more elbow room while still satisfying *FT-. The data in (36), where the root size never varies, shows that the shape of simpler root outputs (where a maximal size is enforced as in §3) is preserved in more complex words (where these same constraints pressure the word to be as short as possible).

The relationship between different output forms is expressed through Transderivational Correspondence (or Output-Output Faithfulness; Benua 1997) for derivationally related outputs, and through Optimal Paradigms for intraparadigmatic faithfulness (McCarthy 2001, 2005). Output-Output Faithfulness characterizes the relationship between a less complex output, which serves as a base, and a morphologically derived counterpart, which must be faithful to this base. This type of interaction will be described for bare roots (§4.1.1), which are a base for all other outputs of the root. When the base is carried over to complex outputs through Output-Output Faithfulness, then any size restrictions, as discussed in §3, are spread as well.

Optimal Paradigms describes the correspondence relationships between members of an inflectional paradigm. In short, all members are equally complex, so one form cannot serve as a base for the others. Instead, the members of the paradigm are analyzed in parallel, with the winning output the one which best satisfies the paradigm as a whole. Optimal Paradigms ensures that the root shape is consistent within the paradigm, as illustrated in §4.1.2.

The analysis of Czech provides insight into the interaction of Output-Output and Optimal Paradigms Faithfulness, showing that the root form determined intraparadigmatically through Optimal Paradigms can serve as a base for more complex outputs through Output-Output Faithfulness (§4.2). This supports McCarthy's (2005) claim that OO- and OP-Faithfulness are complementary theories. The term "Output Faithfulness" is used to refer to their cumulative effect, which produces a consistent root size in all outputs.

Output Faithfulness is critical to ensuring that the root size restriction achieved under one set of circumstances is shared in all outputs. For example, a bare root output can be up to two syllables under *FT- » MAX, as seen in §3.1. However, a different inflection of the same root may require a syllabic suffix; this would make the

PrWd – root plus suffix – more than one foot long. But the root still has the same, maximally disyllabic shape in all outputs. It does not reduce so that the word (root + suffix) can be one foot or less. This is because Output Faithfulness blocks any process which would cause the root to change shape, such as the deletion which would normally lead to a maximum prosodic word size. The inflectional suffix is protected by separate constraints, discussed in §3 above and returned to presently. The end result is that the PrWd can violate the maximal size restriction in order to preserve the (maximally disyllabic) root shape determined when the root was a bare morpheme.

The effects of Output Faith are seen when it outranks "standard" Input-Output (IO) Faithfulness, such as the deletion employed to obtain a maximal word size. Output Faith can also lead to a violation of the ban on unfooted syllables or a sequence thereof, which were found to play a role in the analysis of maximal size restrictions in the previous section. This relationship is represented below, where Output Faithfulness is integrated into the constraint ranking determined in (14) in §3.

(37) *Root size maintained in complex words*

/CV-C-CVCVC-VC-C-V/ → /(ˈCV-C-CV)CVC-VC-C-V/

*FT- FAITH' REALIZEMORPH Output Faith

*LAPSE

PRESCONTRAST

PARSE-σ

MAX

The influence of Output Faith on root size is shown in the following pair of tableaux. In Recursion A, a root longer than two syllables is pared down to the length of a single binary foot, as in §3. (The ban on non-head feet, which triggers this interaction, is not represented here.) In Recursion B, the output from A is taken as the base for

Output-Output Faithfulness, so that when prefixed – and thereby pushing the word over the length of a binary foot – the root shape is perfectly preserved. Output Faith blocks deletion, so the next best repair (in this case, non-exhaustive parsing) is employed instead.

(38) *No deletion from base root shape in complex words*

Recursion A: Parse all syllables into feet » Don't delete from input

/CVCVCVC/	MAX-Output	PARSE-σ	MAX-IO	>>
a) [(CV.CV)CVC]		*!		
Λ b) [(CV.CVC)]			*	

Recursion B: Don't delete from base » Parse all syllables into feet

/CV-CVCVCVC/	MAX-Output: [CVCVC]	PARSE-σ	MAX-IO
Λ a) [(CV.CV)CVC)]		*	*
b) [(CV.CVC)]	*!		**

A related phenomenon is found when looking at roots which cannot surface as a bare form, but which require an overt suffix in every inflection (§3.2). Again, a theory without Output Faithfulness – specifically, without Optimal Paradigms Faithfulness – would predict that the root may change size, depending on the inflection. In Czech, this is not the case, and even bound roots have the same shape in all outputs. This is illustrated by the schematic input in (39), which looks at two members of the same inflectional paradigm. In interaction (A), the morphology demands suffixes adding up to two syllables, as for plural verb forms in Czech. In order to accommodate the required suffixes, the root form must shrink down to a non-syllabic shape (represented here by C, a single consonant forming a syllable onset) to prevent the word from exceeding the length of a foot. Other outputs of the root cannot augment this root shape – even when a shorter inflection would allow a longer root form while adhering to the maximum size restriction (39B). Without Output Faith, we would expect roots to be able to alternate in length, depending on the length of suffixation required. However, this is not the case in Czech, providing further evidence the language must employ Output Faithfulness.

(39) *Root size consistent in all members of inflectional paradigm*

(A) *Disyllabic inflection*: Parse all syllables into feet » Don't delete from input

/CVC-VCV/	DEP-Output	PARSE-σ	MAX-IO	>>
Λ a) [(CV.CV)]			*	
b) [(CV.CV)CV]		*!		

(B) *Monosyllabic infl.*: No epenthesis in paradigm » Don't delete from input

<<	/CVC-V/	DEP-Output: [C]	PARSE-σ	MAX-IO
	Λ a) [(CV)]			*
	b) [(CV.CV)]	*!		

The analysis of Czech substantiates the complementary nature of Output-Output and Optimal Paradigms Faithfulness. In Czech, the root shape in complex words is determined through faithfulness to a base for both bare and near-bare roots, as in Benua's (1997) Transderivational Correspondence Theory. As described in the preceding section, the bare root output is an Output-Output base. For bound roots the base is determined in the manner described by McCarthy's (2005) Optimal Paradigms faithfulness, with all members of a paradigm devolving towards the least marked member, resulting in intraparadigmatic consistency. Once this output form is determined intraparadigmatically, it, too, serves as an Output-Output Faithfulness base for more complex outputs.

Finally, it will be argued that the same ranking as in (37) also predicts the behavior of polymorphemic words in Czech. In a highly inflected language like Czech, words are frequently composed of many morphemes. *FT- encourages words to have a single foot, with deletion being the first choice of repair in Czech. But constraints requiring each morpheme to have an overt and distinct output realization prevent the loss of meaning by blocking deletion. Each morpheme is protected by REALIZEMORPH and PRESCONTRAST, and so a word with many morphemes can straightforwardly surface as a word with many syllables, despite the pressure for the PrWd to have a maximal size. Therefore, the maximal size is evident in roots and simple words, where the size is enforced in simple PrWds and spread through Output Faithfulness, but may be blocked in complex prosodic words.

Intuitively, the pressure for shorter words combined with morpheme preservation results in the practical effect that Czech affixes, while numerous and readily concatenated, are all relatively short. Even when the language cannot limit PrWds to a maximal size of one foot, it still ensures that they are as close to one foot – that is, in most cases, as short – as possible. As above, root shape is invariable due to the effects of Output Faithfulness, and blocking of deletion leads to non-exhaustive parsing so that a single binary foot stands at the left edge of the word.

The rest of this section is organized thus: §4.1.1 looks at Output Faithfulness with respect to bare and §4.1.2 near-bare roots. Then, §4.2 discusses the phonology of longer, complex words.

4.1 Output Faithfulness within an inflectional paradigm

4.1.0 Introduction

All Czech roots are members of a complex inflectional paradigm, with nouns inflecting for number and seven different cases, and adjectives additionally inflecting for four genders. Meanwhile, verbs inflect for person and number. This demanding morphological system receives its most basic expression in inflectional paradigms, which can have monosyllabic, disyllabic and null suffixes. The analysis of bare and near-bare roots in §3 concluded that the length of the inflectional affix can affect the length of the root morpheme. Yet once this root shape is determined, it is the same in all outputs throughout the inflectional paradigm and the language as a whole.

This section probes why the root size is consistent, despite the wide variety of affixation regularly undertaken in a highly inflected language like Czech. It will argue that this consistency is due to a correspondence relationship between different outputs of the same root. One output is taken as a referent, or “base”, to which other outputs must be faithful, more so than to the input; this interaction is known as Output-Output Faithfulness (Benua 1997). In inflections which provide for a null inflection, the base is the bare root, which is morphologically simpler than all other outputs (§4.1.1). When a bare root is not a viable output, as for bound roots, where the morphology requires an overt inflection in all outputs, then the root shape which incurs the fewest markedness violations throughout the inflectional paradigm is selected (§4.1.2). Intraparadigmatic faithfulness is governed by Optimal Paradigms Faithfulness (McCarthy 2001, 2005).

4.1.1 Output Faithfulness in paradigms with a null inflection

A root always has the same output shape in Czech, regardless of the length or syllabification of affix material. This consistency of output forms is not predicted by the account of maximal size employed in §3 alone. These constraints encourage prosodic words to be as close to one foot or smaller as possible, without regard for morpheme consistency. Taken alone, constraints on PrWd size predict that bare roots can be up to two syllables long [(CV.CVC)], but the same root in a more complex word might reduce, allowing the word as a whole to be one foot or less, producing variable root shapes such as [(CV.C-V)] or [(C-V-.CV)]. Each of these allophones would fully satisfy *FT-, yet such alternations never occur in Czech. Instead, the root has the same size in every output, so a root which can be disyllabic as a bare morpheme, e.g., [(□jɛ.řaːp)] 'stork'-NomSg, has the same shape in a more complex form, although the prosodic word as a whole will be longer than a single foot, [(□jɛ.řaː)b-o.vɪ] 'stork'-GenSg.

The ban on alternating root size indicates that there is a correspondence relationship between different outputs of the same root: all outputs of the root are encouraged to have a uniform shape, even when this violates other prosodic considerations such as the ban on unparsed syllables. This consistency among output forms is enforced through Output Faithfulness. Faithfulness between outputs must be more potent than the maximal PrWd size and faithfulness to the input in order to prevent root size alternations.

Disyllabic roots are only found in paradigms with a null inflection. As a bare morpheme, the root can be up to two syllables while still satisfying the maximal word size. But in members of the same paradigm, which are overtly inflected, the affixed root has the same shape as in the bare root, at the expense of the maximal word restriction. The root is the same size as it was as a bare morpheme, forcing overtly inflected members of the paradigm to exceed one foot in length. Consider the inflection of the following noun classes in Czech. Coda devoicing ([(ˈjɛ.řaːp)] / [(ˈjɛ.řaː)bo.vɪ]) is a standard process in Czech and does not affect the prosodic structure. The null-suffix endings have been shaded gray; all other outputs exceed the size of one foot.

(40) *Nominal paradigms with a null suffix*

a) *Masculine animate*

'crane'	*Singular*	*Plural*
Nominative	[(ˈjɛ.řaːp)]	[(ˈjɛ.řaː)b-ɪ]
Genitive	[(ˈjɛ.řaː)b-a]	[(ˈjɛ.řaː)b-uː]
Dative	[(ˈjɛ.řaː)b-o.vɪ]	[(ˈjɛ.řaː)b-uːm]
Accusative	[(ˈjɛ.řaː)b-a]	[(ˈjɛ.řaː)b-ɪ]
Vocative	[(ˈjɛ.řaː)b-ɛ]	[(ˈjɛ.řaː)b-ɪ]
Locative	[(ˈjɛ.řaː)b-o.vɪ]	[(ˈjɛ.řaː)b-ɛx]
Instrumental	[(ˈjɛ.řaː)b-ɛm]	[(ˈjɛ.řaː)b-ɪ]

b) *Masculine inanimate*

'language'	*Singular*	*Plural*
Nominative	[(ˈja.zɪk)]	[(ˈja.zɪ)k-ɪ]
Genitive	[(ˈja.zɪ)k-u]	[(ˈja.zɪ)k-uː]
Dative	[(ˈja.zɪ)k-u]	[(ˈja.zɪ)k-uːm]
Accusative	[(ˈja.zɪk)]	[(ˈja.zɪ)k-ɪ]
Vocative	[(ˈja.zɪ)k-u]	[(ˈja.zɪ)k-ɪ]
Locative	[(ˈja.zɪ)k-u]	[(ˈja.zɪ)t͡s-iːx]
Instrumental	[(ˈja.zɪ)k-ɛm]	[(ˈja.zɪ)k-ɪ]

c) *Feminine*

'hour'	*Singular*	*Plural*
Nominative	[(ˈɦo.ɟɪ)n-a]	[(ˈɦo.ɟɪ)n-ɪ]
Genitive	[(ˈɦo.ɟɪ)n-ɪ]	[(ˈɦo.ɟɪn)]
Dative	[(ˈɦo.ɟɪ)ɲ-ɛ]	[(ˈɦo.ɟɪ)n-aːm]
Accusative	[(ˈɦo.ɟɪ)n-u]	[(ˈɦo.ɟɪ)n-ɪ]
Vocative	[(ˈɦo.ɟɪ)n-o]	[(ˈɦo.ɟɪ)n-ɪ]
Locative	[(ˈɦo.ɟɪ)ɲ-ɛ]	[(ˈɦo.ɟɪ)n-aːx]
Instrumental	[(ˈɦo.ɟɪ)n-ou]	[(ˈɦo.ɟɪ)n-a.mɪ]

d) *Neuter*

'knee'	*Singular*	*Plural*
Nominative	[(ˈko.lɛ)n-o]	[(ˈko.lɛ)n-a]
Genitive	[(ˈko.lɛ)n-a]	[(ˈko.lɛn)]
Dative	[(ˈko.lɛ)n-u]	[(ˈko.lɛ)n-uːm]
Accusative	[(ˈko.lɛ)n-o]	[(ˈko.lɛ)n-a]
Vocative	[(ˈko.lɛ)n-o]	[(ˈko.lɛ)n-a]
Locative	[(ˈko.lɛ)ɲ-ɛ]	[(ˈko.lɛ)n-ɛx]
Instrumental	[(ˈko.lɛ)n-ɛm]	[(ˈko.lɛ)n-ɪ]

The inflections with a null suffix allow the roots to reach a maximum size of two syllables, as illustrated §3.1. Of course, roots smaller than the disyllabic data above will also satisfy the maximal size restriction.

Previously, the constraint REALIZEMORPH (Samek-Lodovici 1993; "Every morpheme is realized overtly") was employed to account for why a morpheme may not be wholly deleted from an output. However, the bare roots above may surface without an overt inflection, indicating that in Czech REALIZEMORPH may block deletion but may not trigger epenthesis, DEP » REALIZEMORPH » MAX. Neither can PRESERVECONTRAST affect the outputs here, as this constraint merely stipulates that distinct inputs remain distinct in the output, which also holds here (Łubowicz 2003).

To recap, an over-long hypothetical input is subject to deletion, reaching a maximal size of two syllables when inflected with a null suffix. The most important interaction – *FT- and PARSE-σ triggering deletion – is reprised below.

(41) *Null inflection allows root up to two syllables*

Don't have non-head feet » Parse all syllables into feet » Don't delete

‽/jazɪkatat/	*FT-	PARSE-σ	MAX-IO
a) [(ˈja.zɪ)$^{+}$(ˌka.tat)$^{-}$]	*!		
b) [(ˈja.zɪ)$^{+}$kat.at]		*!	
Λ c) [(ˈja.zɪk)$^{+}$]			*

While this analysis accounts for the root size in cases with a null suffix, other members of these paradigms exceed a foot in length. These outputs raise the questions: Why do these forms not trigger deletion? Why are longer forms tolerated (e.g., [(ja.zɪ)k-u] GenSg vs. [(ja.zɪk-Ø)] NomSg), instead of being reduced so that *all* inflections satisfy the maximum PrWd size (e.g., *[(ja.z-u)] GenSg vs. *[(jaz-Ø)] NomSg)?

The only way for a disyllabic root to emerge in every output is if this null-suffix form – which, taken on its own, perfectly satisfies the ban on non-head feet – is used as an Output-Output Faithfulness base for the longer, more complex forms with syllabic suffixes (Benua 1997). This allows inflections with longer suffixes to exceed the maximal size, because it is more important for the complex output to resemble the disyllabic base than for the total output to be one binary foot or less. This is illustrated in the pair of tableaux below. The null suffix form, which can be up to two syllables in length (43A), serves as a base for other outputs, forcing a complex output to be longer than a single binary foot (43B). When deletion is blocked by Output Faith, then the next best repair, non-exhaustive parsing, takes over.

(42) *No deletion from base root shape in complex words*

Recursion A: Null-inflected root can be up to two syllables

/jazɪk-Ø/	MAX-Output	PARSE-σ	MAX-IO	>>
Λ a) [(ja.zɪk)]				
b) [(jaz)]			*!	

Recursion B: Don't delete from base » Parse all syllables into feet

/jazɪk-u/	MAX-Output: [jazɪk]	PARSE-σ	MAX-IO
Λ a) [(ˈja.zɪ)ku]		*	
b) [(ˈja.zu)]	*!		*

Without Output Faithfulness, the root might change sizes. With Output Faithfulness, the root shape is consistent in all outputs, and any size restriction imposed upon the root in a base output will be spread to more complex PrWds.

In conclusion, when an inflectional paradigm allows a null suffix, then the root can be up to two syllables in that inflection. As a bare root is morphologically extremely simple, this output serves as a base for more complex outputs through Output-Output Faithfulness. Using a disyllabic root as the base form will result in outputs longer than one foot, but this outcome is compelled when Output Faith blocks deletion. The result is a universal maximum root size.

4.1.2 Output Faithfulness in paradigms without a null inflection

A second illustration of the importance of Output Faithfulness is provided by near-bare root inflections. As for bare roots above, some variance in root shape would be expected if there were no Output Faithfulness. For example, a verbal root might wrongly be predicted to be monosyllabic when with a monosyllabic inflection, ʔ[(ka.d-aː-m)], but non-syllabic when with a disyllabic inflection, [(k-aː.-mɛ)]. This strategy would allow both outputs to be one foot or less, while minimizing violations of MAX in the monosyllabic form [(ka.d-aːm)]. Yet such alternations never occur.

Verbal and adjectival roots can be either non-syllabic or monosyllabic, but they are the same in all inflections: [(daːm)] 'to give'-1Sg vs. [(daː.mɛ)] 'to give'-1Pl, or [(baː.daːm)] 'to research'-1Sg vs. [(baː.daː)mɛ] 'to research'-1Pl.

Verbal inflectional paradigms for both non-syllabic and monosyllabic roots are repeated below to illustrate the consistency of root size.

(43) *Verbal inflectional paradigms have consistent root size*

a) *Non-syllabic root*

'to give' INF: [(ˈd-aː-t)]	*Singular*	*Plural*
1	[(ˈd-aː-m)]	[(ˈd-aː.-mɛ)]
2	[(ˈd-aː-ʃ)]	[(ˈd-aː.-tɛ)]
3	[(ˈd-aː)]	[(ˈd-a.-jiː)]
IMP	[(ˈd-ɛj)]	[(ˈd-ɛj.-tɛ)]

b) *Monosyllabic root*

'to research' INF: [(ˈbaː.d-a-t)]	*Singular*	*Plural*
1	[(ˈbaː.d-aː-m)]	[(ˈbaː.d-aː)-mɛ]
2	[(ˈbaː.d-aː-ʃ)]	[(ˈbaː.d-aː)-tɛ]
3	[(ˈbaː.d-aː)]	[(ˈbaː.d-a)-jiː]
IMP	[(ˈbaː.d-ɛj)]	[(ˈbaː.d-ɛj)-tɛ]

Again, Output Faithfulness must be responsible for this invariance of root shape.

The necessity of Output Faith is illustrated below with 1Sg and 1Pl inflections of the hypothetical verbal root ʔ/kad-/. Without Output Faithfulness, the root might be expected to change size in order to best accommodate the inflectional suffix. A non-syllabic root would surface with a disyllabic inflection (44Aa), while a more faithful, monosyllabic root would surface with a monosyllabic inflection (44Bb). The appeal of a variable root shape is illustrated below, but such root size alternations never occur in Czech.

(44) *Root size varies within the inflectional paradigm (Unattested in Czech)*

(A) *Disyllabic inflection*: Parse syllables into feet » Don’t delete from input

‽/kad-aː-mɛ/ -1Pl	PARSE-σ	MAX -IO
Λ a) [(ˈkaːmɛ)]		*
b) [(ˈkadaː)mɛ]	*!	

(B) *Monosyllabic inflection*: Parse syllables into feet » Don’t delete from input

‽/kad-aː-m/ -1Sg	PARSE-σ	MAX-IO
a) [(ˈkaːm)]		*
💣 b) [(ˈkadaːm)]		

Instead, the root has the same shape in all outputs, regardless of the morphological consistency of the PrWd. Optimal Paradigms, which governs intraparadigmatic faithfulness, requires the roots to have the same shape in every inflection. The inflectional paradigm is analyzed as a whole, and the optimal root shape is enforced in all outputs through Output Faithfulness.

The question remains as to which output should be employed throughout the paradigm. Both the smaller root [(ˈkaːmɛ)] in (44Aa) and the longer root [(ˈkadaːm)] in (44Bb) are winners, with plural and with singular inflections, respectively. Both of these outputs are less than the size of one foot, and the two are equally morphologically complex – as argued in McCarthy (2005), there is no grounds to presume that one member of an inflectional paradigm is more or less complex than any other member.

The difference lies in the type of overall violations they incur: the root [k] as in [(ˈkaː.mɛ)]-1Pl / [(ˈkaːm)]-1Sg satisfies the markedness constraint PARSE-σ in all instances at the expense of Input-Output Faithfulness, while the root [kad] as in [(ˈka.daː)mɛ]-1Pl / [(ˈka.daːm)]-1Sg better satisfies IO-Faithfulness but features non-exhaustive parsing in some outputs. Because these two forms are morphologically equally good candidates in some inflections, the winner is determined by relative markedness (McCarthy 2001, 2005). The shorter outputs [(ˈkaːmɛ)] / [(ˈkaːm)] incur no markedness violations, while the longer outputs [(ˈkadaː)mɛ] / [(ˈkadaːm)] run afoul of PARSE-σ in some instances. That is, a non-syllabic root is the right length for a disyllabic inflection, and also avoids markedness violations with a monosyllabic suffix at the expense of IO-Faith. The reverse – spreading a monosyllabic base – satisfies PARSE-σ with a monosyllabic inflection, but results in a markedness violation with disyllabic inflections and so is resorted to only when demanded by PRESERVECONTRAST (see §3.2.2). This quality of inflectional paradigms is expressed in the Optimal Paradigms approach's tenet of Attraction to the Unmarked (McCarthy 2001, 2005).

Therefore, Output Faithfulness ensures that all members of the inflectional paradigm have the same output shape, while Attraction to the Unmarked determines the output to be that which is least marked overall. The result is that the shorter root is employed in all members of the inflectional paradigm.

(45) *No epenthesis within a paradigm*

Disyllabic inflection: Parse all syllables into feet » Don't delete from input

ʔ/kad-aː-mɛ/ -1Pl	DEP-Output	PARSE-σ	MAX -IO	>>
Λ a) [(ˈkaːmɛ)]			*	
b) [(ˈka.daː)mɛ]		*!		

Monosyllabic inflection: No epenthesis in paradigm » Don't delete from input

<<	ʔ/kad-aː-m/ -1Sg	DEP-Output	PARSE-σ	MAX-IO
	Λ a) [(ˈkaːm)]			*
	b) [(ˈka.daːm)]	*!		

In conclusion, the Optimal Paradigms branch of Output Faith ensures that root shape is consistent in all inflections, which results in paradigm leveling: if one inflection is limited to a certain size, then this restriction is spread to all other members of the paradigm. The difference between the bare root size above and the near-bare roots discussed here is the how the root shape is determined. The bare root paradigms take the simple null-inflected form – which can be up to two syllables – and use that as a base for other outputs. But for bound roots, a root with a monosyllabic inflectional suffix such as [-aː-m] 1Sg is no more or less complex than a root with a disyllabic inflectional suffix like [-aː-mɛ] 1Pl, so the base form is determined by markedness violations rather than relative morphological complexity. As the following section will show, the root shape determined through Optimal Paradigms Faithfulness is then used as an Output-Output Faithfulness base for complex outputs.

As a final note, participation in Optimal Paradigms Faithfulness is not strictly determined by participation in an inflectional paradigm. For example, roots which may surface as a bare morpheme are indisputably members of an active inflectional paradigm, with other outputs of this paradigm overtly inflected. Yet the null-inflected output serves as an OO-base for more complex outputs, even members of the same inflectional paradigm. Instead, Optimal Paradigms Faithfulness is restricted to those roots where there is no obvious base. Near-bare roots do not provide a clear candidate for a base form, since all outputs are overtly inflected and equally complex. Therefore, the root shape (and subsequent base for more complex outputs) is determined through Optimal Paradigms.

4.2 Output Faithfulness in complex words

Czech prosodic words commonly have multiple morphemes parsed into several syllables, which exceed the maximal PrWd limit of one foot proposed to account for the root size phenomena found in Czech. Clearly, these words are still viable outputs and so need to be accounted for under the present theory. This section argues that long, polymorphemic words are permitted in Czech for the same considerations outlined in §3: the language cannot completely delete a morpheme or reduce it so much that it is no longer distinct from other morphemes. Both of these responses would lead to a loss of morphological data, and so deletion may be blocked. Additionally, the Output Faithfulness discussed in §4.1 prevents deviations in the output form of the root. The result is long words composed of many small morphemes.

Czech words have a single stress on the initial syllable, regardless of the length or morphology of the word (Chlumský 1928, Palková 1994). This is evident in the following data from (11), repeated here for ease of exposition.

(46) *Simple and complex words*

[(ˈd-aː-t)] give-TH-INF	‘to give’	[(ˈdo.-d-a)-va.-t-ɛl] P-give-TH-CONT-E1-NOM	‘supplier’
[(ˈp-iː-t)] drink-TH-INF	‘to drink’	[(ˈna.-p-a)-jɛ.-dl-o)] P-drink-TH-E2-NOM-NomSg	‘watering place’
[(ˈdn-o)] bottom-NomSg	‘bottom’	[(ˈbɛ.z-ɛ)-dn-iː] P-EP-bottom-AdjNomSg	‘bottomless’
[(ˈmst-a)] revenge-NomSg	‘revenge’	[(ˈpo.-mst-ɪ)-xc-ɪ-.v-ost] P-revenge-GenSg-want-TH-E3-NOM	‘vindictiveness’
[(ˈxc-iː-t)] want-TH-INF	‘to want’		
[(ˈstřɛt)] center-NomSg	‘center’	[(ˈu.-pro)-střɛt] P-P-center	‘in the middle’
[(ˈbaː.d-a-t)] research-TH-INF	‘to research’	[(ˈpro.-baː)d-aː.-ɲ-iː] P-research-TH-E4-GER	‘exploration’
[(ˈmo.ř-ɛ)] ocean-NomSg	‘ocean’	[(ˈmo.ř-ɛ)-pla.v-ɛt͡s.-tv-iː] ocean-TH-swim-NOM-ABS-AdjNomSg	‘nautical’
[(ˈja.zɪk)] language-NomSg	‘language’	[(ˈɲɛ.-k-o)l-ɪ.k-a.-ja.zɪt͡ʃ.-n-iː] INDEF-Q-NUM-NOM-PL-language-E4-AdjNomSg	‘multilingual’
[(ˈko.lɛ)n-o] knee-NomSg	‘knee’	[(ˈnaː.-ko)lɛ.ɲ-iːk)] P-knee-NOM	‘knee pad’

A single stress indicates that each PrWd has a single, left-aligned foot. (Stress is the phonetic realization of the head syllable of a foot (Hayes 1995); when a word has one stressed syllable, it has one foot.) The presence of a single foot, no matter the length of the word, is further evidence for a ban on non-head feet in Czech. This ban in turn leads to a number of syllables remaining unparsed in the output.

(47) *Longer words have a single foot*

Don't have non-head feet » Parse all syllables into feet

/ɲɛ-k-ol-ɪk-a-jazɪk-n-iː/	*FT-	PARSE-σ
Λ a) [(ˈɲɛ.ko)+lɪ.ka.ja.zɪt͡ʃ.niː]		*
b) [(ˈɲɛ.ko)+(ˌlɪ.ka)-(ˌja.zɪt͡ʃ)- (ˌniː)-]	***!	

The alternation from /k/ to [t͡ʃ] is a standard process of palatalization (Kučera 1961) and does not affect the discussion of size restrictions.

Recall that in the first instance, *FT- triggers deletion so that the output is one binary foot or shorter (§3.1). However, deletion can be blocked by the constraints REALIZEMORPH and PRESERVECONTRAST to allow each morpheme to have an overt and distinct realization in the output, so that valuable morphological material is retained (§3.2). When deletion is blocked, then non-exhaustive parsing emerges as the optimal repair. This same argument developed in previous sections also accounts for the longer outputs found in more complex words. Again, the pressures for each morpheme to have a distinct surface realization block the process of deletion, such that a word comprised of several morphemes can exceed the maximal size restriction by quite a bit, as each one of its morphemes deserves preservation.

The first aspect of this process can be seen below, where deletion of segments falling outside the foot is blocked by REALIZEMORPH. Candidate (48a) satisfies the ban on non-head feet by deleting segments until the maximal size is reached, but in doing so completely eliminates several of the morphemes. Instead, the longer candidate (48b) wins out because it preserves the morphological material of the input. It still has a single foot and so satisfies *FT-, but does so by adopting the next best strategy, non-exhaustive parsing in place of deletion.

(48) *Morpheme preservation blocks deletion*

Morphemes overtly realized » Parse all syllables into feet » Don't delete

/ɲɛ-k-ol-ɪk-a-jazɪk-n-iː/	REALIZEM	PARSE-σ	MAX-IO
a) [(ˈɲɛk.jan)]	*!		*
Λ b) [(ˈɲɛ.ko)lɪ.ka.ja.zɪt͡ʃ.niː]		*	

Additionally, there is pressure for distinct input morphemes to have distinct expressions in the output, characterized by the constraint PRESERVECONTRAST. This constraint blocks deletion when it would lead to different morphemes having identical output shapes, compromising the integrity of their morphological expression. For example, reducing the quantitative morpheme [ol] would cause it to be indistinct from the linking morpheme [o] or the agentive [l].

(49) *Morpheme contrastiveness blocks deletion*

Morphemes overtly realized » Parse all syllables into feet » Don't delete

/ɲɛ-k-ol-ɪk-a-jazɪk-n-iː/	PRESCON	PARSE-σ	MAX-IO
a) [(ˈɲɛ.klɪ)ka.ja.zɪt͡ʃ.niː]	*!	****	*
Λ b) [(ˈɲɛ.ko)lɪ.ka.ja.zɪt͡ʃ.niː]		*****	

REALIZEMORPH and PRESCONTRAST both serve to protect morphemes – roots and affixes alike – from undergoing so much deletion that they no longer have overt, distinct representations in the output.

These constraints conspire to create morpheme consistency in the sense that REALIZEMORPH and PRESCONTRAST protect morphemes, while PARSE-σ tries to keep them as short as possible. Morphemes subject to these factors are thereby constrained into a shape which is as short as possible but not too short, leaving no room for alternating forms in different outputs. Intuitively, this explains why Czech affixes, while numerous, are all relatively short. They are protected up to the point they have an overt manifestation in the output which is distinct from other morphemes. But beyond this, they are subject to deletion down to their minimal size in order to reduce the number of violations of the constraint PARSE-σ.

Root morphemes also have a consistent shape, but this cannot necessarily be attributed to the effects of REALIZEMORPH and PRESCONTRAST. In a complex word like [(□ɲɛ.ko)lɪ.ka.ja.zɪt͡ʃ.niː], PARSE-σ and MAX will work to keep the output as short as possible, and it seems unlikely that the morpheme [ja.zɪt͡ʃ] is preserved by morpheme preservation constraints alone. Two syllables is the longest possible morpheme length in Czech, yet no root ever changes size from one output to another. This is further evidence for Output Faithfulness encouraging outputs to be faithful to a base form, which is argued to be the bare root when possible, like [(ˈja.zɪk-Ø)], else the least marked member of the inflectional paradigm for bound roots (§4.1).

The phenomenon of Output-Output Faithfulness was introduced in §4.1.1, where it was argued that a bare root serves as a referent for other members of the inflectional paradigm, potentially forcing the PrWd to exceed the length of one foot. Complex words show the exact same behavior, again taking the null-suffix output as the base form in longer words. Of course, the bare root output can freely be up to two syllables in length (50A). In a longer form, the PrWd is still trying to be one foot or less, but has many more morphemes to accommodate. The affixes are already reduced to their smallest possible size while retaining distinct outputs, as argued in (48) and (49). Another strategy for keeping the word as short as possible – and thus best satisfying PARSE-σ – would be to reduce the length of the root morpheme (so long as it is still morphologically distinct) like in (50Bb). Yet the root never reduces, which can be attributed to Output Faith.

(50) *No deletion from base root shape in complex words I*

Recursion A: Null-inflected root can be up to two syllables

/jazɪk-Ø/	MAX-Output	PARSE-σ	MAX-IO	>>
Λ a) [(jazɪk)]				
b) [(jaz)]			*!	

Recursion B: Don't delete from base » Don't delete from input

/ɲɛ-k-ol-ɪk-a-jazɪk-n-iː/	MAX-Output: [jazɪk]	PARSE-σ	MAX-IO
Λ a) [(ˈɲɛ.ko).lɪ.ka.ja.zɪt͡ʃ.niː]		*****	
b) [(ˈɲɛ.ko).lɪ.ka.jaz.niː]	*!	****	*

The same process is found for bound roots, where the output is determined by the relative number of markedness violations incurred (§4.1.2; cf. bare roots, where one inflection serves as a base for others on the basis of morphological complexity). However, once this root size is established within the basic inflectional paradigm through Optimal Paradigms, it is used as an Output-Output Faithfulness base in complex words. For instance, the root /moř-/ 'ocean' freely satisfies the maximal word size in simple inflections, since each inflectional suffix is monosyllabic and so each PrWd remains one foot or less: [(mo.ř-ɛ)] NomSg, [(mo.ř-ɪ)] GenSg, etc. (see (22) for the full paradigm). However, as a member of a longer word [(ˈmo.ř-ɛ)-pla.v-ɛt͡s.-tv-iː] 'nautical', there would again be pressure for this root to be shorter so that in turn, the word can be as small as possible and thereby minimally violate PARSE-σ.

Here, the root shape employed in the simple inflectional paradigm is spread regardless of the pressures in complex words – indicating that the shape determined in near-bare outputs serves as a base for more complex words. This aspect of Output Faithfulness is illustrated below, where the near-bare root shape employed in (51A) is taken as a base for the complex word in (B), rather than an output minimizing the overall length of the word.

(51) *No deletion from base root shape in complex words II*

Recursion A: Inflected root can be up to one syllable

/moř-ɛ/	MAX-Output	PARSE-σ	MAX-IO	>>
Λ a) [(mořɛ)]				
b) [(mřɛ)]			*!	

Recursion B: Don't delete from base » Don't delete from input

/moř-ɛ-plav-ɛt͡s-tv-iː/	MAX-Output: [moř]	PARSE-σ	MAX-IO
Λ a) [(ˈmo.řɛ)pla.vɛt͡s.tviː]		***	
b) [(ˈmřɛ.pla)vɛt͡s.tviː]	*!	**	*

The onset cluster [mř] is valid in Czech, as evident in words such as [(ˈmřiːʃ)] 'lattice', so candidate (b) cannot eliminated on phonotactic grounds.

If all outputs of a bound root, not just the simplest forms in the inflectional paradigm, were analyzed in parallel through Optimal Paradigms, then these complex words would also have an influence on root shape. The result would be every root being as short as possible to accommodate the outputs in complex words. Since this is not the case, Optimal Paradigms must be restricted to the basic inflectional paradigm, while Output-Output Faithfulness takes this root shape as a base in more complex outputs.

This interaction leads to an important insight on the cooperation of Output-Output Faithfulness and Optimal Paradigms. As suggested by McCarthy (2005), the two are complementary. For bound roots, the shape determined intraparadigmatically through Optimal Paradigms is taken as a base for more complex outputs through Output-Output Faithfulness.

5 CLASSES AND SIZE RESTRICTIONS

The bulk of this chapter has argued that native Czech roots, and, latently, PrWds, are subject to restrictions on their maximum length. However, non-native roots must not comply with the same limitations. Loanword roots can exceed the maximum size of one or two syllables, depending on morphological factors, which is attributed in this section to a family of faithfulness constraints specific to loanwords.

Non-native roots can exceed the maximum length imposed on native Czech roots. The following data, based on Fronek (1999), illustrates this point.

(52) *Loanword roots can be longer than two syllables*

[(ˈʔa.ba)kus]	‘abacus’	[(ˈrɪ.vɪ)eː.r-a]	‘riviera’
[(ˈma.na)ʒɛr]	‘manager’	[(ˈʔɛ.lɛ)gaːn]	‘elegant’
[(ˈdɛ.mo)kra.t͡s-i͡ɛ]	‘democracy’	[(ˈlo.ko)mo.ti.v-a]	‘locomotive’

Loanword roots alone can exceed two syllables in length. This suggests the existence of a set of faithfulness constraints specific to loanwords, comparable to the foreign stratum proposed in Itô and Mester’s (1995) work on Japanese. In order for loanwords to defy the maximal size restriction, a constraint preserving their shape must block the process of deletion. This constraint is formulated here as a subset of faithfulness constraints, penalizing faithfulness violations in loanwords more stringently than those in native words.

(53) *Loanword-specific Faith leads to supermaximal roots*

Don’t delete from loanwords » Parse all syllables into feet » Don’t delete

/abakus/	MAX-Loan	PARSE-σ	MAX-IO
a) [(ˈʔa.bak)]	*!		*
Λ b) [(ˈʔa.ba)kus]		*	

In this way, the inputs of loanwords are preserved in the face of constraints which would normally require the root to be one foot or less. Because loanword faithfulness leads to violations of markedness constraints found to be active in Czech, like *LAPSE and PARSE-σ, it must outrank them.

6 CONCLUSIONS

This section has argued that maximal root size restrictions are in fact due to a restriction on the maximal size of prosodic words. In simple outputs – that is, a bare or minimally inflected root – the maximal PrWd size led to deletion of root segments which would otherwise force the word to be longer than one foot. This approach accounts for the differing maximal sizes of bare roots (which can be up to a full foot, or two syllables) and bound roots (which can be up to the length of one foot minus the obligatory suffix, or one syllable). The size restriction is placed not on the root, but on the word, so the root will accommodate other morphemes in the same PrWd by reducing its size.

Once the maximal root size was established in this way, it was spread to other, more complex outputs of the same root through Output Faith. Constraints maintaining the integrity of the output, such as REALIZEMORPH and PRESERVECONSTRAST, in addition to Output Faith, caused deletion to be blocked in longer, more complex outputs. In these cases, non-exhaustive parsing became the optimal repair. This chapter also contended that non-native words and roots are not subject to the same maximal size restrictions as native words, indicating the presence of high-ranking loanword faithfulness constraints.

The overall constraint ranking determined in the section is the following:

(54) *Czech maximal root size constraint ranking*

*FT- FAITH' REALIZEMORPH Output Faith Loan Faith

*LAPSE

PRESCONTRAST

PARSE-σ

MAX

The next chapter will further develop the ideas introduced here by examining the different shapes a minimal or maximal prosodic size restriction may take, as well as the strategies available to a language for obtaining this size.

CHAPTER 3

MINIMAL AND MAXIMAL SIZE RESTRICTIONS

1 INTRODUCTION

Minimal and maximal prosodic size restrictions are derived from independently motivated constraints which produce a well-defined set of predictions. Minimal size is triggered by foot binarity, which leads to a minimal size of one binary (i.e., bimoraic or disyllabic) foot. All prosodic words must have at least one foot, so when this foot must be binary, then the PrWd will acquire a minimal size restriction. Maximal size is conditioned by a ban on non-head feet, which can produce a number of different shapes. Languages with a maximal word size of one foot *Ft*, one foot plus a single unfooted syllable *Ftσ* / *σFt* or one foot plus two non-adjacent unfooted syllables *σFtσ* are predicted by the interaction of *Ft- and syllable-parsing constraints (PARSE-σ, LAPSE). This section explores minimal and maximal size restrictions and their possible output shapes at the level of the prosodic word. The following chapter will discuss how a prosodic size restriction may be acquired by a root.

A necessary condition for minimal prosodic size is that FT-BIN outrank some relevant faithfulness constraint (McCarthy and Prince 1986 *et seq.*). Through Headedness, all prosodic words must dominate at least one foot (Selkirk 1984, Nespor and Vogel 1986, Itô and Mester 1993, Selkirk 1995); combining this consideration with foot binarity leads to a minimal PrWd size. A minimal size may be a foot which is binary on the level of the mora or the syllable, i.e., a bimoraic or disyllabic foot.[9] A

[9] Gordon (1999) lists other types of "minimal word", but this discrepancy is down to a difference in terminology. The present work takes "minimal word" to mean that a PrWd must have a prosodically-based minimal size, such as a foot. In contrast, Gordon uses the term to mean the smallest word a

case of minimal size is found in Shipibo, which requires each word to be at least one bimoraic foot (Elias-Ulloa 2006). This restriction is shown in the data below, where many different word shapes are permitted in the output, but none may be as short as a single light syllable.

(1) *Minimal word size in Shipibo*

[(CVː$_{\mu\mu}$)]	[(ˈtʃiː)]	‘fire’	[(ˈtɨː)]	‘work’
[(σσ)]	[(ˈba.k□)]	‘child’	[(ˈpi.-ti)]	‘food’
[Ft…]	[(ˈa.ta)pa]	‘hen’	[(a.□in)bu]	‘woman’
	[(ju.ˈmiː)(t͡su.-ˌriː)(ba.ˌwiː)]		‘steal-again-imperative’	
*[(σ$_{\mu}$)]				

The mechanisms behind minimal size are illustrated through the analysis of Shipibo, where the constraint rankings leading to its bimoraic minimal size and the competing disyllabic minimal size are discussed in Section 2.1.

Maximal size restrictions are achieved through a ban on non-head feet. When each word may have a single, head foot, then the output size is prosodically constrained. The ban on non-head feet may interact with other phonological requirements such that four different types of maximal size emerge: σFtσ, Ft, Ftσ and σFt. The section on maximal size will be headlined by Māori, which permits outputs up to a single heavy foot plus non-adjacent unfooted syllables [σFtσ] (de Lacy 2003). This size restriction can be seen in the data below, where a) shows that monomorphemic words may be up to the size of σFtσ; b) shows roots (i) plus the passive suffix /-ia/ (ii) which may be up to the size of σFtσ; and c) shows that a root (i) plus passive suffix (ii) undergoes deletion to avoid exceeding this maximal size. In short, Māori prosodic words may not have a secondary foot or a string of unfooted syllables.

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language will permit. For example, Czech content words must be at least C-V-C, CC-V or CVC. This dissertation holds that these word shapes are due to the language’s requirements that each word/root have an onset, and that each root end in a consonant (Ch2§2.1), but this is not a minimal word restriction per se because it is not derived from prosodic restrictions.

(2) *Maximal word size in Māori*

a) *Maximal size in bare roots*

[ta(ˈmai͡)ti] 'child' [ma(ˈnaː)ki] 'to show kindness'

b) *Output surfaces faithfully*

i) [(ho.ka)]	'to run out'-ACT	ii) [ho(ka-i)a]	PASS
[(ti.a)]	'to paddle vigorously'-ACT	[ti(a-i)a]	PASS

c) *Deletion from suffix*

i) [ta(pae)]	'to present'-ACT	ii) [ta(pae)-a]	PASS
[ko(pou)]	'to appoint'-ACT	[ko(pou)-a]	PASS

*[(Ft)(Ft)], *[σ(Ft)σσ] – i.e., *[ko.(pou)-i.a], *[ko.(pou)(-ˌi.a)]

Permuting restrictions on non-exhaustive parsing, lapses and constituent alignment leads to other types of maximal size. If unfooted syllables are banned, the maximal size will be a single foot [Ft]. Alignment with a PrWd edge results in a foot plus a single syllable, [Ftσ] or [σFt]. The different types of maximal size restriction will be discussed in Section 3.1, along with constraint rankings accounting for each size.

This chapter also addresses the responses a language may employ to obtain its minimal and/or maximal size restriction. Essentially, any repair which suitably augments or restricts the output shape may be employed to achieve a size restriction. The range of responses for achieving minimal or maximal size is similar.

(3) *Responses to size restrictions*

a) Faithfulness violation
   i) Minimal size: Epenthesis, Segment splitting, Segment lengthening
   ii) Maximal size: Deletion, Coalescence, Segment shortening
b) Exceptional prosodification
c) Null parse (i.e., ineffability)

The first set of responses involves a faithfulness violation. A minimal size may be obtained through an output segment with no input (epenthesis), while a maximal size may have an input segment with no output (deletion). Equally, a minimal size may require multiple output segments to stem from a single correspondent in the input (segment splitting), while maximal size may see a single output segment as a product of multiple correspondents in the input (coalescence). A change in the length of a segment may result in vowel lengthening or shortening or consonant (de)gemination. Many of these strategies are analyzed individually in §2.2 for minimal size and §3.2 for maximal size.

The second approach, "exceptional prosodification," refers to the strategy of altering the prosodic structure to accommodate a minimal or maximal size. A size restriction is a prosodic target, so it may also be satisfied by a change in prosody. One example is a violation of the Strict Layering Hypothesis (Selkirk 1984), which allows for unfooted syllables in order to avoid a non-head foot while best satisfying faithfulness to the input, as in Māori (§3.2.1). Another approach employed by this language is splitting a single, over-long morphological word into multiple prosodic words so that each PrWd can independently observe the maximal word restriction. Manam also exhibits exceptional prosodification to achieve an emergent minimal size in §2.2.3. Standardly, a vowel-vowel sequence surfaces as onset glide-vowel, but glide formation is blocked when the result is a subminimal word. An onsetless syllable is tolerated so that foot binarity may be satisfied.

The final possible repair is a null parse, where the optimal output is no output at all. Ineffability obtains a prosodic size restriction in that a supermaximal or subminimal input has no output, while compliant forms are permitted. This will be exemplified by Tiene in §3.2.2, which has a process reduplicating the final syllable of the word. Attempts to reduplicate a trisyllabic maximal word yield no output at all, because the base plus reduplicant would be four syllables and so violates the maximal word size. Here, no output is better than a flawed output.

Because of the great theoretical overlap in the strategies leading to size restrictions, each type of response is illustrated once in the context of minimal or maximal size. One-to-zero correspondence is illustrated by deletion in Māori (§3.2.1; see also deletion in Czech (Ch2§3) and the analysis of epenthesis in Lardil in Ch4§3.2). One-to-two correspondence is shown in segment splitting in Tagalog (§2.2.2), and a change in weight is analyzed in the discussion of vowel lengthening in Shipibo (§2.2.1; see also the analysis of gemination in Yup'ik in Ch4§2.1.3). The complementary strategies – epenthesis, coalescence and vowel shortening/ degemination – are not explicitly analyzed in this chapter. Likewise, a null parse is discussed in the context of maximal size in Tiene (§3.2.2) but is not readdressed for minimal size. However, exceptional prosodification receives more attention because it may take many forms, such as non-exhaustive parsing and prosodic word splitting in Māori (§3.1, §3.2.1) and onset glide blocking in Manam (§2.2.3).

Another factor potentially influencing a minimal or maximal size restriction is extraprosodicity (§4). This is a phenomenon in which the word-final prosodic constituent may not form a prosodic peak (Prince and Smolensky 1993, Hyde 2003). That is, word-final consonants may be treated as light where they are otherwise heavy, and word-final syllables may be prevented from bearing stress. For instance, Modern Standard Arabic has word-final consonant extraprosodicity and requires all roots – and commensurately its shortest output, a bare root – to be consonant final. In order to satisfy foot binarity, the minimal word size must be $[(\sigma_{\mu\mu}<C>)]$ or $[(\sigma\sigma<C>)]$ (McCarthy and Prince 1990). Extraprosodicity may describe a minimal word size even where foot binarity does not play a role. Hixkaryana has a trimoraic minimal size due to independent phonological factors: the final syllable may not be stressed, so each word must be at least two syllables (Derbyshire 1979, Garrett 2002). Closed syllables are treated as heavy, and an initial light syllable would be lengthened, as all stressed open syllables undergo compensatory lengthening. Therefore, each word is minimally $[(\text{ˈ}\sigma_{\mu\mu}<\sigma>)]$.

The rest of this chapter is organized as follows. Minimal size is exemplified by Shipibo, where the different restrictions and constraint schemas leading to bimoraic and disyllabic minima are addressed in §2.1. Section §2.2 looks at the array of responses leading to a minimal size restriction, beginning with vowel lengthening in Shipibo in §2.2.1. The following sections explore the creation of a minimal word size through segment splitting in Tagalog (§2.2.2) and exceptional prosodification in Manam (§2.2.3). Section 3 looks at the case of maximal size in Māori, which provides insight into the types of maximal size and the mechanisms behind them in §3.1. Section 3.2.1 continues the analysis of Māori's range of responses to maximal size, with supplementary evidence from Tiene's null parse in §3.2.2. The influence of extraprosodicity on size restrictions is addressed in §4. Finally, Section 5 gives conclusions.

2 MINIMAL SIZE

2.0 Introduction

A minimal size restriction arises when the requirement for feet to be binary at the level of the mora or the syllable outranks faithfulness to the input. Headedness requires each prosodic word to have a foot (Selkirk 1984), and FT-BIN forces this foot to be binary (Prince 1980, McCarthy and Prince 1986 *et seq.*). This size restriction is satisfied by just one outcome: a binary foot. A smaller output, such as a single light syllable, does not satisfy foot binarity, while a larger minimal output, such as four syllables, would not be penalized but cannot be predicted by FT-BIN alone. This section examines the typology of minimal size restrictions and the repairs which can be employed to reach this minimal size.

The factors creating a minimal word size, Headedness and foot binarity, were first identified in McCarthy and Prince (1986 *et seq.*). Headedness postulates that each member of the Prosodic Hierarchy must dominate a head (i.e. at least one member) of the immediately subordinate category (Selkirk 1984, Nespor and Vogel 1986, Itô and Mester 1993, Selkirk 1995). Therefore, each prosodic word must have at least one foot, and each foot must have at least one syllable. When Headedness is combined with the requirement that all feet be binary (Prince 1980, Hayes 1985), then each prosodic word will be at least one binary foot in length (McCarthy and Prince 1986 *et seq.*).

The formation of a minimal word size will be analyzed within the framework of Shipibo in Section 2.1. Every prosodic word must be at least one bimoraic foot in size; the PrWd may take many different shapes, but a word consisting of a single light syllable is banned.

Shipibo represents just one sort of minimal size restriction, a bimoraic foot. A second minimal size is characterized by the second type of binarity, a disyllabic foot. The two types of binary feet produce two different minimal size restrictions, not including other options provided by extraprosodicity (§4).

(4) *Typology of minimal size*

a) $(\sigma_{\mu\mu})_{Ft}$

b) $(\sigma\sigma)_{Ft}$

The analysis of Shipibo will discuss the factors determining whether the minimal size is bimoraic or disyllabic, as well as the relationship of minimal size to prosody.

There are several strategies that a language may employ to obtain a minimal size, be it bimoraic or disyllabic. In short, any process which turns a subminimal input into an output satisfying the minimal size restriction may be used. These include faithfulness violations, a change in prosodic structure or a null parse, where a subminimal input has no output whatsoever.

(5) *Strategies creating a minimal size*

a) Segment lengthening
b) Segment splitting
c) Exceptional prosodification
d) Epenthesis
e) Null parse

The analysis of Shipibo is expanded in §2.2.1 to show how minimal size may be satisfied through segment lengthening. The language standardly has disyllabic feet, but a monosyllabic heavy (CV:) foot is permitted when necessary to satisfy the minimal word restriction, because vowel lengthening is the repair of choice in Shipibo. A similar case will be encountered in the analysis of Yup'ik (Ch4§2.1.3), which obtains a minimal root size through consonant gemination.

Segment splitting is found in Tagalog, where a class of roots known as "pseudoreduplicants" resembles a base plus reduplicant, but do not behave like standard reduplicants (Zuraw 2002). The words do not satisfy the standard requirements on reduplicants in Tagalog and do not exhibit base-reduplicant correspondence. Most tellingly, these words only appear with a monosyllabic "base", leading to the analysis in §2.2.2 that subminimal inputs undergo segment splitting to satisfy the disyllabic minimal size. That is, segments in a too-short input have multiple correspondents in the output, augmenting the word size and explaining why the two syllables resemble one another.

A third response is illustrated by Manam in §2.2.3, which applies exceptional prosodification in order to reveal an emergent minimal word size (Lichtenberk 1983). In most outputs, a VV sequence surfaces as an onset glide plus vowel. However, when creating an onset glide would leave the word with a single light syllable, then the process is blocked. The result is one or more onsetless syllables, but the minimal word size is met. Other outputs tolerate a subminimal size, such as a CV, indicating that an augmentative repair such as epenthesis or segment lengthening is not viable. The minimal size only emerges through prosodification.

The other available repairs are illustrated elsewhere in this dissertation. Epenthesis is employed to reach a minimal size in Lardil in Ch4§3.2, and its complement, deletion, will be covered in the analysis of Māori in §3 and was seen in Czech in Ch2§3. A null parse as a repair leading to a size restriction will be discussed in §3.2.2 with an analysis of this phenomenon in Tiene.

This section looks first at the theoretical mechanisms behind minimal bimoraic and disyllabic size in Section 2.1. The different repairs that may be employed to achieve this minimal size are then examined in Section 2.2, looking at segment lengthening in Shipibo (§2.2.1), segment splitting in Tagalog (§2.2.2) and exceptional prosodification in Manam (§2.2.3). Finally, Section 2.3 offers conclusions.

2.1 Typology of minimal size

A minimal word size is produced by a requirement that feet be binary (Prince 1980), and of course every prosodic word must have at least one foot through Headedness (Selkirk 1984). Feet may be binary on the moraic or syllabic level, and this distinction is reflected in the processes leading to minimal size. This section determines the phonological factors behind bimoraic and disyllabic minimal size through an analysis of Shipibo. This language has a bimoraic minimal size, but the same constraints may be reordered to produce a disyllabic minimal size.

The Panoan language Shipibo is an example of a language with a bimoraic minimal size restriction (see also Ch4§2.1.4; Elias-Ulloa 2006). There are no words consisting of a single light syllable, revealing that a potential subminimal input – considering that inputs are unrestricted under Richness of the Base – is somehow repaired. The data below from Elias-Ulloa (2006) gives a representation of Shipibo word shapes, showing that they may be as small as a binary foot, but words shorter than this are banned.

(6) *Bimoraic minimal size in Shipibo*

[(CVː$_{\mu\mu}$)]	[(ˈtʃiː)]	‘fire’	[(ˈtɨː)]	‘work’
[(σσ)]	[(ˈba.k□)]	‘child’	[(ˈpi.-ti)]	‘food’
[Ft…]	[(ˈa.ta)pa]	‘hen’	[(a.□in)bu]	‘woman’
	[(ju.ˈmiː)(t͡su.-ˌriː)(ba.ˌwiː)]		‘steal-again-imperative’	
*[(σ$_{\mu}$)]				

A minimal word size of one binary foot is a product of Headedness (Selkirk 1984, Nespor and Vogel 1986, Itô and Mester 1993, Selkirk 1995) and foot binarity, represented through the constraint FT-BIN (Prince 1980, McCarthy and Prince 1986 *et seq*.). Through Headedness, each prosodic unit must dominate a head of the next lowest category in the Prosodic Hierarchy. So, for the purposes at hand, each prosodic word must have at least one foot. When this foot must be binary, then every PrWd must be at least one binary foot in size. For minimal word effects to surface, the pressure for feet to be binary must outrank faithfulness to the input (McCarthy & Prince 1986 *et seq*.). Headedness is taken to be an inviolable property after Selkirk (1995; cf. Crowhurst 1996).

(7) *Minimal size:*

FT-BIN » Faith

Foot binarity may be enforced on the level of the mora (i.e., feet must be a heavy monosyllable or disyllabic) or the syllable (i.e., feet must be disyllabic). This dichotomy is captured in Elias-Ulloa’s (2006) constraints banning monomoraic and monosyllabic feet, emphasizing the minimal well-formedness of feet. Other approaches split FT-BIN into moraic (“Feet must be bimoraic”) and disyllabic (“Feet must be disyllabic”) formulations, which miss the generalization that HL and LH feet satisfy constraints on moraic-level foot binarity, despite being trimoriac (Elias-Ulloa 2006: §3.1.1 and references cited therein). The constraints leading to each are outlined below.

(8) a) *FOOT(μ): Incur a violation for every foot that contains just one mora.

b) *FOOT(σ): Incur a violation for every foot that contains just one syllable.

In other sections, the distinction between mora- and syllable-level foot binarity captured in (11) is collapsed into a single constraint, FT-BIN.

The first constraint, *FOOT(μ), can be satisfied both by ($\sigma_{\mu\mu}$) feet, like (CV:$_{\mu\mu}$) or (CV$_\mu$C$_\mu$), or by (σσ) feet, like (CV.CV). The second constraint, *FOOT(σ), is satisfied only by a foot with the shape (σσ), e.g., (CV.CV). This creates a stringency relationship between the two constraints, such that any output violating *FOOT(μ) also violates *FOOT(σ), but the reverse is not true. These constraints regulate the minimal size of a foot, and, like all constraints, they are violable. For example, Czech (Ch2) does not require PrWds to be at least bimoraic or disyllabic; unary feet are permitted. Recent research argues that larger, tri-syllabic "ternary" feet do not exist (Kager 1994, Elenbaas 1999, Elenbaas and Kager 1999).

The creation of minimal size in Shipibo is shown below, where a hypothetical subminimal input is augmented to reach a minimal size. The language has a bimoraic minimal size, so the ban on monomoraic feet is readily seen. Shipibo repairs a subminimal input through vowel lengthening (Elias-Ulloa 2006), a process explored further in the following section. The winning candidate has a binary foot and better satisfies faithfulness, either by virtue of the type of faithfulness violation (e.g., vowel lengthening vs. epenthesis, as below) or by the relative number of violations of a single faithfulness constraint (e.g., epenthesis of fewer segments).

(9) *Minimal bimoraic size in Shipibo*

Feet are bimoraic » Don't epenthesize » Don't lengthen V, Feet are disyllabic

ʔ/t̳i/	*FOOT(μ)	DEP	IDENT(weight)	*FOOT(σ)
a) [(t̳i)]	*!			*
b) [(t̳iti)]		*!		
Λ c) [(t̳i:)]			*	*

The winning candidate is not disyllabic, so a repair favoring this outcome must incur a costlier violation than a change in segment weight. The different responses to a minimal word size restriction will be discussed further in the following section. Other languages requiring a word to be at least a bimoraic foot are German (Ch4§2.1), Yup'ik (Ch4§2.1.3) and Lardil (Ch4§3.2).

Reversing the position of the two constraints on foot binarity will lead to a disyllabic minimal size, rather than the bimoraic size above. In fact, the stringency relationship between the two constraints on foot binarity – an output [(σσ)] satisfies both *FOOT(σ) and *FOOT(μ) – ensures a language will have a disyllabic minimal size any time the former outranks Faithfulness, regardless of the position of the latter. This is illustrated in the pair of tableaux below, which both lead to a disyllabic minimal size.

(10) *Disyllabic minimal size: Ranking of* *FOOT(μ) *irrelevant*

a) No monosyllabic feet » Faithfulness to input » No monomoraic feet

ʔ/CV/	*FOOT(σ)	Faith	*FOOT(μ)
a) [(σ_{μ})]	*!		*
b) [($\sigma_{\mu\mu}$)]	*!	*	
Λ c) [(σσ)]		**	

b) No monosyllabic feet, No monomoraic feet » Faithfulness to input

ʔ/CV/	*FOOT(σ)	*FOOT(μ)	Faith
a) [(σ_{μ})]	*!	*	
b) [($\sigma_{\mu\mu}$)]	*!		*
Λ c) [(σσ)]			**

As long as the ban on monosyllabic feet is ranked above Faithfulness, the output must have a disyllabic foot. The relative ranking of the ban on monomoraic feet does not affect the outcome, as this constraint is equally satisfied by a disyllabic output. Lists of languages with bimoraic or disyllabic minimal size are provided by Hayes (1995) and Garrett (2002), among others.

In sum, minimal size of a binary foot is achieved through the following constraint rankings:

(11) a) *Bimoraic minimal size:*

*FOOT(μ) » Faith » *FOOT(σ)

b) *Disyllabic minimal size:*

*FOOT(σ) » Faith

These rankings lead to a minimal size of one foot, but cannot penalize an output for being longer than this size. *FOOT(μ) and *FOOT(σ) require feet to be binary, but do not assess the number of feet in an output. However, longer outputs are never the absolute minimal word size in a language (excluding extraprosodicity, see §4). For example, a word with four syllables will satisfy the rankings in (11), but any language which allows a word with four syllables also permits a shorter word. An output with four syllables will always be harmonically bounded by a shorter output serving as the language's true minimal word size.

This is illustrated below, where a subminimal input is augmented to satisfy foot binarity. While a longer output (12c) also satisfies this constraint, it gratuitously violates Faithfulness.

(12) *Longer minimal size not predicted by foot binarity*

No monosyllabic feet » Faithfulness to input

/CV/	*FOOT(σ)	Faith
a) [(σ)]	*!	
Λ b) [(σσ)]		*
c) [(σσ)(σσ)]		**!

In conclusion, a language with a minimal size restriction must have at least one binary (i.e., bimoraic or disyllabic) foot. Smaller outputs do not satisfy the constraint ranking leading to minimal size. Larger outputs would not be penalized by this ranking, but they would not be the absolute minimal size in the language, either.

Finally, it should also be noted that minimal size may not always be achieved through a faithfulness violation as implied in the ranking schemas in (11). The target is a prosodic unit, so a change in prosody may also satisfy the requirement for all feet to be binary. Equally, a "bad" input may have no output whatsoever, effectively enforcing a minimal size but not technically incurring a faithfulness violation. The responses leading to a minimal word size are addressed in the following section.

2.2 Responses to minimal size

2.2.0 Introduction

As the previous section attested, minimal word size is triggered by Headedness, which requires all prosodic words to have at least one foot, along with pressure for all feet to be binary. Minimal *root* size may also rely on root-foot alignment or positional markedness (Ch4§2.1.2, 2.1.3). Each of these conditioning environments may be repaired with the same inventory of responses for a minimal size to emerge. Like any OT constraint, the forces behind a minimal size identify the problem, but do not specify a repair. A size restriction may be obtained in any manner that suitably augments the shape in the output. This section explores those responses, identifying a distinct and attested set of strategies for achieving a minimal size restriction, enumerated below.

(13) *Strategies creating a minimal size*

a) Segment lengthening (Shipibo; §2.2.1)
b) Segment splitting (Tagalog; §2.2.2)
c) Exceptional prosodification (Manam; §2.2.3)
d) Epenthesis (Lardil; Ch4§3.2)
e) Null parse (cf. Tiene maximal size; §3.2.2)

The first strategy for obtaining a minimal size is employed by Shipibo above and discussed further in §2.2.1, where a subminimal input is repaired by lengthening the vowel to reach the bimoraic minimal size. Lengthening a segment provides the output with an extra mora, allowing the word to reach a minimal bimoraic size. Tagalog performs segment splitting, such that the segments of a subminimal input have multiple correspondents in the output (§2.2.2). A split segment is effectively doubled from the input to the output, again augmenting the size. Finally, Manam exhibits exceptional prosodification to reveal an emergent minimal word (§2.2.3). VV sequences are typically syllabified into an onset glide plus vowel, but when doing so would result in a subminimal word, then glide formation is blocked. Instead, the two vowels emerge as two separate (onsetless) syllables, or a disyllabic foot. Two other methods are addressed elsewhere in this dissertation and so are not discussed here: an analysis of epenthesis in Lardil is provided in Ch4§3.2, and a null parse to obtain a prosodic size restriction will be exhibited by Tiene for maximal size (§3.2.2).

This section addresses these strategies for creating a minimal size, and also explains why the minimal word size may be different from the foot shape preferred in other outputs. This result falls directly out from the use of separate constraints governing bimoraic and disyllabic feet (§2.1). While one foot type may be preferred for prosodification, the responses enumerated in (13) may select a second foot type to best satisfy faithfulness while obtaining a minimal size. This will be illustrated in the discussion of Shipibo in §2.2.1.

Responses to minimal size are addressed first within the context of Shipibo, continuing the analysis from §2.1 to discuss the language's repair strategy of vowel lengthening in §2.2.1. Supplementary strategies will be illustrated by Tagalog, which employs segment splitting, in §2.2.2 and by Manam, which shows a change in prosodification, in §2.2.3.

2.2.1 Segment lengthening in Shipibo

The first response employed to achieve a minimal size, segment lengthening, is examined here in the continued analysis of Shipibo minimal size. As argued in §2.1, Shipibo words must be at least one binary foot long (Elias-Ulloa 2006), which is illustrated by the data below. Words consisting of a single light syllable, such as [(CV$_\mu$)], never surface.

(14) *Shipibo words at least one binary foot*

[(CVː$_{\mu\mu}$)]	[(ˈtʃiː)]	'fire'	[(ˈtɨː)]	'work'
[(σσ)]	[(ˈba.k□)]	'child'	[(ˈpi.-ti)]	'food'
[(σσ)…]	[(ˈa.ta)pa]	'hen'	[(a.□in)bu]	'woman'
	[(ju.ˈmiː)(t͡su.-ˌriː)(ba.ˌwiː)]	'steal-again-imperative'		
*[(σ$_\mu$)]				

Elias-Ulloa (2006) argues that subminimal inputs are repaired through vowel-lengthening. He observes that Shipibo parses a word into disyllabic feet – a bimoraic foot is only permitted to satisfy the minimal word requirement.

In order for a language to have a minimal bimoraic size, rather than disyllabic, the constraint schema *FOOT(μ) » Faith » *FOOT(σ) must be employed (§2.1). A disyllabic foot satisfies the bans on both monomoraic and monosyllabic feet, while a bimoraic foot only satisfies the former. Thus, a bimoraic output must be more faithful to the input in order for it to win out. This can be achieved when it commits fewer violations or, as in Shipibo, the candidates violate different faithfulness constraints. A change in vowel quantity is preferred to epenthesis, and so the minimal word is one bimoraic foot (a). All candidates below satisfy bimoraicity. (The reader is also referred to Elias-Ulloa (2006: Ch4§3.5) for further discussion.)

(15) *Minimal word size through vowel lengthening*

Don't epenthesize » Don't change segment length, No monosyllabic feet

ʔ/ti/	DEP-SEG	IDENT(weight)	*FOOT(σ)
Λ a) [(ti:)]		*	*
b) [(tit)]	*!		*
c) [(ti.ti)]	**!		

Therefore, Shipibo words obtain a minimal size by lengthening the vowel. This approach also explains why a language may have a minimal word size which is different from its footing pattern, an issue raised by Hayes (1995) and Garrett (2002), among others. Shipibo feet are standardly disyllabic, but the minimal word size is a bimoraic foot. A longer input, which freely satisfies the minimal size without augmentation, is parsed into disyllabic feet. A bimoraic foot is only permitted when it is required to satisfy the minimal word restriction because vowel lengthening and tolerance of a bimoraic foot are preferred to the epenthesis required to obtain a disyllabic size. The preference for a change in segment weight also accounts for the disyllabic footing in longer outputs: Shipibo adjusts the weight of syllables in longer words in order to achieve disyllabic footing. This indicates that both constraints on foot binarity actually outrank IDENT(weight), since the pressure to be disyllabic can also force a change in segment weight, *FOOT(μ) » DEP-SEG » *FOOT(σ) »

IDENT(weight). For an analysis of other aspects of Shipibo prosody, see Elias-Ulloa (2006: Ch4§3.2).

Finally, this insight addresses concerns about the predictive power of a Prosodic Hierarchy-based approach to prosodic minimality, discussed by Downing (2005) with respect to reduplication in Axininca Campa. This case was originally analyzed within Generalized Template Theory by McCarthy and Prince (1993a, 1995), and, noting some weaknesses, Downing refutes their analysis and proposes that prosodic minimality is instead caused by a constraint requiring lexical heads to prosodically branch. However, Downing's proposal is itself flawed as it cannot account for near-bare root size restrictions, resyllabification (and consummate loss of prosodic branchingness) in heads or maximal size restrictions. Instead, the new understanding gained from Shipibo allows McCarthy and Prince's (1993a, 1995) analysis to be modified such that the weaknesses pointed out by Downing are resolved, while the problems inherent in Downing's own analysis are avoided. These points will now be illuminated by an in-depth discussion of Axininca Campa.

Like Shipibo, Axininca Campa prefers prosodic words with a disyllabic minimal size but will tolerate a monosyllabic, bimoraic minimal output to reduce violations of the ban on epenthesis. This generalization follows through to the process of reduplication: reduplicants which are at least two syllables in length emerge faithfully (e.g. /noŋ-kawosi-RED-wai-aki/ → [noŋ.ka.wo.si.ka.wo.si.wai.ta.ki] 'bathe'). A disyllabic minimal size for reduplicants is so strongly preferred that the language will even copy non-root (prefix) material in order to obtain this result (e.g. /no-naa-RED-wai-aki/ → [no.naa.no.naa.wai.ta.ki] 'chew'). However, in the absence of prefix material to augment their size, the language will tolerate reduplicants with monosyllabic, bimoraic outputs in order to avoid epenthesis (e.g. /naa-RED-wai-aki/ → [naa.na$_{\mu}$a$_{\mu}$.wai.ta.ki] 'chew', *[naa.naa.ta.wai.ta.ki]). Finally, when there is no other recourse, epenthesis is employed to ensure a minimal size (e.g. /na-RED-wai-aki/ → [na.ta.na.ta.wai.ta.ki] 'carry'). See McCarthy and Prince (1993a, 1995) and Downing (2005) for further discussion and more examples of these phenomena.

McCarthy and Prince (1993a, 1995) couch their analysis of Axininca Campa in Generalized Template Theory, and in her response Downing rightly criticizes several aspects of this account. For one, McCarthy and Prince employ the constraint DISYLL, which essentially states that reduplicants must be at least two syllables. This constraint betrays one of the principles of Generalized Template Theory, that size restrictions be derived from universal constraints on the prosody. Furthermore, in Axininca Campa, vowel hiatus between the root and the reduplicant is banned – but in order for the reduplicant for derive a minimal size restriction, it too must be its own prosodic word, which would allow it to avoid the ban on hiatus. McCarthy and Prince sidestep this issue with a constraint proclaiming that the reduplicant is in fact a suffix, but in doing so cloud the issue of how the reduplicant was able to derive a prosodically-based minimal size in the first place.

In her alternative analysis of Axininca Campa, Downing (2005) proposes that prosodic minimal size is the product of a requirement that lexical heads, such as a root or stem, must prosodically branch; for instance, the prosodic structure affiliated with a root much branch, resulting in a bimoraic or disyllabic root morpheme. This approach superficially resolves the case of Axininca Campa, but runs into problems when expanded to other arenas. For instance, Downing's Head-Dependent Asymmetry theory fails to account for the near-bare root phenomena described in Czech and Shipibo discussed in this dissertation, just as other approaches directly stipulating the prosodic size or structure of a root morpheme fail. The size restrictions on bound roots are clearly derived from restrictions on size (or arguably, "branchingness") on the level of the prosodic word, not the root itself.

Secondly, constraints such as Downing's MORPH-SYLL ("Every morpheme contains at least one syllable") make the same pathological predictions as McCarthy and Prince's DISYLL and other prescriptive constraints (Ch5§5). To give just one example, although a branching-head approach may be able to enforce a minimally bimoraic size in some outputs in a language like German (e.g. [(ˈflɛ$_{\mu}$k$_{\mu}$)] 'stain'), it is shown to fail when this same root undergoes resyllabification when suffixed and the root morpheme no longer dominates two sister prosodic heads (e.g. [(ˈflɛ$_{\mu}$.k-ɪ$_{\mu}$ç)] 'stained'); see Ch4§2.1 for an account of this phenomenon under the current proposal.

Finally, HDA-theory does not offer an avenue for the analysis of prosodic maximality, a phenomenon also documented in the present work. Presumably, a theory of maximality derived from branchingness would require a root or word to branch at most once on the level of the mora, syllable or foot. If this counting-based approach is tenable or how it might deal with non-strictly layered prosody (e.g.

Māori's maximal size of one binary foot plus up to two non-adjacent unfooted syllables) are unclear.

Instead, McCarthy and Prince's Prosodic Morphology approach is salvaged by recent developments, such as the use of independent constraints banning monomoraic and monosyllabic feet as developed by Elias-Ulloa (2006) for Shipibo. As stated above, the output of a reduplicant is governed by a clear chain of command: (1) a reduplicant of at least two syllables emerges faithfully; (2) a subminimal reduplicant will copy non-root material to ensure it is at least disyllabic; (3) where there is no available prefix material to copy, then (a) a monosyllabic, bimoraic reduplicant will emerge faithfully; or (b) a monosyllabic, monomoraic reduplicant will undergo epenthesis in order to reach a minimal disyllabic size (with reduplicants apparently in free variation to epenthesize to a bimoraic or disyllabic size). Given the insights of Elias-Ulloa (2006), this interaction can be straightforwardly characterized by the constraint ranking *FOOT(μ) » DEP-SEG, *FOOT(σ) » RED⊑ROOT without recourse to a constraint such as DISYLL. The fact that Axininca Campa militates against vowel hiatus between the root and the reduplicant may also be resolved based on recent work; the two may be separate, nested prosodic words (McCarthy and Prince 1994a), or a closer examination of the language may find that the minimal size in the reduplicant is the product of a separate domain allowing for an independent size restriction, similar to the discussion of root-foot alignment to obtain a minimal root size in German in Ch4§2.1.2

In short, Shipibo illustrates how a language may have a different minimal word size from the dominant stress pattern. The standard phonotactics of the language call for disyllabic footing, but this may be exceptionally violated in order to satisfy minimality. The opposite situation will be discussed in Lardil (Ch4§3.2). The language is quantity-sensitive, and so a long vowel is treated as heavy and satisfies the minimal word requirement (e.g., [(maːn)] 'spear'). However, a subminimal input is augmented through vowel epenthesis, so a potential violator of the minimal word restriction is repaired to a disyllabic minimum, /wik/ → [(wi.ka)] 'shade', *[(wiːk)]. Again, this is due to the nature of the violation, with epenthesis being preferable to segment lengthening in Lardil.

A second type of segment lengthening, consonant gemination, is employed by Yup'ik to achieve minimal root size (Ch4§2.1.3). The next section examines segment splitting as a strategy to achieve a minimal word size in Tagalog.

2.2.2 Segment splitting in Tagalog

Another potential approach augmenting a subminimal input is for an input segment to have multiple correspondents in the output, effectively lengthening the word. This is the case for a class of disyllabic roots in Tagalog, where the two syllables are segmentally identical or deviate only in phonologically predictable ways. Zuraw (2002) proposes that these roots superficially resemble a base plus reduplicant, but exhibit exceptional behavior in several respects, suggesting that they are better characterized as splitting of the root segments to satisfy the minimal word restriction.

Examples of Tagalog "pseudoreduplicants" are provided below. Those in (a) have two identical syllables, while those in (b) are near-identical, lacking the final coda and in some cases having a long vowel in the initial syllable. The change in vowel quality [o] ~ [u] is standard throughout the language: mid vowels only occur in the ultima and are raised in other syllables.

(16) *Tagalog pseudoreduplicants*

a)	[(ŋas.ˈŋas)]	'scandal'	[(dut.ˈdot)]	'poking'
	[(sag.ˈsag)]	'split'	[(pat.ˈpat)]	'stick'
b)	[(la.ˈlaʔ)]	'acute'	[(lu.□lod)]	'shin'
	[(ˈsuː.soʔ)]	'snail'	[(ˈliː.liw)]	*species of bird*

Tagalog pseudoreduplicants do not behave like standard monomorphemic roots in the language for two reasons given below.

(17) *Pseudoreduplicants do not behave like monomorphemic roots*

Pseudoreduplicants:

a) allow consonant clusters which are otherwise banned (e.g., [(du<u>t.ˈd</u>ot)]).

b) allow repetition of a consonant, where other roots generally restrict consonant co-occurrence.

This unusual behavior, along with the fact that pseudoreduplicants only occur with monosyllabic "bases", suggests that they are employed as a strategy to avoid a subminimal word size. All Tagalog words are at least two syllables in length (French 1988). When the input is too small to meet the minimal word size on its own, it is augmented by giving the input segments multiple correspondents in the output, a violation of the faithfulness constraint INTEGRITY (McCarthy and Prince 1995a).

(18) INTEGRITY: No element of S_1 has multiple correspondents in S_2.

The disyllabic minimal word size, represented by *FOOT(σ) banning monosyllabic feet (§2.1), can compel the faithfulness violation of segment splitting. The result is a class of disyllabic words – originally subminimal inputs – where the two syllables are (nearly) identical.

(19) *Minimal word size through segment splitting*

No monosyllabic feet » Don't split segments

/$ŋ_1a_2s_3$/	*FOOT(σ)	INTEGRITY
a) [(ˈ$ŋ_1a_2s_3$)]	*!	
Λ b) [($ŋ_1a_2s_3$.ˈ$ŋ_1a_2s_3$)]		*

As in Shipibo, the pressure to meet the minimal PrWd size can overrule phonological generalizations present in other outputs, such as restrictions on consonant clusters or on consonant co-occurrence within the root. Tableau (20) illustrates the latter phenomenon, where co-occurrence restrictions are represented through the OCP (Goldsmith 1976).

(20) *Minimal size blocks standard phonotactics*

No monosyllabic feet » Don't split segments, No recurrent root segments

/ŋ$_1$a$_2$s$_3$/	*FOOT(σ)	INTEGRITY	OCP
a) [(ˈŋ$_1$a$_2$s$_3$)]	*!		
Λ b) [(ŋ$_1$a$_2$s$_3$.ˈŋ$_1$a$_2$s$_3$)]		*	*

The pseudoreduplicants which do not have identical syllables (16b) are a product of the constraints governing the standard phonotactics of the language. For example, while consonant co-occurrence is usually banned but permitted in pseudoreduplicants as above, the ban on word-medial glottal stop may be higher ranked and so enforced in all outputs, /laʔ/ → [la.laʔ] 'acute', *[laʔ.laʔ].

The internal similarities between the two syllables suggest that these outputs may be sequences of a base plus reduplicant, the argument put forward by Zuraw. However, there are several arguments against this analysis, enumerated by Zuraw herself (2002: 7-8).

(21) *Pseudoreduplicants do not behave like standard reduplicants*

Pseudoreduplicants:

a) only occur with a mono-syllabic "base".
b) generally do not exhibit base-reduplicant correspondence.
c) employ a CVC template, which is not otherwise productive.
d) are not associated with a fixed meaning (e.g., plural, habitual, etc.).

The segment splitting proposal above has many similarities with Zuraw's account of aggressive reduplication. The primary difference is in motivation: the current analysis argues that subminimal roots violate INTEGRITY to meet Tagalog's well-attested minimal size. Zuraw contends that pseudoreduplicants are caused by a constraint encouraging outputs to have a reduplicant-like structure. Specifically, each word must contain some substring where two segments have the same value for some feature [F] (2002: 17-18). This constraint is unrestricted, potentially leading to a language where all segments must resemble one another, and it also relies on the ill-defined concept of "relative similarity". These lead to massive over-generation, undermining the theoretical basis of the constraint. Moreover, it fails to account for why pseudoreduplication should only occur with monosyllabic "bases", a fact that directly follows from the minimal word account proposed here.

An analysis of another strategy for obtaining a minimal word size, exceptional prosodification, is provided in the following section.

2.2.3 Exceptional prosodification in Manam

Manam is an Austronesian language spoken in Papua New Guinea. It reveals an emergent minimal word size – words conform to a binary minimum when it is possible to do so. Since Manam does not allow epenthesis, the only way it can achieve minimal word restrictions is by altering the prosodic structure. Minimal word restrictions therefore only show up when they can be obtained by blocking a vowel from becoming a glide.

Standardly, a segment /i o/ preceding another vowel is forced to become a glide [j w] to satisfy ONSET. However, this process is blocked when onset glide formation would result in the output being less than one binary foot. Instead, it is preferable for the onset violation to be tolerated so that FT-BIN can be satisfied. This emergent effect of FT-BIN reveals another strategy employed for creating a minimal root size, exceptional prosodification.

Generally speaking, Manam does not have a minimal word or root size; this can be seen in words such as [u] 'kind of fish trap' and [ga] '*Morinda citrifolia*' (Lichtenberk 1953: 52). However, the language has a process whereby the first segment in a vowel sequence becomes an onset glide before a vowel, /iV/ → [jV]; /oV/ → [wV]. This is illustrated in the following data from Lichtenberk (1983).

(22) *Vowel becomes onset glide*

/iambo/	→	[(ˈjam.bo)]	'guava'	p14
/i-un-a/	→	[(ˈju.na)]	'he hit me'	p15
/eoa/	→	[(ˈe.wa)]	'fire'	p15
/gimoa/	→	[(ˈgi.mwa)] / [(ˈgi.mo)]	'hole in ground'	p25

The vowel-glide alternations can be accounted for through the constraint ONSET. Since the only difference between a vowel and a glide is whether it heads a mora (Hyman 1985, Hayes 1989), glide formation is only unfaithful to the constraint IDENT-μ.

Glide formation is blocked when it would produce a subminimal output. Manam avoids a violation of FT-BIN by permitting onsetless syllables in a very limited environment. (It is unclear if the language is militating against monomoraic or monosyllabic feet due to the limited environment, so generic FT-BIN is employed here.) Lichtenberk (1983) provides two relevant examples.

(23) *Glide formation blocked when output would be subminimal*

/ia/	→	[(ˈi.a)	'man's brother's wife'	*[(ˈja)]	p14
/moa/	→	[(ˈmo.a)]	'penis'	*[(ˈmwa)]	p16

The interactions behind Manam's emergent minimal word size are illustrated below. Candidate (a) violates ONSET twice in order to satisfy the demands of FT-BIN.

(24) *Emergent minimal word through blocking of glide formation*

Feet are binary » Syllables have an onset

/ia/	FT-BIN	ONSET
Λ a) [(ˈi.a)]		**
b) [(ˈja)]	*!	

The minimal size restriction only emerges in small words which would be a single light syllable if glide formation were carried out. In longer words, FT-BIN is already satisfied and so glide formation is the best solution. As tableau (25) illustrates, both candidates contain a binary foot, so ONSET can freely influence the shape of the output.

(25) *Glide formation when the minimal word size is satisfied*

Feet are binary » Syllables have an onset

/iambo/	FT-BIN	ONSET
a) [(ˈi.am)bo]		**
Λ b) [(ˈjam.bo)]		

Of course, faithfulness to the input must outrank both FT-BIN and ONSET in order for other outputs to surface without a minimal word size. A root which produces a degenerate foot and/or an onsetless syllable surfaces faithfully, because these violations are preferred over a repair such as epenthesis.

(26) *Faithfulness blocks augmentation to minimal size and onset formation*

Don't epenthesize » Feet are binary » Syllables have an onset

/u/	DEP	FT-BIN	ONSET
Λ a) [(ˈu)]		*	*
b) [(ˈju.ju)]	*!		

It is only when this faithfulness is moot that the minimal word size can emerge.

There is one final aspect to Manam. ONSET can also optionally be resolved through deletion (e.g., /gimoa/ → [(ˈgi.mo)] or [(ˈgi.mwa)]). Deletion is not an option where it would only reduce the violations of ONSET, e.g., /eoa/ → [(ˈe.wa)], *[(ˈe.a)], *[(ˈe.o)a]. In grammars with deletion, the ranking will be ONSET » IDENT-μ » MAX. This ranking will still result in /iambo/→[jam.bo] because deleting /i/ will not resolve ONSET: *[.am.bo]. The ranking will not interfere with the minimal word onset glide blocking, either: /ia/ → *[a] satisfies neither ONSET nor the minimal word requirement.

In this manner, Manam shows how a minimal word size can emerge in certain environments. Moreover, the language provides evidence for how a minimal size restriction can be satisfied through exceptional prosodification.

2.3 Conclusions

This section took a closer look at the mechanisms behind minimal size. First, the typology of minimal size was determined, finding that it may be satisfied with a bimoraic or disyllabic foot, and the constraint rankings leading to each output were identified. Subsequent sections looked at the different responses engendered by a minimal size constraint, from segment lengthening in Shipibo to segment splitting in Tagalog to exceptional prosodification in Manam. Another strategy, epenthesis, will be addressed in the discussion of Lardil in Ch4§3.2, and a null parse will be analyzed for Tiene's maximal size restriction (§3.2.2).

3 MAXIMAL SIZE

3.0 Introduction

A maximal size restriction is produced when a ban on non-head feet triggers a response limiting the size of the output. Different systems of maximal size result from the interaction with other phonological constraints, such as whether the language permits unfooted syllables or forces a certain prosodic unit to align with the left edge of the word. These factors result in a variety of maximal shapes, but each type of maximum is defined, restricted and ultimately triggered by the same condition, a ban on non-head feet. Cause and effect are decoupled in OT, so a maximal size restriction may be equally satisfied through several different repairs. This section examines the systems of maximal size predicted by a ban on non-head feet, as well as the arsenal of responses which may be deployed to satisfy this condition.

A maximal PrWd size restriction is exemplified in Māori, where each word is limited to at most one binary foot, plus non-adjacent unfooted syllables [σFtσ] (de Lacy 2003). This maximal word size is brought about through a ban on non-head feet, represented through the constraint *FT-.

De Lacy (2003) argues that the maximal word size in Māori [σFtσ] requires a complex balance of constraints. Non-head feet are banned, and unfooted syllables are allowed but restricted: a sequence of unfooted syllables, or lapse, is not permitted. The language selects an output that avoids secondary feet and lapses, but otherwise best maintains faithfulness to the input. Pressure for the left edge of the word to be aligned with a head foot or (non-)head syllable may also influence the maximal size, producing the following cross-linguistic typology of maximal size restrictions.

(27) *Typology of maximal size*

a) σ Ft σ

b) Ft

c) Ft σ

d) σ Ft

It is crucial that non-exhaustive parsing be limited if a maximal word size is to emerge. A language with a single foot but unlimited non-exhaustive parsing, like complex words in Czech (Ch2§4.2), will satisfy the ban on non-head feet without upholding a maximal size. The output is segmentally fully faithful to the input and so does not exhibit a maximal size, and the ban on non-head feet is only reflected in the prosodic structure. In Māori, non-exhaustive parsing is limited by preventing a sequence of unfooted syllables from surfacing. Analysis of the maximal size in Māori leads to identification of the types of maximal size and the phonological factors behind each in §3.1.

The systems of maximal size all ultimately stem from a ban on non-head feet, which may be realized through different responses. Effectively, any repair restricting the size of the output may be used to achieve a maximal word size. Strategies for obtaining a maximal size restriction include the following.

(28) *Responses creating a maximal size*

a) Deletion

b) Exceptional prosodification

c) Segment shortening

d) Coalescence

e) Null parse

The first two of these responses are exhibited by Māori, with its maximal size of [σFtσ], and will be analyzed with respect to the process of suffixation in §3.2.1. Non-adjacent unfooted syllables are permitted, with deletion taking place where necessary. When deletion is not adequate for reaching the maximal size – for example, where it is blocked to prevent total deletion of a morpheme – then exceptional prosodification is undertaken and the input is split into separate prosodic words, such that each PrWd has at most one foot. The other strategies – segment shortening, where a long vowel becomes short or a geminate becomes a singleton, and coalescence, where two or more input segments blend into one in the output – may also be used to restrict the size of the output. (Their complementary processes, lengthening and segment splitting, were illustrated by Shipibo and Tagalog in §2.2.1 and 2.2.2.)

The final strategy, a null parse, will be exhibited by the Bantu language Tiene in §3.2.2. Outputs are limited to a maximal size of [Ftσ], and the definitive aspect is standardly expressed through reduplication of the final syllable. This process can be actively seen in disyllabic words. However, reduplication of a trisyllabic word would push the output up to four syllables, causing the derivation to crash. Although it is an inefficient repair, processing an over-long input into a null parse ensures that no output will exceed the maximal word size.

This section is organized as follows. Analysis of the Māori maximal size provides insight into the processes behind a maximal size restriction in §3.1. This section identifies the typology of maximal size and the constraint schemas leading to each. The following section examines the responses a language may employ to obtain a maximal size, looking first at deletion and exceptional prosodification in Māori in §3.2.1, before turning to the use of the null parse in Tiene in §3.2.2. Conclusions are provided in §3.3.

3.1 Typology of maximal size

Prosodic words obtain a maximal size when a ban on non-head feet triggers a repair limiting the size of the output. Through its interaction with other phonological considerations, such as faithfulness to the input, pressure to parse all syllables into feet, avoidance of a sequence of unfooted syllables and alignment of prosodic constituents, a maximal size of one foot has several different surface realizations. This section identifies maximal word shapes of Ft, Ftσ, σFt and σFtσ, and examines the theoretical mechanisms accounting for each one.

The Polynesian language Māori limits prosodic words to a maximal size of a single foot, allowing for a single unfooted syllable at either side (de Lacy 2003).

Many different word shapes are permitted, as long as each output has one and only one binary foot. Unfooted syllables are allowed, but a sequence of them (called a lapse) is not. For monomorphemic words, the maximal size is simply a phonotactic generalization (29a), but suffixation allows insight into the factors behind the maximal word size. The passive suffix /-ia/ surfaces faithfully when possible (b), but will reduce when necessary to avoid violating the maximal size (c).

(29) *Māori words maximally one foot*

a) *Maximal size in bare roots*

[ta(ˈmai)ti] ‘child’ [ma(ˈnaː)ki] ‘to show kindness’

b) *Output surfaces faithfully*

i) [(□ho.ka)] ‘to run out’-ACT ii) [ho(□ka□-i)a] PASS

[(□ti.a)] ‘to paddle vigorously’-ACT [ti(□a□-i)a] PASS

c) *Deletion from suffix*

i) [ta(□pa□e)] ‘to present’-ACT ii) [ta(□pa□e)-a] PASS

[ko(□po□u)] ‘to appoint’-ACT [ko(□po□u)-a] PASS

*[(□Ft)(□Ft)], *[σ(□Ft)σσ] – i.e., *[ko(□po□u)-i.a], *[ko(□po□u)(-ˌi.a)]

The primary phenomenon in maximal word size is a ban on non-head feet, which limits each word to a single foot. This pressure must outweigh faithfulness to the input, so that the prosodic word is restricted to a maximal size. In Māori, where a trimoraic word [ko(□pou)] is concatenated with the passive suffix /-ia/, a faithful output (30a) would be too long. In order to avoid formation of a secondary foot, the winning candidate is unfaithful to the input.

(30) *Non-head feet banned*

Don’t have non-head feet » Don’t delete

/kopou-ia/	*FT-	MAX
a) [ko(ˈpou)(ˌi.a)]	*!	
Λ b) [ko(ˈpou)a]		*

Another possible response is for the word to force all syllables to be parsed into feet, while still permitting only a single foot. Clearly, Māori allows unfooted syllables, so the pressure for all syllables to be footed must lose out to faithfulness to the input.

(31) *Unfooted syllables permitted*

Don't delete » Parse all syllables into feet

/kopou-ia/	MAX	PARSE-σ
a) [(ˈko.pa)]	***!	
Λ b) [ko(ˈpou)a]	*	**

However, unfooted syllables are only permitted up to a point. Although a sequence of unfooted syllables would be more faithful to the input (a), this result is blocked by a ban on lapses (b; Green and Kenstowicz 1995).

(32) *Sequence of unfooted syllables banned*

No adjacent unfooted syllables » Don't delete » Parse all syllables into feet

/kopou-ia/	*LAPSE	MAX	PARSE-σ
a) [ko(pou)i.a)]	*!		***
Λ b) [ko(ˈpou)a]		*	**

In sum, the ban on non-head feet interacts with *LAPSE, PARSE-σ and Faithfulness to yield a maximal word size of four moras in Māori. This case will be expanded in the following section to explore the different responses to a maximal word requirement, and the reader is referred to de Lacy (2003) for a full analysis of this complex case.

Permuting these constraints leads to different maximal word sizes. For example, if unfooted syllables are completely banned, then each word will consist of a single binary foot. This outcome is reflected in isolating languages, such as Vientiane Lao (Morev, Moskalev and Plam 1979) and Ancient Thai (Brown 1965), and in simple Czech PrWds, although it may be obscured in complex outputs (Ch2).

(33) *Maximal size of* [Ft]

Don't have non-head feet, Parse all syllables into feet » Faithfulness

	/CVCVCVCV/	*FT-	PARSE-σ	Faith
	a) $[(\sigma\sigma)^{+}(\sigma\sigma)^{-}]$	*!		
	b) $[(\sigma\sigma)^{+}\sigma\sigma]$		**!	
Λ	c) $[(\sigma\sigma)^{+}]$			*

Adding alignment of prosodic categories leads to a third type of maximal word size. This dissertation argues that head and non-head prosodic categories may be aligned with a higher order prosodic unit at the left edge (Ch5§4.1). A language allowing a single foot and solitary unfooted syllables, like Māori, but also requiring the head foot to align with the left edge of the word leads to a maximal word size of [Ftσ] (34A). Alignment of a head syllable with the left edge of the prosodic word leads to a similar prediction, a left-aligned trochaic system with a maximal size of [(ˈσσ)σ] / $[(^{\text{ˈ}}\sigma_{\mu\mu})\sigma]$ (34B). An example of a language with this maximal size is Tiene (§3.2.2).

(34) *Maximal size of* [Ftσ]

A) Don't have non-head feet, Align foot with PrWd » Faithfulness

	/CVCVCVCV/	*FT-	ALIGN-L (Ft^{+}, PrWd)	Faith
	a) $[(^{\text{ˈ}}\sigma\sigma)^{+}(_{\text{ˌ}}\sigma\sigma)^{-}]$	*!		
	b) $[\sigma(\sigma\sigma)^{+}\sigma]$		*!	
Λ	c) $[(^{\text{ˈ}}\sigma\sigma)^{+}\sigma]$ / $[(\sigma^{\text{ˈ}}\sigma)^{+}\sigma]$			*

B) Don't have non-head feet, Align stress with PrWd » Faithfulness

	/CVCVCVCV/	* FT -	ALIGN-L (σ^{+}, PrWd)	Faith
	a) $[(^{\text{ˈ}}\sigma\sigma)^{+}(_{\text{ˌ}}\sigma\sigma)^{-}]$	*!		
	b) $[\sigma(^{\text{ˈ}}\sigma\sigma)^{+}\sigma]$		*!	
Λ	c) $[(^{\text{ˈ}}\sigma\sigma)^{+}\sigma]$ / $[(^{\text{ˈ}}\sigma_{\mu\mu})^{+}\sigma]$			*

The opposite situation, a maximal size of [σFt], is also a possibility, although the factors behind it are more complex. This dissertation argues against right-alignment; apparent right-alignment of heads is instead expressed through left-alignment of non-heads. Alignment of the left edge of the word with a non-head syllable leads to a maximal size of [σFt]. However, its distribution is limited to an unfooted syllable plus heavy foot [$\sigma^{-}_{\mu}(\sigma_{\mu\mu}^{+})$], or an unfooted syllable plus a trochee [$\sigma^{-}(\sigma^{+}\sigma^{-})$]. (An iambic foot inherently satisfies non-head syllable-PrWd alignment [$(\sigma^{-}\sigma^{+})$], accurately predicting that there are no right-to-left iambs and preventing a maximal size of [$\sigma^{-}(\sigma^{-}\sigma^{+})$]. See Ch5§4.1 for further discussion of (non-)head alignment of prosodic categories.) Moreover, PARSE-σ must outrank faithfulness to the input, so that the output with the fewest unfooted syllables [σFt] is preferred to a more faithful output [σFtσ]. If all these conditions are satisfied, then the language will have a maximal size of [σFt]. The author is unaware of a language with this maximal size restriction, although the Bantu, Mon-Khmer and Polynesian languages may provide a rich resource for future investigation.

(35) *Maximal size of* [σFt]

No non-head feet, Align σ^{-} with PrWd, Parse all syllables » Faithfulness

/CVCVCVCV/	*FT-	ALIGN-L (σ^{-}, PrWd)	PARSE-σ	Faith
a) [$(\sigma\sigma)^{+}(\sigma\sigma)^{-}$]	*!			
b) [$({}^{\text{ˈ}}\sigma\sigma)^{+}\sigma$]		*!		*
c) [$\sigma({}^{\text{ˈ}}\sigma\sigma)^{+}\sigma$]			**!	*
Λ d) [$\sigma({}^{\text{ˈ}}\sigma\sigma)$]			*	*

The constraint rankings leading to the different maximal word sizes discussed in this section can be summarized as follows.

(36) *Maximal size constraint schemas*

a) Ft: $*$FT$^-$, PARSE-σ » Faith

b) σFtσ: $*$FT-, $*$LAPSE » Faith » PARSE-σ

c) i. Ftσ: $*$FT-, $*$LAPSE, ALIGN-L(Ft$^+$, PrWd) » Faith » PARSE-σ

ii. Ft$_{\text{TROCHEE}}$σ: $*$FT-, $*$LAPSE, ALIGN-L(σ$^+$, PrWd) » Faith » PARSE-σ

d) σFt$_{\text{TROCHEE}}$: $*$FT-, $*$LAPSE, ALIGN-L(σ$^-$, PrWd), TROCHEE » PARSE-σ » Faith

It should be noted that "Faith" refers to any response that limits the size of the output, including a null parse and exceptional prosodification, although these do not strictly represent a faithfulness violation. These responses will be discussed in the following section.

In conclusion, the ban on non-head syllables leads to several different maximal sizes. The unifying factors are the presence of a single binary foot and possible solitary unfooted syllables. As a development of Prosodic Morphology, the maximal size restriction must be based on authentic units of prosody (McCarthy 1986 *et seq*.). A random maximal size such as CCVC or seven moras is not predicted to occur. Equally, the inventory of maximal size is influenced by other phonological factors, such as *LAPSE and PARSE-σ. While other responses to a ban on non-head feet are perfectly viable and attested, such as a single foot with any number of unfooted syllables, these outputs do not translate into a maximal size restriction. The possible responses to a maximal size restriction will be addressed in the following section.

3.2 Responses to maximal size

3.2.0 Introduction

A maximal size restriction is imposed when a language's response to a ban on non-head feet limits the size of the output. Many approaches are employed to avoid secondary feet while best satisfying the other phonological constraints in the language. The investigation into Māori in §3.1 above revealed two strategies leading to a maximal word size, non-exhaustive parsing and deletion. The analysis of Māori is extended in §3.2.1, finding that the language will also employ PrWd splitting as a last resort. A second case study is provided by Tiene in §3.2.2, where an input potentially exceeding the maximal size is avoided by giving it a null parse. Where there is no output, there is no maximal size violation.

3.2.1 Deletion and exceptional prosodification in Māori

The Māori maximal word size was introduced in §3.1, and this section develops the analysis with an eye to the system of responses employed by the language in the process of suffixation. All PrWds have at most one binary foot, which is satisfied in the first instance by allowing non-adjacent unfooted syllables. When this is not sufficient, then affix material may be deleted. Finally, when deletion is blocked, then the language breaks the input into multiple prosodic words.

These responses can be seen in the data below, which builds on the data from (29) so that three separate responses to suffixation of the passive /-ia/ are evident. (37a) shows fully faithful outputs incorporating non-exhaustive parsing, and (37b) undergoes minor deletion to avoid a second foot or a sequence of unfooted syllables. The data in (37c) cannot be satisfactorily repaired with either of these approaches, so a final tactic, PrWd splitting with onset epenthesis, is employed.

(37) *Māori responses to the ban on non-head feet*

a) *Output surfaces faithfully*

i) [(□ho.ka)]	'to run out'-ACT	ii) [ho(□ka□-i)a]	PASS
[(□ti.a)]	'to paddle vigorously'-ACT	[ti(□a□-i)a]	PASS

b) *Deletion from suffix*

i) [ko(□po□u)]	'to appoint'-ACT	ii) [ko(□po□u)-a]	PASS
[ta(□pa□e)]	'to present'-ACT	[ta(□pa□e)-a]	PASS

c) *Fracture into separate prosodic words*

i) [(ˈma.hu)e]	'to put off'-ACT	ii) [{(ˈma.hu)e}{(-ˈti.a)}]	PASS
[(ˈa.ɾi)hi]	'to chop'-ACT	[{ˈa.ɾi)hi}{(-ˈti.a)}]	PASS

*[(□Ft)(□Ft)], *[σ(□Ft)σσ] – i.e., *[ko.(□po□u)-i.a], *[ko.(□po□u)(ˌi.a)]

The previous section explored the first two responses to the maximal word size restriction in Māori. Non-adjacent unfooted syllables are permitted, and when necessary, affix material may be deleted in order to comply with the maximal word size (tableaux 30-32). This outcome is expressed through the constraint ranking *FT-, *LAPSE » MAX » PARSE-σ. The third strategy, the exceptional prosodification (37c), is analyzed here.

When the maximal size cannot be met through the strategies of non-exhaustive parsing and deletion, then the input is split into multiple prosodic words as a last resort. For example, the input in (38) /mahue-ia/ is too long to surface faithfully while avoiding a secondary foot, *[(□ma.hu)(ˌe.i)a], or a lapse, *[ma(□hu.e)i.a]. The next option, deletion, is blocked: the suffix cannot be completely deleted because its morphological material must be preserved in the output (a; Samek-Lodovici 1993, Walker 1998), and deletion from the root is blocked by positional faithfulness (b; Beckmann 1998). In this case, the next option is to parse the input into multiple prosodic words (c). This represents a violation of a version of Truckenbrodt's WRAP constraint – WRAP(MWd, PrWd) – which requires each morphological word to be contained in a single prosodic word (1999, 2006).

(38) *Morphological word broken into separate prosodic words*

Morphemes overt, Don’t delete from root » MWd in one PrWd » Don’t delete

/mahue-ia/	REALIZEMORPH	MAX-Root	WRAP (MWd, PrWd)	MAX
a) [(ˈma.hu)e]	*!			*
b) [(ˈma.hu)a]		*!		*
Λ c) [{(ˈma.hu)e}{(ˈti.a)}]			*	

Evidence that the morphological word must form separate prosodic words is found in the stress and intonation patterns of the language (de Lacy 2003: 8) and in the epenthesis of [t], which is a product of Māori’s restriction that PrWd-initial affixes must have on onset (de Lacy 2003: 11).

The differing outcomes of /kopou-ia/ → [ko(ˈpou)a] but /mahue-ia/ → [{(ˈmahu)e}{(ˈtia)}], *[ma(ˈhu.e)a], is due to their syllabification. Māori feet are under pressure to align with the left edge of the prosodic word (de Lacy 2003). However, this may be overridden by the Weight to Stress principle, which states that a heavy syllable should be the head of the foot (Prince 1990a, Hayes 1995). This enables the diphthong to attract the foot away from the foot edge.

(39) *Left-alignment blocked by stress attraction to heavy syllable*

Stress a heavy syllable » Align the head foot with the left edge of the word

/kopou-ia/	WEIGHT-TO-STRESS	Align-L(Ft^+, PrWd)
a) [{(ˈkopo)u}{ti.a)}]	*!	
Λ b) [{ko(ˈpou)a}]		*

This same concept accounts for the maximal size in monomorphemic words, like [ma(ˈnaː)ki] ‘to show kindness’. Words with the shape [σFtσ] only emerge in Māori when the foot is a single, heavy syllable. Since the output *[ma(ˈhu.e)a] does not have a heavy syllable to attract stress, the foot must remain at the left edge of the word.

To sum up, Māori provides a good example of the strategies used to uphold a ban on non-head feet. Restricted non-exhaustive parsing is found as a first response, followed by deletion, with PrWd splitting employed as a final resort. Deletion is also employed in Czech maximal size (Ch2§3.1). Another potential strategy for achieving a maximal word size is coalescence, where multiple segments merge into a single segment in the output. In practice, coalescence and deletion may be difficult to distinguish; for example, each word is at most a single foot in an isolating language like Vientiane Lao (Morev, Moskalev and Plam 1979), but this phonotactic generalization does not provide any insight into the processes behind it. An input too long to be parsed into a single foot is somehow reduced, but the exact repair can only be determined by an investigation into other aspects of the phonology, if at all. The length of the word may also be limited by vowel shortening or degemination. These processes' complements, segment splitting and vowel lengthening, were discussed in Tagalog in §2.2.2 and Shipibo in §2.2.1.

A final response is exhibited by Tiene's null parse of supermaximal outputs, analyzed in the following section.

3.2.2 Null parse in Tiene

The Bantu language Tiene has a maximal word size of a left-aligned foot plus a single unfooted syllable (Hyman and Inkelas 1997, Orgun and Sprouse 1999). Standardly, the definitive aspect is expressed in the language through reduplication of the final syllable. However, when reduplication of a trisyllabic word would push the word over the maximal size, then there is no output at all. A lack of output is also a candidate in Optimality Theory, called a null parse (⊙; Prince and Smolensky 1993, McCarthy and Wolf 2005). The data below shows disyllabic roots and their reduplicated forms (40a), and trisyllabic forms which cannot undergo reduplication (b; Orgun and Sprouse 1999).

(40) *Tiene reduplication*

a) *Disyllabic bases*

BASE		REDUPLICATED FORM	
[(ˈjɔ.bɔ)]	‘bathe’	[(ˈjɔ.bɔ)bɔ]	‘bathe thoroughly’
[(ˈma.ta)]	‘go away’	[(ˈma.ta)ta]	‘go away once and for all’
[(ˈja.ka)]	‘believe’	[(ˈja.ka)ka]	‘believe once and for all’
[(ˈlɔ.ŋɔ)]	‘load’	[(ˈlɔ.ŋɔ)ŋɔ]	‘load once and for all’

b) *Trisyllabic bases*

[(ˈko.to)ba]	‘chase’	⊙,	i.e *[(ˈko.to)(ˌba.ba)], *[(ˈko.to)ba.ba], *[ko(ˈto.ba)ba]
[(ˈvu.te)kɛ	‘come back’	⊙	
[(ˈbi.ne)ma]	‘sleep’	⊙	
[(ˈpa.na)ma]	‘frighten’	⊙	

*[(ˈσσ)(ˌσσ)], *[(ˈσσ)σσ], *[σ(ˈσσ)σ]

Recall that a maximal size of Ftσ is achieved through the constraint ranking *FT-, *LAPSE, ALIGN-L(Ft^{+}, PrWd) » Faith » PARSE-σ (see §3.1 for discussion). Trisyllabic roots may not be reduplicated because they would violate the ban on non-head feet *[(ˈσσ)(ˌσ-σ)], the ban on lapses *[(ˈσσ)σ-σ] or the requirement that the foot be aligned with the left edge of the prosodic word *[σ(ˈσσ)-σ]. Instead, the optimal output is a null parse; the constraint working against such an outcome is MPARSE.[10]

[10] Other “bad” reduplicated forms employ deletion plus the periphrastic causative suffix to avoid having coronal onsets in both the ultimate and penultimate syllables, /bota + RED/ → [(ˈbo.o)-sɛ] ‘deliver (child)’, *[(ˈbo.ta)-ta] (Orgun and Sprouse 1999). However, this strategy would not satisfy the maximal word size for the same reasons the reduplicant does not in (45): /kotoba + RED/ → *[(ˈko.to)(ˌo.-sɛ)], *[(ˈko.to)o.-sɛ], *[ko(ˈto.o)-sɛ].

(41) *Maximal size through null parse*

No non-head feet, No lapses, Align head foot with PrWd » No null parse

/kotoba + RED/	* FT-	*LAPSE	ALIGN-L (Ft^+, PrWd)	MPARSE
Λ ⊙				*
a) [(ˈko.to)(ˌba.ba)]	*!			
b) [(ˈko.to)ba.ba)]		*!		
c) [ko(ˈto.ba)ba]			*!	

Sometimes, as in Tiene, the maximal word size is satisfied by giving potentially over-long inputs no output whatsoever. Faithfulness considerations, e.g., preventing deletion down to an acceptable size, must also be highly ranked. The fact that monomorphemic words (i.e., bare roots) are subject to this same maximal word size suggests that an over-long root may also be subject to a null parse, or perhaps the morpheme is preserved through REALIZEMORPH (Samek-Lodovici 1993), blocking the null parse in favor of a faithfulness violation such as deletion.

3.3 Conclusions

This section has explored the theoretical mechanisms driving a maximal word size and the responses available for implementing this size. Constraint rankings leading to maximal word sizes of Ft, σFtσ, Ftσ and σFt were provided in §3.1, while §3.2 showed how the strategies of restricted non-exhaustive parsing, deletion, exceptional prosodification and a null parse may enforce these size restrictions. The next section takes a closer look at how extraprosodicity may affect a minimal or maximal size restriction.

4 NONFINALITY AND SIZE RESTRICTIONS

In the metrical systems of many languages, heads avoid final position, a phenomenon referred to as "extraprosodicity." For example, a word-final syllable may be banned from receiving stress, or a word-final consonant may be treated as a light syllable although codas are standardly heavy in the language. As pointed out by Garrett (2002), extraprosodicity may have implications for prosodic size restrictions. This section identifies some of those effects and how they may be incorporated into the account of minimal and maximal prosodic size restrictions described here, but does not aim to provide a full analysis of these phenomena.

OT implements extraprosodicity through the constraint NONFINALITY (Prince and Smolensky 1993, Hyde 2002, 2003, McGarrity 2003). Prince and Smolensky (1993) and McGarrity (2003) argue that NONFINALITY refers to a ban on peaks – i.e., a head syllable or head foot – in final position, breaking from traditional extraprosodicity. Hyde (2002, 2003) extends this proposal to argue that NONFINALITY is expressed through a ban on gridmarks at a given prosodic level, preserving the emphasis on heads while also accounting for final consonant extraprosodicity.

NONFINALITY can affect prosodic size restrictions by requiring the word-final element to be extraprosodic. For example, Modern Standard Arabic word-final consonants are extraprosodic, i.e., they do not contribute to heaviness even though other coda consonants do (McCarthy and Prince 1990a§7). The extraprosodicity of word-final consonants is most evident in the stress pattern of the language, where final CVC syllables act light despite having a coda. Roots – and subsequently, the smallest content words – are required to end in a consonant. The language requires feet to be binary, but an extraprosodic coda is non-moraic and so cannot contribute towards this size. These factors combine so that the minimal word has the shapes [($CV_{\mu\mu}$<C>)], [($CV_{\mu}C_{\mu}$<C>)] or [($CV_{\mu}.CV_{\mu}$<C>)].

As Garrett argues, NONFINALITY can influence a minimal PrWd size even in the absence of the traditional "Minimal Word" phenomena employed in this dissertation. For example, Hixkaryana counts closed syllables as heavy and lengthens vowels in stressed open syllables. The final syllable is extraprosodic and so cannot receive stress, and the second syllable in a short word is necessarily heavy (i.e., a closed syllable or a lengthened vowel in an open syllable). The result of this system is that every PrWd must be at least three moras in length, e.g., [(ˈnɨ$_{\mu}$m$_{\mu}$<no$_{\mu}$>)] ‘house’ or /kwæjæ/ → [(ˈkwæː$_{\mu\mu}$<jæ$_{\mu}$>)] ‘red and green macaw’ (Derbyshire 1979, Garrett 2002).

A similar example is found in the Chukotko-Kamchatkan language Aljutor (or Alutor; McGarrity 2003*n*). Aljutor stress is typically iambic with final syllable extraprosodicity [(σˈσ)<σ>], and stress shifts to the penultimate syllable when the word is a single foot long to avoid a final stressed syllable [(ˈσ<σ>)], *[(σˈσ)]. When the initial syllable of a disyllabic word is a schwa, and therefore unsuitable for receiving stress in the language, then epenthesis occurs: /səgaj/ → [(sə.ˈgaj)<jə>] ‘sand’, *[(sə.ˈgaj)], *[(ˈsə<gaj>)]. If an iambic language employed epenthesis as its first choice of repair, rather than second choice as in Aljutor, then it would have a trisyllabic minimal word size [(σˈσ)<σ>]. However, most iambic languages avoid final stress by having trochees in disyllabic words, which is also Aljutor’s preferred strategy.

NONFINALITY has also been argued to take place on the foot level, preventing a head foot from being the final foot in a word (Prince and Smolensky 1993, Hayes 1995, Hyde 2003, McGarrity 2003). This constraint would lead to a minimal size of two feet: every PrWd must have a head foot (Selkirk 1984), so if the head foot may not occur word finally, then the word must have at least one final non-head foot and one non-final head foot [ˈFt<ˌFt>]. To my knowledge, no language has a minimal size of two feet. Therefore, it may be that final foot extraprosodicity is impossible. (Cf. Ussishkin’s (2000) proposed maximal size of two feet (i.e., a binary PrWd), which would also predict a minimal size of two feet when fully integrated into Prosodic Morphology.)

NONFINALITY may also have implications for maximal size, producing systems with a maximal size of a foot plus an extraprosodic mora or syllable, plus potential unfooted syllables as outlined in §3.1. The effects of extraprosodicity generate a large inventory of possible word sizes, up to a foot plus non-adjacent unfooted syllables, [σFt<σ>]. This is the same maximal size as in Māori, which does not employ extraprosodicity; a longer maximal size, such as [σFtσ<σ>], is not predicted because NONFINALITY simply requires the word-final syllable to be unstressed, which is already the case for [σFt<σ>]. The more variable maximal sizes plus the relatively low awareness of maximal size phenomena means these conditions are difficult to discern and isolate, and potentially very numerous. For these reasons, an in-depth study of the role of extraprosodicity in maximal size restrictions is left for future research.

5 CONCLUSIONS

A variety of minimal and maximal word sizes are produced through a limited number of constraints, leading to restricted and well-defined predictions. The majority of the constraints are independently motivated and generally accepted. The most novel is the ban on non-head feet, which belongs to a family of constraints banning marked structure (see also Ch5§4.1 for discussion of a ban on non-head feet as a product of PCat-PCat alignment). The ban on non-head feet creates a maximal word size, which may take the shape of [Ft], [σFtσ], [Ftσ] or [σFt] depending on its interactions with other phonological constraints. A maximal size may be obtained through several different strategies, including restricted non-exhaustive parsing, deletion, exceptional prosodification, coalescence or a null parse.

Minimal size comes about when the pressure for feet to be binary triggers a repair. All prosodic words must have a foot through Headedness, and additional mechanisms leading to a minimal size in roots will be discussed in Ch4§2.1. Constraints on foot binarity lead to different types of minimal size, bimoraic or disyllabic. Both of these may be obtained through epenthesis, segment lengthening, segment splitting, exceptional prosodification or a null parse.

Digging deeper into minimal and maximal size restrictions revealed that the ranking schemas in §2.1 and §3.1, which characterize minimal and maximal size restrictions through faithfulness violations, are somewhat simplistic. Indeed, faithfulness violations such as epenthesis, segment splitting, segment lengthening, deletion, coalescence and segment shortening play a crucial role in minimal and maximal size. But size restrictions may also be achieved through altering the prosodic structure rather than unfaithfulness. This is the approach employed for Manam onset glide blocking (§2.2.3) and Māori non-exhaustive parsing and prosodic word splitting (§3.2.1). A null parse is another example where a size restriction may be met without a faithfulness violation, as in Tiene reduplicants exceeding the maximal size (§3.2.2).

This section also addressed the effects of NONFINALITY, where a word-final prosodic constituent is treated as extrametrical, on the typology of size restrictions.

The next chapter examines how the prosodic size restrictions discussed here may be acquired by a root morpheme.

CHAPTER 4

SIZE RESTRICTIONS ON THE ROOT

1 INTRODUCTION

In some languages, roots exhibit prosodically-based size restrictions. However, there are no constraints that directly require morphological constituents to have a particular prosodic size, like those discussed for prosodic words in the preceding chapter. Consequently, size requirements must be imposed on a root indirectly and then spread to all other outputs to result in a universal minimal and/or maximal root size. To be specific, a morphological category must acquire a prosodic size restriction through independently motivated factors, a phenomenon called "Concurrence" here (McCarthy & Prince 1986 *et seq*.). Then, this size restriction must be spread to all outputs through Output Faithfulness, so that the root shape is consistent throughout all word forms (Benua 1997, McCarthy 2005). In this manner, a universal minimal or maximal root size is achieved indirectly, discussed in §2 and §3. After the mechanisms behind prosodically-based root size restrictions have been identified, the relationships between prosodic word and root size restrictions will be explored. In short, a root size restriction must be accompanied by a PrWd size restriction because both spring from the same source, the pressures of foot binarity for minimal size or a ban on non-head feet for maximal size. However, a PrWd size restriction does not imply a root size restriction, depending on the role of Output Faithfulness in ensuring a universal root size.

A morpheme acquires a prosodic size when it is concurrent with a prosodic unit in the output. This prosodic unit *can* be restricted to a certain prosodic size, both through its own properties and through its relationship to the Prosodic Hierarchy (Ch3). When this prosodic unit is subject to a minimal or maximal size restriction through factors such as foot binarity or Headedness, then this size is translated to a concurrent morphological unit. For example, a bare root is coextensive with a prosodic word, so any size restriction on the prosodic word is transferred to the root. If the PrWd is required to have at least one binary foot (and so has a minimal size) or bans non-head feet (and so has a maximal size), then a bare root will share this size restriction. Concurrence is not a unified process, but rather a collection of environments in which a root must obtain a minimal or maximal root size.

This dissertation illustrates six distinct environments where the root may be obliged to obtain a minimal or maximal prosodic size.

(1) *Concurrent environments*

a) Bare root
- i) Minimal size: German (§2.1.1)
- ii) Maximal size: Czech (§2.2.1; Ch2§3.1)

b) Root-foot alignment
- i) Minimal size: German (§2.1.2)

c) Root-stress positional markedness
- i) Minimal size: Yup'ik (§2.1.3)

d) Near-bare root
- i) Minimal size: Shipibo (§2.1.4)
- ii) Maximal size: Czech (§2.2.2; Ch2§3.2)

Each of these cases of Concurrence will be explored in greater depth in Section 2, turning first to the four concurrent environments leading to a minimal root size restriction. Then the analysis of the maximal size restriction for bare and near-bare roots in Czech is recapped from Chapter 2.

The second aspect of the indirect approach promoted here is the necessity of Output Faithfulness (Benua 1997). Once a root obtains a prosodic size restriction through Concurrence, this form may serve as a referent for other outputs, thus spreading the size restriction to all outputs of the root. Output Faithfulness allows the root size restriction to be universal in the language, rather than an environmentally conditioned product of regular prosodic interactions. For example, if a bare root must be at least or at most one binary foot through Concurrence as above, and Output Faithfulness takes this simple output as a base to which more complex outputs must be faithful, then the restriction on root size is effectively spread throughout the language.

The importance of Output Faithfulness will be illustrated with analyses of two languages which start off from the same point, a minimal PrWd size restriction. In German, all bare roots must be at least one foot to satisfy the minimal word restriction. The minimal root size obtained through Concurrence is then carried over to other, complex outputs through Output Faithfulness so the language has a universal minimal root size restriction (§3.1). In contrast, Lardil bare roots are also augmented to meet the minimal PrWd size, but when this root is affixed in more complex outputs, it surfaces as a smaller form, so long as the minimal word size is reached (§3.2). That is, German roots are more faithful to the (minimal) Output Faithfulness base derived as a bare root, while Lardil roots are more faithful to the (subminimal) input form. It is only through Output Faithfulness that the root sizes derived in the limited environments described by Concurrence are spread to all outputs, resulting in a language-wide minimal or maximal root size restriction.

The indirect approach outlined here predicts a limited typology of minimal and maximal root size phenomena. Roots should not be restricted except in situations depicted through Concurrence. That is, a language cannot simply proclaim each root to have a certain prosodic size; there must first be a concurrent environment linking the morpheme to the Prosodic Hierarchy. Equally, a root size restriction must be based on an authentic prosodic unit, like a binary foot, rather an arbitrary factor like "roots must be CVC". Finally, Output Faithfulness is indispensable for ensuring that the root size restriction is universal, rather than limited to those scenarios described by Concurrence.

This chapter also addresses the fact that prosodic word and root size restrictions are not isolated phenomena. A PrWd may obtain a prosodic size requirement independently, as outlined in the previous chapter. However, the root size is dependent on the prosodic word size. In some instances, a root size restriction is directly derived from the prosodic word, as in a bare or near-bare root size restriction. The other cases where a root may derive a minimal size through Concurrence, incorporating root-foot alignment or positional markedness, are still contingent on a minimal prosodic word requirement. The minimal root size restriction is predicated on foot binarity forcing a subminimal input to augment. This same situation leads to a simple minimal PrWd size. In other words, no root size restriction derived through Concurrence may occur independently of an equivalent minimal word restriction. The relationships between word and root size restrictions are discussed in Section 4.

The remainder of this chapter is organized so: Section 2 addresses the environments leading to a prosodic size restriction on a morpheme through Concurrence. Acquisition of a minimal root size is discussed in §2.1, examining bare roots (§2.1.1) and root-foot alignment in German (§2.1.2). The role of positional markedness in minimal root size phenomena is explored in Section 2.1.3's discussion of Yup'ik. Finally, the minimal root size in Shipibo near-bare roots is addressed in §2.1.4. After that, the strategies for obtaining a maximal root size are examined. A recap of the analysis of Czech (Ch2) explores a maximal root size through a bare (§2.2.1) or near-bare root (§2.2.2). Next, Section 3 develops the role of Output Faithfulness in universal root size restrictions by examining two similar cases: Section 3.1 deals with German, which translates a minimal prosodic word into a universal minimal root size through Output Faithfulness. Following that, Section 3.2 presents the counter-example of Lardil, which also has a minimal prosodic word requirement but does not lead to a universal minimal root because Output Faithfulness is crucially dominated. Section 4 then discusses the interrelationships of minimal and maximal PrWd and root sizes, identifying the predicted language systems. Section 5 presents conclusions.

2 CONCURRENCE

2.0 Introduction

The first issue facing prosodic size restrictions on morphological units is how to relate an MCat to a PCat so that the latter can come to bear on the size of the former. Formally, the two belong to wholly separate modules; morphological categories can interact with one another in processes such as concatenation, and prosodic categories are related through the Prosodic Hierarchy, but morphological and prosodic processes are independent from one another.

This section explores Concurrence, or how these two domains can become related in order to account for processes where a morphological unit, such as a root, is restricted to a size based on a prosodic unit, such as a foot. Morphoprosodic relationships will be shown to stem from two major situations: 1) passive environments, where a prosodic size requirement on the prosodic word is also imposed on an MCat when the two are fully or nearly coextensive in some output; and 2) cases where the two modules are actively linked, through MCat-PCat alignment or through a positional markedness constraint requiring the root to receive stress.

Concurrence is not a uniform process, but a collection of phenomena which lead to a minimal and/or maximal root size. This chapter addresses the positive predictions of the current proposal, showing how Concurrence can account for root size phenomena through independently motivated constraints. Arguments against other analyses, e.g., an encompassing constraint "ROOT = FOOT", will be presented in Chapter 6.

The foundation of all prosodic size restrictions is the relationship between different prosodic units, characterized by the Prosodic Hierarchy (Selkirk 1980a, 1980b, 1984, Clements 1990, McCarthy and Prince 1990, 1995b; Ch1(3)). The prosodic units are the prosodic word (PrWd), the foot (Ft) and the syllable (σ). The author is unaware of any evidence for mora-based (μ) size restrictions (Ch5§1). McCarthy and Prince's work on alignment encountered a similar result and suggested that moras may be better described as a property of syllables rather than an independent prosodic unit (1993b: 84). Therefore, moras are excluded from the Prosodic Hierarchy here.

The compositionality and dominance relationships expressed in the Prosodic Hierarchy lead to predictions about one prosodic unit based on what is known about another. For instance, Headedness predicts that each prosodic unit must dominate a head of the immediately subordinate unit. Therefore, the presence of a PrWd implies the presence of a foot (binary or otherwise), and so the presence of at least one syllable (Selkirk 1984, Nespor and Vogel 1986, Itô and Mester 1993, Selkirk 1995).

Another key element of prosodic size restrictions is markedness constraints governing the shape of the output. Since the arguments here frequently hinge on a binary foot as a maximal or minimal size, there is clear evidence for a constraint mandating all feet be binary. This is represented by the constraint FT-BIN (Prince 1980, Hayes 1985, McCarthy and Prince 1986). (The term "binary" means different things in different languages, such as feet must be disyllabic or bimoraic (Hayes 1995). The exact usage of the term will be clarified in the discussion of individual languages, and the reader is also referred to the discussion of bimoraic vs. disyllabic word minima in Ch3§2.1.)

Together, the Prosodic Hierarchy and FT-BIN account for one type of minimality, known as the Minimal Word. If every PrWd must have at least one foot, and that foot must be binary, then every PrWd must be at least one binary foot (Prince 1980, Hayes 1985, McCarthy and Prince 1986). This minimal word size can in turn lead to a minimal root size. If a PrWd and a root are coextensive, as in a bare root, then a minimal word size will be directly translated to the root. This situation will be illustrated with German bare roots (§2.1.1).

Equally, a maximal word size relies on the relationships expressed in the Prosodic Hierarchy. This not only requires FT-BIN to encourage feet to be binary, but also a constraint limiting words to at most one foot. It was argued in the preceding chapter that this is caused by a constraint banning all feet except the head foot (de Lacy 2003). There can only be one head foot per PrWd, so the result is a word with a single foot. If this ban on non-head feet is met with a repair which limits the size of the output, such as deletion or coalescence, then the word size will be restricted, as in Czech (§2.2.1; see also Ch3§3.2 for a discussion of other repairs triggered by *FT-). Again, where a root is coextensive with the PrWd, a prosodic size restriction will be passed directly onto the morpheme.

A related phenomenon arises for near-bare roots – that is, minimally inflected bound roots –, like bare roots/PrWds above. But bound roots require overt inflection in all outputs, so a restriction on the size of the prosodic word will lead to even greater limitations on root size, as the PrWd must also accommodate the obligatory suffix. The result is that the root size restriction is smaller than the PrWd size restriction triggering it. For example, Czech PrWds strive to be at most one foot in length; when a root requires a syllabic suffix in every inflection, then the root can be at most one syllable so that together the root plus suffix (i.e., the PrWd) are one foot or less (§2.2.2). The same effect crops up for minimal size, as well. Shipibo requires words to be at least one foot long; thus, a root which can occur as a bare morpheme must be at least one foot, as in German. However, bound roots can be less than one foot and still meet the minimal size requirement. A monosyllabic inflectional suffix counts towards the minimal word size, thereby lowering the minimal size restriction on the root to one syllable (§2.1.4).

Near-bare root phenomena as in Czech and Shipibo are only predicted by a theory like the one presented here, which can derive root size restrictions from restrictions on the prosodic word. A bound root and its associated inflections tally up to a single PrWd, and so size restrictions on bound roots can be different from those on bare roots. The length of the PrWd – not the root – is the determining factor, and the root size will vary accordingly so that a minimal or maximal word size is enforced.

Beyond bare and near-bare roots, minimal size restrictions can also be created through alignment of the root with a binary foot. If the left edge of the root must align with a foot boundary, and the opposite edge also concurs with a prosodic boundary through independent means, then the root will be at least one binary foot in length. The root is pegged to a foot and hemmed in between two prosodic boundaries, so a root less than one foot will not satisfy FT-BIN.

Minimal size creation through root-foot alignment will be exemplified by two separate cases in German (§2.1.2). The first is drawn from word-final roots. The stress pattern of German shows that the left edge of roots must align with a binary foot; when the root occurs word-finally, then the right edge of the root concurs with the PrWd boundary. In order for the foot the root aligns with to be binary, the root must expand. A second case arises in the process of compounding. The first root in a compound is again defined by prosodic units at both edges – at the left edge through root-foot alignment, and at the right edge by the successive root, which must also be aligned with a foot. Again, the root must augment if it is to satisfy FT-BIN within this prosodically-defined space.

One final environment for creating a minimal root size is addressed in §2.1.3. Yup'ik requires that roots receive stress, and further enforces a strict iambic stress pattern. Roots are always word-initial in Yup'ik, so when the root would dominate only a light syllable in the output – e.g., the root is CVC where the coda would be resyllabified into the onset of the following syllable – then the language has two options for stressing the root: either break the iambic stress pattern of the language [(ˈCV.C-V)], or augment the root so that it can bear stress as a single, heavy (and so suitably iambic) syllable [(ˈCVC)(ˌC-V)]. The language opts for the latter, achieved through gemination of the following syllable onset. In this way, a minimal root size is effectively created.

Finally, this section also speaks to approaches which presuppose that a morphological category can only have a prosodic size restriction when MCat = PCat, a proposal which will be considered further in Ch5§5. In fact, this will be shown to bear out in many cases: a bare root concurs with a PrWd at both edges (§2.1.1, 2.2.1); German alignment-based minimal size aligns the left edge of a root with a foot while the right edge concurs with a PrWd boundary or with a second root in a compound, which must also be aligned with a foot (§2.1.2). In these cases, the root is contained within a space defined by prosodic boundaries at either edge, and must also construct a binary foot, so the only option is for a subminimal root to augment.

However, cases where a root has a minimal or maximal size but is not precisely defined by prosodic boundaries are also presented here. The near-bare roots in Shipibo and Czech have a minimal and maximal size restriction, respectively, but are also bound roots which require an inflectional suffix in all outputs (§2.1.4, 2.2.2). In both of these languages, the left edge of the root concurs with a prosodic boundary, the start of the PrWd, but the right edge does not; this edge abuts with an inflectional suffix, which then meets the other PrWd boundary at its right edge. The root acquires a minimal or maximal size of a single syllable, but characterizing this result with a constraint "ROOT = σ" misses the point that this size is a product of a restriction on the prosodic word.

Likewise, the minimal root in Yup'ik is not created by an environment where MCat = PCat (§2.1.3). Instead, external factors – requirements that the root must receive stress and a strictly iambic stress pattern – force creation of a minimal size. In the end, the root is at least one foot long, but this is a result of other phonological phenomena rather than a triggering condition.

The remainder of this section is organized as follows: minimal size will be addressed in §2.1, looking first at bare roots and root-foot alignment in German (§2.1.1, 2.1.2). Next, positional markedness in Yup'ik is explored (§2.1.3) before turning to near-bare root size minima in Shipibo (§2.1.4). Section 2.2 returns to maximal root size phenomena, which were introduced in the analysis of Czech in Chapter 2. Maximal size restrictions derived from a bare and near-bare root are recapped in §2.2.1 and 2.2.2, respectively.

As a final note, it is important to bear in mind that these sections address how a minimal or maximal size restriction is acquired by roots in certain environments. The theory also requires Output Faith to ensure that the root sizes as determined here are maintained in all outputs, an aspect which will be discussed in greater detail in Section 3. Output Faithfulness also allows an augmented subminimal root (e.g., CVC plus an epenthetic segment V, [(CV.C-V]]) to be reanalyzed as a single morpheme (e.g., CVCV) because there are no surface alternations. This point will be discussed further in the conclusions (§2.3.)

2.1 Minimal size

2.1.0 Introduction

A minimal root size restriction is intimately linked to a minimal PrWd size. In some cases, such as a bare root, the minimal root size is directly derived from the restriction on the prosodic word. The bare root is coextensive with the PrWd, so any restriction on the latter is directly translated to the former. However, a minimal root size may also be obtained where the minimal PrWd size is independently satisfied, due to the effects of root-foot alignment or a requirement that all roots be stressed. The latter cases of Concurrence must also be accompanied by a standard minimal PrWd size, as all are based on the fundamental interaction of foot binarity triggering a repair to obtain a minimal size. The use of root-foot alignment or positional markedness to stress the root opens up another set of environments producing a minimal size in bound roots.

A minimal size restriction is predicted by the tenet of Headedness, which states that each prosodic unit must dominate at least one of the immediately subordinate units (Selkirk 1984, Nespor and Vogel 1986, Itô and Mester 1993, Selkirk 1995), and the constraint FT-BIN, which requires all feet to be binary (Prince 1980, Hayes 1985). Combined, they predict that each PrWd will dominate at least one binary foot (Ch3§2.1; McCarthy and Prince 1986 *et seq*.). For a bare root, this translates into a minimal size of one foot, as well. German provides a good example of how a minimal word size can lead to a minimal root size (§2.1.1).

However, German bound roots also have a minimal size of one binary foot, not the shorter size restrictions seen for Czech (§2.2.2) or Shipibo (§2.1.4) bound roots which must accommodate an obligatory inflectional affix. Instead, German bound roots obtain a minimal size through root-foot alignment. The left edge of every root must align with a binary foot. The root is isolated when its right edge also abuts with a prosodic boundary, such as the end of the PrWd or a second root, which must also align with a separate foot. German bound roots obtain a minimal size of a full binary foot because of root-foot alignment and independent factors which isolate the root morpheme within this foot, so that the only way to achieve foot binarity is for the root to augment (§2.1.2).

A third method for obtaining a minimal root size is through positional markedness, which requires the root morpheme to receive stress (Smith 2002). This constraint commonly affects the prosodic structure of the word so that the root may be stressed, but under specific circumstances positional markedness may lead to a minimal root size. In Central Alaskan Yup'ik, all roots occur PrWd-initially and the stress pattern is strongly iambic. For the root to receive stress, it must be at least one foot long, either 1) at least two syllables, with stress falling on the second syllable (i.e., an iamb), or 2) at least one heavy syllable, which attracts stress. When the root would otherwise be parsed into a single light syllable, the onset of the following syllable is geminated in Yup'ik, so that the root dominates a heavy syllable and thus receives stress (§2.1.3). The end result is that all roots dominate at least one binary foot in the output.

Finally, a minimal size restriction may also be conferred on a near-bare root. When the PrWd must be at least one binary foot, then a bound root requiring an overt inflection in every output may be shorter than a binary foot while still allowing the PrWd to reach its minimal size. Minimal size in a near-bare root is illustrated in Shipibo, where PrWds and so bare roots must be at least one binary foot in length. However, bound roots, which require an inflectional suffix of at least one syllable in all outputs, may be as short as a single syllable. Together, the root plus inflection meet the minimal PrWd size restriction, and so the minimal size is shorter for near-bare roots than for bare roots (§2.1.4).

This section will look first at German root size restrictions, examining the cases of Concurrence provided by a bare root (§2.1.1) and through root-foot alignment (§2.1.2). Then the role of positional faithfulness in minimal root size is analyzed for Yup'ik (§2.1.3). Section 2.1.4 deals with the shorter size restrictions obtained for near-bare roots in Shipibo, and Section 2.1.5 presents conclusions.

2.1.1 Bare roots: German

The root and the prosodic word are effectively one and the same in a bare root. This allows for any prosodic size restriction imposed on the PrWd, such as a minimal size requirement, to be translated directly to the root morpheme in this environment. This section shows how a minimal root size can be derived from the standard minimal PrWd size requirement, which is determined by Headedness ("All words have at least one foot") and FT-BIN ("All feet are binary").

German roots are all at least disyllabic or one heavy syllable in length (Hayes 1995, Golston and Wiese 1998).[11] This minimal size is easily accounted for in many roots, which can surface as a bare form and are thus directly affected by any size restriction in the prosodic word. Minimal size in German can be observed in the following survey of nouns, drawn from Clark and Thyen (1998).

(2) *German roots minimally one binary foot*

[($\sigma_{\mu\mu}$]	[(ˈt͡sɛː)]	'tough'	[(ˈba͡u)]	'building'
	[(ˈglyk)]	'luck'	[(ˈflɛk)]	'stain'
[($\sigma\sigma$)]	[(ˈʔaː.təm)]	'breath'	[(ˈʔaɐ̯.ba͡it)]	'work'
*[(σ_{μ})]				

The words may reach this minimal binary size with a long vowel or diphthong, with a closed syllable, or through disyllabicity – but a subminimal PrWd such as CV is banned in German.

A comment on the weight of CVC syllables is necessary here. CVC syllables are bimoraic when they need to reach the minimal size restriction, as in [(ˈflɛ$_{\mu}$k$_{\mu}$)]. However, they are monomoraic in longer words in order to avoid having a non-head foot: e.g. [(ˈʔaː$_{\mu\mu}$.tə$_{\mu}$m)], *[(ˈʔaː$_{\mu\mu}$)(ˌtə$_{\mu}$m$_{\mu}$)]. The contextual weight of coda consonants is expressed through the ranking *FT-, Faith » WEIGHT-BY-POSITION ("Codas are moraic"; Hayes 1989, 1994, Morén 2000, Elias-Ulloa 2006).

Minimal size in a bare root is brought about through the same mechanisms leading to a minimal prosodic word size. The relationship is transitive: Headedness

[11] Native German roots are exactly one binary foot, indicating both a minimal and a maximal size restriction, but this section focuses on the minimal size to highlight this aspect of Concurrence.

stipulates the word must have at least one foot, and FT-BIN says this foot must be binary. Thus, the word (and so a bare root) must be at least one binary foot. As long as foot binarity outranks faithfulness, then a subminimal root input will be augmented to satisfy FT-BIN. (There is no evidence of a subminimal root in German, so a hypothetical input is provided in order to explore the constraint interactions leading to the attested minimal word/root size.)

(3) *German minimal word/root size*

Feet are binary » Don't change segment weight

ʔ/kɛ/	FT-BIN	IDENT(weight)
Λ a) [(ˈkɛː)]		*
b) [(ˈkɛ)]	*!	

Thus, when a language has a minimal PrWd requirement, then a bare root must also meet this minimum because the PCat and the MCat are effectively the same. A similar size restriction based on the PrWd is obtained for near-bare roots, as in Shipibo in §2.1.4, but for now the analysis of German continues to explore why bound roots also have a minimal size of a binary foot.

2.1.2 Root-foot alignment: German

A minimal size restriction can also come about when the root must be aligned with a binary foot. Crucially, the opposite edge of the root must also concur with a prosodic boundary, such as the edge of a prosodic word or another foot. If a root is simply aligned with a foot at one edge, with the other edge left undefined, then the root will be aligned with a foot in the prosodic structure but will not obtain a minimal size. Another morpheme may comprise part of the foot, thus satisfying alignment and foot binarity without imposing a minimal size on the root. A minimal root size through alignment must be accompanied by a standard minimal PrWd size restriction, as both are triggered by the same circumstance: FT-BIN preventing a subminimal output.

Central to the argument at hand is the ALIGNment family of constraints, which compel the edge of one prosodic or morphological category to concur with the edge of another (McCarthy and Prince 1993b). The general schema for these constraints is provided below.

(4) *Generalized Alignment*

ALIGN(Cat1, Edge1, Cat2, Edge2) = $_{\text{def}}$

$\forall$ Cat1 $\exists$ Cat2 such that Edge1 of Cat1 and Edge2 of Cat2 coincide

Where

Cat1, Cat2 $\in$ PCat $\cup$ MCat

Edge1, Edge2 $\in$ {Right, Left}

The categories which can be aligned are PCat, the set of prosodic categories, and MCat, the set of morphosyntactic categories. The constraint format for the purposes at hand is shortened to ALIGN-L(MCat, PCat), which reads as "The left edge of *every* MCat aligns with the left edge of *some* PCat," where MCats are roots, and PCats are the prosodic word, the foot and the syllable. (See Chapter 5 for further discussion of the formation of and participants in ALIGN constraints.)

Aligning the left edge of a root with a foot does not produce a minimal root size restriction by itself. The alignment constraint only provides information about one edge of the root. Other morphological material could factor into the binary foot without disrupting the root-foot alignment and so prevent acquisition of a minimal root size. In order for alignment to lead to a minimal root size, other morphemes must be prevented from contributing towards construction of the binary foot. This can be achieved when the left edge of the root must align with a binary foot due to ALIGN-L(root, Ft), while the right edge of the root concurs with a separate prosodic boundary.

The acquisition of a minimal root size through root-foot alignment is illustrated by German word-final roots, where the left edge of the root must align with a binary foot and there is no morphological material to the right of the root to help obtain a binary foot. A second example, also drawn from German, is found in compound words. The left edge of the initial root must align with a binary foot, which is followed by a second root, which also must align with a foot at its left edge. The result of each of these cases is that the root is perfectly contained between two prosodic boundaries, with the alignment constraint and FT-BIN further requiring the root to align with a binary foot. The only way to create the obligatory binary foot is through augmentation of the root, since it is isolated between two prosodic bounds. In this way, the root achieves the minimal size of one foot.

The data below, based on Clark and Thyen (1998), shows that even German roots which may not surface as a bare morpheme must be at least one binary foot in length. Both word-final and compound-initial roots are provided, as these are the types of Concurrence argued to produce a minimal root size in this section.

(5) *Bound roots have minimal size in all outputs*

/hø:ʀ-/	'hear'	[gə-(ˈhø:ɐ̯)]	'[sense of] hearing'
		[(ˌfɛ□□-)(ˈhø:.ɐ̯)]	'interrogation'
		[(ˈhø:ɐ̯-)(ˌfʊŋk)]	'radio'
		[(ˈhø:ɐ̯-)(ˌfe:.lɐ)]	'hearing defect'
		*[(ˈhø:ɐ̯)]	
/tʀa:g-/	'carry'	[bə-(ˈt□a□k)]	'sum'
		[(ˌʔ□□□-)(ˈt□a□k)]	'yield'
		[(ˈt□a:g-)(ˌwa͡i.t-ə)]	'consequences'
		[(ˈt□a:g-)(ˌflɛçə)]	'hydrofoil'
		*[(ˈtʀa:k)]	
/zu:x-/	'search'	[b□-(ˈzu:x)]	'visit'
		[(ˌfɛ□□-)(ˈzu:x)]	'attempt'
		[(ˈzu:.x-)(ˌhʊnt)]	'tracker dog'
		[(ˈzu:.x-)(ˌmɛl.d-ʊŋ)]	'missing-person announcement'
		*[(ˈzu:x)]	

German root morphemes are always aligned with a foot, which is illustrated in polymorphemic words by two factors: 1) the initial syllable of the root always bears stress; and 2) the left edge of the root serves as a boundary for syllabification processes such as /ʀ/ → [ɐ] coda vocalization and glottal stop onset epenthesis (a "crisp edge", Itô and Mester 1999).

The analysis will first establish root-foot alignment, before showing how this leads to a minimal root size. Turning to the first argument for alignment, stress always falls on the initial syllable of the root, regardless of the length or number of any associated affixes.[12] The placement of stress gives insight into the prosodic structure because a stressed syllable is phonologically analyzed as the head syllable of a foot (Hayes 1995). In German, the consistent placement of stress on the initial syllable of the root is indicative that the left edge of the root is aligned with a trochaic foot.

Syllabification also points towards root-foot alignment in German. The left edge of the root always aligns with an crisp syllable boundary. This can be seen in words such as /ɛʀ-aʀba͡it-ən/ → [(ˌʔɛɐ̯)(ˈʔaɐ̯.ba͡i)tn̩] ‘to work for’, *[(ˌʔɛ.ʀaɐ̯)(ˈba͡i.tn̩)]. The syllable boundary is marked by the coda vocalization of /ʀ/ → [ɐ̯] in the prefix and the epenthesis of glottal stop root-initially (Hall 1992). These factors can be compared with a mono-morphemic near-match such as /ɛːʀa/ → [(ʔɛː.ʀa)] ‘era’, *[(ʔɛːɐ̯)ʔa], where the onset sequence [ʀa] is not avoided. However, this strict boundary only occurs at the *left* edge of the root. Resyllabification can freely occur between the root and a suffix, as in the same example above, where /…t-ən/ → [.tn̩], *[t.ʔn̩]. Thus, the left edge of the root must be aligned with a foot boundary, but not the right.

Therefore, the data indicates that German roots are left-aligned with a binary foot. This is expressed by formulating an ALIGNment constraint so:

(6) ALIGN-L(root, foot): “The left edge of every root aligns with the left edge of some foot.”

When a German root occurs word-finally, then the constraint above forces it to be at least one binary foot in length. This is because the left edge of all roots must align with a binary foot, so a word-final root – that is, where the right edge of the root coincides with a PrWd boundary – bears the burden of foot binarity alone. Parsing the hypothetical subminimal input below into a single binary foot violates this alignment

[12] The root typically bears primary stress, and the initial root of a compound receives primary stress (Ortner and Ortner 1984). The so-called German “separable prefixes”, which attract main stress away from the root, are not true prefixes, but compounds (Clark and Thyen 1998: vii).

(7a). Root-foot alignment must be maintained even when doing so leads to a faithfulness violation (7b).

(7) *Word-final root must have minimal size I*

Align all roots with a foot » Don’t change segment segment weight

‽/ɛʀ-k̳ɛ̳/	ALIGN-L(root, foot)	IDENT(weight)
a) [(ˈɛɐ̯.k̳ɛ̳)]	*!	
Λ b) [(ˌɛɐ̯)(ˈk̳ɛ̳ː)]		*!

German requires all feet to be binary, so although both outputs below exhibit root-foot alignment, (8b) is preferred. This forces the root to epenthesize until a binary foot is produced, thus creating a minimal root size.

(8) *Word-final root must have minimal size II*

Align all roots with a foot, Feet are binary » Don’t change segment weight

‽/ɛʀ-k̳ɛ̳/	ALIGN-L (root, foot)	FT-BIN	IDENT(weight)
a) [(ˌɛɐ̯)(ˈk̳ɛ̳)]		*!	
Λ b) [(ˌɛɐ̯)(ˈk̳ɛ̳ː)]			*!

German shows that a root size restriction can be obtained by coinciding one edge of the MCat with a prosodic boundary through root-foot alignment, and the other with a PrWd edge. A second tactic is found in the language’s compounding system. In these cases, a minimal root size comes about because the left edge of the root must align with a binary foot, while the right edge concurs with the edge of a second foot, which is aligned with the second root in the compound. (Recall the data in (5).)

When a root is the first element in a compound word, then it may obtain a minimal size through root-foot alignment. Both roots must align with a foot boundary – and feet must be binary – so the first root is contained within a minimal prosodic domain of one foot. Foot binarity can only be satisfied if the initial root is at least one binary foot in size, as illustrated in the following tableau. Candidate (9a) is eliminated because it fails to align every root with a foot edge, and although (9b) has the proper alignment, the foot aligned with the first root is not binary. Therefore, (9c), which aligns both roots with a binary foot – despite the fact that augmentation of the initial root is required – is the winning candidate.

(9) *Compound-initial root must have minimal size*

Align all roots with a foot, Feet are binary » Don't change segment weight

ʔ/kɛ-fʊŋk/	ALIGN-L (root, foot)	FT-BIN	IDENT(weight)
a) [(ˈkɛ.fʊŋk)]	*!		
b) [(ˈkɛ)(ˌfʊŋk)]]		*!	
Λ c) [(ˈkɛː)(ˌfʊŋk)]			*

In summary, root-foot alignment can produce a minimal size when the opposite edge of the root also coincides with a prosodic boundary, such as the end of the PrWd or a second root. In this manner, a bound root may have the same prosodic size restriction as a bare root, because both are isolated within a prosodic domain and must satisfy foot binarity. Between bare roots, word-final roots and German's rich compounding system, which allows any root to participate (Ortner and Ortner 1984), all German roots – free or bound – have a minimal size of a binary foot.

The analysis presented in this section is theoretically very similar to the minimal size of bare roots presented in §2.1.1. The cases of root-foot alignment examined here and the bare roots above all require environments where the MCat (i.e., the root) coincides precisely with PCat boundaries. In a bare root, the left and right edges concur with a PrWd boundary [{(CVCV)}]. In word-final roots, the left edge aligns with a foot boundary while the right edge concurs with the PrWd boundary [{…(CVCV)}]. In compound roots, the left edge aligns with a foot boundary, and the right edge coincides with the foot boundary of the following root [{(CVCV-)(C…}]. In all cases, the root is confined to a prosodically-defined space, and FT-BIN ensures that it is at least one binary foot.

Finally, root-foot alignment can only produce a minimal size restriction, but not a maximal size. This is due to the nature of the alignment constraint: the root must align with a binary foot, so under the right circumstances the root must be at least one binary foot to satisfy this constraint, as argued above. But there are no formulations which can employ ALIGNment to create a maximal size restriction. This would require a constraint like "Align the left edge of every root with at most one foot". ALIGN compels prosodic and morphosyntactic units to coincide at a given edge, but cannot control factors outside of that locus. The constraint only evaluates if a foot is aligned with the edge of the root, but the permission or prevention of additional feet – and thereby, a maximal size restriction – is beyond its scope.

The next section looks at how positional markedness requiring the root to be stressed, which is due to factors beyond the reach of ALIGNment, can be employed to obtain a minimal root size in Yup'ik.

2.1.3 Root-stress positional markedness: Yup'ik

Some languages require the root to be stressed, which can lead a root to have a minimal prosodic size under certain conditions (Fitzgerald 2001, Smith 2002). This is a separate phenomenon from the root-foot alignment examined in the previous section, although both can have the practical effect of attracting stress to the root. Root-foot alignment simply requires a root to be aligned with a foot at its left edge, but without further reference to the morphological or prosodic constituency of the segments being parsed. Root-stress positional markedness requires that some segment which is a member of the root morpheme serve as the head of a foot, or a stressed syllable.

Smith (2002) proposes that markedness constraints can apply exclusively to material in prominent positions, such as onsets, stressed syllables and roots. (See also Beckman (1998) for relevance to faithfulness constraints.) Positional markedness opens up another avenue through which morphology and prosody can be linked, through reference to prominent PCats and MCats. To this end, Smith argues for a markedness constraint which requires that a segment dominated by the root serve as a head syllable, or receive stress (2002: §4.2.2). This is captured in the following constraint.

(10) STRESS-TO-ROOT: Some segment affiliated with the root must be parsed into the nucleus of the head syllable of a foot.[13]

Requiring a root to be stressed does not immediately confer a minimal root size. So long as the root, whatever its size, is stressed, then STRESS-TO-ROOT is satisfied. However, this consideration can be combined with external factors to conspire towards a minimal root size. This is illustrated by the case of Central Alaskan Yup'ik, which requires the root to receive stress and also has a strict left-to-right iambic stress system. This metrical pattern predicts that stress falls on the second syllable or on the first syllable if it is heavy, so a root must be at least one foot long to ensure that it is stressed.

Central Alaskan Yup'ik is an Eskimo language spoken along the central coast of Alaska. The language has no prefixes, meaning roots always occur word-initially. Yup'ik has a complicated stress pattern described in detail by Jacobson (1984, 1985).[14] The stress system is reduced here to a few main points which capture the interactions relevant to the formation of a minimal root size.

(11) *Stress pattern of Yup'ik*

a) Iambs are constructed from left to right.
b) Heavy syllables attract stress.
c) The root must dominate at least one stressed syllable.
d) When the root would otherwise emerge unstressed, the following onset is geminated so that the root may receive stress.

The fundamentally iambic nature (11a) of the language can be seen in words with longer roots in data from Jacobson (1984). Additionally, this data shows that primary stress falls in the left-most foot. (Jacobson only sporadically marks secondary stress, so the author has provided prosodic structure based on his descriptions.)

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[13] Smith formulates her original constraint HAVESTRESS/Root so: "For all syllables *x*, if the head of *x* is affiliated with a root, then *x* bears stress" (Smith 2002:160). This wording requires any and every syllable nucleus affiliated with a root to be stressed. Typologically, this predicts a language where *every* syllable in the root receives stress. To my knowledge this pattern is unattested, and so the constraint is revised in (12) to reflect the findings in Yup'ik, which requires every root to dominate at least one stressed syllable.

[14] See also Hayes (1995§6.3.8) for an extensive discussion of Yupik stress, but without reference to the root-based phenomenon discussed here.

(12) *Iambic feet from left to right*

[(qa.ˈjaː)(q-a.ˌqaː)]	‘it is my kayak’	p316
[(i.ˈkam)(ˌrar)(-ˌpak)]	‘big sled’	p318

Heavy syllables (i.e., long vowels, diphthongs and closed syllables) attract stress and form an (H) foot alone (11b). The examples in (13) show how this affects the footing processes of the language.

(13) *Heavy syllables form their own foot and so attract stress*

[(ˈaŋ)(-lu.ˌniː)]	‘it being big’	p314
[(ˈqiː)(-qa.ˌqaː)]	‘it is my gray hair’	p315
[(ˈaŋ)(-ˌjar)(ˌpak)]	‘big boat’	p317

In each of the examples so far, some segment in the root has inadvertently ended up in a stressed syllable. An interesting interaction arises when the iambic pattern of the language would cause the root to be wholly unstressed. For example, if the coda of a CVC root resyllabifies into the onset of the following syllable, then no root segment is the nucleus of the stressed syllable. In these cases, the onset of the following syllable geminates, allowing the root to dominate a heavy syllable and so form its own foot. Assimilation of the coda to the following onset is obligatory, ruling out candidates like *[(ˈjug)(-ˌpik)]. The initial schwa of the root ‘house’ is only present in the uninflected form [(ə.ˈnə)] but is dropped in complex forms [(ˈnək)(ˌka)]. This may reflect an emergent minimal size – the language prefers to delete a word-initial schwa, unless doing so would produce a subminimal output.

(14) *Potentially unstressed root augmented through gemination*

/aŋ-uq/	→	[(ˈaŋ)(ˌŋuq)]	‘it is big’	cf. [(ˈaŋ)(-lu.ˌni)]	p315
/jug-pik/	→	[(ˈjup)(ˌpik)]	‘real person’	cf. [(ˈjug)]	p315
/ənə-ka/	→	[(ˈnək)(ˌka)]	‘my house’	cf. [(ˈnə-ɣ)(-ˌpak)]	p315

This gemination occurs because STRESS-TO-ROOT requires that some part of the root morpheme to be parsed into the head of a foot, or a stressed syllable. The following onset geminates so that the syllable dominated by the root becomes heavy and forms its own foot, attracting stress in the process. The root segment must dominate a stressed syllable *nucleus*, not a margin of a stressed syllable, otherwise (a) would satisfy STRESS-TO-ROOT and germination would be unnecessary.

(15) *Requirement for root to be stressed triggers gemination*

Root receives stress » Don't change segment weight

/aŋ-uq/	STRESS-TO-ROOT	IDENT(weight)
a) [(a.ˈŋuq)]	*!	
Λ b) [(ˈaŋ)(ˌŋuq)]		*

The onset of the following syllable must geminate so that the initial syllable, where the root is, can form a foot by itself. The constraint IAMB prevents the foot from becoming trochaic to satisfy STRESS-TO-ROOT.

(16) *Gemination preferred over non-iambic foot*

Have iambic stress » Don't change segment weight

/aŋ-uq/	IAMB	IDENT(weight)
a) [(ˈa.ŋuq)]	*!	
Λ b) [(ˈaŋ)(ˌŋuq)]		*

Equally, the root must not undergo some other repair, such as epenthesis, because gemination is the lowest ranked – and so the most readily violated – repair which can satisfy STRESS-TO-ROOT in Yup'ik.

(17) *Gemination preferred over epenthesis*

Don't epenthesize » Don't change segment weight

/aŋ-uq/	DEP	IDENT(weight)
a) [(ˈat)(ˌŋuq)]	*!	
Λ b) [(ˈaŋ)(ˌŋuq)]		*

Thus, Yup'ik achieves a minimal size restriction due a complex set of conditions. STRESS-TO-ROOT requires some segment in the root to be the head of a foot, and the strong iambic stress pattern and other faithfulness constraints conspire so that the optimal solution is gemination, causing each root to be at least one foot in length.

The next section addresses the final case of Concurrence to produce a minimal root size, in which a near-bare root acquires a size restriction through the PrWd. However, the obligatory inflectional affixes allow the root to be shorter than a binary foot while the PrWd as a whole obtains this minimal size.

2.1.4 Near-bare roots: Shipibo

Bound roots which are minimally inflected, dubbed "near-bare roots," also exhibit minimal and maximal size restrictions. Just as for bare roots (§2.1.1), the basis of these restrictions is a minimal or maximal size restriction on the prosodic word. In short, foot binarity forces the PrWd to be at least one binary foot in length. For near-bare roots, which necessarily have some type of inflection in all outputs, the size restriction on the word translates into an even smaller size restriction on the root. This is because the inflection is also a member of the prosodic word, so the root and the affix must *together* be at least or at most one foot. So if the word must be at least two syllables, and one syllable is consumed by the affix, then the bound root can be as small as a single syllable, but not shorter. This is a unique prediction of the theory promoted in this dissertation, which derives a prosodic size restriction on the root based on its relationship to the PrWd.

An example of a near-bare root minimum is found in the Panoan language Shipibo (Elias-Ulloa 2006). Shipibo nouns, which can surface as a bare root, must be at least one foot in length. However, verbs, which are bound roots requiring an overt inflection in every output, can be as short as a single light syllable – unless the root can also serve as a noun, and so surfaces as a bare root in some outputs. Then the root must again be at least one binary foot in size, even when serving in its capacity as a verb. In this manner, the dichotomy between bare vs. near-bare roots (and so foot vs. syllable minimum size) is split along the line of noun vs. verb. This is in contrast with Czech, where e.g., different classes of nouns can have a maximal size of one foot or one syllable, depending on their inflectional paradigm.

Shipibo requires all PrWds to be at least one binary foot, i.e., a long vowel or two syllables (Ch3§2). For bare roots, this translates into a minimal size requirement of one foot as well. The following data gives a representation of Shipibo words, showing that each word and each bare root is at least one foot.

(18) *Shipibo bare roots: Minimal word and root size*

[(ˈt̠ʃiː)]	'fire'	[(ˈt̠ʃiː-ki)]	'fire'-Loc	p52
[(ˈtɨː)]	'work'	[(ˈtɨː)-kɨ]	'(he) worked'	p53
[(ˈtsaː)]	'splinter'	[(ˈtsaː)-ti]	'to splinter'	p55
[(ˈbakɨ)]	'child'	[(ˈbakɨ-n)]	'child'-Erg	p74
[(ˈata)pa]	'hen'	[(ˈata)(ˌpa-bo)-ra]	'hens'-Evi	p62

For these words/bare roots, the minimal size would be achieved in the same way seen for German in §2.1.1: FT-BIN forces each PrWd to be at least one binary foot, so a bare root must also be one binary foot. A subminimal root would be augmented so that this minimal size is met. A more complete analysis of the Shipibo minimal size is provided in Ch3§2.

(19) *Minimal size for bare roots*

Feet are binary » Don't change segment weight

?/t̠ʃɨ/	FT-BIN	IDENT(weight)
a) [(ˈt̠ʃɨ)]	*!	
Λ b) [(ˈt̠ʃiː)]		*

However, Shipibo roots which require an inflectional affix in all outputs can be less than one foot in length. This can be seen in the data below, where verbal roots may be a single light syllable because together with the obligatory inflection the PrWd reaches the minimal size of one foot. (Closed syllables like [his] are light in word-initial position in Shipibo (Elias-Ulloa 2006).)

(20) *Shipibo near-bare roots: Minimal word and root size*

[(ˈpi.-ti)]	‘food’	*[(ˈpi)]	p53
[(ˈhis.-kɨ)]	‘(he) saw (it)’	*[(ˈhis)]	p56
[(ˈhis.-ti)]	‘sight’		
[(ˈbana)-non]	‘(he) planted’	*[(ˈbana)]	p54

Of course, longer roots like [bana-] are also permitted, as they, too, satisfy the minimal PrWd size.

Because the minimal size restriction is on the prosodic word and not directly on the root, it is not necessary for the root itself to be one foot long. This is because the inflectional suffix contributes towards the minimal word size. The following tableau illustrates this point, by comparing a candidate with a foot-length root (21a) against one with a monosyllabic root (21b). The shorter, faithful output wins, because both outputs satisfy FT-BIN (b). There is no motivation for a longer root (a), since it is the prosodic word and not the root that is subject to a minimal size of one foot. Augmenting the root so that it is a full one foot long produces a gratuitous violation of IDENT(weight).

(21) *Binary minimal size for near-bare roots unmotivated*

Feet are binary » Don’t change segment weight

‽/pi-tɨ/	FT-BIN	IDENT(weight)
a) [(ˈpiː)tɨ]		*
Λ b) [(ˈpi.tɨ)]		

Thus, the minimal PrWd size requirement leads to a minimal size restriction on near-bare roots, but these two sizes are different. The word must be one foot in length, but the root – considering the help provided by the obligatory inflectional suffix – need only be one syllable to satisfy the minimal PrWd restriction.

The size of the root never changes, so when a nominal root (e.g., [(ˈtɨː)] ‘work’) is used as a verb, it still has a minimal size of one foot: [(ˈtɨː)-kɨ] ‘(he) worked’. This size consistency is accounted for through Output Faithfulness in §3.

2.1.5 Conclusions

This section has identified several environments of Concurrence in which the root may acquire a minimal size restriction. A minimal root size may be obtained through direct association with the prosodic word, as a bare or near-bare root, as argued in Sections 2.1.1 and 2.1.4. Root-foot alignment and positional markedness may also play a role in achieving a minimal root size restriction. Even where the root size is not directly derived from the prosodic word, there must be a minimal PrWd size in the language, as all types of root minimality are the result of foot binarity triggering a repair to subminimal inputs.

The augmentation that is undertaken – e.g., the epenthetic or geminate segment – is not truly part of the root. Consistency of Exponence states that a morpheme cannot change its lexical specification, so the augmentatives (which have no morphological specification in the input) are not strictly affiliated with the root in the first instance (McCarthy and Prince 1986/1993, 1994b). However, if the augmentatives are present in all outputs of the root through Output Faithfulness (§3), then they will quickly be reanalyzed as full members of the root morpheme. The next section examines how a root may acquire a maximal size restriction, where Consistecy of Exponence is not a concern: if the input is reduced, e.g. through deletion, then the segments remaining in the output are of course still affiliated with the root morpheme.

2.2 Maximal size

2.2.0 Introduction

A maximal root size restriction is a product of a maximal PrWd. In other words, when the size of the prosodic word is restricted, then the root constituting all or part of that word must also be restricted. One environment in which a root may derive a maximal size restriction is a bare morpheme, where it will directly inherit the PrWd size restriction. A bare root is coextensive with the prosodic word, so any restriction on the PrWd is translated directly to the root morpheme, as well. For instance, Czech bare roots have the same maximal size as a simple PrWd, a binary foot. A root may also acquire a size restriction from the prosodic word as a bound morpheme, where the root size must be restricted in such a way as to also accommodate the obligatory inflectional affixes within the PrWd maximum. Some classes of Czech roots require a monosyllabic inflectional suffix in all outputs. These roots are limited to a maximal size of a single syllable, so that together the root plus the inflection (i.e., the prosodic word) are one binary foot or less.

The bare and near-bare root size restrictions in Czech were first introduced and fully analyzed in Chapter 2§3. This section presents a summary of those findings in order to highlight the strategies for obtaining a maximal size restriction in a root. A maximal root size must be derived from a maximal prosodic word size. That is, there may not be a maximal root size restriction unless there is also one on the PrWd, although the word size restriction may be obscured as in Czech polymorphemic words (Ch2§4.2).

Maximal size in a bare root is discussed first in §2.2.1, while near-bare roots are addressed in §2.2.2. As for all types of Concurrence, these examples merely show how a root may acquire a prosodic size restriction. Whether or not this leads to a universal root size restriction, as in Czech, is determined by Output Faithfulness (§3).

2.2.1 Bare roots: Czech

When a prosodic word is subject to a maximal size restriction, then a bare root must have this same size. In this way, the root morpheme is subject to a maximal size restriction as well. This is the case for those classes of Czech roots whose inflectional paradigms provide for an output with a null suffix. These roots can be up to one full foot in length, or two syllables in the quantity-insensitive prosodic organization of the language. Maximal root size in Czech has already been discussed extensively in Chapter 2, with the main arguments reprised here.

The maximal size for roots which can occur as a bare morpheme in Czech is two syllables (Slavičková 1975). This can be seen in the following data, where roots can have a variety of shapes, so long as they do not exceed two syllables (i.e., one foot) in length. See Ch2§2.2 for a larger body of data.

(22) *Czech roots maximally two syllables*

[(σ)]	[(prst)]	'finger'	[(ˈluːj)]	'suet'
[(σσ)]	[(ˈja.zɪk)]	'language'	[(ˈjɛřaːp)]	'crane'

*[(ˈFt)(ˌFt)…], *[Ftσ…]

This maximal size is due to the constraint *FT-, which prevents the output from having secondary feet, outranking the ban on deletion. Thus, words – and transitively, roots – are reduced to the length of a single foot. Czech provides no evidence of roots which are longer than two syllables in length; the maximal root size is a phonotactic generalization which nevertheless requires explanation. A hypothetical over-long input is considered below, in order to show the necessary interactions of the language to reach the maximal size. (The fact that the maximal word size can be blocked in polymorphemic outputs in Czech is addressed in Ch2§4.2.)

(23) *Czech maximal PrWd/bare root size*

Don't have non-head feet » Don't delete

ˀ/jazɪkatat/	*FT-	MAX
a) [(ˈja.zɪ)$^+$(ˌka.tat)$^-$]	*!	
Λ b) [(ˈja.zɪk)$^+$]		*

In this way, a maximal PrWd size leads directly to a maximal root size when the root surfaces as a bare morpheme. Because the two are coextensive, a prosodic size restriction on one results in a prosodic size restriction on the other. This relationship also leads to a maximal size in near-bare roots, which is the topic of the next section.

2.2.2 Near-bare roots: Czech

Several classes of Czech roots – verbs, adjectives and some nominal inflections – require a syllabic suffix in all inflections. Czech PrWds are encouraged to have a maximal size of two syllables, or one foot. Therefore, when one syllable is used up by the inflectional suffix, then the root can be at most one syllable in order to avoid violating the maximal word size. Minimally inflected roots, or "near-bare" roots, acquire their maximal size restriction from the maximal PrWd restriction, while also accommodating their obligatory inflectional suffix. The result is that near-bare roots are subject to a maximal prosodic size, but this size is shorter than that imposed on the level of the PrWd. This point was first discussed in Ch2§3.2, and the process is reviewed in brief here.

The following data shows the inflectional paradigm of the noun [(ˈmo.ř-ɛ)] 'ocean' (Fronek (1999)'s paradigm 49). Note that each inflection requires a monosyllabic suffix.

(24) [(ˈmo.ř-ɛ)] *nominal paradigm: All inflections monosyllabic*

'ocean'	*Singular*	*Plural*
Nominative	[(ˈmo.ř-ɛ)]	[(ˈmo.ř-ɛ)]
Genitive	[(ˈmo.ř-ɛ)]	[(ˈmo.ř-iː)]
Dative	[(ˈmo.ř-ɪ)]	[(ˈmo.ř-iːm)]
Accusative	[(ˈmo.ř-ɛ)]	[(ˈmo.ř-ɛ)]
Vocative	[(ˈmo.ř-ɛ)]	[(ˈmo.ř-ɛ)]
Locative	[(ˈmo.ř-ɪ)]	[(ˈmo.ř-iːx)]
Instrumental	[(ˈmo.ř-ɛm)]	[(ˈmo.ř-ɪ)]

Because the suffix also counts towards the disyllabic maximal PrWd size, roots belonging to this paradigm are at most one syllable in length. This is confirmed through Slavičková (1975) and a survey of the first half of the Czech entries in Fronek (1999).

The process responsible for this phenomenon is identical to that seen for Czech bare roots in the preceding section. A ban on secondary feet is met with deletion, with the end effect that the PrWd must be one binary foot or shorter. For a paradigm requiring a monosyllabic suffix in every inflection, the disyllabic maximal word size limits the root to one syllable at most. This allows the word – root plus inflection – to be one foot or less. The following tableau, employing the same constraint ranking which produced Czech disyllabic bare roots in the preceding section, illustrates this point.

(25) *Disyllabic maximal word size leads to monosyllabic bound root maximum*

Don't have non-head feet » Don't delete

ʔ/<u>mořɪkat</u>-ɛ/	*FT-	MAX
a) [(ˈ<u>mo.řɪ</u>)⁺(ˌ<u>ka.t</u>ɛ)⁻]	*!	
Λ b) [(ˈ<u>mo.ř</u>ɛ)⁺]		*

The theory presented in this dissertation, which requires maximal root size be based on a maximal PrWd size, predicts near-bare root effects as in Czech. For a more in-depth look at Czech maximal root size, including a discussion of other inflectional paradigms and the violability of maximal word size restrictions, see Chapter 2. In summary, bare and near-bare roots produce environments of Concurrence, where the root may acquire a prosodic size restriction based on its relationship to the prosodic word.

2.3 Conclusions

Creating an environment where the MCat and the PCat are related through Concurrence is essential for root size restrictions. This can be achieved through scenarios where the root is bounded on both edges by prosodic boundaries, as in Czech and German bare roots (both root edges at PrWd edges), and in German word-final roots (one root edge at foot boundary, opposite edge at PrWd boundary) and compound-initial roots (both root edges at foot edges). Similarly, Yup'ik forces each root to be at least one foot for the purposes of stress assignment. An MCat can also derive a minimal or maximal size restriction when it does not perfectly concur with a prosodic unit, as in Czech and Shipibo near-bare roots. Here, a restriction on the prosodic word is transferred to the root plus its obligatory inflectional affixes, resulting in a different size restriction from the triggering PrWd. For instance, if the word must be at least one foot, then a monosyllabic inflection will only require the root to be at least one syllable, as in Shipibo.

The cases of near-bare roots in Czech and Shipibo examined here argue against theories which account for root size restrictions by directly requiring the MCat to obtain a given PCat size. For example, an approach proposing that Shipibo bare roots just happen to have a minimal size of one foot, while bound roots happen to be minimally one syllable, misses the insight that the size restrictions revolve around satisfaction of a minimal PrWd restriction. This forced approach is further refuted by the absence of languages with a complementary system, where bare roots must be at least one light syllable while bound roots must be at least one foot. A system like this is not predicted by the prosodic word-based process proposed here, while ad hoc assignment of root minima or maxima would predict some such cases. Arguments against the direct "encompassing" approach will be returned to in Ch5§5.

Now that this section has described the different environments in which minimal and maximal sizes can be derived, the next section deals with how size becomes consistent throughout all root outputs. This is achieved through Output Faithfulness, which can spread the root sizes created as in §2 to other outputs.

3 OUTPUT FAITHFULNESS

3.0 Introduction

The second factor leading to a universal root size restriction is Output Faithfulness, in which an output is in a correspondence relationship, and therefore encouraged to be faithful to, a second, morphologically less-complex output. With respect to root size restrictions, Output Faithfulness can cause one root shape to be spread among all outputs, resulting in consistency of root size throughout the language. When this consistency is coupled with a prosodically-based minimal or maximal root size obtained through Concurrence, as outlined in §2 above, then a language-wide root size restriction is instituted.

The central role of Output Faithfulness in root-size restrictions is highlighted by a comparison of German (§3.1) and Lardil (§3.2). Both languages have the same starting point: an inviolable requirement for every word to be at least one binary foot in length. Thus, a bare root in each language must also be at least one foot long. In German, this minimal size is retained in all outputs of a root. The result is that every root in every output has the same shape, equivalent to at least one binary foot. Meanwhile, Lardil roots do not maintain the same shape in all outputs. The shape employed in a bare root output, which must be at least one foot through the minimal PrWd requirement, is not consistent throughout the language. Other outputs of the root may have a different shape, so long as the prosodic word as a whole is at least one foot in length. The difference between these two languages is whether or not the shape of the root as a bare morpheme is carried over to all outputs. Where it is, as in German, root size will be consistent and there is a language-wide minimal word and minimal root size. Where it is not, as in Lardil, the root shape may vary and the language has a minimal word but no minimal root size.

Consistency of root size is enforced through Output Faithfulness, which encourages outputs to be faithful to a base output form, like a bare root (Benua 1997). This is in competition with Input-Output (IO) Faithfulness, which compels faithfulness to the input form. When Output Faithfulness is higher ranked than IO-Faith, then the root size will be consistent as in German. When it is lower ranked, root size can be variable. Ranking schemas leading to each of these outcomes are given below, with the difference between the two systems coming down to the relative ranking of Output Faith. FT-BIN must be highly ranked in German and Lardil, in order to produce the attested minimal prosodic word sizes. (A language with a maximal size of one foot would also incorporate a high-ranking *FT-, see §2.2.) When root size is consistent, Output Faith outranks IO-Faith, while the reverse situation calls for the reverse ranking.

(26) *The role of Output Faith*

a) *Language with consistent minimal root size (e.g., German)*

FT-BIN Output Faith

IO-Faith

b) *Language with variable minimal root size (e.g., Lardil)*

FT-BIN

IO-Faith

Output Faith

The term "Output Faithfulness" is employed here to refer to the combined effects of Output-Output Faithfulness and Optimal Paradigms Faithfulness. Transderivational correspondence, or Output-Output Faithfulness, takes one output to be a base to which other, more complex outputs must be faithful (Benua 1997). For example, in German, the output of the bare root is the base, and more complex outputs are encouraged to be faithful to this form. In this manner, the root size restriction imposed on the bare root (§2.1.1) is spread to all outputs.

Optimal Paradigms Faithfulness deals only with faithfulness within the inflectional paradigm of a bound root (McCarthy 2001, 2005). Here, members of an inflectional paradigm are analyzed in parallel because each inflection is equally complex, and so no single output serves as an unambiguous base as required for Output-Output Faithfulness; the practical result of analyzing all members of the inflectional paradigm in parallel is paradigm levelling. With respect to size restrictions, if one output must obtain a minimal or maximal size, then the shape of the root in this output will be spread to all other members of the paradigm. The analysis of Czech in Ch2 echoes the findings of Cable (2004) as cited in Bobaljik (2005), arguing that OP-Faith is only relevant where there is no clear base for transderivational faithfulness; where a root may surface without overt inflection, then OO-Faithfulness standardly applies, taking the bare root as the base.

Once the root shape is determined intraparadigmatically through Optimal Paradigms, then this output may serve as an Output-Output Faithfulness base for more complex outputs. This is the case in Czech (Ch2), where a root size restriction acquired within the inflectional paradigm is spread to all outputs of the root, producing a universal maximal root size.

Notably, OO- and OP-Faith must be decoupled in Itelmen as discussed in Bobaljik (2005), where intraparadigmatic faithfulness produces universal schwa-epenthesis within certain verbal paradigms, but this schwa-epenthesis is not obligatory in derived nominal outputs. Nominal roots, which can standardly surface as a bare morpheme, are exempt from paradigm levelling. This non-uniformity leads to Bobaljik's conclusion that McCarthy's OP-Faith effects are in fact a product of noun-verb asymmetries, and this proposal is not contradicted by the analysis of Arabic (McCarthy 2001). However, it is controverted in Chapter 2 by the analysis of Czech, where all roots are intraparadigmatically uniform but the nature of this uniformity – the maximal size restriction – is not evenly split along the noun-verb divide. Any root which can surface without overt inflection – which the morphology determines to be a number of noun classes – may be up to a binary foot in length. Any root which requires overt, syllabic inflection in all outputs – a mixture of nouns, verbs and adjectives – may be at most one syllable. The complementary system of Output-Output and Optimal Paradigms Faithfulness is described in greater detail in the discussion of Czech in Ch2§4. For the discussion at hand, only Output-Output Faithfulness plays a role.

This section illustrates the importance of Output Faithfulness by examining two similar situations which differ in their ranking of Output Faith. First, the case of German minimal root size will be revisited, with emphasis here on the role of Output Faith in making sure the root size restriction is absolute throughout the language (§3.1). The opposite situation is found in Lardil. The language has the same minimal word size as German, resulting in a minimal size for bare roots, but this is not carried over to all outputs. This is because while Lardil has the same starting conditions as German, Output Faith is not enforced and so there is no minimal root size in the language (§3.2).

3.1 Output Faithfulness: German

German roots uphold a minimal size restriction in all outputs, both where it is prosodically required as in a bare root, and where this size is not otherwise mandated. This consistency among output forms is achieved through Output Faithfulness, which takes one output as a base to which other outputs must be faithful. When this base is limited to a given prosodic size through Concurrence as outlined in §2, then a minimal or maximal root size restriction is effectively spread throughout the language.

Recall that German roots must be at least one binary foot in certain circumstances, such as a bare root (§2.1.1), a word-final bound root or as part of a compound word (§2.1.2). However, these same root shapes are also found where the factors of a minimal prosodic word size and root-stress alignment do not proscribe a minimal root size. This section focuses solely on bare roots in German in order to draw the most straightforward parallels to the case of Lardil presented in the following section.

The following data from Clark and Thyen (1998) shows that a minimal root size required for a bare root (27i) is also carried over into complex forms (ii).

(27) *All German roots have a minimal size*

i)	[(ˈt͡sɛː)]	‘tough’	ii)	[(ˈt͡sɛː-.ə)]	‘tough’-F
	[(ˈflɛk)]	‘stain’		[(ˈflɛ.k-ɪç)]	‘stained’
	[(ˈʔaː.təm)]	‘breath’		[(ˈʔaː.təm)(ˌ-loːs)]	‘breathless’
	[(ˈba͡u)]	‘building’		[(ˌfɛɐ̯)(-ˈba͡u-.ən)]	‘to obstruct’
	[(ˈglyk)]	‘luck’		[bə(-ˈgly.k-n̩)]	‘to make happy’

The bare roots in the left-hand column require the root to be at least one foot due to foot binarity and Headedness (Ch3§2). However, the forms in the right-hand column do not demand a minimal root size in this manner. The constraints leading to German minimal PrWd size in certain outputs, FT-BIN and ALIGN-L(root, foot), would be satisfied by the outputs in (ii), even if the root were shorter than the minimal size: hypothetical words like [(ˈt͡sɛ.ə)] and [(ˈflɛ-.ɪç)] would be properly aligned and meet the minimal PrWd requirement. Yet German roots have the same shape in all outputs, which is equivalent to one binary foot as a bare root output, even when this shape is not otherwise phonologically motivated.

The following tableau illustrates this point, by pairing a hypothetical subminimal root ‽/kɛ/ with the infinitive verbal suffix /-ən/. This input would yield a left-aligned, binary output (28a), satisfying FT-BIN and ALIGN-L(root, foot), which were shown to trigger a minimal size restriction in German bare roots (§2.1.1) and word-final roots (§2.1.2). Yet German bans CV root shapes in all instances, suggesting that an augmented form, as in (28b), should be the winner instead. Compare similar well-formed words such as [(ˈkɛː.z-n̩)] ‘to make cheese’, [(ˈkɛ.m-ən)] ‘to comb’ and [(ˈka͡u-ən)] ‘to chew’, where each root has a minimal CVV or CVC size.

(28) *Subminimal roots emerge when suffixed (Unattested)*

Feet are binary » Don't change segment weight

‽/kɛ-ən/	FT-BIN	IDENT(weight)
💣 a) [(ˈkɛ.ən)]		
b) [(ˈkɛː.ən)]		*!

The language-wide minimal root size is a by-product of root size consistency, enforced through Output Faithfulness. One output, such as the bare root, is taken as a base form to which other outputs must be faithful. The base is a morphologically less complex output (Benua 1997), such as a bare root or the output determined through intraparadigmatic faithfulness (Ch2§4.1; McCarthy 2001, 2005). Thus, an output is in a correspondence relationship with the input and with the base form, relationships which can sometimes conflict. For example, if a bare root is augmented so that it is at least one foot, then a more complex output will be torn between faithfulness to the subminimal input or to the foot-long base. When Output Faithfulness to the base wins out – and that base requires a prosodically-determined minimal or maximal size – then the language will acquire a universal minimal or maximal root size restriction.

The relationship between different output forms of the same root is illustrated in the following tableaux. Recursion A shows how alignment and prosodic constraints compel a subminimal bare root to undergo epenthesis in order to reach the binary minimal size through Concurrence. In Recursion B, both candidates satisfy ALIGN and FT-BIN, but the root maintains its larger size in order to be faithful to base derived in Recursion A. In this manner, Output Faith trumps IO-Faith: it is more important that the root resemble its base, the bare root, than it does the input. Again, this process is illustrated with hypothetical examples, as German does not provide any cases where a subminimal root input can be seen to be augmented to meet the minimal size requirement.

(29) *No deletion from Output Faith base*

Recursion A: Feet are binary » Faithfulness to input

ʔ/kɛ/	ID(weight) -Output	FT-BIN	ID(weight) -IO	>>
a) [(kɛ)]		*!		
Λ b) [(kɛː)]			*	

Recursion B: Faithfulness to base » Faithfulness to input

ʔ/kɛ-ən/	ID(weight) -Output: [kɛː]	FT-BIN	ID(weight) -IO
a) [(kɛ.ən)]	*!		
Λ b) [(kɛː.ən)]			*

In conclusion, Output Faithfulness plays a central role in instituting a root size restriction. When a language requires a minimal or maximal size through Concurrence, as in §2, and that size is used as an Output Faith base for more complex outputs, as in German, then the language acquires a universal root size restriction. The opposite situation will now be exemplified by Lardil, which has a minimal PrWd requirement, but does not translate this into a universal root size restriction.

3.2 No Output Faithfulness: Lardil

Lardil has a minimal PrWd requirement that plays a dynamic role in the language (Wilkinson 1988), operating in much the same way as German's minimal size requirement for bare roots (§2.1.1). But unlike German, the Lardil minimal word PrWd restriction does not lead to a language-wide minimal root requirement. This section argues that this is because Lardil roots are not bound by Output Faithfulness. The conditions for creating a minimal root size are present, but not spread to all outputs.

PrWds in Lardil must be at least bimoraic, or one foot (a; Wilkinson 1988, Prince and Smolensky 1993, McCarthy and Prince 1995b). This can be seen in active alternations, in which a subminimal input undergoes epenthesis of [a] when occurring alone (b,i), but emerges faithfully when joined by affixes that enable the PrWd to meet the minimal size requirement (b,ii; Wilkinson 1988).

(30) *Lardil words minimally bimoraic*

(a) *Bimoraic or greater PrWds/roots undergo no change*

(i)	[(ˈwi.t̪e)]	'inside'-Nom	(ii)	[(ˈwi.t̪e-n)]	Acc
	[(ˈpeːr)]	'ti-tree species'-Nom		[(ˈpeː.r-in)]	Acc
	[(ˈmaːn)]	'spear'-Nom		[(ˈmaː.n-in)]	Acc

(b) *Subminimal PrWds/roots undergo epenthesis*

(i)	[(ˈwi.k-a)]	'shade'-Nom	(ii)	[(ˈwi.k-in)]	Acc
	[(ˈte.r-a)]	'thigh'-Nom		[(ˈte.r-in)]	Acc
	[(ˈja.k-a)]	'fish'-Nom		[(ˈja.k-in)]	Acc

When a Lardil root stands alone, [a] is epenthesized to meet the minimal PrWd size, similar to German. This minimal word is created as discussed in Ch3§2 and above in §2.1.1: all PrWds must have at least one binary foot because of Headedness and FT-BIN. The creation of a minimal word size is illustrated below. As other repairs, such as vowel lengthening [wiːk], are not carried out, these constraints (e.g., IDENT(weight)) must be higher ranked than the ban on epenthesis.

(31) *Epenthesis to create a minimal word size*

Feet are binary » Don't epenthesize

/wik/	FT-BIN	DEP
a) [(ˈwik)]	*!	
Λ b) [(ˈwi.ka)]		*

Yet Lardil roots do not uphold a universal minimal size. When the minimal word requirement is met by incorporating affixes into the PrWd, the roots can emerge faithfully as subminimal sequences. This is because Output Faith is lower ranked than Input-Output Faithfulness, and so root outputs are not bound to the form created in the augmented PrWd/roots. This is the opposite scenario from the analysis of German in the preceding section. When a Lardil root does not require a minimal size to meet the minimal PrWd requirement, then it prefers to be faithful to the input, which may be subminimal (c.f. tableau (29) in the discussion of German).

(32) *Input-Output Faithfulness blocks universal minimal root size*

Recursion A: Feet are binary » Faithfulness to input

/wik/	FT-BIN	DEP-IO	DEP-Output	>>
a) [(ˈwik)]	*!			
Λ b) [(ˈwi.ka)]		*		

Recursion B: Faithfulness to input » Faithfulness to base

/wik-in/	FT-BIN	DEP-IO	DEP-Output: [wika]
Λ a) [(ˈwi.kin)]			*
b) [(ˈwi.kan)]		*!	

To sum up, minimal and maximal MCat restrictions become salient when this size is spread to all outputs through Output Faith. Otherwise, the minimal or maximal size only emerges in those situations defined through Concurrence in §2, such as a bare root, and has no broader implications for the size of the MCat on the whole.

3.3 Conclusions

Output Faithfulness determines whether or not a prosodic size restriction obtained through Concurrence is carried through to all outputs of a root. Both German and Lardil have a minimal PrWd size, requiring a bare root morpheme to be augmented. In complex outputs, this root size is retained in German, but rejected in favor of faithfulness to a subminimal input in Lardil. The difference between these two systems is the prominence of Output Faithfulness.

Of course, the augmentations (mora epenthesis in German and segment epenthesis in Lardil) are not truly part of the root morpheme, due to Consistency of Exponence (McCarthy and Prince 1986/1993, 1994b). A morpheme may not change morphological affiliation from the input to the output; when a segment has no correspondent in the input, then it is not associated with any morpheme at all. However, when the augmentation is present in every output, as in German, then it will be reanalyzed by a language learner as part of the root morpheme. In Lardil, where [a] only surfaces in some outputs, its status as an epenthetic segment is maintained and there is no motivation for it to be reanalyzed as part of the root.

Output Faithfulness is required by any theory of minimal and maximal root size in order to account for why root shape is consistent although prosodic structure may vary. For example, a German root must be at least one foot as a bare root, [(ˈflɛk)] 'stain', but may actually be less than one foot in other outputs, [(ˈflɛ.k-ɪç)] 'stained'. In the second output, the root segments only dominate a single light syllable, but the two factors accounting for minimal root size here – a minimal prosodic word and consistency of output shapes – are both satisfied. The differing prosodic structure does not present a problem for the proposals in this dissertation, but it does raise questions for templatic approaches, such as a constraint "ROOT = FOOT". Presumably such an approach would also need to adopt an Output Faithfulness tenet in order to account for processes such as the resyllabification seen here. This point will be returned to in Ch5§5. The following section examines the relationships between prosodic restrictions on the PrWd and the root.

4 PROSODIC WORD VS. ROOT SIZE RESTRICTIONS

Prosodic word and root size requirements are intimately related. In the case of bare and near-bare roots, a root size restriction is directly derived from a restriction on the prosodic word (§2.1.1, 2.1.4, 2.2.1, 2.2.2). A minimal root size may also be compelled in an environment resulting from root-foot alignment or a requirement that all roots be stressed; even in such cases, the constraint triggering the minimal prosodic word requirement, FT-BIN, is responsible for forcing a minimal root size (§2.1.2, 2.1.3). This section explores the relationships between minimal and maximal roots and words, identifying the possible combinations of these factors.

The correlation between word and root size restrictions leads to the following predictions. The size restrictions are abbreviated here to Min(root), Max(root), Min(PrWd) and Max(PrWd), with "→" representing implication and "≈" indicating that a restriction is possible but not required.

(33) *Theory of Relative Root and PrWd Size Restrictions*

1) a) Min(root) → Min(PrWd)

If there is a minimal root restriction, there is a minimal PrWd restriction.

b) Min(PrWd) → ≈Min(root)

If there is a minimal PrWd restriction, there may be a minimal root restriction, depending on the status of Output Faithfulness.

2) a) Max(root) → ≈Max(PrWd)

If there is a maximal root restriction, there is a maximal PrWd restriction, though the latter's effects may be obscured.

b) Max(PrWd) → ≈Max(root)

If there is a maximal PrWd restriction, there is standardly a maximal root restriction. (Exceptions are predicted, but are unattested and likely to not be functionally viable.)

3) a) Min(root) = Min(PrWd)

If there if a minimal root and a minimal PrWd restriction, their sizes are the same.

b) Max(root) = Max(PrWd)

If there is a maximal root and a maximal PrWd restriction, their sizes are the same.

These implications will be discussed independently below. The arguments rest on the facts that both minimal root and word size have the same origin, FT-BIN triggering a faithfulness violation, and that a maximal root size may only be derived from a maximal prosodic word restriction.

- *Min(root) → Min(PrWd)*

If there is a minimal root size, there must be a minimal prosodic word size. The two are derived from the same fundamental circumstances, so a minimal root (which is more complex, considering the role of Output Faithfulness) implies a minimal PrWd restriction. This implication can be seen by revisiting the constraint rankings leading to minimal PrWd and root size restrictions. A minimal PrWd size is due to foot binarity causing a faithfulness violation (Ch3§2). A minimal root size requires the same IO-Faith violation, plus Output Faithfulness to create a universal root size, and some cases of Concurrence additionally require root-foot alignment or positional faithfulness (§2.1).

(34) a) *Minimal PrWd size*
FT-BIN » IO-Faith
b) *Minimal root size*
FT-BIN, Output Faith, [ALIGN-L(root, foot), ROOT-TO-STRESS] » IO-Faith

The relationship between minimal root and PrWd sizes holds because the root size restriction is derived through standard phonological processes. If the constraints motivating a minimal size could also be formulated to be root-specific – e.g., FT-BIN(root) – then the implicational relationship between root and PrWd minimal size would not hold. Root-specific constraints would be freely rankable, leading to outputs where roots have a minimal size, but PrWds containing exclusively non-root material must not obtain this size (FT-BIN(root) » Faith » FT-BIN). The author is unaware of such a case, but the opposite situation – where both root and non-root PrWds must obtain a minimal size – are readily attested.

For example, German definite articles are standardly unstressed and reduced; as function words, articles are commonly exempted from standard prosodic processes, including a minimal size restriction (37a; Selkirk 1995). However, when the article is emphasized to express the demonstrative, then it receives stress and so must also be at least one binary foot in length, like all PrWds (b; Dedenbach 1987).

(35) *German articles obtain a minimal size when stressed*

a) *Function words must not be stressed or obtain minimal word size*

[(ˌʊn.tɐ-m) (ˈh͡aus)] ‘below the house’

[(ˌʊn.tɐ-s) (ˈh͡aus)] ‘under the house’

[(ˌʊn.tɐ-n) (ˈʃtuːl)] ‘under the chair’

b) *When stressed, function words behave like any other PrWd*

[(ˌʊn.tɐ) (ˈdeːm) (ˌh͡aus)] ‘below *that* house’

[(ˌʊn.tɐ) (ˈdas) (ˌh͡aus)] ‘under *that* house’

[(ˌʊn.tɐ) (ˈdeːn) (ˌʃtuːl)] ‘under *that* chair’

*[(ˌʊn.tɐ) (ˈʔn̩) (ˌʃtuːl)]

Therefore, a minimal root size is predicated on the same conditions as a minimal PrWd size, so a minimal root size always entails a minimal PrWd size. The following section will argue that the reverse is not always true.

- *Min(PrWd) → ≈Min(root)*

A minimal PrWd size may or may not be reflected in a minimal root size. For example, a bare root will be subject to the minimal word size because the two are coextensive. Whether or not a universal minimal root size follows is contingent on Output Faithfulness (§3). If Output Faithfulness is highly ranked, then a minimal PrWd size will produce a minimal root size through Concurrence in bare and near-bare roots.

The fact that a minimal PrWd may led to a minimal root size – and the crucial role of Output Faithfulness in determining the outcome – was discussed in the comparison of German and Lardil in §3. In short, both languages have a minimal PrWd size (i), and in German this translates into a universal minimal root size through Output Faithfulness (a,ii). In Lardil, there is no minimal root size, and a shorter root size freely surfaces so long as the minimal PrWd size is satisfied (b,ii).

(36) *Minimal PrWd may imply a minimal root*

a) *Minimal PrWd and minimal root in German*

i)	[(ˈt͡sɛː)]	‘tough’	ii)	[(ˈt͡sɛː-.ə)]	‘tough’-F
	[(ˈflɛk)]	‘stain’		[(ˈflɛ.k-ɪç)]	‘stained’
	[(ˈʔaː.təm)]	‘breath’		[(ˈʔaː.təm)(ˌ-loːs)]	‘breathless’
	[(ˈb͡au)]	‘building’		[(ˌfɛɐ̯)(-ˈb͡au-.ən)]	‘to obstruct’

b) *Minimal PrWd but no minimal root in Lardil*

i)	[(ˈwi.t̪e)]	‘inside’-Nom	ii)	[(ˈwi.t̪e-n)]	Acc
	[(ˈmaːn)]	‘spear’-Nom		[(ˈmaː.n-in)]	Acc
	[(ˈwi.k-a)]	‘shade’-Nom		[(ˈwi.k-in)]	Acc, *[(ˈwi.k-a-n)]
	[(ˈte.r-a)]	‘thigh’-Nom		[(ˈte.r-in)]	Acc, *[(ˈte.r-a-n)]

Therefore, a minimal PrWd size may translate into a minimal root size, but it is not necessary for it to do so.

- *Max(root) → ≈Max(PrWd)*

If there is a maximal root size, there must be a maximal prosodic word size , although it may be obscured. A maximal root can only be derived from an output constrained by a maximal PrWd restriction, which is then carried over to all outputs of the root through Output Faithfulness (§2, 3). The discussion of maximal size restrictions in Ch3§3 proposed that it is shaped by constraints such as *FT-, PARSE-σ and *LAPSE. None of these constraints may be specific to roots or non-roots, such as a constraint banning non-head feet only in roots. The ranking *FT-(root) » IO-Faith » *FT- would predict some rather odd stress patterns (e.g., non-root material must be exhaustively parsed, but any material affiliated with the root outside of the head foot would remain unfooted), and could also lead to a maximal size for roots where there is no maximal PrWd size. As this system is unattested, and such constraints are undesirable, it appears that a maximal root size may only be derived from a maximal PrWd size, as discussed in §2.2.

Although a maximal root size must be directly acquired from a maximal PrWd size, the latter may be obscured in some outputs. This is the case in Czech, where PrWds and so bare and near-bare roots try to be one binary foot or less due to the pressure to avoid a non-head foot, *FT-, PARSE-σ » IO-Faith. However, in polymorphemic words the maximal size may be blocked due to pressure for each morpheme to have an overt realization in the output (REALIZEMORPH; Ch2§4.2). Output Faithfulness further ensures that root size is consistent, *FT-, REALIZEMORPH, Output Faith » PARSE-σ » IO-Faith. That is, roots derive a maximal size from the PrWd and maintain this size in all outputs, but the maximal PrWd size may itself be violated in complex words. A maximal root size requires a maximal PrWd on some level, but the latter may be blocked in some outputs.

Previously, it was argued that a minimal root size necessarily entailed a minimal PrWd size. This is because there are no constraints which could block attainment of a minimal PrWd, in contrast to REALIZEMORPH which can block a maximal PrWd size. A constraint blocking a minimal PrWd size but allowing for a minimal root size would be something like “Don’t have a binary foot in non-root material”, which is unattested and typologically unsound.

- *Max(PrWd) → ≈Max(root)*

If a maximal prosodic word size is enforced, then a maximal root size standardly follows. Whatever process restricts the size of the prosodic word (Ch3§3) would also restrict the root, which is part of the PrWd. Therefore, a maximal prosodic word size is commonly accompanied by a maximal root size, even when the latter is not explicitly enforced through Output Faithfulness.

However, the root may demand greater faithfulness than non-root material (Beckman 1998), leading to cases where a maximal root size may not coincide with a maximal PrWd size. For example, a maximal PrWd size may be realized through deletion, but deletion from the root may be banned, MAX(root) » *FT- » MAX. Roots may be any size, e.g., ʔ/pukamuka/ → [(ˈpuka)(ˌmuka)]. However, affixes would be banned, except where the root is short enough so that root plus affix can satisfy the maximal PrWd size, ʔ/pukamuka-to/ → [(ˈpuka)(ˌmuka)], but ʔ/pu-to/ → [(ˈputo)].

Such a language appears to be unattested, and is probably unstable in the sense that it would not survive diachronic transmission intact: there are so few environments where the effect of the affixes may be seen, that they are liable to be reanalyzed as part of the root by a learner. For recent work in this vein, see Blevins (2004).

Another exception to an implicational relationship between a maximum PrWd size and a maximum root size is predicted by the type of repair employed by the language. For example, if a maximal PrWd size were obtained by breaking every overlong input into multiple MWds, then the root size would not be affected, e.g., ʔ/<u>pukamuka</u>/ → [{(ˈ<u>puka</u>)}{(ˈ<u>muka</u>)}]. Again, this system appears to be unattested and is probably very unstable, because a root that is consistently broken into separate PrWds may be perceived as separate MWds over time.

- *Max(root) = Max(PrWd), Min(root) = Min(PrWd)*

If a language has a PrWd and root size restriction, then their sizes will be the same. For example, if the minimal word size is disyllabic, then the minimal root size will also be disyllabic, not bimoraic. This agreement occurs because the mechanisms behind size restrictions are fundamentally the same, whether they affect the prosodic word or the root. That is, there are no relevant markedness constraints specific to roots or non-roots. A maximal root size is directly derived from a maximal PrWd size, so the size restrictions must identical (§2.2.1). The same holds for a minimal size derived from a bare root (§2.1.1). Even when root-foot alignment or positional markedness come into play, the size restriction still hinges on the same situation: the pressure to be binary – bimoraic or disyllabic – triggering a repair. An OT constraint ranking is global: the same hierarchy is applied to every candidate set (Prince & Smolensky 1993). Therefore, root and word size restrictions must be the same because they are driven by the same constraint rankings.

The exception to this statement is near-bare roots: the root size restriction differs in a limited and predictable way from the PrWd size restriction. Czech showed that bound roots have a maximal size of one syllable to accommodate the obligatory inflectional suffix (Ch2§3.2), and Shipibo showed that roots may be as short as a single light syllable and still satisfy the minimal PrWd restriction because the suffix also contributes (§2.1.4). However, size restrictions with a wholly different basis – e.g., roots have a minimal bimoraic size, while words have a minimal disyllabic size – are never an outcome.

The interactions between minimal and maximal word and root sizes described above lead to a restricted typology. The following chart provides a graphic representation of the predicted systems of root and word size. The “root” and “word” columns permute the conditions of minimal and maximal root and PrWd size restrictions, while the right-most column lists an example language of each system, or denotes the system as being impossible or unattested where applicable. For example, the first entry has a minimal and maximal root size and a minimal and maximal PrWd size, and is exemplified by Vientiane Lao. The second entry has a minimal and maximal root size, and a maximal PrWd size but no minimal. This system is predicted to be impossible: the mechanisms behind minimal size are the same for roots and words, so if the root must obtain a minimal size, then the word must do so, too.

(37) *Typology of maximal and minimal root and word sizes*

ROOT		*WORD*		*Example*
Max.	*Min.*	*Max.*	*Min.*	
✓	✓	✓	✓	Māori (Ch3§3; de Lacy 2003) Lao (Morev, Moskalev and Plam 1979)
		✓	×	*impossible*
		×	✓	German (Ch 4§2.1; Golston and Wiese 1998) Ngalakgan (Baker and Harvey 2003)
		×	×	*impossible*
✓	×	✓	✓	Bantu Pidgin (Heine 1973)
		✓	×	Tiene (Ch3§3.2.2; Orgun and Sprouse 1999)
		×	✓	Axininca Campa (Payne 1981) Zezuru Shona (O'Neil 1935)
		×	×	Czech (Ch2; Palková 1994) Slave (Rice 1989)
×	✓	✓	✓	*unattested*
		✓	×	*impossible*
		×	✓	Shipibo (Ch3§2; Elias-Ulloa 2006) Tagalog (Ch3§2.2.2; Blake 1925)
		×	×	*impossible*
×	×	✓	✓	*unattested*
		✓	×	*unattested*
		×	✓	Lardil (Ch4§3.2; Wilkinson 1988) Choctaw (Nicklas 1975)
		×	×	Manam (Ch3§2.2.3; Lichtenberk 1983) French (Scullen 1997)

Most of the rankings listed above are attested, although some are more common than others. Systems like German, Czech and Shipibo appear to be relatively widespread, while those with a maximal PrWd size are generally more difficult to identify (e.g., Bantu Pidgin and Tiene).

Impossible systems are those which are not generated by any constraint ranking. The impossible rankings above are identified as such because they call for a minimal root size but no minimal PrWd size. If the conditions for a minimal root size are met, then there must be a minimal PrWd size because these fall out from the same ranking (see point "Min(root) → Min(PrWd)" above).

Those rankings labeled as "unattested" call for a maximal PrWd size but no maximal root size. (There are only three unattested patterns because the fourth is listed as "impossible" for the reasons above.) While positional faithfulness predicts that a language may impose a PrWd size maximum which is blocked in roots, these systems are instable for the reasons discussed in the point discussing "Max(PrWd) → ≈Max(root)" above.

In conclusion, minimal and maximal word and root restrictions may not occur in free distribution with one another. A minimal or maximal size restriction has essentially the same source, whether it applies to the root or the PrWd. This leads to a limited typology of size restrictions. Some size combinations are impossible and cannot be predicted through any ranking; other systems have identical surface effects despite different underlying rankings.

5 CONCLUSIONS

This chapter has argued that minimal and maximal root size restrictions are most accurately characterized indirectly through independently attested processes, such as FT-BIN, ALIGNment and Output Faithfulness. The creation of a minimal or maximal size restriction through Concurrence was described through several different scenarios in §2, which played off the interaction of morpheme and prosodic boundaries. A root size restriction can come about passively, as in a bare or near-bare root where the morphology induces MCat and PCat (approximate) concurrence. Alternatively, root-foot alignment and root-stress positional markedness can force a minimal size when the root morpheme is confined by prosodic boundaries at either edge and compelled to dominate a binary foot.

These various situations suggest that different classes of roots may adopt different strategies within a single language. For instance, Czech bare roots and near-bare roots have different maximal sizes due to their respective morphological constructions (§2.2.1, 2.2.2). Potentially, many languages which do not at first glance appear to have a minimal or maximal root size restriction may apply different size requirements for one class of roots, such as a bare root, than for others, like a bound root.

The key to a language-wide minimal or maximal root restriction is Output Faithfulness. Minimal and maximal root size is created when the root is subject to certain prosodic considerations, or Concurrence; when this root is taken as a base to which other, more complex outputs must be faithful, then the language will have a universal minimal or maximal root size, even where the conditioning prosodic factors do not hold. Turning the argument on its head, a minimal or maximal root size clearly indicates that prosodic factors can control the size of the root, and Output Faithfulness is required to ensure that these same factors do not lead to different root sizes in different environments.

Finally, this chapter looked at how minimal and maximal PrWd and root sizes may interact, leading to a restricted typology of predicted languages. The next chapter examines the theoretical implications of the present theory, including the insights gained into the ALIGN family of constraints.

CHAPTER 5

THEORETICAL IMPLICATIONS

1 INTRODUCTION

This chapter examines the broader implications of the constraints and theoretical mechanisms used in this dissertation. Many of the tools employed – Input-Output and Output-Output Correspondence, theories of prosody and syllable weight, as well as constraints regulating foot binarity, syllable lapse, positional markedness, and so on – are generally accepted and/or extensively discussed in other work and so are not comprehensively addressed in this dissertation (see McCarthy 2002a for a guide to most of these, in addition to references cited elsewhere in this dissertation). However, the analysis of root size restrictions opens up a new perspective on the role and formulation of alignment constraints, including what types of constraints should and should not belong to CON. The implications of size restrictions for alignment are the focus of this chapter.

The arguments in this dissertation can typically be framed within any theory of constituent alignment. Currently, this is most often represented through Generalized Alignment theory, also referred to as ALIGNment in this work. The original formulation of ALIGNment as proposed by McCarthy and Prince (1993b) is repeated below.

(1) *Generalized Alignment (McCarthy & Prince 1993b)*

ALIGN(Cat1, Edge1, Cat2, Edge2) = $_{\text{def}}$

∀ Cat1 ∃ Cat2 such that Edge1 of Cat1 and Edge2 of Cat2 coincide

Where

Cat1, Cat2 ∈ PCat ∪ MCat

Edge1, Edge2 ∈ {Right, Left}

This proposal is amended below, but the basic definition of ALIGNment is adopted. The standard shorthand, such that ALIGN-L(α, β) calls for the left edge of *every* member of α to be aligned with the left edge of *some* member of β, is also employed. However, I propose that ALIGNment constraints must be restricted in regard to the combinations of MCats and PCats which may be aligned with one another, which edges may align as well as what units compose the classes of MCat and PCat.

(2) *Restricted Alignment Theory (RAT)*

ALIGN-Left(Cat_1, Cat_2) =$_{\text{def}}$

For all Cat1 and some Cat2, the left edge of Cat_1 and Cat_2 coincide

Where

(i) Cat1 ∈ {Root} and Cat2 ∈{σ, Ft, PrWd};

(ii) Cat1 ∈ {(non-)head of $PCat_1$} and Cat2 ∈ {$PCat_2$}; or

(iii) Cat1∈ {$PCat_2$} and Cat2 ∈ {(non-)head of $PCat_1$}.

- There are no ALIGN-L(PCat, MCat) constraints in CON.
- There is no right-alignment (also see Nelson 1998, 2003, Bye & de Lacy 2000, Alber 2002).

This chapter will focus on issues of MCat-PCat and PCat-MCat alignment because these are the scenarios most relevant to Prosodic Morphology and the aims of this dissertation. Issues facing the PCat-PCat and MCat-MCat families of alignment will also be touched on but discussed in less detail. A final type of alignment, requiring an MCat to be "encompassed" by a PCat, will also be discussed and subsequently rejected. An overview of each type of alignment – MCat-PCat, PCat-MCat, PCat-PCat, MCat-MCat and encompassing constraints – will be outlined first, before the overall conclusions against right-edge alignment and the prosodic and morphological categories which may participate in alignment are presented.

Turning to the first claim (2a), MCat-PCat alignment predicts languages where *every* root must align with *some* foot, prosodic word or syllable. This will be illustrated in §2 by analyses illustrating alignment of a root with respect to each class of PCat. Feet are addressed first, since this PCat is most familiar from previous arguments. Root-foot alignment is evident in German, where the morphological boundary of the root affects the stress pattern, and so by inference foot construction (§2.1). Next, root-syllable alignment is observable in the much-discussed case of Northern Italian intervocalic /s/-voicing. In line with previous analyses, the voicing distribution of /s/ is argued to be conditioned by a prosodic boundary, but Section 2.2 will contend that this prosodic boundary must be that of a syllable. Alignment with a foot or a prosodic word would make unsubstantiated predictions about the stress pattern of the language. Finally, root-prosodic word alignment is supported by Korean, which separates prefixes and roots into separate PrWds. The root must align with a prosodic word boundary, so any material preceding the root (e.g., prefixes) must form a separate prosodic word. In summary, each of the members of ALIGN-L(MCat, PCat) accounts for attested linguistic phenomena while avoiding unwanted predictions.

On the other hand, the converse family of constraints, ALIGN-L(PCat, MCat), leads to false predictions. By forcing every member of a PCat to align with the edge of some MCat, these constraints superficially resemble a maximal MCat size restriction. For example, if each foot must be aligned with the left edge of the root, then the word/root must be at most one foot long, since any additional feet would be misaligned. However, this family of constraints makes unattested predictions, such as a language with a maximal PrWd size of a single light syllable, and does not add any unique contributions to CON. Therefore, PCat-MCat alignment is rejected in Section 3.

PCat-PCat and MCat-MCat alignment are also touched on here in order to complete the Restricted Alignment Theory. However, they receive less attention because these formulations do not link prosody and morphology and so cannot be used to derive a prosodic size restriction on roots, the principle aim of this dissertation. It is proposed that alignment between two PCats does bear out, provided it is between a (non-)head PCat, like a (non-)head syllable, and a dominant PCat, such as a foot. This formulation characterizes trochaic vs. iambic feet, and foot-PrWd (non-)head alignment may aid the development of theories of secondary stress. PCat-PCat alignment without reference to (non-)heads predicts unattested systems, such as a language where all syllables are stressed. Crucially, the use of head and non-head PCats captures stress systems while avoiding the untoward predictions concomitant with right-alignment. Another important insight from PCat-PCat alignment relates to maximal word size, which may also be achieved through (non-)head syllable-prosodic word alignment: if every head or non-head syllable must align with the edge of the prosodic word, then the word will have a single (non-)head syllable, parsed into a single foot. These points will be developed further in Section 4.1.

Moving on to alignment between two MCats, much is left open for debate here. There is still uncertainty about which MCats can participate in processes of alignment in the first place. Roots are argued to be active participants, as illustrated many times over in this dissertation, while the concerns surrounding alignment of other MCats are clarified in §4.2 but merit future research.

The last type of alignment explored here are the so-called "encompassing constraints", which require a given MCat to be fully encompassed by a PCat, leading to a situation akin to left and right edge alignment. One obvious contender would be a family of templatic constraints directly mandating root size, such as "ROOT = FOOT", "ROOT ≤ FOOT" and "ROOT ≥ FOOT". These encompassing constraints will be argued to overpredict, underpredict and generally be unnecessary in §5. Their intended purpose can be more accurately captured through the independently motivated approach employing Concurrence and Output Faithfulness proposed in this dissertation (Ch4).

This chapter also highlights arguments that while left-edge ALIGNment is valid, right-edge alignment makes unnatural predictions. This builds on the recent body of work arguing against right-edge alignment (Nelson 1998, 2003, Bye and de Lacy 2000, Alber 2002). The examination of MCat-PCat alignment finds that these phenomena only occur at the left edge of the root. Right-alignment would predict the root to have a crisp edge at its right edge (§2.1; 2.2; 5), a language where the final syllable of the root attracts stress (§2.1) or a language where suffixes are pared off into a separate PrWd, just as prefixes are in Korean (§2.3). Furthermore, right-alignment would predict a language where every syllable is stressed (§4.1) and one which bans suffixes but permits prefixes (§4.2). These points are compounded in the discussion of encompassing constraints (§5). As these myriad predictions are all unattested, right-alignment is rejected.

Finally, the scrutiny of alignment in this chapter offers insight into the types of categories which may participate in this process. The prosodic categories argued to align are the prosodic word, foot and syllable; moras are excluded. This is because in valid branches of alignment, such as ALIGN(MCat, PCat), it is unclear what typological predictions, if any, mora alignment would make. McCarthy and Prince's work on alignment came across a similar complication and conjectured that moraic units may be more accurately described as attributes of syllables and segments, rather than independent prosodic units (1993b: 84). This dissertation acknowledges the issue but leaves further study to future work. With respect to MCats, roots are found to participate in alignment, while the concerns surrounding other MCats will be discussed without much resolution. This work does not represent a broad typological study of the issue and so leaves much to future research.

This chapter is organized as follows: the first section looks at MCat-PCat alignment, finding that it is a valid and necessary branch of constraints and provides examples of a root aligning with each type of PCat (§2). However, the inverse relationship, ALIGN-L(PCat, MCat), is argued to make unwanted typological predictions in Section 3. The next section turns to alignment between two PCats, finding that the constraint inventory of this branch must be refined: (non-)head alignment against a higher level PCat bears out, but general alignment, without reference to the head, makes faulty predictions (§4.1). This section also addresses the possibility of alignment of all (non-)head syllables with a prosodic word as a source of the ban on non-head feet, or maximal word size. MCat-MCat alignment is briefly explored in Section 4.2, although many questions remain open as to which types of MCats which can participate in alignment. Finally, encompassing constraints, which essentially require the left and right edges of an MCat to be wholly encompassed by a PCat and have been employed to capture MCat size restrictions in other work, are rejected on several grounds in Section 5. Conclusions are presented in Section 6.

2 MCAT-PCAT ALIGNMENT

2.0 Introduction

MCat-PCat alignment leads to robust typological predictions. This type of alignment predicts cases where every MCat, such as a root, must align with the edge of some PCat, such as a syllable, foot or PrWd. This section illustrates the salience of MCat-PCat alignment by exploring cases where a root is aligned with the left edge of each member of the Prosodic Hierarchy.

Alignment between the root and a foot is examined first, since the foot is the most familiar PCat from previous sections. Root-foot alignment has already been introduced in this dissertation to account for languages like German, where this alignment played a crucial role in some types of Concurrence (Ch4§2.1.2). The case of German, where processes of footing and syllabification are organized with respect to the left edge of the root, will be revisited in Section 2.1. These factors indicate a clear relationship between the root morpheme and foot construction.

Next, alignment between the root and a syllable will be argued for in a reanalysis of the much-discussed case of Northern Italian intervocalic /s/-voicing (§2.2). As argued extensively in previous work (e.g., Nespor and Vogel 1986, Peperkamp 1997), the distribution of [s] vs. [z] is determined by the prosodic organization of the word. The analysis presented here argues that the factor determining voicing is best characterized through root-syllable alignment; neither the traditional root-PrWd alignment nor the alternative root-foot alignment bears out because both would predict unattested stress patterns. Root-syllable alignment provides the prosodic boundary required to account for the distribution of Northern Italian intervocalic /s/-voicing without making the unwarranted predictions contingent in larger PCats.

The final type of MCat-PCat alignment examined here, caused by ALIGN-L(root, PrWd), is found in languages which militate against prefixes. In some languages, this may lead to a ban on prefixes altogether, as in the Eskimo language Yup'ik (Ch4§2.1.3). However, because the prosodic word and the morphological word are frequently coextensive, a ban on prefixes may be due to either root-PrWd or root-MWd alignment (see also §4.2). A less ambiguous example is provided by Korean in Section 2.3, which permits prefixes within the morphological word but forces them outside of the prosodic word. The left edge of the root must align with a

PrWd boundary, so any material preceding the root – e.g., a prefix – is organized into a separate prosodic word, although the prefix and the root together constitute a single morphological word.

2.1 ALIGN-L(root, foot): German

Alignment between the root and a foot is evident in languages where foot construction is influenced by the root morpheme. For example, in German, the initial syllable of native roots is always stressed (Golston and Wiese 1998).[15] This stress pattern indicates that the left edge of the root must align with a trochaic foot. Root-foot alignment has also been employed previously in Ch4§2.1.2 to account for certain instances of minimal root size.

The left edge of native German roots must be aligned with the left edge of a binary foot, which can be seen in two phenomena. First, the initial syllable of a root must bear stress, regardless of the morphological constituency of the word as a whole. Secondly, the left edge of the root forms a distinct prosodic boundary, or crisp edge (Itô and Mester 1999), preventing resyllabification of any elements preceding the root in the prefix. These points are illustrated in the data below, drawn from and Clark and Thyen (1998) and native speaker consultants.

(3) *German roots always stressed on initial syllable*

/zuːx-/ ‘search’	[b□-(ˈzuːx)]	‘visit’
	[(ˈzuː.x-ə)]	‘search’
	[(ˌʊn.tɐ-)(ˈzuː.x-n̩)]	‘to investigate’
/ʔaːtm/ ‘breath’	[(ˈʔaːtəm)]	‘breath’
	[bə-(ˈʔaːt.m-ən)]	‘to ventilate’
	[gə-(ˈʔaːt.m-ət)]	‘breathed’

[15] This generalization does not always hold for non-native roots (Alber 1998); see discussion of loanword faithfulness in Czech in Ch2§5.

/ʔaʀba͡it/ ‘work’	[bə-(ˈʔaɐ̯.ba͡i)t̠-n̩]	‘to handle’
	[(ˌfɛɐ̯-)(ˈʔaɐ̯.ba͡i)(ˌt̠-ʊŋ.-ən)]	‘uses’
	[(ˌyː.bɐ-)(ˈʔaɐ̯.ba͡i)t̠n̩]	‘to rework’

The prosodic structure of German words reveals that there is a distinct and unimpeachable prosodic boundary at the left edge of every root. For one, the regular placement of stress with regard to the root shows that there is alignment between these two categories. (This is distinct from Root-to-Stress (Ch4§2.1.3), which requires the root receive stress somewhere but does not otherwise interact with the prosodic structure.) Root-foot alignment competes with other prosodic constraints, such as one requiring all syllables to be parsed into feet.

(4) *Foot is aligned with the root, not the PrWd*

Align every root with the left edge of a foot » Parse all syllables into feet

/be-aʀba͡it-en/	ALIGN-L(root, Ft)	PARSE-σ
Λ a) [bə(ˈʔaɐ̯.ba͡i)t̠n̩]		*
b) [(ˌbe.aɐ̯)(ˈba͡i.t̠n̩)]	*!	

German roots may also be seen to align with a prosodic boundary because they have a “crisp” left edge (Itô and Mester 1999), blocking resyllabification and forcing onset epenthesis. The crisp alignment of German roots is visible in the coda vocalization of /ʀ/ to [ɐ̯] in the prefix and the root-initial onset glottal stop epenthesis in words such as /fɛʀ-aʀba͡it-ʊŋ-ən/ → [(ˌfɛɐ̯)(ˈʔaɐ̯.ba͡i)(ˌt̠ʊŋ.ən)] ‘uses’, *[(ˌfɛ.ʀaɐ̯)(ˈba͡i.t̠ʊŋ.ən)] (Hall 1992). These outputs can be compared with a mono-morphemic near-match such as /ɛːʀa/ → [(ʔɛː.ʀa)] ‘era’, *[(ʔɛːɐ̯)ʔa], where the onset sequence [ʀa] is not avoided. Resyllabification between the prefix and the root is blocked because the root must align with a prosodic boundary.

In summary, the prosodic structure of the word can reveal root-foot alignment. When stress must regularly fall on a certain syllable of the root, then ALIGN-L(root, foot) is in play. Similar phenomena are never found at the right edge of the root: the right edge of the root never forms a crisp edge for processes of syllabification, as the left root edge does in German. Equally, no language assigns stress with respect to the right edge of the root. An example of this would be a language where stress consistently fell on the final syllable of the *root*. Of course, there are languages where stress falls on the final syllable of the *prosodic word*, like French; see §4.1 for further discussion. The absence of such languages suggests that right edge alignment is not valid.

The next section examines alignment between a root and the second prosodic unit, the syllable.

2.2 ALIGN-L(root, syllable): Northern Italian

Alignment between the root and a syllable boundary is a more subtle proposition than the root-foot alignment discussed in the preceding section. Root-syllable alignment can be isolated as a unique phenomenon when a root clearly aligns with a prosodic boundary, but the prosodic unit in question cannot be a PrWd or foot. This section argues that this is precisely the basis of the much-discussed case of Northern Italian intervocalic /s/-voicing. There is a distinct prosodic boundary between the left edge of a root and a preceding prefix, but this boundary cannot be that of a prosodic word, since the prefix and root form a single unit with respect to stress assignment, and it cannot be a foot, because stress is assigned independently of the root morpheme boundaries (Saltarelli 1970, Canepàri 1999). Root-syllable alignment alone can account for the voicing facts in Italian while avoiding the unmotivated predictions of alignment with a different prosodic unit.

In Northern Italian dialects, there is intervocalic voicing in certain well-defined environments (Nespor and Vogel 1986, Kenstowicz 1996, Peperkamp 1997, van Oostendorp 1999, Krämer 2005). Firstly, [s] never occurs intervocalically within a morpheme; the intervocalic [s] in other dialects surfaces as [z] in Northern Italian (5a). Equally, a root-final alveolar strident preceding a vowel-initial suffix is also always voiced (b). However, in (c), an underlying /s/ in root onset position following a vowel-final prefix – again putting the /s/ in intervocalic position – is not voiced. Yet when an /s/-final prefix precedes a vowel-initial root, intervocalic voicing is again undertaken (d). The data is based on Nespor and Vogel (1986: §4.2.2.2).

(5) *Northern Italian intervocalic s/z distribution*

a. [z] *within a morpheme*

[a.ˈzo.l-a]	'button hole'	[a.ˈzi.l-o]	'nursery school'

b. [z] *between a root and suffix*

[ˈka.z-e]	'house'-Pl	[ka.ˈz-i.n-a]	'house'-DIM

c. [s] *root-initially*

[a.-so.ˈt͡ʃ-a.l-e]	'asocial'	[la .si.ˈrɛ.n-a]	'the siren'
[lo .sa.ˈpe.-vo]	'I knew it'	[ga.tːo .s͡ia.ˈm-e.s-e]	'Siamese cat'

d. [z] *in prefix-final position, preceding an onsetless root*

[di.z-ˈar.m-o]	'disarmament'	[di.z-o.ˈnɛ.st-o]	'dishonest'
cf. [dis.-pre.-mu.n-ˈir.-si]		'dis-pre-arm oneself'	

Within a single morpheme, there are no cases of intervocalic [s] in Northern Italian. This gap could be caused by several different factors, such as deletion or change in manner or place of articulation, but the intervocalic voicing in prefixes (c) as well as comparison with other dialects of Italian suggests that /VsV/ becomes [VzV]. Intervocalic voicing is well-attested cross-linguistically and is motivated here by the constraint *VsV. Because there is no direct evidence for underlying intervocalic /s/ within a single morpheme in Northern Italian, the input here is hypothetical. (See Krämer (2005) for discussion of why /s/ alone undergoes intervocalic voicing in Northern Italian.)

(6) *Intervocalic* /s/*-voicing*

Don't have intervocalic [s] » Don't change voicing

ʔ/ason-a/	*VsV	IDENT(voice)
Λ a) [a.ˈzona]		*
b) [a.ˈsona]	*!	

However, when a root-initial /s/ is preceded by a vowel-final prefix, intervocalic voicing does not occur: [a.-so.ˈt͡ʃa.l-e], *[a.-zo.ˈt͡ʃa.l-e]. Enforcing voicing in this environment would require the root onset to be linked across the syllable boundary to the previous segment of the prefix via its [voice] feature:

(7) (a) a s o | | | [+vd] [-vd] [+vd] (b) a z o \|/ [+vd]

If the left edge of the root must align with a crisp prosodic boundary (Itô and Mester 1999), then voicing will be blocked. This prosodic boundary prevents double linking across the morpheme boundary and the voicing it produces.

(8) *Intervocalic* /s/*-voicing blocked in root onsets*

Align root with syllable » Don't have intervocalic [s] » Don't change voicing

/a-sotʃ-al-e/	ALIGN-L(root, σ)	*VsV	IDENT(voice)
a) [{a.zo.ˈt͡ʃa.le}]	*!		*
Λ b) [{a.so.ˈt͡ʃa.le}]		*	

This alignment-based analysis is similar to previous works, many of which attribute the crisp edge blocking to a prosodic word boundary, instead of a syllable as in this analysis (Nespor and Vogel 1986, Peperkamp 1997, van Oostendorp 1999, Krämer 2005; see also Krämer 2005 for discussion and rejection of the Output Faith account in Kenstowicz (1996)). The prefix is supposed to form its own prosodic word, separate from the prosodic word which aligns with the root morpheme: [{a}{so.ˈt͡ʃa.le}].

This approach does not bear out for two reasons: 1) the disenfranchised prefix would not meet Italian's minimal PrWd size (Canepàri 1999); and 2) the prefix and root form a single domain for stress, which is standardly equated with a prosodic word (Nespor and Vogel 1986). Turning to the first point, Italian enforces a minimal PrWd size of one foot, which is unviolated throughout the language. Words consisting of a single light syllable cause gemination of the following onset (Canepàri 1999: §5.6.4).[16] This gemination in turn causes the syllable to be heavy, and so every Italian

[16] The minimal size restriction does not apply to function words, so they must not force gemination of the following onset: /di lana/ → [dilana], *[dillana] 'of wool' (Canepàri 1999; see Selkirk (1995) for

word is at least one foot in length. This is illustrated by the following data, from Canepàri (1999: 171). Saltarelli (1970) states that all monosyllabic roots must be stressed and this gemination does not alter the stress pattern; therefore, each root must form its own prosodic word.

(9) *Italian subminimal roots augmented to meet minimal size*

/sa tutː-o/	→	[{sat}{tu.tːo}]	'(he) knows everything'
/tɛ fredː-o/	→	[{tɛf}{fre.dːo}]	'cold tea'
/blu mar-e/	→	[{blum}{ma.re}]	'blue sea'

In many cases, a prefix which would be forced to form its own prosodic word would not meet this minimal size requirement. This is not only an unusual and unmotivated environment in which to allow an exception to the minimal word size, but it is also unnecessary given the more adequate account provided by root-syllable alignment here. The data below illustrates that prefixes do not trigger gemination to produce a minimal prosodic word size.

(10) *Disenfranchising the prefix should trigger gemination*

/a-sot͡ʃ-al-e/	→	[{a.so.ˈt͡ʃa.le}]	'asocial'	*[{ˈas}{so.ˈt͡ʃa.le}]
/bi-sɛsː-ual-e/	→	[{bi.sɛ.sːu.ˈa.le}]	'bisexual'	*[{ˈbis}{sɛ.sːu.ˈa.le}]

A subminimal PrWd like [{a}] or [{bi}] should trigger gemination of the following onset, just like the subminimal inputs in (9). Of course, geminate [sː] is allowed in Italian: e.g., [t͡ʃi.ˈprɛs.s-o] 'cypress tree'. The lack of gemination suggests that the prefixes do not constitute their own prosodic word.

Secondly, the formation of two separate prosodic words is disputed by the assignment of stress in the language. Generally, Italian stress falls on the penult, else on the antepenult when the penult is light; some stress is also lexically based (Saltarelli 1970: §3.4.2). Prefixes and roots form a single domain for stress, regardless of whether or not the root happens to begin in /s/. This is evident in a word like [{an(ˈti-fra)zi}] 'antiphrasis', where the light penult forces stress to retract to the

discussion of content vs. function words). Canepàri does not address how the process of gemination is affected when the following word is onsetless.

antepenultimate syllable, which happens to be a constituent of the prefix (Reynolds 1985). The words in (9) also form a single domain with respect to stress. One of the central definitions of a PrWd is its role as a prosodic domain (Nespor and Vogel 1986), and so the unified prosodic structure of prefixes and roots points to a single prosodic word.

Likewise, the crisp edge blocking intervocalic voicing cannot be due to root-foot alignment. This is again illustrated by the data in (9): just as prefixes and roots form a single prosodic domain, stress assignment ignores the morphological boundaries of the root. If the root must align with a foot, then it would be expected for feet, and so stress, to be constructed with respect to this boundary. As this is not the case, root-foot alignment is also discounted. Therefore, in order to represent the prosodic boundary between roots and prefixes, a crisp syllable boundary caused by ALIGN-L(root, σ) is preferred to root-PrWd or root-foot alignment.

The final twist in Northern Italian /s/-voicing, where voicing occurs between the prefix and the root when the prefix ends in /s/ and the root is vowel initial (5d), can be straightforwardly attributed to the constraint ONSET. While root-syllable alignment can block voicing in certain cases, it can itself be blocked when this crisp edge would force the syllable to emerge without an onset.

(11) *Violation of root-syllable alignment forced in onsetless syllables*

[di.ˈz-ar.m-o]	‘disarm’	cf. [ˈar.m-o]	‘arm’
[di.z-o.ˈnɛ.st-o]	‘dishonest’	cf. [o.ˈnɛ.st-o]	‘honest’

A syllable will doubly link to the coda of a preceding morpheme to avoid surfacing without an onset, even though this results in less than perfect root-syllable alignment. This process can be seen in the following tableau, which accounts for intervocalic /s/-voicing despite the root boundary.

(12) *Root-syllable alignment violated to provide onset*

Syllables have an onset » Align root with syllable » Don't have intervocalic [s]

/dis-arm-o/	ONSET	ALIGN-L(root, σ)	*VsV
Λ a) [{di.ˈzar.mo}]		*	
b) [{dis.ˈar.mo}]	*!		*

In conclusion, the blocking of intervocalic s-voicing at the left edge of the root is best attributed to alignment of the root with a syllable boundary. This can account for the required crisp edge without the unnecessary baggage of root-PrWd or root-foot alignment. Like all constraints, ALIGN-L(root, σ) can be violated, as in Italian when the syllable would otherwise surface without an onset.

Similar effects involving alignment of the right edge of the root boundary do not bear out. This alignment would block resyllabification between a consonant-final root and a vowel-initial suffix, predicting that the suffix be subject to onset epenthesis /VC-V/ → [VC.ʔV] or the root might undergo coda-devoicing, e.g., /Vd-V/ → [Vt.V]. However, such right edge effects do not seem to exist, again implying the absence of ALIGN-R constraints.

The next section discusses alignment of a root with the final prosodic category, the prosodic word.

2.3 ALIGN-L(root, PrWd): Korean

Alignment of the left edge of the root with a prosodic word affects the status of material which would normally surface to the left of the root, such as prefixes. In some languages, such as Yup'ik, this restriction may result in an outright ban on prefixes (Ch4§2.1.3; also see §4.2). Another example is provided by Korean, which ensures alignment between the root and a prosodic word by forcing any material to the left of a root – such as a prefix or a second root constituting a compound word – to form its own prosodic word. In this way, each root is aligned with the left edge of a PrWd, even though this requires the morphological word to be broken up into multiple prosodic words (Kim 1992).

Korean has several phonological processes which help demarcate PrWd boundaries (Martin 1954, Kim 1992): i) in derived forms, a coronal stop palatalizes before a high front vowel; ii) in derived forms, the vowel [ɯ] deletes when adjacent to another vowel or following a lateral; and iii) in all forms, syllable-final obstruents are neutralized to an unreleased plain stop (e.g., /t tʰ t' s t͡ʃ etc./ → t̚]$_{\sigma}$), among other pointers. The data below use these three indicators to show that each root coincides with a prosodic word boundary at its left edge (Kim 1992: 153-4; word for 'male crane' provided by Seunghun Lee, p.c.). Between a prefix and a root or two compounded roots, the derivational processes i) and ii) fail to apply, while iii) does apply, showing that the given segment is in the syllable coda rather than resyllabifying into the onset of the following syllable.

(13) *Korean phonological processes show PrWd boundary at left edge of root*

i) /t/-*palatalization occurs PrWd internally*

/patʰ-i/	→	[{pa.t͡ʃʰi}]	'field'-Nom	
/mat-hjʌŋ/	→	[{{mat̚}{hjʌŋ}}]	'eldest brother'	*[{ma.t͡ʃʰjʌŋ}]
/patʰ-ilaŋ/	→	[{{pat̚}{i.ɾaŋ}}]	'ridge of the field'	*[{pa.t͡ʃʰi.ɾaŋ}]

ii) [ɯ]-*deletion occurs PrWd internally*

/into-ɯlo/	→	[{in.do.ɾo}]	'India'-Loc	
/su-ɯakse/	→	[{{su}{ɯ.ak̚.se}}]	'male crane' (dialect)	*[{su.ak̚.se}]
/into-ɯmak/	→	[{{in.do}{ɯ.mak̚}}]	'Indian music'	*[{in.do.mak̚}]

iii) *Obstruent neutralization occurs at PrWd boundary*

/os-i/	→	[{o.si}]	'clothes'-Nom	
/tʌs-os/	→	[{{tʌt̚}{ot̚}}]	'additional clothes'	*[{tʌ.sot̚}]
/os-ip/	→	[{{ot̚}{ip̚}}]	'to wear clothes'	*[{o.sip̚}]

Korean prefixes are bound morphemes which must attach to a root, while compound roots form a single semantic unit (Kim 1992). Aligning the root with the prosodic word in this manner forces the MWd to be broken into separate PrWds. An analysis of how this data indicates root-PrWd alignment is now provided.

Korean allows resyllabification between morphemes within a single PrWd in order to achieve the optimal prosodic structure by satisfying constraints like ONSET. The following tableau shows how a root segment can be syllabified into the onset of a suffix. The strident [s] must be in the onset of the following syllable, because Korean neutralizes all segments to a simple obstruent in coda position [t˺]$_{\sigma}$. The root coincides with the left edge of the prosodic word in both candidates, vacuously satisfying ALIGNment.

(14) *Resyllabification within a PrWd*

All roots align with left edge of PrWd, Syllables have an onset

	/os-i/	ALIGN-L(root, PrWd)	ONSET
Λ	a) [{o.si}]		
	b) [{{ot˺}{i}}]		*!

However, this resyllabification does not occur between a root and a prefix. Instead, standard coda neutralization takes place, indicating that the two morphemes are separated by a prosodic boundary. The left edge of the root must align with a prosodic word boundary, so the prefix material is shunted into a separate prosodic word.

(15) *No resyllabification between PrWds I: Prefixes*

All roots align with left edge of PrWd » Syllables have an onset

	/tʌs-os/	ALIGN-L(root, PrWd)	ONSET
	a) [{tʌ.sot˺}]	*!	
Λ	b) [{{tʌt˺}{ot˺}}]		*

Equally, resyllabification cannot occur between two roots making up a compound word. Again, it is blocked by the pressure for each root to be properly aligned with its own prosodic word.

(16) *No resyllabification between PrWds II: Compounds*

All roots align with left edge of PrWd » Syllables have an onset

/os-ip/	ALIGN-L(root, PrWd)	ONSET
a) [{o.sip˺}]	*!	*
Λ b) [{{ot˺}{ip˺}}]		**

Breaking a single MWd into multiple PrWds violates the constraint WRAP(MWd, PrWd), which bans such a mismatch (Peperkamp 1997, Truckenbrodt 1999, 2006). Clearly, root-PrWd alignment and constraints preserving the prefix outrank the impetus for an MWd to be parsed into a single PrWd. (The prefix could be preserved through a constraint such as MAX or REALIZEMORPH; this preservation is simply represented here with the constraint PREFIX.)

(17) *MWd breaks into multiple PrWds*

All roots align with PrWd, Prefix preserved » Don't break up MWds

/tʌs-os/	ALIGN-L (root, PrWd)	PREFIX	WRAP (MWd, PrWd)
a) [{tʌ.sot˺}]	*		
b) [{ot˺}] / [{ot˺.tʌt˺}]		*!	
Λ c) [{{tʌt˺}{ot˺}}]			*

In conclusion, ALIGN-L(root, PrWd) is a salient constraint illustrated by Korean, where pre-root material is obliged to form a separate prosodic word. However, the same constraint cannot refer to the right edge of the root. There is no anti-Korean language, where suffixes must form their own prosodic word, as Korean does for prefixes here.

2.4 Conclusions

This section found that the ALIGN-L(PCat, MCat) family of constraints, represented by the constraints ALIGN-L(root, Ft), ALIGN-L(root, σ) and ALIGN-L(root, PrWd), is necessary to account for the linguistic typology. Importantly, these constraints do not make any unwarranted typological predictions. Moreover, this section provided evidence that PCat-MCat alignment can only refer to the left edge, but never the right edge.

The constraints explored in this section refer to cases where *every* member of a PCat must align with *some* member of an MCat. The next section argues that the inverse relationship, where *every* member of an MCat must align with *some* member of a PCat, makes incorrect typological predictions and is therefore invalid as a family of constraints.

3 PCAT-MCAT ALIGNMENT

Constraints which require *every* PCat to align with *some* MCat are rejected here because they make unattested predictions or are unnecessary. Key here is the difference between *every* and *some*: while the previous section found that ALIGN(∀MCat, ∃PCat) was valid, this section argues that ALIGN(∀PCat, ∃MCat) is not. The permutation allowed by OT requires a potential constraint to make legitimate typological predictions in any potential ranking. When a constraint fails this test, then it is deemed invalid or at the very least subject to intense skepticism.

The systems predicted by PCat-MCat alignment superficially resemble a maximal size restriction. For example, if all feet must align with the root, then all roots (indeed, all content words) will be at most one foot long. However, syllable-root alignment predicts a language where every word is at most a single light syllable, an unattested system. The other types of alignment, foot-root and PrWd-root, do not make unwanted predictions but neither do they account for the full crosslinguistic typology of maximal size or make any unique contribution to CON. A ban on non-head feet equally predicts maximal size restrictions, without the undesirable predictions incumbent in PCat-MCat alignment. Cumulatively, ALIGN(PCat, MCat) is rejected because of its untoward predictions, while any potential predictive power of the constraints can be captured through other means.

Again using roots as a token MCat, alignment with each member of the Prosodic Hierarchy will be explored here and subsequently rejected. Because these constraints are invalid and therefore unsupported by data, schematic inputs are employed.

- *ALIGN-L(σ, root)*

The constraint ALIGN-L(σ, root) predicts a language where every word consists of a single light syllable. There are no languages like this. While there are languages that require one syllable per word, like Ancient Thai (Brown 1965), they *always* allow heavy syllables. The current proposal avoids this unwanted prediction by accounting for isolating languages through a ban on non-head feet, which permits heavy syllables.

The constraint ALIGN-L(σ, root) may be coupled with a ban on heavy syllables to produce a language where every prosodic word consists of a single light syllable, which is an unattested system.

(18) *Unattested maximal word size of a single light syllable*

All syllables aligned with root, Codas and long vowels banned » Don't delete

/CVCV/	ALIGN-L(σ, root)	NO-CODA	*V:	MAX
a) [($CV_{\mu}.CV_{\mu}$)]	*!			
b) [($CV_{\mu}C_{\mu}$)]		*!		
c) [($CV\!:_{\mu\mu}$)]			*!	
Λ d) [(CV_{μ})]				*

A language with a maximal PrWd size of a single light syllable is unattested. Natural languages with a monosyllabic maximal size require every word to be a *heavy* syllable, suggesting that the words are compounding a maximal size of one binary foot with the requirement that all stressed syllables be heavy. A system such as Ancient Thai could be described by the ranking *FT-, PARSE-σ, STRESS-TO-WEIGHT, TROCHEE » MAX without unnecessarily predicting a typology with a maximal size of a single light syllable. Isolating languages can be accounted for under the current approach without the false predictions of ALIGN-L(σ, root). Therefore, syllable-root alignment is rejected for making typological predictions not reflected in natural language.

- *ALIGN-L(Ft, root)*

A constraint aligning every foot with the left edge of a root would result in a language where every content word is coextensive with a single root at most one foot long, or has a left-aligned root with a class of short suffixes, so long as root plus suffix are less than or equal to one foot. A maximal PrWd size of one foot is predicted through a constraint ranking such as PARSE-σ, ALIGN-L(Ft, root) » MAX, REALIZEMORPH. This type of language is attested and is commonly referred to as an isolating language, like Ancient Thai (Brown 1965) or Vientiane Lao (Morev, Moskalev and Plam 1979). In isolating languages, this constraint behaves similarly to the ban on non-head feet which is argued to be responsible for maximal size restrictions in this dissertation, with both resulting in a maximal word/root size of one foot. Since a maximal PrWd size of one foot can be equally predicted by *FT-, foot-root alignment is unnecessary.

- *ALIGN-L(PrWd, root)*

The final type of alignment discussed here requires every prosodic word to abut with the left edge of a root. In and of itself, this constraint has very limited predictive power and does not lead to any unattested systems. The main prediction of ALIGN-L(PrWd, root) is a language which bans prefixes. This is a salient prediction, as in Yup'ik (Ch4§2.1.3), but this is also equally predicted by its inverse, ALIGN-L(root, PrWd).

However, this constraint does not predict other types of responses militating against prefixes. For example, §2.3 found that Korean prefixes are split into separate PrWds so that the root may align with a PrWd boundary. This response would violate ALIGN-L(PrWd, root): *every* prosodic word must align with a root, so a PrWd consisting of just affix material, as in Korean, would not satisfy PrWd-root alignment. Therefore, the functions of ALIGN-L(PrWd, root) are fully subsumed under ALIGN-L(root, PrWd), while the latter also has greater predictive power. The former constraint is unnecessary and inadequate.

This section has argued that ALIGN(PCat, MCat) constraints are undesirable or at least unnecessary, in some cases overpredicting and other cases underpredicting linguistic typologies. Equally important, the valid predictions of these constraints can all be achieved through other means, so PCat-MCat alignment does not add any unique value to CON. Therefore, the entire family of ALIGN(PCat, MCat) constraints is rejected, significantly limiting and refining the power of alignment. The next section looks into ALIGN(PCat, PCat) and ALIGN(MCat, MCat) constraints, finding that they, too, are subject to limitations.

4 PCAT-PCAT AND MCAT-MCAT ALIGNMENT

Alignment between two PCats or two MCats does not typically have any effect on PrWd or root size restrictions, the subject of this dissertation. Aligning two PCats with respect to one another will affect the prosodic structure of the output, while aligning two MCats has implications for the morphology. Solely in order to complete the typology of ALIGNment begun in Sections 2 and 3, PCat-PCat and MCat-MCat alignment are briefly addressed here. The main aim of this section is to provide a starting point for future exploration into the implications of the present theory in areas other than morphological size requirements.

One contribution of the current work is the emphasis on head vs. non-head categories. It will be argued that constraints aligning a head or non-head PCat, like a syllable, against a higher level PCat, such as a foot, are desirable (§4.1). The standard formation, aligning *all* members of a PCat with some edge of another PCat, is argued to be unnecessary and in some cases to overpredict. Moreover, it will be proposed that the ban on non-head feet may also be characterized by alignment of all (non-)head syllables with the edge of a prosodic word, which can limit the PrWd to a single foot.

Section 4.2 will look at MCat-MCat alignment, finding that much remains open to question until those MCats participating in alignment are better understood.

For the time being, alignment of roots is affirmed, while directions for future research into MCat alignment are outlined.

4.1 PCat-PCat Alignment

Alignment between syllables, feet and the PrWd is commonly employed to account for the stress patterns of a given language. Recently, the predictive power of this branch of the ALIGN family has been much enhanced by the introduction of Categorical Alignment (McCarthy 2002b) and Rhythmic Licensing constraints (Kager 1999, 2006, Alber 2002), which also eliminate the need for right-aligned constraints in the characterization of stress. This section examines PCat-PCat alignment constraints in light of the findings of this dissertation, in particular the role of head and non-head constituents in prosody. Possible creation of a maximal prosodic size restriction through (non-)head syllable-prosodic word alignment will also be discussed.

It is argued here that a head or non-head PCat may be aligned with respect to a higher-order PCat. That is, head and non-head syllables may be aligned with respect to the left edge of a foot, head and non-head feet may be aligned with respect to the left edge of a prosodic word, and head and non-head syllables may be aligned with respect to the left edge of a prosodic word. ALIGNment constraints are also enhanced through Categorical Alignment, which introduces a new way of assigning alignment violations (McCarthy 2002b). Alignment in terms of different prosodic units – (mis)alignment on the order of a segment, syllable or foot – is employed. Violations are assigned non-gradiently: either the unit is properly aligned, or it is not. Equally, Rhythmic Licensing argues that the typology of stress systems can be accounted for by employing left-alignment constraints and independently motivated constraints on clash and lapse – but not right-alignment constraints (Kager 1999, 2006, Alber 2002).

Alignment of a (non-)head avoids the problems that arise when the PCat is not specified as being head or non-head. For example, if *every* syllable must align with *some* foot boundary, then a system where each foot is a single syllable is predicted. Only one syllable can be properly aligned with the edge of the foot, so each foot would have a single syllable, an unattested stress pattern. Similarly, a constraint compelling every foot, without reference to headedness, to align with the left edge of the prosodic word is unnecessary. This constraint would predict a prosodic word with a maximum size of one foot, since any other feet would not be properly aligned. This same result can be achieved through a ban on non-head feet (§4.1, Ch3§3), and so the constraint ALIGN(Ft, PrWd) – coupled with the poor predictions of its relative, ALIGN(σ, Ft) – is unwarranted. The converse relationship, requiring *every* foot to align with *some* syllable or *every* PrWd to align with *some* foot, essentially restates the theory of Headedness (Selkirk 1984, Nespor and Vogel 1986, Selkirk 1995). Therefore, head reference is necessary for PCat-PCat alignment constraints. McCarthy and Prince's work on alignment also incorporated reference to head PCats, albeit to a lesser extent (1993b).

Aligning a head syllable with respect to the left edge of a foot (ALIGN-L(σ^+, Ft)) leads to a trochaic foot [($\sigma^+\sigma^-$)], while aligning a non-head syllable with the left edge of a foot (ALIGN-L(σ^-, Ft)) produces an iambic foot [($\sigma^-\sigma^+$)]. The two foot types are both derived by constraints referring to the left edge. There are no constraints that refer to the right edge: iambs are *not* produced by a constraint such as ALIGN-R(σ^+, Ft). The ban on right-alignment is necessary. If both ALIGN-R(σ^+, Ft) and ALIGN-L(σ^+, Ft) were active, the result would be a language where every foot is a single (head) syllable, (σ^+)(σ^+)(σ^+). Such a system is unattested (Hayes 1995, Hyde 2002). This provides further evidence that right-alignment is impossible. Because there is only one (non-)head syllable per foot, constraints aligning *every* (non-)head syllable with *some* foot or *every* foot with *some* (non-)head syllable have the same effect.

Aligning a head or non-head foot with respect to the prosodic word can help characterize stress patterns, along with Categorical Alignment (McCarthy 2002b) and Rhythmic Licensing constraints (Kager 1999, 2006, Alber 2002). Incorporating reference to head and non-head feet may allow characterization of the full typology of stress systems, including secondary stress. Because of the typological complexity of stress, a deeper inquiry is avoided here so as to not deviate from the main goals of this dissertation. However, it is suggested here that the perspective of (non-)head foot alignment could result in Ussishkin's (2000) maximal word size of two feet – a single head and a single non-head foot, with other feet expelled through alignment violations. As for syllables and feet above, there is only one head foot per PrWd, so the order of the constituents is irrelevant.

Constituent ordering becomes important when more than one smaller PCat may be found in the larger PCat, as for syllables and prosodic words, where each PrWd may have multiple (non-)head syllables. Both types of alignment – ALIGN-L(PrWd, $\sigma^{+/-}$) and ALIGN-L($\sigma^{+/-}$, PrWd) – lead to salient predictions. The former characterizes the known stress typology that trochees can be arrayed from left-to-right or right-to-left, but iambs may only be constructed left-to-right. If every PrWd must begin with a head syllable, then left-to-right trochees are produced: $[\{(\sigma^{+}\sigma^{-})(\sigma^{+}\sigma^{-})\sigma^{-}\}]$. If every PrWd must begin with a non-head syllable, then right-to-left trochees, $[\{(\sigma^{-}(\sigma^{+}\sigma^{-})(\sigma^{+}\sigma^{-})\}]$, or left-to-right iambs, $[\{(\sigma^{-}\sigma^{+})(\sigma^{-}\sigma^{+})\sigma^{-}\}]$, are produced. However, there is no ALIGNment constraint which would force the PrWd to begin with *two* non-head syllables, as required for (unattested) right-to-left iambs, $*[\{(\sigma^{-}(\sigma^{-}\sigma^{+})(\sigma^{-}\sigma^{+})\}]$. Therefore, head-reference plays an important role in characterizing cross-linguistic stress patterns.

The inverse alignment, where *every* (non-)head syllable must align with *some* prosodic word, may produce another strategy for obtaining a maximal size restriction. For instance, if *every* (non-)head syllable must be aligned with the left edge of the PrWd, then there will be a single (non-)head syllable and so a single foot. On many counts, syllable-PrWd alignment coincides with the maximal size predictions of *FT-. One way in which they differ is that the latter predicts a maximal size of [σFtσ], where the foot may have any acceptable binary shape. ALIGNment only predicts an output where the isolated foot has reason to be drawn away from the PrWd edge, such as stress attraction to a heavy foot $[\sigma(\sigma_{\mu\mu})\sigma]$ through a ranking WEIGHT-TO-STRESS, *LAPSE » ALIGN-L(Ft^{+}, PrWd) » Faith » PARSE-σ. A maximal size with a disyllabic foot is not predicted through alignment alone *[σ(σσ)σ]; a constraint ranking forcing the PrWd to align with a non-head syllable under (non-gradient) Categorical Alignment, which would equally penalize all feet at least one syllable from the PrWd edge, the misaligned output [σ(σσ)σ] would be otherwise indistinguishable from a more faithful output, e.g., *[σσσσ(σσ)]. Whether or not one account of maximal size proves to be superior to the other will be elucidated by future study into the typology of maximal size. For now, the constraint *FT- is employed in order to make the prosodic foundation of the maximal size restriction more transparent.

In summary, PCat-PCat alignment appears to be valid on many levels, provided that the (non-)head of the subordinate unit is aligned against the superordinate unit. Future research will provide better understanding into the alignment of two prosodic categories.

4.2 MCat-MCat Alignment

Roots have been the focus of this work, so their role in alignment has been illustrated multiple times. This section discusses the relevance of other MCats, like morphological words, affixes, stems or classes of roots like nouns and verbs. The arguments surrounding each class of MCat, including diagnostics for determining their role in alignment, are discussed below. Since MCat-MCat alignment is not generally relevant to prosodic size restrictions, discussion is limited.

Alignment of a morphological word is difficult to isolate because in many cases the MWd is coextensive with a PrWd. For example, the Southern Wakashan language Nuuchahnulth bans prefixes but has a class of left-oriented infixes which fall as far left as possible without intervening between alignment of the root and the word, while also complying with the language's ban on onset consonant clusters (Swadesh 1939, Haas 1972, Nakayama 2001, Stonham 2004). This case clearly shows root-word alignment triggering a violation of LINEARITY after Horwood (2002), but it is ambiguous *which* word the root must align with: the PrWd and the MWd are coextensive in Nuuchahnulth so alignment with either one would produce the same pattern. Root-PrWd alignment has already been argued for in §2.3, so this is a distinct possibility.

An indisputable case of MWd-root alignment would first require a mismatch between the MWd and the PrWd. Root-MWd alignment would be illustrated by a language where the root clearly aligns with the MWd, somewhat of an inverse of the Korean case arguing for root-PrWd alignment in §2.3. Alignment between the MWd and a PCat, for instance MWd-foot alignment, would be evident in a language where the footing patterns are predicated on a morphological word boundary (distinct from the PrWd or root boundary), on the order of German in §2.1. As argued for roots in Ch4§2, MWds could only acquire a prosodic size restriction through Concurrence.

Alignment of individual affixes has been employed in some analyses (e.g., McCarthy and Prince 1993b, Yu 2003), although this leads to problematic typological predictions. If every affix were left-aligned and higher-ranked than root-MWd alignment, this would predict a language with prefixes but no suffixes whatsoever. Since there are numerous languages which ban prefixes, but none banning suffixes (except languages with no affixation whatsoever; Greenberg 1957, Bye and de Lacy 2000), affix alignment makes unwanted predictions. A competing solution is put forth by Horwood (2002), who argues that morphemes, including affixes, are ordered in the input, and that disrupting this order leads to a violation of LINEARITY. This approach accounts for the prefix-suffix dichotomy, which is beyond the grasp of affix alignment. That is, root-word left-alignment may dislodge prefixes and result in their loss, but there is no equivalent right-edge force which can ban suffixes. The unwanted system of a language banning suffixes but permitting prefixes would also be predicted by a constraint aligning the right edge of every root with the word, providing further evidence against right-alignment.

Finally, the participation of sub-classes of roots, such as a noun or root, should be relatively straightforward to confirm or condemn. For example, if a language bans prefixes with nouns but not with verbs, this would be a clear indicator of independently rankable noun-word vs. verb-word alignment. However, noun/verb differences can also be due to external factors. In Shipibo, nouns have a minimal size of one foot, while verbs can be as small as a single syllable. This is due to nouns being able to surface as a bare root, while verbs are all bound roots and so can be smaller while still permitting the PrWd to reach its minimum size (Ch3§2.2). This point is reinforced by Czech maximal size (Ch4§2.2), where different roots have different size requirements based on their morphology, which are not evenly divisible into classes of nouns vs. verbs.

To sum up, the alignment of MCats still requires much research. This dissertation advances participation of roots in processes of alignment, but leaves the role of other MCats open to debate.

4.3 Conclusions

This section has provided an overview of the issues facing PCat-PCat and MCat-MCat alignment. The main issues identified here are the necessity of reference to (non-)heads in PCats and the lingering questions surrounding MCat units and their participation in alignment. Most relevant to other aspects of the theory presented in this dissertation, the possibility of a maximal size restriction through (non-)head syllable-PrWd alignment was briefly explored. The next section looks at a final type of alignment, the so-called encompassing constraints.

5 ENCOMPASSING CONSTRAINTS

Another approach which has been employed to account for root size restrictions are those which say a root morpheme must be coextensive with a given PCat, dubbed here "encompassing" constraints. Examples of these are constraints such like "ROOT = FOOT" (e.g. McCarthy and Prince 1986), CONTAIN(root, Ft) ("Every root is contained within a foot"; Golston and Wiese 1998) or WRAP(root, Ft) ("Every root is wrapped in a foot"; extending a proposal by Truckenbrodt 1995, originally WRAP(XP, PPh)). While it is true that several of the concurrent environments depicted in Ch4§2 rely on a situation where an MCat is coextensive with an PCat, this is a product of external factors rather than a triggering condition. Moreover, this MCat-PCat coincidence only holds in certain cases of Concurrence

Encompassing constraints vary as to how they relate to alignment. Golston and Wiese's (1998) CONTAIN is used to account for minimal and maximal root size in German (where all roots are exactly one foot), so this constraint can essentially be interpreted as a template, forcing the left and right edges of the root to align with a binary foot boundary. The same goes for a constraint ROOT = FOOT, although these constraints are typically employed to capture a phonotactic generalization without detailing how such a constraint actually works. The WRAP constraint would require an MCat to fall within a PCat, but not necessarily to coincide with it, based on extension of Truckenbrodt's (1995) proposal with respect to other morphosyntactic and phonological categories. This constraint would resemble a constraint "ROOT ≤ FOOT". Each of these approaches more or less originate from templatic morphology and McCarthy and Prince's use of the term "MCat = PCat" for certain aspects of Prosodic Morphology (1986). Whether the authors intended this as a true constraint or as a placeholder until other aspects of Prosodic Morphology could be further developed is unclear. Even so, the arguments discussed below hold for any variety of encompassing constraint.

- *Encompassing constraints overpredict*

Encompassing constraints overpredict because they set no limits on when or where root size restrictions may arise. In theory, a language may simply stipulate that each root is exactly one foot long through an encompassing constraint. However, the author is unaware of a case where a root size restriction cannot be traced back to a case of Concurrence like those described in Ch4§2. It is unattested for a language to be able to produce a minimal or maximal root size any time, anywhere, which is not in some way independently motivated through the prosody and Concurrence. For a language to do so, as predicted by encompassing constraints, would massively over-generate minimal and maximal root size phenomena.

- *Encompassing constraints underpredict*

Encompassing constraints stipulate that a given MCat should have a certain prosodic size, but for this reason cannot account for cases where root size is determined by an MCat-PCat mismatch. For example, near-bare roots in Czech and Shipibo (Ch4§2.1.4, 2.2.2) are at most or at least one syllable in order to accommodate the obligatory inflectional affixes into a maximal PrWd size of one foot. An encompassing constraint cannot capture this distinction, or if it does, it misses the point: one class of roots would have a maximal size of one binary foot ("ROOT1 ≤ FT"), while a second class is at most one syllable ("ROOT2 ≤ σ"). This approach does not capture the insight that the maximal size of the root is predicated on its relationship to the prosodic word rather than an ad hoc size restriction. Tellingly, an anti-Czech system, where bare roots have a maximal size of one syllable while bound roots must be at most one foot, is unattested.

A case like Yup'ik, where a root must be stressed and will augment to achieve this as necessary (Ch4§2.1.3), is not adequately characterized through encompassing constraints. The end effect in Yup'ik is that each root is at least one foot long, but a constraint like "root ≥ Ft" again misses the generalization that this augmentation is due to positional markedness rather than a blanket minimal root size restriction. The argument that encompassing constraints simply miss the point can also be applied to cases of bare roots (Ch4§2.1.1, 2.2.1) and root-foot alignment (Ch4§2.1.2) to a lesser extent.

While encompassing constraints cannot predict sizes less than a given prosodic unit, they also cannot account for outputs greater than that prosodic size. For example, Māori prosodic words all have exactly one foot and no unfooted sequences, leading to outputs with the shape [{(ˈLL)}], [{(ˈLL)L}], [{(ˈHL)L}], [{L(ˈH)}] or [{L(ˈH)L}] (de Lacy 2003). While each of these word shapes is straightforwardly accounted for through a ban on non-head feet, this inventory cannot be predicted through an encompassing constraint. Moreover, such a constraint cannot account for Māori's maximal size of four moras (e.g., "μμ ≤ ROOT ≤ μμμμ"?), which is an expected outcome of the constraint *FT-.

- *Encompassing constraints do not properly encompass*

A root which is properly contained within a given prosodic unit should exhibit edge effects at both ends. However, only the left edge of the root may form a crisp edge, while the right edge does not. This can be seen again in the case of German, where the left edge of the root forms a crisp prosodic boundary leading to glottal stop epenthesis and vocalization of the preceding coda, while the right edge is permeable and allows resyllabification (§2.1, Ch4§2.1.2). This also follows from recent work arguing against right edge ALIGNment constraints (Nelson 1998, 2003, Bye and de Lacy 2000, Alber 2002).

Furthermore, it is unclear how or if an encompassing constraint can dictate the size of the root in outputs where the root is not properly contained within the target prosodic structure. For example, Czech roots can be up to one foot long, but each prosodic word has a single left-aligned foot so many roots are fully unfooted in the output, as in [(ˈɲɛ.-k-o)l-ɪ.k-a.-<u>ja.zɪt͡ʃ</u>.-n-iː] 'multilingual'. Presumably, in order for encompassing constraints to determine the size of the root even when it is not encompassed by the relevant prosodic unit would require Output Faithfulness, just as in the current indirect proposal outlined in Chapter 4.

- *Encompassing constraints unnecessary*

Finally, encompassing constraints are not necessary. The phenomena which they are intended to predict are equally – and in many cases, more accurately – predicted by the indirect, non-templatic approach promoted in this dissertation. The combined proposals of Concurrence and Output Faithfulness employ independently motivated constraints in order to capture the phenomena of minimal and maximal size in an accurate and typologically sound manner.

To sum up, encompassing constraints are undesirable on many different levels, ranging from overprediction to underprediction to theory-internal reasons. In the end, encompassing constraints do not make any predictions which cannot be derived from independently motivated constraints, and they make many unsound predictions along the way. Therefore, encompassing constraints are rejected.

6 CONCLUSIONS

This chapter has argued that the ALIGN family of constraints should be restricted to ALIGN-Left(MCat, PCat), ALIGN-Left((non-)head PCat, PCat), ALIGN-Left(PCat, (non-)head PCat) and perhaps ALIGN(MCat, MCat). Other candidates, such as those that refer to right alignment, encompassing constraints, PCat-MCat alignment and PCat-PCat alignment without reference to heads make inaccurate or unnecessary predictions for the linguistic typology and so should be discarded. Only those constraints potentially pertinent to MCat size restrictions – MCat-PCat and PCat-MCat alignment and encompassing constraints – were discussed in depth; the other types of alignment were touched upon but leave much for future research.

Krämer (2003) raises objections to the idea that there should be no right-edge alignment. He examines languages where rightmost vowels avoid harmony, and those where they trigger harmony. He also cites languages with restrictions at the right edge, such as Yapese's requirement that stems end in a consonant, and Ojibwa's permission of more contrasts in word-final consonants. Krämer argues that these languages require faithfulness constraints that refer to the right edge.

However, some apparent right-edge effects are due to conditions that inadvertently protect or restrict medial segments. For example, Yapese bans word-internal coda consonants, but *requires* them word-finally. Krämer proposes that final codas are permitted by a constraint that requires faithfulness to the rightmost segment. However, there is an alternative solution which does not demand right-edge faithfulness. Yapese has apocope: /luba/ → [ˈluːb] 'breath', cf. /luba-gu/ → [lu.ˈbaːg] 'my breath', /luba-mu/ → [lu.ˈbaːm] 'your breath' (Piggott 1999:64). Apocope is forced by a requirement that stressed syllables branch at both the syllable and rime levels (called STRESS-BRANCH here). Consequently, stressed syllables are CVːC, e.g. [lu.ˈbaːg] 'my breath'. The apparent right-edge effects in Yapese can be accounted for through apocope and the condition that stressed syllables in this language are PrWd-final (a restriction that does not require right-edge alignment – see Bye & de Lacy 2003 for discussion).

(19) *Apocope triggers apparent right-edge effect in Yapese*

(A) Stressed syllable must branch » Don"t have coda » Don't delete

/luba/	STRESS-BRANCH	NOCODA	MAX
Λ (a) [ˈluːb]		*	*
(b) [lu.ˈbaː]	*!		

(B)

/makgad/	STRESS-BRANCH	NOCODA	MAX
(a) [mak.ˈgaːd]		* *!	
Λ (b) [ma.ˈgaːd		*	*

In short, an incidental condition that happens to trump NOCODA produces an apparent right-edge faithfulness effect.

Some languages have right-controlled harmony. However, Revithiadou (1998) has argued that such cases are amenable to analysis in terms of faithfulness to the morphological head, which happens to often be the rightmost morpheme.

Without doubt, there remain interesting challenges to the proposal that there are no right-edge referring constraints. However, it is at least clear that unfettered right-edge reference is pathological.

CHAPTER 6

CONCLUSIONS

This dissertation has provided a unified account of prosodically-based size restrictions in prosodic words and roots. A minimal size restriction is a product of the inviolable requirement that all PrWds have a foot, and the violable impetus for all feet to be binary. A maximal size restriction is brought about by a ban on non-head feet. These factors may also coincide, such that an output may be subject to both a minimal and maximal size restriction. These findings follow directly from previous research in Prosodic Morphology (McCarthy and Prince 1986 *et seq*.) and other independently motivated phenomena.

This dissertation's proposals are firmly set within the tenets of Generalized Template Theory: (1) size restrictions are due to constraint interaction, and (2) there are no constraints that directly impose morphophonological size restrictions – size restrictions are an epiphenomenon of morphology-prosody alignment and constraints that influence prosodic form.

One of the principal contributions here is observational. This dissertation examines certain aspects of GTT in a systematic way, uncovering some novel predictions, as well as affirming and expanding on some recently observed ones. For example, synthesizing prosodic size restrictions with Output Faithfulness logically predicts that a size restriction may be translated to the root, a prominent morpheme, through the output, a prediction borne out in many languages. Moreover, with Output Faithfulness playing a key role, the morphology in the output may also influence the size of the root morpheme. If a root requires overt inflection in all outputs, then the size restriction on this morpheme must accommodate the affix and so deviate from the original size restriction on the prosodic word: this prediction is substantiated by Czech and Shipibo. Building on the recent work of de Lacy (2003) and Ussishkin (2000), this dissertation shows that current standard conceptions of constraints predict maximal restrictions as well as minimal ones.

The other principal contribution here is to impose limits on the constraints that (indirectly!) influence “template” form. In particular, discussion of the ALIGN family of constraints led to proposals that right-edge and PCat-MCat alignment be rejected. Directions for future study were identified, including the role of (non-)head specification in alignment of two PCats. Another subject meriting future exploration is the legitimacy of *FT- (Ch1§2.2) vs. (non-)head syllable-PrWd alignment (Ch5§4.1). The two make nearly identical predictions, but differ as to whether a maximal size of [σ(σσ)σ] is allowed. Moreover, the complex constraint rankings inherent in (non-)head syllable-PrWd alignment lead to slightly different typological predictions from the simplistic *FT-. A broader crosslinguistic study into maximal size restrictions may provide further insight into this issue.

Another avenue for future research is the role of different prosodic units in size restrictions. This dissertation focused on the binary foot as a size limitation, and does not intrinsically predict other prosodic analyses. A minimal size of one binary foot is essentially due to foot binarity. Since there are no similar well-formedness constraints for other prosodic categories, they should not produce a minimal size in the same manner (e.g., all syllables or all PrWds must be binary; cf. Ussishkin 2000). Likewise, a ban on non-head feet bears out to produce a maximal size restriction, but a similar constraint banning other non-head PCats makes faulty predictions. A ban on non-head syllables could lead to a language where all syllables are stressed, which is unattested (Ch5§4), and a ban on non-head prosodic words would predict a language where every PrWd was also a phonological phrase (PPh); in other words, there may only be a single, head PrWd per PPh. A related topic is the participation of moras in constituent alignment. This dissertation found no evidence for mora-alignment, but deeper study may produce more concrete results.

Finally, the role of extrametricality/NONFINALITY in the shape of a minimal or maximal size restriction would benefit from further examination. This topic was addressed in Ch3§4 and by Garrett (2002), but exploring the role of extrametricality in minimal and maximal size restrictions may prove fruitful.

The main work hoped to be inspired by this dissertation is further recognition of prosodically-based maximal size and root size restrictions. These phenomena have received little formal and descriptive attention; this dissertation has provided a framework in which to understand such cases.

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